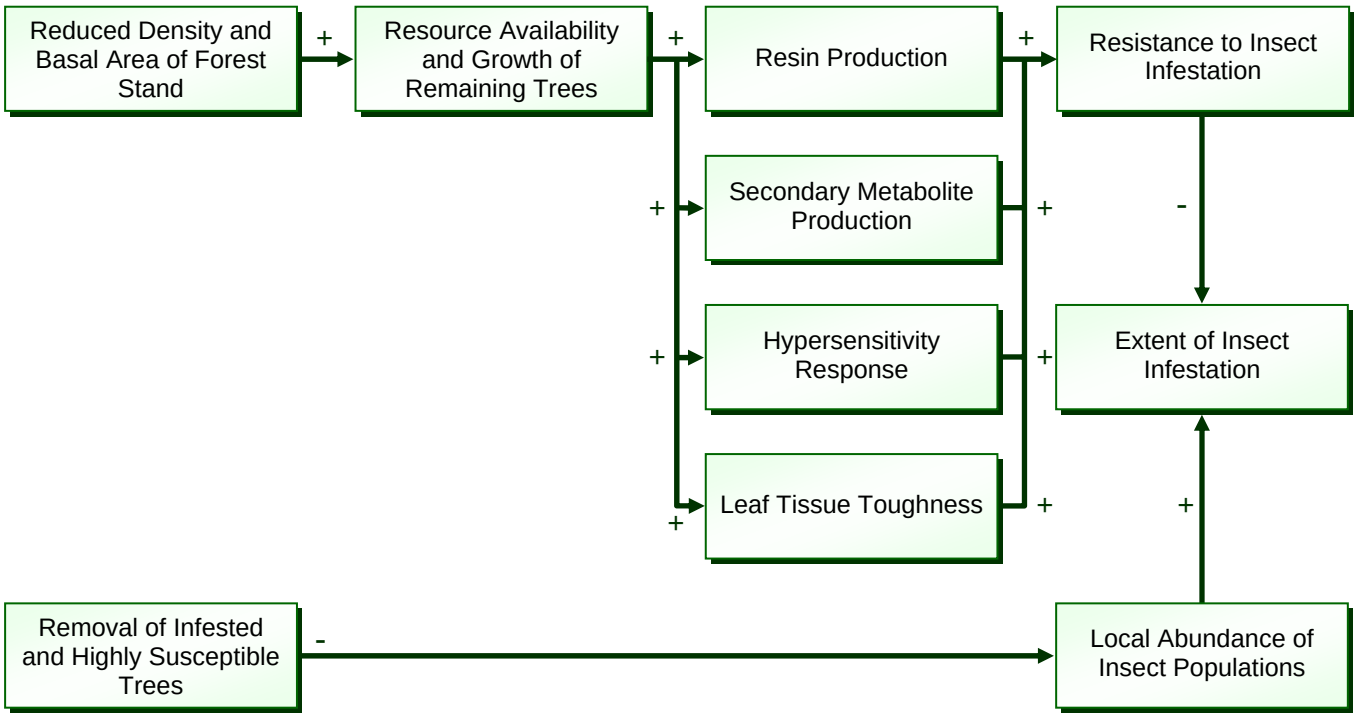
The likelihood that a colonized tree will be extensively damaged or killed by bark beetles depends on:

- resistance of the tree to beetle infestation, and
- the number of beetles available to respond to aggregation pheromones and attack the tree.

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Source: EDAW 2006

**Conceptual Model of Thinning Effects on Insect Infestation** **Exhibit 5-5**

Slower-growing trees may produce lesser resin flow, lesser concentrations of secondary metabolites, and may have a less effective hypersensitive response than faster-growing trees. Consequently, slower-growing trees, and trees with shorter and more ragged crowns (i.e., crowns with less live foliage), are more likely to die during bark beetle outbreaks (Ferrell et al. 1994). Major factors affecting tree growth include competition with other trees and annual rainfall. Stands with higher densities and basal areas contain numerous slower growing trees, and mortality is often concentrated in such stands. Growth of white fir and Jeffrey pine is reduced during low rainfall years (Wensel and Turnblom 1998) making mortality more likely. When bark beetles are very numerous, however, even vigorous trees may be killed.

Bark beetle mortality has recently affected forest stands at Northstar. During the low rainfall years of 1987–1992, bark beetles killed many white fir and Jeffrey pine throughout the region, particularly in stands with the greatest densities and basal areas (Ferrell et al. 1994, Wood et al. 2003).

### Enhancement Treatment

To reduce the risk of a bark beetle outbreak, dense stands would be treated (e.g., with group selection, sanitation and salvage, or other prescriptions) to remove the most susceptible trees, and reduce overall density. The removal of the most susceptible trees would reduce the overall size of bark beetle populations. Reducing overall density would increase growth of the remaining trees and the resistance of these trees to bark beetle attack (Exhibit 5-5). In

ponderosa pine forests in Arizona, such thinning treatments (some in conjunction with prescribed burns) have resulted in increased growth, and increased potential for resin flow (Wallin et al. 2004).

At the resort, silivicultural treatments are designed both to reduce risk of bark beetle outbreaks and to reducing fire hazards. In some stands, thinning treatments also will be designed to facilitate the development of late-seral attributes. Silvicultural treatments (and the constraints on their implementation) are described in more detail in the sections *Reduce Likelihood of Catastrophic Fire* and *Facilitate Development of Late-seral Habitat*.

### Potential Enhancement Locations

Stands with greater densities of trees (i.e., those mapped as CWHR moderate [M] or dense [D] cover categories) could benefit from treatments to reduce the likelihood of bark beetle outbreaks. Exhibit 3-5 shows the current location of these stands. Over time, other stands will develop greater densities of trees and forest management will reduce tree density in other stands; consequently, the location of relatively dense forest stands will continually change at the resort.

### Implementation

Stand thinning to reduce the likelihood of bark beetle outbreaks is being performed in conjunction with fuel reduction; stands are selected for the purpose of reducing fire hazards as described in the section *Reduce Likelihood of Catastrophic Fire*. Exhibit 5-4 shows the location of high priority stands for fuel reduction treatments. Approximately 100 acres per year (on average) would be treated in these areas during the next 8 years, contingent on availability of staff and funding. Similar treatments have previously been performed in most years.

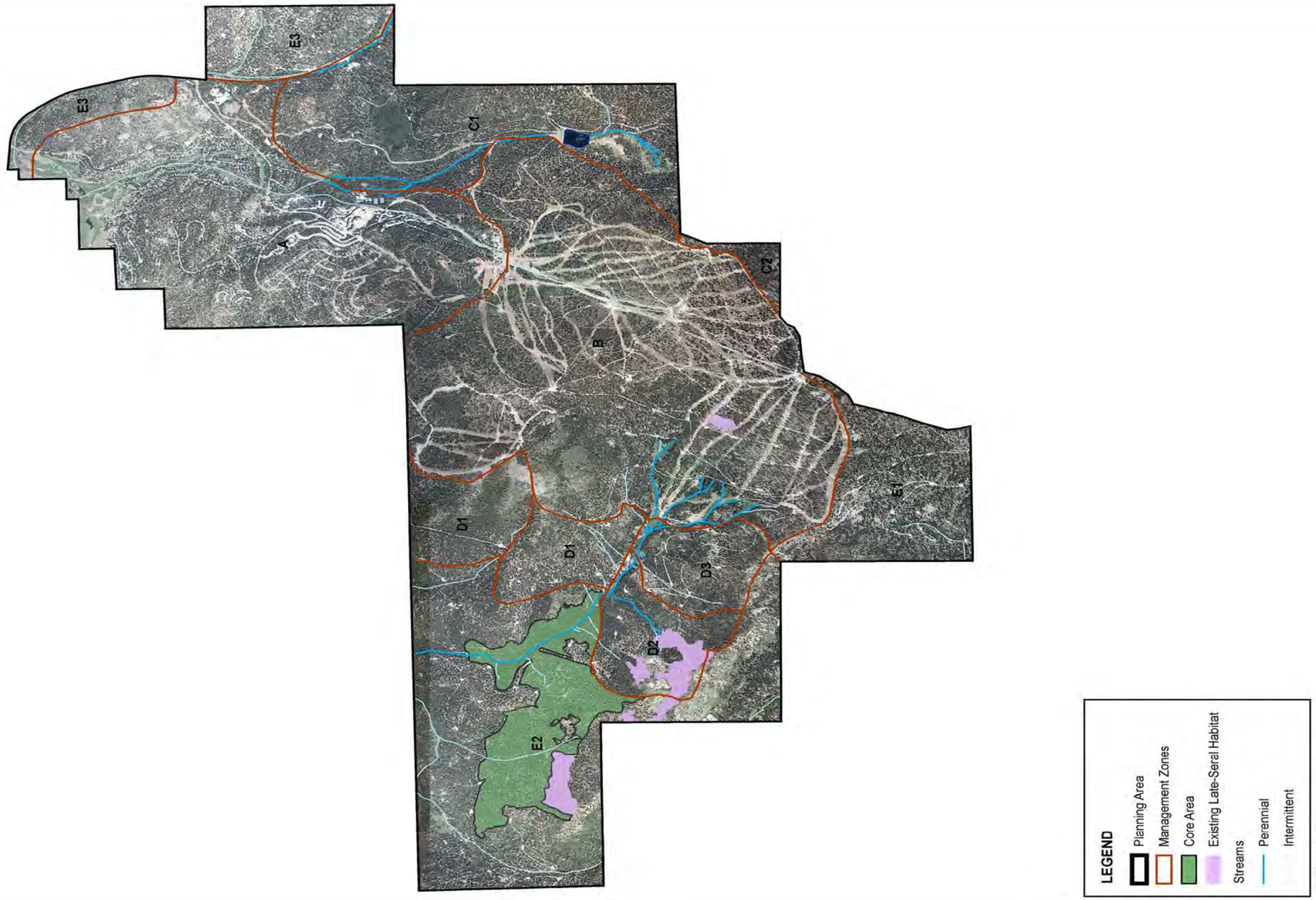
Dense stands with larger trees also may be suitable for enhancement of late-seral habitat. In these stands, thinning treatments will be designed to reduce the likelihood of catastrophic fire or bark beetle outbreaks only to the extent compatible with enhancement of late-seral habitat.

## FACILITATE DEVELOPMENT OF LATE-SERAL HABITAT

Some types of late-seral forests provide high quality for several target species of this HMP. Northstar will manage forests at the resort to facilitate the development of this late-seral habitat. During implementation of the HMP, efforts to develop late-seral habitat will be concentrated in a 362-acre core area in Subzone E2. (Exhibit 5-6 illustrates this core area.) This section describes the issue, relevant background information, and Northstar's approach to facilitating the development of late-seral habitat, including potential treatments and locations.

### Issue

Older forests (i.e., mature or late-seral forests) provide wildlife habitats and other ecological functions that are distinct from those of younger forests. (This is particularly the case for forests with relatively closed tree canopies [i.e., CWHR classes 5M, 5D, and 6].) The extent of late-seral forest has been substantially reduced in the region, primarily because of historic timber harvests (for example, see Manley et al. 2000); thus, because they provide distinct ecological functions and their extent has been reduced, increasing the extent of late-seral forest is a regional conservation goal. The resort contains approximately 93 acres of late-seral stands in CWHR classes 5M, 5D, and 6 (which provide higher value habitat for several focal species of this HMP), 290 acres of late-seral stands in CWHR classes 5P and 5S (which provide habitat of less value than CWHR classes 5M, 5D, and 6), and extensive areas of less mature stands that are 50–100 years old (many of which provide some habitat for focal species of this HMP).




# Northstar Habitat Management Plan

**Exhibit 5-6**
**Core Area for Development of Late-Seral Habitat**

April 3, 2008

## Background

### *Development of Late-seral Stand Structure*

Over time, as trees grow and die, the structure of a forest stand changes in a relatively predictable manner. The size of canopy trees, and of snags and downed wood, increases, and eventually canopy structure becomes more complex as younger (and smaller) cohorts of trees are recruited into the canopy. The rate of these changes and the stand structures that result differ among tree species, the resources available at a site for tree growth, and the major disturbances that occur at a site (such as fire, insect outbreaks, and logging) that may remove many, but not all, canopy trees.

Late-seral forests have canopies dominated by larger and taller trees, and have a more complex canopy structure than younger stands. They also tend to have greater quantities of large snags and larger coarse wood debris than younger stands. Table 5-1 presents the average densities of large trees and snags (> 30 inches in DBH) that have been documented for late-seral forests in the Sierra and Lake Tahoe Basin. Densities vary considerably among sites, however. In Sierran data compiled by Beardsley et al. (1999), the standard deviation of large tree and snag densities was 25–50% the value of the mean, which indicates a wide range of densities in large trees and snags; Barbour et al. (2002) reported comparable variability among old-growth stands in the Lake Tahoe Basin.

**Table 5-1**
**Mean Density per Acre of Large Trees and Snags in Sierra Nevada Late-Seral Forests**

| Forest Type | Large Trees (> 30 inches in DBH) | | Large Snags (> 30 inches in DBH) | |
|---|---|---|---|---|
| | Beardsley et al. 1999[1] | Barbour et al. 2002[2] | Beardsley et al. 1999[1] | Barbour et al. 2002[2] |
| Jeffrey pine | 6 | 10 | 1 | 5 |
| White fir | 16 | 14 | 4 | 3 |
| Red fir | 16 | 20 | 4 | 6 |

[1] Densities are based on USFS inventory plots in National Forests (excluding wilderness areas) throughout the Sierra Nevada.
[2] Densities are based on data collected in 38 old-growth stands in the Lake Tahoe Basin.

The conifer species that dominate Sierra Nevada forests are large, long-lived trees. In late-seral stands, canopies are dominated by trees 100–180 feet high. Jeffrey pine, and white and red fir reach canopy size in 25–75 years, but may require another 50 years or more before reaching a large size (i.e., > 30 inches in DBH), and can often live for 200–400 years. Thus, in the absence of major disturbances (e.g., insect outbreaks, catastrophic fires, timber harvests), only a small fraction (0.5–2%) of large canopy trees dies in a given year. These trees then become snags (if they remain standing after their death) or large pieces of woody debris on the forest floor.

Snags and large pieces of woody debris are eliminated through decay, fire, and removal during timber harvests. As a result of continual decay, snags eventually break apart and/or fall down, becoming downed wood. In eastside pine forests in northeastern California, on average, 1–2% of snags broke apart (i.e., remaining portion < 20 feet high) or fell over annually (Landram et al. 2002). In other forests, faster rates of turnover have been reported (up to 10% per year; Harmon et al. 1986). As wood decays, its structure changes, eventually loosing its structural integrity and breaking into small blocky pieces. During this process, its mass diminishes typically with half of a log's mass being lost in 5–25 years depending on size, species, and climate (Harmon et al. 1986).

In the absence of a major disturbance, the quantity of snags and downed wood gradually accumulate as a stand matures, eventually reaching an equilibrium level. This is the process that produces the characteristic structure of late-seral stands. The quantity of snags and fallen logs also can change rapidly as a result of insect outbreaks killing large numbers of trees, fires killing trees or consuming snags and downed wood, or by removal during timber harvests. When these disturbances remove most of the tree canopy, a maturing stand is replaced and the

process of stand development begins anew. When only a portion of the canopy is removed, the development of late-seral characteristics continues, but the stand will have a more heterogeneous structure with many younger trees, and fewer large trees, snags, and fallen logs.

### *Habitat Value of Snags and Large Woody Debris*

Snags and large woody debris on the forest floor are important components of habitat for many animals, including focal species, such as Pileated Woodpecker. They provide a foraging resource and many birds nest in snags by creating holes or using previously excavated holes. Downed woody debris also affects the quality and diversity of forest floor and soil environments, and provides habitat for fungi, other microbes, insects, and amphibians, reptiles, and mammals.

Larger snags and fallen logs provide different habitat conditions from smaller pieces. For birds, for example, the habitat value of snags is related to snag diameter. Many cavity-nesting birds generally do not excavate nests in small diameter snags (i.e., snags < 1 foot in DBH), and nests are increasingly frequent in larger snags (Ganey and Vojta 2004, Bunnell et al. 2002). In a study of cavity-nesting bird use of snags in pine forests of northeastern California, the mean DBH of snags with cavities occupied by nesting birds was over 2 feet (Laudenslayer 2002). However, during bird surveys conducted at Northstar in 2006 and 2007, several small cavity-nesting birds (e.g., Mountain Chickadee [*Poecile gambeli*], Pygmy Nuthatch [*Sitta pygmaea*], Red-breasted Nuthatch [*Sitta Canadensis*]) were observed nesting in small-diameter snags (EDAW unpublished data).

### *Fire Hazards of Snags and Large Woody Debris*

Increasing the number of snags and quantity of fallen logs provides greater benefits to wildlife but also increases fire hazards. Because snags and fallen logs are large pieces of fuel, they do not substantially increase fire intensity, flame lengths, or rate-of-spread (Brown et al. 2003). They do, however, affect resistance-to-control, fire behavior, and soil heating. Woody debris on the forest floor increases the time required by hand crews and bulldozers to control a unit of fire perimeter. Large pieces of fuel also smolder for long periods and winds can fan smoldering fuels into more rapidly moving fires. Soil is heated for prolonged periods beneath coarse woody debris, and this can result in loss of organic matter and volatilization of nutrients.

The fire hazards created by snags and fallen logs are not well simulated by available fire models. Thus, these models cannot be relied on entirely to determine coarse woody debris loads that would be acceptable fire risks.

For dry ponderosa pine forests in the Pacific Northwest, Brown et al. (2003) argued that 5–20 tons per acre of coarse woody debris (i.e., snags plus downed wood) were sufficient to provide most benefits of woody debris, and that more than 25 tons per acre of coarse woody debris could increase fire hazards to high levels when associated with small amounts of fine fuels (< 5 tons per acre), and that lesser quantities of coarse woody debris could represent an unacceptable fire risk when combined with large amounts of fine fuels (i.e., > 8–10 tons per acre).

At the resort, stands thinned to reduce fire hazards, and more naturally open stands, generally will not accumulate the amount of coarse woody fuels considered hazardous by Brown et al. (2003). The density and typical mortality rate of canopy trees, together with the longevity of snags and downed woody debris, determine the amount of snags and downed woody debris that will be present in the absence of a major disturbance. Thinned or naturally open stands at the resort could eventually accumulate from several to over 25 tons of coarse woody fuels based on the density of canopy trees (about 50–100 canopy trees per acre), mortality rates in the absence of catastrophic disturbance (0.5–2% $yr^{-1}$), mass of snags (from less than a hundred pounds to 1–4 tons depending on their diameter, height, and species), and likely decay rates (a 10-year half-life) and persistence of snags and logs as large pieces of wood (up to 20 years). However, estimates of over 20 tons per acre rely on somewhat unrealistic combinations of canopy tree density and mass, and even 10–20 tons per acre may be unlikely in stands with low densities of trees.

## Enhancement Treatment

At the resort the development of additional late-seral forest will be supported in selected stands by reducing the risk of catastrophic fire and major insect outbreaks, minimizing timber harvests that would preclude the development of late-seral characteristics, and in some stands, by applying silvicultural treatments to facilitate the development of late-seral characteristics.

In forests, the development of late-seral characteristics is a consequence of the natural, on-going process of stand development. The development of these characteristics is interrupted by major disturbances, such as catastrophic fire, major insect outbreaks, and silvicultural treatments that remove most large trees. Consequently, an important component of any effort to develop late-seral habitat is managing forests to reduce the likelihood of major disturbance including:

- treating forest stands to reduce the risk of catastrophic fire and insect outbreaks, and
- avoiding silvicultural treatments that remove large snags, most large trees, or both.

This enhancement plan includes treatments to reduce the risk of catastrophic fire and major insect outbreaks, and these treatments are described in the section *Reduce Risk of Catastrophic Disturbance.* Because catastrophic fire and major insect outbreaks are landscape-scale phenomena, treatment of a large portion of the landscape is necessary to reduce the risk of these disturbances. However, stands in which late-seral characteristics are developing do not necessarily have to be treated (or treated intensively) to reduce their risk of loss to catastrophic fire. For example, fuels reduction treatments in adjacent forest stands would reduce the likelihood of catastrophic fire spreading into stands being managed to develop late-seral habitat; also, limited treatments to reduce ladder fuels also would reduce the likelihood of catastrophic fire consuming stands being managed to develop into late-seral habitat.

Silvicultural treatments that remove most large trees and snags from the canopy of a stand will interrupt (and delay for decades) the development of late-seral characteristics. The forest management practices and forest structure targets described in Chapter 4 for Zones D and E limit the removal of larger trees and snags, and in stands being enhanced for the development of late-seral characteristics, timber harvests will be minimized and limited to silvicultural treatments that facilitate the development of late-seral characteristics, or that are necessary for forest health or human safety.

In some stands, silvicultural treatments can facilitate the development of late-seral characteristics. Silvicultural treatments and prescribed fire have been proposed for enhancing or restoring late-seral forests and are applicable to stands at Northstar (Garman et al. 2003; LaBarge et al. 2004; Arno and Fiedler 2005). For example, thinning treatments reduce tree density, and thus concentrate growth on fewer stems, which facilitates the development of large trees. This treatment is most effective in stands that have both substantially greater densities than current or historical late-seral stands and a canopy dominated by moderate-sized trees, which have the potential to become large trees within several decades. Both these conditions exist in some stands at the resort. Thus, in some stands, thinning of the tree canopy would promote the growth of moderate-sized trees and result in tree densities more similar to late-seral forests. Understory vegetation also can respond substantially to thinning of tree canopies (Huffman and Moore 2004; Metlen and Fiedler 2006).

Prescribed fire could provide these and additional benefits, particularly if performed in conjunction with a thinning treatment. These benefits include reduced fuels loads, increased nutrient and water availability. Also, the conditions at the forest floor would become more suitable for establishment of Jeffery pine and a variety of understory species (Huffman and Moore 2004; Metlen and Fiedler 2006). At the resort, however, prescribed fire is not being used because of risks to public safety and infrastructure.

Applying these treatments to suitable areas adjacent to late-seral stands could cause these patches of late-seral forest to expand more rapidly. For example, preliminary modeling with the Forest Vegetation Simulator (Dixon 2003) indicates that thinning dense stands from below would increase the size of canopy trees substantially within

30 years; in three of four stands modeled, the simulated DBH of average canopy trees increased from 23–28 inches in 2036 to 34–39 inches in 2036 if thinned from below in 2006 (EDAW unpublished data). (Total canopy cover, however, would be reduced in thinned stands.) In addition, thinning and prescribed fire also increase the resistance of stands to catastrophic disturbances (e.g., fires that kill canopy trees, insect outbreaks). This increase in resistance is described in *Reduce Risk of Catastrophic Disturbance***.**

Although thinning facilitates the development of larger trees, snags, and fallen logs, it also reduces canopy cover. Initially, a substantial reduction in cover may reduce the habitat value of thinned stands for some species, including Northern Goshawk and California Spotted Owl, both focal species (California Interagency Wildlife Task Group 2002). Subsequent growth and recruitment, however, will increase cover again, and may result in a multilayered canopy along with the larger trees resulting from the enhancement, and providing greater habitat values than the pre-enhancement stand. But, to avoid a temporary, adverse effect on habitat values for focal species, the extent of thinning could be reduced, although this would also reduce the beneficial effects on development of large trees, snags, and fallen logs.

During this enhancement treatment, the number of large snags and pieces of downed wood is increased by retaining existing snags and fallen logs, and the gradual accumulation of additional snags and logs, which is facilitated by the increased numbers of large trees resulting from the thinning treatment.

To reduce their effects on existing habitat and other natural resources, thinning treatments intended to facilitate the development of late-seral habitat would implement the relevant management practices for timber harvest operations described in Chapter 4. In addition, these thinning treatments would be designed to retain more canopy cover than thinning treatments whose primary purpose was to reduce the risk of catastrophic disturbance.

### Potential Enhancement Locations

Potential enhancement locations were evaluated based on attributes of forest stands and of the surrounding landscape. These attributes included:

- suitability of stand structure for development of late-seral characteristics;
- proximity to existing or planned development, roads, or ski runs/lifts, on or adjacent to the resort;
- proximity to existing late-seral stands, riparian corridors, or properties managed for biodiversity; and
- contiguous acreage of stands suitable for development of late-seral characteristics.

Stands classified in CWHR in size category 4, (i.e., stands dominated by trees 11–24 inches in DBH) have the greatest potential for development of late-seral characteristics in the foreseeable future. In most of these stands, many of the canopy trees that die will become large snags, and many of the surviving canopy trees will grow into large trees in the next several decades. Furthermore, thinning and other silvicultural prescriptions can facilitate the development of late-seral attributes (e.g., large trees and snags) in many of these stands that also have moderate to high densities of canopy trees (i.e., stands classified in CWHR moderate [M] or dense [D] cover categories). (It may not be feasible to facilitate the development of these attributes in stands with lower densities of trees because thinning may not substantially increase growth of remaining trees and canopy cover may be reduced below levels that provide higher quality habitat for species associated with late-seral stands.)

Enhancement may not be feasible, or may provide lesser benefits, in stands adjacent to development, roads, or ski runs and lifts (e.g., in much of Zone D). In these areas, where dying trees and snags can be safety hazards, more extensive thinning and removal of dead wood may be necessary to reduce fire hazards, and human disturbance may reduce habitat quality for wildlife. These effects (e.g., removal of snags, disturbance of goshawk nests) can extend 100 meters (328 feet) or further into forests from boundaries of development, roads, and ski runs. Therefore, stands within 328 feet of development, roads, and ski runs/lifts were considered to have less potential for enhancement of late-seral habitat.

In contrast, enhancement of stands adjacent to perennial streams or existing late-seral forest (particularly CWHR 5M, 5D, or 6 stands) provides greater benefits. Facilitating the development of late-seral habitat adjacent to existing late-seral stands could expand those patches of late-seral forest, which would increase their habitat value. Enhancement of stands adjacent to perennial streams could provide greater benefits because of their proximity to and effects on adjacent riparian habitats. (These benefits are described further in *Increase Habitat Functions Provided by Vegetation of Stream Corridors*.)

Increasing connectivity of habitats on the resort and on properties adjacent to the resort was also considered. This connectivity was greatest in Zone E, which also contained the greatest acreage of stands with potential for development of late-seral habitat.

Based on this evaluation, in Subzone E2, a 362-acre core area has been designated for the development of late-seral forest, which is an area of sufficient size to support nesting pairs of Northern Goshawk and California Spotted Owl. Most forests within this area are in CWHR 4M and 4D, and thus, through on-going growth and mortality of trees, many of these stands will likely develop late-seral characteristics in the next several decades; and, in some of the denser stands, the development of late-seral characteristics would be facilitated by silvicultural treatments. Furthermore, this core area is adjacent to an existing area of late-seral forest, and connects this patch to Schaffer Creek, and is contiguous with USFS land to the west of the resort; it is also relatively isolated from existing and planned development on the resort and adjacent lands.

### Implementation

Northstar plans to manage the 362-acre core area to facilitate the development of late-seral forest. This management will include:

- allowing natural processes of stand development to progress by limiting timber harvest operations to treatments that are consistent with the development of late-seral characteristics, or that are necessary for forest health or human safety;
- enhancing selected stands by implementing silvicultural treatments that aid the development of late-seral attributes (e.g., large trees and snags); and
- reducing the risk of catastrophic fire through fuels reduction treatments (primarily outside of the core area in adjacent forest stands, which will limit the potential for spread of catastrophic fire into the core area).

The forest canopy in the core area will be managed to attain a cover of at least 50% on average, be dominated by trees > 30 inches in DBH, and have a multi-tiered structure. Greater canopy covers also will be allowed to develop in some stands within the core area, and at least 40% will be retained in stands receiving silvicultural treatments. Recreational uses will be limited to tree skiing and to hiking and other non-mechanized recreational activities that do not require developed facilities, and are consistent with the management practices described in Chapter 4.

Forests in the 362-acre core area will be allowed to develop late-seral characteristics through the on-going natural processes of stand development. In addition, during the first 8 years of implementation of the HMP, silvicultural treatments to facilitate the development of late-seral habitat will be implemented in 10–20 acres of stands with dense canopies. Additional silvicultural treatments in subsequent years are also anticipated.

Treatments will be designed to reduce fire risks to the extent compatible with facilitating the development of late-seral characteristics. These treatments will remove understory trees and some canopy trees to reduce ladder fuels and to reduce competition among canopy trees (and thus increase the growth of remaining trees), but in general will not remove trees greater than 30 inches or snags > 15 inches in diameter, and in general will retain at least 5 tons per acre of downed wood and at least 40% canopy cover.

Some sensitive species occupy stand types that could be candidates for enhancement (e.g., class 4M and 4D stands). For example, Northern Goshawk presently nests in a 4M stand within the core area, and a Spotted Owl pair occurs in 4M and 4D stands in the core area. Because thinning for late-seral development could disturb and cause abandonment of occupied habitat (despite potential long-term benefits to habitat quality), silvicultural treatments to facilitate late-seral habitat will be carefully designed to minimize or avoid effects on these species. Within the core area, forest stands that are occupied by Spotted Owl or Northern Goshawk, and immediately adjacent stands within the core area, will be excluded from silvicultural treatments intended specifically to facilitate development of late-seral habitat. However, thinning treatments that are consistent with developing late-seral characteristics could be implemented, if necessary for fuels management, forest health, or human safety.

During the first 8 years of implementation of the HMP, Northstar is planning to implement fuel reduction treatments on a substantial acreage of stands near the core area. (The implementation of these treatments is contingent on the availability of funding.) These treatments are described in the section *Reduce Risk of Catastrophic Disturbance*, and Exhibit 5-4 illustrates the location of high priority areas for treatment. The implementation of these treatments would considerably reduce the risk of catastrophic fire in the core area.

## LIMIT HUMAN DISTURBANCE OF WILDLIFE

### Issue

Human activities can interfere with animals' use of an area and thereby reduce the area's value as habitat, and reduce the survival and/or reproduction of disturbed animals. Human activities occur throughout the resort and could disturb wildlife.

### Background

In this context, human disturbance is any human activity that changes the contemporaneous behavior or physiology of one or more animals (Nisbet 2000). Human activities could interrupt the foraging or reproductive activities of animals and cause them to flee or avoid an area. This may expose these animals to increased risk of mortality, or reduce their reproductive success. In essence, animals perceive humans as potential predators and respond accordingly (Frid and Dill 2002). This perceived predation risk diminishes with distance, but it is affected by other factors. The sensitivity to human disturbance varies among animal species (Cooke 1980, Blumstein et al. 2003), across sites (Blumstein et al. 2003, Rodgers et al. 1997), on trails versus off trails (Miller et al. 2001), with barriers visible to animals (Ikuta and Blumstein 2003) the number of humans (Beale and Monaghan 2004), the type of activity (Holmes et al. 1993, Rodgers and Smith 1995, Rodgers and Smith 1997, Miller et al. 2001), and the visibility of humans to animals (Richardson and Miller 1997, Phillips et al. 2001). Also, to some extent, some animals habituate to human activities (Cooke 1980, Nisbet 2000).

Animals known to be sensitive to human activities include several of this HMP's focal species. For example, human activities can interfere with Northern Goshawk nesting (TRPA 2002 *citing* J. Keane data) and mule deer fawning (Nicholson et al. 1997).

Human activities can also directly cause mortality. For example, numerous studies document mortality of reptiles and amphibians along roads and apparent effects on their populations (Gibbs and Shriver 2002, Marchand and Litvaitis 2004, Pellet et al. 2004, Aresco 2005). However, because of the limited access to most of the resort and restricted use of resort-owned roads, human activities are unlikely to cause substantial direct mortality.

### Enhancement Treatment

Northstar's management practices regarding limited access and human use reduce human disturbance of wildlife. One of these practices, the implementation of use restrictions if sensitive species are using a zone of the resort, would enhance habitat in that zone by reducing human disturbance below existing levels. Potential use restrictions are listed in Table 4-5.

### Potential Enhancement Locations

Most enhancements to limit human disturbance of wildlife would be implemented on a zone or subzone basis, and will be emphasized in Zones D and E. For example, during deer fawning season, recreational access will be prohibited in the restricted area described in Chapter 4 and shown on Exhibit 4-1; also, the bike trail adjacent to Schaffer Creek will be closed.

### Implementation

Measures to limit human disturbance will be implemented by Northstar as management practices, and additional measures would be implemented if wildlife monitoring indicates that human disturbance could affect focal species.

## REMOVE INVASIVE PLANTS

### Issue

Invasive plants alter the structure and species composition of ecosystems, and thus also alter the functions and values provided by ecosystems (such as wildlife habitat and recreation values). A number of invasive plant species have been documented at the resort. Thus, invasive plants could degrade ecosystems at the resort.

### Background

Through human transport, thousands of plant species have established populations beyond their prior range. Of these, some have become invasive, and their rapid expansion in range and local abundance is causing substantial ecological change (Mack et al. 2000). More than 1,050 plant species have established populations in California, and more than 80 of these are considered problematic invasive species (Randall et al. 1998, Bossard et al. 2000).

Problematic invasive species alter the species composition, structure, and function of ecosystems. Invasive species may reduce the cover and diversity of native species, alter water or nutrient availability, increase fire hazards, or alter wildlife habitats (D'Antonio and Vitousek 1992, Gordon 1998, Mack et al. 2000).

In general, infestations of invasive plants initiate where soil and vegetation has been disturbed. Seeds and fragments of invasive plants frequently are introduced into these areas, and the removal of vegetation creates opportunities for these introduced propagules to develop into established plants. Through growth and reproduction, these plants may subsequently spread throughout the disturbed area, and some invasive species may spread into adjacent, undisturbed vegetation as well.

Invasive species that have occurred at the resort, or could become established in the future (based on a review of available data and literature [California Invasive Plant Council 2006, Bossard et al. 2000, Holst and Ferguson 2000]), include:

- cheatgrass (*Bromus tectorum*),
- medusahead grass (*Taeniatherum caputmedusae*),
- musk thistle (*Carduus nutans*),
- Scotch thistle (*Onopordium acanthium*),
- Canada thistle (*Cirsium arvense*),
- bullthistle (*Cirsium vulgare*),
- spotted knapweed (*Centaurea maculosa*),
- Russian knapweed (*Acroptilon repens*)
- whitetop/hoary cress (*Cardaria draba*),
- tall whitetop/perennial pepperweed (*Lepidium latifolium*), and
- woolly Mullein (*Verbascum thapsus*).

Currently, however, none of these species is widespread at the resort. But, infestations of tall whitetop, spotted knapweed, Russian knapweed, and musk thistle were recently eradicated at the resort. These infestations had primarily become established at erosion control sites.

### Enhancement Technique

The primary treatment for controlling invasive plants is to detect and rapidly remove infestations while they are still small, localized populations. To detect infestations soon after they establish, informal, on-going monitoring for new infestations of invasive plants is conducted by Northstar staff in conjunction with their other activities.

Rapid control eliminates opportunities for the incipient population to establish additional infestations at the resort, and removes the population while it still consists of relatively few individuals and occupies a small area. Once a population has become widespread, its control is much more difficult and costly, and often is not feasible.

Specific techniques for eradicating invasives that are applicable at the resort include:

- **Herbicide application—**Herbicide application involves the spraying or injected chemicals on selected areas or plants, and is the least costly and most effective technique for eradicating larger infestations, particularly where invasive plants dominate a site that has very little cover of other species.

- **Mechanical methods—**Mechanical methods are physical removal actions such as mowing, cutting, and pulling. These methods can be time consuming, and thus costly, but also can be effective for small infestations, especially where invasive plants are interspersed in native vegetation.

- **Mulching—**Mulching involves the placement of a barrier, such as 3–6 inches of wood chips, to smother smaller herbaceous weeds. (It also can prevent germination of invasive plant seed.)

Currently, Northstar controls invasive plants through a combination of mechanical methods and herbicide treatments. Northstar applies herbicides in accordance with all herbicide label directions, and in compliance with all state and federal laws. Herbicides are selected based on their efficacy in controlling the invasive plant, their safety for applicators and members of the general public, and toxicity levels to other non-targeted organisms.

Post-treatment revegetation can aid control efforts by establishing desired vegetation that competes with the invasive plant. Revegetation treatments can be applied immediately after removal of invasives, or delayed in instances where additional control measures are necessary and would interfere with revegetation.

For all infestations, post-treatment monitoring is conducted, and combined with retreatment as needed, until the infestation is eradicated, or until control has become impracticable. This monitoring does not involve quantitative measurements; rather, it is a qualitative assessment of the status of the infestation and of the need for retreatment. Monitoring and retreatment may continue for several years.

In addition to enhancing ecosystems by removing invasive plants, Northstar implements several management practices to reduce the likelihood that invasive plants will initially become established at the resort. These practices are described in Chapter 4.

Northstar also coordinates removal efforts with regional control efforts. For example, as part of a regional effort, Placer County department of Agriculture staff recently surveyed the resort for noxious weeds and eradicated the infestations they located. These locations were primarily associated with on-going or recent construction.

### Potential Enhancement Locations

The current distribution of invasive plants is very limited at the resort. For example, no current infestations are known in Zone E. Thus, removal of invasive plants will enhance relatively little acreage at the resort, but is

important to prevent extensive alteration of ecosystems that would then require extensive and costly treatments to reverse. In order to prevent these alterations, invasive plant removal is applicable on any Northstar property where non-native invasive plants become established.

### Implementation

Management practices to prevent the establishment of invasive plants, and treatments to eradicate infestations that become established, are being implemented on an on-going basis on all resort properties.

## RIPARIAN AND STREAM ENHANCEMENT

In conjunction with proposed projects, Northstar will enhance some riparian and stream conditions. This section describes the issue, relevant background information, and Northstar's approach to riparian and stream enhancement, including potential treatments and locations.

While a wide variety of changes in land use can affect hydrology, sediment transport, and channel and riparian conditions, the road system and land use in and immediately adjacent to the riparian corridor have the greatest potential for substantial effects at the resort. Therefore, Northstar’s approach to restoring riparian and stream ecosystems would emphasize:

- reducing the effects of road and trail crossings on stream ecosystems, and
- enhancing the capacity of riparian and stream corridors to provide habitat and water quality functions.

Riparian and stream ecosystems could also be enhanced by limiting human disturbance and reducing conifer encroachment of aspen stands. In addition, Northstar implements numerous design and management practices that avoid or minimize effects on riparian and stream ecosystems. These practices are described in Chapter 4.

### REDUCE EFFECTS OF ROAD AND TRAIL CROSSINGS ON STREAM ECOSYSTEMS

#### Issue

Forest road crossings can cause major effects on streams and associated wetlands (Gucinski et al. 2000). In particular, the road surface can be a major source of sediment, and because road crossings alter topography, they also frequently alter surface and ground water flows, and channel form (e.g., channel slope, width, and streambed form) both downstream and upstream of the road crossing. These effects are generally greater on unmaintained roads; for example, plugged culverts or fill-slope failures can substantially increase sediment inputs and affect channel and floodplain form. Because the resort has an extensive road system, roads could cause substantial effects on riparian and stream ecosystems.

#### Background

Although they occupy a relatively small area, roads can alter the movement of water and sediment within a watershed, and thereby affect riparian and aquatic ecosystems. Watershed hydrology, the process of erosion, road effects on those processes, and associated changes in the form of stream channels are described in the following sections.

##### *Watershed hydrology*

Streamflows originate from the precipitation falling throughout a stream’s watershed. Before reaching a stream as runoff, precipitation may infiltrate to become groundwater (which may subsequently emerge to enter streams) or return to the atmosphere through evapotranspiration (i.e., evaporation of water from soil and plant surfaces).

Human alterations affect the proportion of precipitation following each of these pathways, and thus the quantity and timing of streamflows. Removal of vegetation can reduce evapotranspiration, and construction of roads and development can reduce infiltration; both of these changes can increase runoff.

There are three basic types of runoff:

- overland flow,
- subsurface flow, and
- saturated overland flow.

Each of these runoff types can occur individually or in some combination in the same locale. Despite involving belowground flow, subsurface and saturated overland flows are considered components of runoff because they are closely linked to overland flow.

Overland flow occurs when the rate of rainfall or snowmelt exceeds the rate of water movement into the soil (i.e., infiltration rate). The infiltration rate is affected by soil structure and moisture content (and infiltration diminishes as water saturates a soil). Areas with natural vegetative cover and leaf litter usually have high infiltration rates. These features protect the surface soil pore spaces from being plugged by fine soil particles as a consequence of raindrop splash.

Overland flows may subsequently enter the soil as rainfall diminishes in intensity or ceases, or they may reach a stream channel before entering the soil. Slope and vegetation affect the speed of overland flow, and thus the portion that discharges directly into stream channels.

Subsurface flow is a storm-generated pulse of groundwater. Before a storm, where the water table slopes toward a stream, water moves down and into the stream channel as baseflow. During a storm, as rainwater infiltrates the soil, the water table can rise more rapidly near the stream than it does further upslope. This can happen when the soil near the stream has greater moisture content and a shorter distance to the water table than does soil upslope. This newly arrived groundwater moves relatively rapidly towards the stream channel, mixes with baseflow, and increases groundwater discharge to the channel.

Saturated overland flow is a combination of direct precipitation and subsurface flows. Where the water table reaches or emerges from the surface, soils are saturated. Consequently, all rain falling on these soils, as well as emerging groundwater, moves down slope as overland runoff.

Overland flow and saturated overland flow strongly affect erosion. Where human alterations (such as roads) have increased these flows, erosion can be increased substantially.

### *Erosion*

Gravity, wind, and water transport soil to riparian areas and streams. Soil is dislodged when the force of wind, water, or gravity exceeds the forces holding soil in place. Several factors affect the balance of these forces: the soil's physical properties; vegetation structure; topography; and the quantity, concentration, and speed of runoff. Soil characteristics, such as lithology (i.e., rock or mineral content), cohesion, and granulometry (i.e., grain size association), influence the erodibility of soils. Vegetation reduces erosion by binding soil particles and by slowing wind and water (Brinson et al. 2002); accordingly, greater cover of vegetation reduces the potential for erosion. Because both velocity and shear stress increase with slope, the potential for erosion increases with the angle and length of upland slopes. Also, as more runoff is generated and concentrated (i.e., greater runoff depth), the force exerted by flowing water on the soil surface—and hence erosion— increases.

Gravity can also induce the slow downhill movement of soil and rock (i.e., soil creep) and mass failures such as debris flows. In steep terrain, mass failures can transport enormous quantities of sediment into riparian areas and stream channels. Mass failures are often triggered by intense rainstorms falling on saturated soils (Swanston

1991). Under such conditions, soil is particularly heavy due to the added water, and subsurface flows can reduce the forces that offset gravity.

The magnitude and distribution of erosion in watersheds affect the yield of sediment to the stream corridor. Soil erosion can occur gradually over a long period or it can be cyclic or episodic, accelerating during certain seasons or during certain rainstorm events (Grove and Rackham 2001). Erosion does not proceed at a uniform rate, because rainstorms are episodic events of varied intensity and because the forces binding soils continually change with temperature, moisture content, and vegetation structure.

Forestry practices, including clear-cutting, skidding, yarding, site preparation, and road construction and maintenance, can substantially increase sediment input to streams. Poorly designed logging roads and skid trails are persistent sources of sediment. Open slopes with soils exposed by yarding activities (or by associated mass failures or fires) erode easily (Chamberlain et al. 1991).

Excavation, grading, and other disturbance of the soil surface for infrastructure construction and maintenance is a primary source of sediment transported to streams. Development on steep hillsides further increases erosion and transport of sediment (Waters 1995, Renard et al. 1997).

In addition to these effects of land use activities, roads, graded and recontoured land, and the routing of stormwater drainage can all spatially concentrate runoff, and hence increase both surficial erosion and the likelihood of mass failures.

### *Stream Channel Form*

The form of stream channels and their floodplains affects most stream and riparian functions. For example, the shape and gradient of channels can affect the frequency of overbank flooding, depth to groundwater, and the location of areas of sediment deposition and removal. Similarly, amphibian habitats, and fish spawning and rearing habitats, are affected by the interplay of channel geometry with flow depth, velocity, and the scour and deposition of sediments.

The form of a stream's channel and active floodplain is a product of water and sediment inputs from the watershed, geologic constraints, channel or floodplain vegetation, and historic events. Consequently, changes in sediment inputs, flow regime, or vegetation cause changes in channel and floodplain form. These geomorphic responses can be complex because of interactions among these important factors. Flow regime, sediment transport, and vegetation influence each other; changes in channel and floodplain form likewise affect the growth of plants and the movement of water and sediment. Consequently, changes in a watershed (such as road construction) may cause channels and floodplains to undergo complex patterns of change across decades.

In the absence of human alterations, the form of stream channels is not static, unless constrained by geology. Channel and floodplain morphology changes slowly in response to long-term changes in climate; it can also change rapidly in response to periodic intense storms or to massive inputs of sediments from slope failures.

Human alterations often cause changes in flow regime and sediment input that lead to unstable channels with rapidly changing forms. Unstable channels result from rates of erosion and sedimentation that are much more rapid than in comparable, but relatively unaltered, streams (Doyle et al. 2000). This instability can affect riparian and stream functions (Paul and Meyer 2001, Brinson et al. 2002).

Channel instability has both horizontal (channel bed) and vertical (channel banks) components. A longitudinal section of streambed is stable when the size and quantity of sediment entering the section equals the size and quantity of sediment carried downstream. If the capacity of flows to transport sediment changes (e.g., change in peak flows) without a corresponding change in sediment inputs, or vice versa, then net erosion or deposition will occur and the channel may become unstable. The rising (i.e., aggradation) or lowering (i.e., incision or

degradation) of channel beds generally alters flows of groundwater and surface water through riparian areas by changing the elevation or slope of the water table, and by changing the discharge necessary for overbank flows.

Human alterations affect channel stability by changing vegetation in or adjacent to the channel, flow regime (i.e., the quantity and timing or stream flows), sediment inputs, or by placing structures along or in the channel. Their net affect on channel form is to alter the balance between erosion and deposition along the stream channel, causing a corresponding change in channel form. While a wide variety of changes in land use can affect hydrology, sediment transport, and channel and riparian conditions, the road system and land use in and immediately adjacent to the riparian corridor have the greatest potential for substantial effects at the resort.

### *Road Effects on Hydrology and Erosion*

Roads alter watershed hydrology and erosion through several mechanisms (USFS 2002, Forman et al. 2003). These mechanisms include:

- increasing runoff,
- intercepting and diverting surface and subsurface flows, and
- blocking movement of water and sediment.

Paved roads are impermeable, and unpaved roads have relatively unvegetated and compacted surfaces that have low permeability. Consequently, precipitation onto road surfaces generates runoff that contains sediment. This runoff may move along or across the road, depending on topography and road design. Eventually, this water flows onto adjacent uplands, or directly into riparian zones, wetlands, or streams, where it may adversely affect aquatic ecosystems.

Roads also may intercept surface and subsurface flows that are moving down slope. Where these flows cross the road, the road surface may be eroded, which may contribute sediment to streams, increase road maintenance, and limit road use or even cause failure of cut and filled slopes along the road. Where these flows enter sloping roads, they often become more concentrated, move along and erode the road surface or adjacent slopes, and may be diverted into adjacent drainages.

Roads also may block flows of water and sediment at stream crossings. Where roads cross small, intermittent channels, culverts are frequently used to convey water under the road. If of insufficient size or if they become clogged, water and sediment will accumulate at the road crossing, and may flow over the road surface, which erodes the road surface, and can lead to slumping and failure of the road bed.

In addition, culverts at road crossings can concentrate stream flows. For example, at the resort, several stream corridors consist of a complex of wetland, riparian, and upland vegetation, and have braided channels and seeps. Water moves along these stream corridors in a relatively wide zone. At road crossings, this water is often collected in a roadside ditch and then conveyed under the road through a single culvert. This concentrated flow of water has more power to cause erosion, and can form an entrenched channel and no longer support the wide zone of wetlands, seeps, and braided channels that previously existed.

## Enhancement Treatment

There are a variety of potential treatments that could be implemented to reduce road effects on riparian and stream corridors (USFS 2002). These treatments include:

- changes in road maintenance,
- construction of additional water bars or rocked rolling dips,
- outsloping of the road surface,
- installation of additional culverts or replacement of existing but damaged or under-sized culverts,
- placement of permeable fill, and

- road decommissioning.

Most of these treatments (e.g., water bars and roadway dips) divert flow from the road surface onto the adjacent slope, where it may disperse and infiltrate. Properly sized and maintained culverts allow channel flows to pass under roads. Permeable fill allows the passage of surface and shallow subsurface flows over a wide zone, and thus with minimal concentration of flow. In some cases, road decommissioning can eliminate road effects; but, where riparian vegetation and stream channels have adjusted in response to roads, decommissioning can cause new disruptions (particularly where fill and structures would be removed at stream crossings) and so the potential effects of decommissioning roads should be evaluated carefully.

### Potential Enhancement Locations

At the resort, the road system is well maintained and incorporates numerous components (e.g., culverts) that reduce road effects on aquatic ecosystems. Nonetheless, the recent stream assessment (Appendix B) identified a number of opportunities to reduce road effects and thereby enhance aquatic ecosystems. Exhibit 5-7 displays stream reaches where roads have altered the movement of water and sediment into or along streams, or both. Frequently, these effects have been caused by roads that are no longer in use, and where recovery of the channel and vegetation is well under way. However, some road crossings are causing on-going effects. Based on the stream survey and observations of Northstar staff, 6 road crossings that are causing on-going effects have been identified for enhancement (Exhibit 5-7).

### Implementation

The 6 road crossings located on Exhibit 5-7 will be enhanced during the first 8 years of HMP implementation by installing or replacing culverts and permeable fill, recontouring the road surface, or both. At other sites, treatments to reduce road effects on stream ecosystems will be considered during the adaptive management process, if monitoring indicates that water quality or stream and riparian condition targets are not being attained. (The adaptive management process is described in Chapter 6.) These enhancements would be implemented in conjunction with proposed projects. Additional enhancements to reduce road effects also may occur in conjunction with future projects. Exhibit 5-7 also illustrates 4 road segments that will be abandoned and left to return to a natural state during the first 8 years of HMP implementation by installing access barriers.

## Limit Human Disturbance of Wildlife

The effects of human disturbance on wildlife in riparian corridors, and the treatments to reduce these effects are similar to those previously described for the resort's conifer forests. Additionally, the hiking and mountain bike trail along the northeast side of Schaffer Creek in Zone D will be closed to reduce disturbances to mule deer fawning and other species associated with this important riparian zone. Also, similar to forests, treatments or seasonal use restrictions to reduce human disturbance could be applicable to Zones B–E and would involve the management practices described in Chapter 4 for access and use (some of which would be implemented as necessary based on wildlife monitoring [which is described in Chapter 6]). During deer fawning season, recreational access will be prohibited generally in the restricted area displayed on Exhibit 4-1; also, the bike trail adjacent to Schaffer Creek will be closed.

## Increase Capacity of Riparian and Stream Corridors to Provide Water Quality Functions

### Issue

The vegetation and soils of riparian zones and adjacent uplands can strongly influence the water quality of streams. The resort has an extensive stream network, and a variety of human uses occur throughout the resort and

the location of many of these uses will change over time. Therefore, maintaining and enhancing the integrity of the vegetation and soils adjacent to these streams is integral to maintaining water quality.

### Background

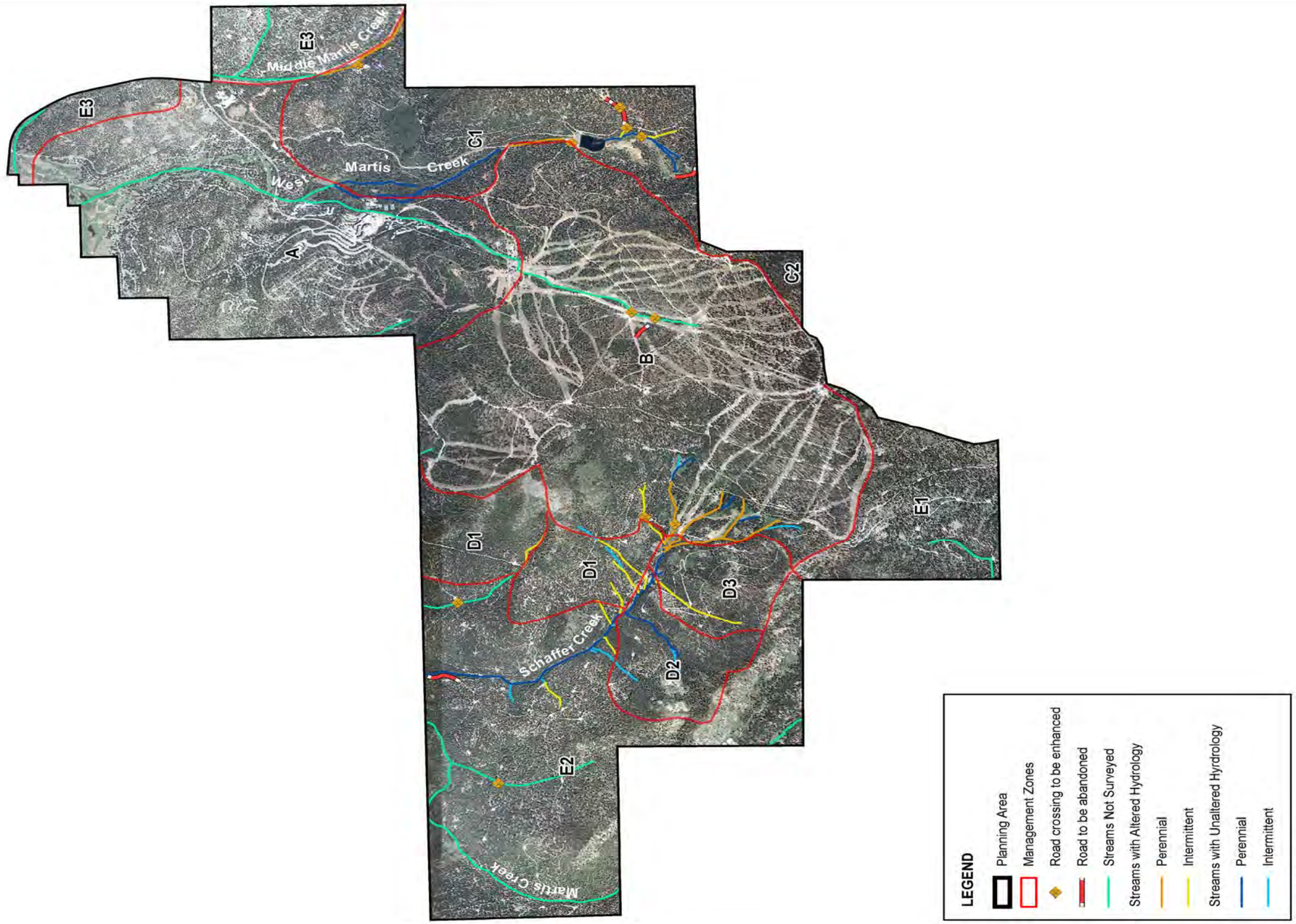
Changes in land use and other human activities within a watershed can alter water and sediment inputs to streams, and affect water quality, channel form, and riparian and aquatic habitats. Many of these effects can be reduced, however, by intact corridors of natural vegetation along stream channels (especially if these corridors extend beyond the active floodplain and onto the adjacent uplands). Conversely, effects on the soils and vegetation of channel banks, floodplains, and immediately adjacent uplands can in turn affect riparian and stream ecosystems to a much greater extent than comparable changes elsewhere in the watershed.

There has been considerable research on the effects of natural riparian (and of adjacent upland) vegetation, and of managed buffers, on the movement of runoff and suspended sediment. (This literature has been reviewed by Castelle et al. 1992, Wenger 1999, Brinson et al. 2002, Lowrance et al. 2002, Correll 2003). This research indicates that setbacks have three beneficial effects: slightly reducing the area of sediment sources in a watershed, increasing the distance of runoff and erosion sources from streams, and interposing a zone of vegetation with high roughness and high infiltration capacity between streams and sources of runoff and erosion. The roughness of both natural and managed vegetation can slow runoff and cause the deposition of sediment before it reaches the stream. This deposition of sediment increases with vegetation width; at any given width, deposition is greatest when flows are evenly distributed (not locally concentrated) and when vegetation and topography are uniform (Herrone and Hairsine 1998, Wenger 1999, Brinson et al. 2002).

Numerous studies document the effectiveness of managed or natural vegetation in removing suspended sediment, particularly sands and silts, from runoff before it reaches stream channels (Castelle et al. 1992; Wenger 1999; Brinson et al. 2002; Lowrance et al. 2002). (Because clay particles are very small [less than 2 μm], they remain suspended even in still water for hours, and thus are much more likely to remain in runoff.) If this sediment is deposited on the active floodplain, it may be only temporarily stored there before entering the stream channel. However, if sediment is removed from runoff before it reaches the floodplain, it is much less likely to be remobilized into the stream channel.

There is considerable variation among the results of studies assessing the relationship between the width of streamside vegetation and sediment removal from runoff. A number of studies document narrow widths (less than 33 feet) removing substantial amounts of sediment from runoff (Castelle et al. 1992, Wenger 1999, Lee et al. 2000, Hook 2003). Other studies have indicated wider corridors (66–197 feet) are necessary to remove most sediments (Cooper et al. 1987, Castelle et al. 1992, Davies and Nelson 1994, Wenger 1999). These include longer-term studies that have shown most sediment moving considerable distances into riparian areas (Cooper et al. 1987), and studies that document effects of excessive sedimentation on aquatic organisms in streams bordered by relatively wide corridors of vegetation (Megahan 1987 *in* Rhodes 1994). In general, short-term studies and studies of managed vegetation indicate greater benefits of narrow corridors of streamside vegetation, and longer-term studies of natural vegetation indicate lesser benefits (Grove and Rackham 2001). This difference results from substantial quantities of sediment being transported during intense storms and at locations where varied topography and vegetation concentrates overland flow.

In addition to inputs from the watershed, erosion of channel banks also adds sediment to streams; and, where stream flows and channel bank vegetation have been altered, the erosion of channel banks can produce substantial quantities of sediment (as well as changing channel form). The stability of channel banks is affected not only by the force of flowing water, but also by the force of gravity pulling bank sediments downward, which can lead to mass failure of sections of bank (i.e., bank failure). The binding of sediment particles by plant roots can substantially reduce the bank erosion caused by these forces. (After vegetation is removed from above-ground, sediment continues to be bound by dead plant roots [especially those of woody plants] for several years.) A tree's roots typically extend up to twice the radial distance of the tree's crown; thus, at the resort, trees up to 60 feet




# Northstar Habitat Management Plan

**Exhibit 5-7**
**Road Effects on Streams**

April 3, 2008

from the channel may contribute to bank stability. Therefore, bank retreat (i.e., net linear recession of the bank) is increased not only by changes in flow regime that increase the forces eroding banks, but also by removal of vegetation along and near the banks, which reduces the resistance of banks to erosion (Lawler et al. 1997).

Channel bank vegetation is directly altered by timber harvesting, land-cover conversion, and by the trampling associated with intensive summer recreational use. Consequently, all these activities may lead to excessive erosion and bank retreat.

### Enhancement Treatment

A wide variety of treatments could be applied because there are many different scenarios that could concentrate overland flow, or disturb soil or vegetation. These treatments may include trail rerouting, placement of barriers to unauthorized access (e.g., logs), or installation of structures to disperse flows (e.g., water bars), placement of mulch, temporary erosion control, treatment of soil to reduce compaction, or revegetation. (For descriptions of potentially applicable treatments see USFS 2002 or Hogan 2005.)

### Potential Enhancement Locations

Potential enhancement locations include any locations where concentrated overland flow is entering riparian areas, or soils or vegetation has been disturbed by recreation, or other activities, along channel banks, in riparian zones or in adjacent uplands. These locations will be identified through monitoring of stream and riparian conditions. This monitoring is described in Chapter 6.

### Implementation

During the adaptive management process, enhancement of the capacity of streamside vegetation to provide water quality functions will be considered, if monitoring indicates that water quality or stream and riparian condition targets are not being attained. (The adaptive management process is described in Chapter 6.) Enhancement of streamside vegetation also may occur in conjunction with development of facilities necessary for existing or planned uses.

## INCREASE HABITAT FUNCTIONS PROVIDED BY VEGETATION OF STREAM CORRIDORS

### Issue

The corridors of riparian and upland vegetation along streams provide important habitat functions for numerous species, including focal species of this HMP. These habitat functions are strongly influenced by the structure of riparian and adjacent upland vegetation.

### Background

Riparian zones provide important wildlife habitat, and influence the habitat value of associated streams and uplands. Many of the species associated with or using riparian habitats also use upland habitats, and uplands immediately adjacent to riparian zones also influence conditions in riparian zones and streams, particularly in mountainous terrain (as at the resort), where riparian corridors can be quite narrow. Therefore, corridors of streams, riparian zones, and adjacent uplands are integrated landscape units.

Although some riparian–associated species, such as mountain yellow-legged frog and Willow Flycatcher (both focal species), are practically restricted to riparian and stream corridors or wet meadows, other species such as Sierra Nevada mountain beaver (also a focal species) use adjacent upland vegetation as well. For example, many amphibian and reptile species, although strongly associated with streams and adjacent riparian vegetation, use adjacent uplands for foraging or refugia. Similarly, many bird species that breed in riparian areas, such as

MacGillivray's Warber (*Oporonis tolmiei*) and Yellow Warbler (*Dendroica petechia*), also forage in adjacent upland vegetation.

Conversely, streams and riparian areas are important to many wide-ranging and upland species, including bats (such as Yuma Myotis [*Myotis yumanensis*]) and deer. Riparian scrub and woodlands are important for migratory mule deer (another focal species) that forage, breed, and take cover there. Optimal deer fawning habitat has been described as having moderate to dense shrub cover near forest cover and water, such as riparian zones (Leckenby et al. 1982, Wood et al. 1999 *citing* Thomas 1979, Hall 1985). A source of surface water (e.g., creek or river) is especially important to mule deer (Leckenby et al. 1982, Zeiner et al. 1990a) and many other mammals.

Adjacent uplands shade riparian areas and streams, and are a source of coarse woody debris. Because of the steep terrain, typically narrow width of riparian vegetation, and the large size of conifers at the resort, adjacent uplands cast important shade that maintains cool, moist conditions in stream and riparian corridors. Snags and coarse woody debris provide necessary habitat elements for a variety of species. For example, western toads (*Bufo boreas*) and Pacific chorus frogs (*Pseudacris regilla*) seek cover under rotting logs, and some bird species (most woodpeckers, owls, and some swallows and flycatchers) require large snags for nesting (Morey 2002 a, b; Zeiner et al. 1990b; Riparian Habitat Joint Venture 2004). Large pieces of woody debris are also important components of aquatic habitats (Harmon et al. 1986, Brinson et al. 2002). Because small trees and shrubs (mountain alder and willow species) dominate the resort's riparian vegetation, large woody debris primarily originates in adjacent uplands.

The species associated with riparian habitats vary considerably in their requirements for riparian vegetation structure, home range or territory sizes, and use of upland habitats. Consequently, more diverse assemblages of wildlife are associated with heterogeneous, wide, and contiguous riparian corridors bordered by natural upland vegetation. Amphibian and reptile species use a variety of microhabitats including both sunny and shaded conditions. Mammal species often require dense vegetation close to the ground for cover. Many breeding bird species, including Willow Flycatcher (a focal species) use primarily early successional and shrub-dominated vegetation; other bird species prefer late-successional vegetation with taller trees and snags.

Overall, the species richness of riparian and stream corridors increases with their width, continuity, and presence of surface water or saturated soils in the stream channel and adjacent floodplain. For birds, this has been demonstrated by numerous studies in a variety of riparian ecosystems including studies in California (Keller et al. 1993, Dickson et al. 1995, Sanders and Edge 1998, Kilgo et al. 1998, Rottenborn 1999, Hagar 1999, Hannon et al. 2002, Heath and Ballard 2003, Jones & Stokes 2004). The importance of wide, contiguous corridors may be related to increased habitat heterogeneity in larger corridors, absence of interior habitats in narrower, fragmented corridors, and corridors of greater area supporting species with larger home ranges.

Width and continuity also affect the use of riparian and adjacent uplands as movement corridors. Very narrow corridors or corridors fragmented by development or lacking dense cover, may not be used by some species. In particular, if riparian and adjacent upland does not meet a species' habitat requirements, it may not be used for dispersal and hence will not provide a suitable corridor connecting habitat patches, particularly for smaller, less mobile animals (Noss et al. 1996, Rosenberg et al. 1997, Brinson et al. 2002).

In addition to riparian vegetation characteristics, habitat suitability for some riparian-associated bird species is a function of hydrologic conditions. For example, important characteristics of meadows and riparian corridors suitable for breeding Willow Flycatchers include a high water table that results in standing or slow-moving water, or saturated soils (e.g., "swampy" conditions), during the breeding season; abundant riparian deciduous shrub cover (particularly willow ); and riparian shrub structure with moderate to high foliar density that is uniform from the ground to the shrub canopy (Sanders and Flett 1989, Bombay 1999, Green et al. 2003).

### Enhancement Treatment

Either riparian or adjacent upland vegetation could be treated to enhance the habitat functions of these stream reaches. During the stream assessment, however, good opportunities for enhancement of riparian vegetation were

not observed (except at road crossings as described in *Reduce Effects of Road and Trail Crossings on Stream Ecosystems*). Adjacent upland vegetation, however, could be enhanced. Woody debris, snags, and tall trees are limited or absent along some stream reaches. Dense understory cover is also lacking along some reaches. Increasing these important features would enhance habitat functions along these reaches. This would be done through silvicultural treatments similar to those described previously for facilitating the development of late-seral habitat, or through modifying silvicultural practices to retain patches of dense understory vegetation in proximity to streams.

To reduce their effects on existing habitat and other natural resources, thinning treatments intended to enhance riparian or adjacent upland habitats would implement the relevant management practices for timber harvest operations described in Chapter 4. In addition, these thinning treatments would also be designed to retain more canopy cover than thinning treatments whose primary purpose was to reduce the risk of catastrophic disturbance.

In addition to enhancement treatments, Northstar implements numerous design and management practices (described in Chapter 4) to sustain the habitat values of riparian and stream corridors.

### Potential Enhancement Locations

Potential enhancement locations exist in Zones D and E, which have greater existing habitat values, greater connectivity to habitats outside of the property, and lesser conflicts with existing uses than stream corridors in Zones A, B, and C.

Within Zones D and E, very little late-seral habitat exists along streams, and along many reaches, coarse woody debris, snags, large trees, and patches of dense cover are not abundant. Enhancement to facilitate the development of these attributes would be appropriate along any stream reaches. However, the benefits of this enhancement would differ among reaches. Reaches near late-seral habitats could provide greater benefits, and reaches near development, roads, or ski runs could provide lesser benefits. The reasons for these differences, and the locations of stands providing potentially greater benefits are described in *Facilitate Development of Late-seral Habitat*.

Along these stream reaches, the benefits of enhancing adjacent upland habitat are greatest in Zone E2 within 200 feet of the stream (i.e., a zone extending 200 feet from each stream bank, and whose total width is 400 feet plus the width of the stream itself). This zone is slightly wider than the maximum height of the tree species dominating conifer forests at the resort, and thus represents the zone with the greatest potential to shade the stream and contribute large woody debris; it also is sufficiently wide to include adjacent riparian vegetation, and to provide dense cover and upland habitat elements required by riparian-associated species. Therefore, potential enhancement locations in Zone E2 consist of the zone extending 200 feet from each channel bank. In Zone D, which is a recreational use/habitat transition area, recreational uses may limit the habitat benefits of enhancing adjacent uplands. However, at locations not near or isolated by existing or proposed recreational land uses, benefits of enhancing adjacent forest may be comparable to those in Zone E2.

### Implementation

The habitat functions of vegetation adjacent to streams would be enhanced either 1) in conjunction with silvicultural treatment of adjacent forest to reduce the likelihood of catastrophic disturbance, or 2) in conjunction with development of facilities necessary for existing or planned uses.

## CONTROL INVASIVE PLANTS

The effects of invasive plants on riparian corridors, and the treatments to control invasive plants are similar to those previously described for forests at the resort. Also, similar to forests, invasive plant control would be applicable to any riparian corridors on Northstar property because of the potential for invasive plant populations to expand and become uncontrollable. Proposed monitoring of riparian and stream conditions would provide a mechanism for early detect of invasive plant infestations, and would trigger control treatments.

## REDUCE CONIFER ENCROACHMENT OF ASPEN STANDS

### Issue

Conifer encroachment into riparian areas, in particular into aspen stands, has been occurring throughout the western United States (Bartos 2000), including the Lake Tahoe Basin and portions of riparian corridors at the site. This encroachment converts broadleaf-dominated vegetation to conifer-dominated vegetation, and this reduces habitat values for many species, including several focal species of this HMP. Aspen stands also provide scenic values and can have cultural values; these values also are reduced by conifer encroachment.

### Background

Stands of quaking aspen (*Populus tremuloides*) occur in riparian zones at the resort (Exhibit 5-8). These stands provide distinct and valuable wildlife habitat, have scenic values, and can have cultural values as well (Richardson 2004). Conifer encroachment is occurring in these stands, which reduces their wildlife habitat, scenic and cultural values, and could eventually eliminate these aspen stands.

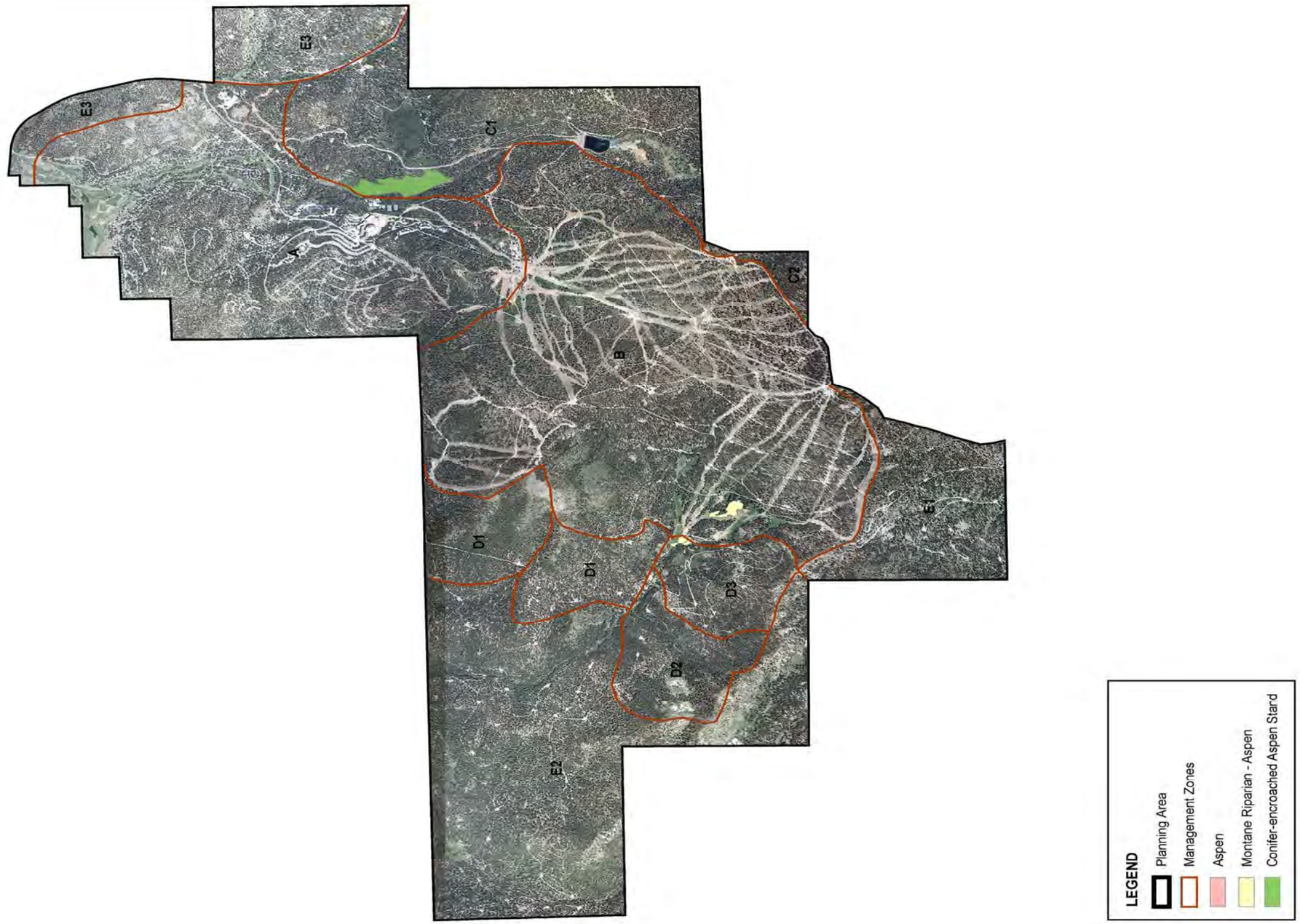
Quaking aspen is a clonal tree that produces multiple shoots (i.e., sprouts) from its root system (Perala 1990). Following disturbances, such as logging or a canopy fire, the root system produces large numbers of shoots; this often results in a patch of forest (i.e., a stand) with a canopy composed almost entirely of aspen. Although individual shoots of aspen are relatively short-lived (typically 80–120 yrs [Perala 1990, Shepperd et al. 2006]), aspen stands can persist for centuries through the repeated replacement of stems with new stems from the root system. The recruitment and persistence of new shoots depends on disturbances that create conditions suitable for the initiation and growth of new shoots and intervals between disturbances suitable for the survival and growth of shoots.

In most aspen stands at the resort, there has been a long interval free of fire and logging; as a result, opportunities for recruitment of new aspen shoots have been reduced. In contrast to the reduced recruitment of aspen stems, this interval without fire or logging has provided an opportunity for the establishment of conifers (primarily white firs) and for their growth into the canopy of aspen stands (i.e., conifer encroachment). White fir, which can tolerate and grow in the shade of aspen, has a narrower crown and reaches greater heights than aspen. It can grow between or through the aspen crowns and overtop them. Because aspen is not shade-tolerant, its growth and survival are substantially reduced by over-topping white firs. Consequently, encroachment by white fir not only results in increased cover of white fir but also results in decreased aspen cover.

The extent of conifer encroachment has varied in the resort's aspen stands. In general, however, there are numerous white fir saplings in these stands, many of which are approaching the canopy. Thus, substantial recruitment of mature white fir into these aspen stands could occur in the next 10–20 years.

### Enhancement Treatment

Current conifer encroachment can be reduced, future conifer encroachment prevented, and future recruitment of aspen increased through enhancement treatments (Shepperd et al. 2006). These treatments involve the removal of conifers: the removal of understory saplings by hand-felling prevents recruitment of additional conifers into the canopy, the removal of conifers from the canopy of aspen stands reduces current encroachment, and the removal of adjacent conifers also reduces conifer competition with existing aspen shoots, and provides an opportunity for the expansion of aspen stands (Jones et al. 2005). Generally, new aspen shoots may originate at distances from existing shoots that are equal up to 1.5–2 times the height of the existing shoots (Shepperd et al. 2006). (This represents the zone adjacent to the aspen stand into which aspen roots extend.) Because the resort is not grazed, and browse herbivory is not otherwise extensive, protection of new stems from herbivores is probably unnecessary.




# Northstar Habitat Management Plan

**Exhibit 5-8**
**Aspen Stand Locations**

April 3, 2008

Canopy conifers may be felled through varied techniques. The soil disturbance and compaction associated with tree cutting and removal may be reduced by minimizing the use and movement of heavy equipment in the aspen stand or by harvesting in winter when soils are frozen and snow covered. Because the production of aspen shoots is enhanced by increased light and warmth, the stem and limbs of cut trees should be removed from the aspen stand.

Aspen stands can be adversely affected by off-highway vehicles (OHVs) and concentrated recreational use, in addition to conifer encroachment. Closing or re-routing trails could eliminate these effects; even without closing the trail, off-trail incursions into aspen stands could be reduced through the placement of barriers (e.g., logs). In addition, covering the trail with wood chips or mulch could provide some protection to aspen roots.

### Potential Enhancement Locations

Exhibit 5-8 displays the location of aspen stands at the resort. Treatment to reduce conifer encroachment would benefit any of these stands. Some of these stands, however, are owned (at least in part) by others or have a conservation easement on them. Treating these stands may be difficult or impractical.

### Implementation

Treatments to reduce conifer encroachment into aspen stands will be implemented either 1) in conjunction with silvicultural treatment of adjacent forest to reduce the likelihood of catastrophic disturbance, or 2) in conjunction with, and as mitigation for, impacts resulting from development of facilities that are necessary for existing or planned uses.

# 6 MONITORING AND ADAPTIVE MANAGEMENT FRAMEWORK

This chapter describes the monitoring, record keeping, decision-making, and reporting that is integral to the adaptive management component of the Habitat Management Plan (HMP).

## ADAPTIVE MANAGEMENT PROCESS

It is generally understood that uncertainty is an unavoidable component of managing natural systems. Adaptive management strives to reduce that uncertainty and improve management over time. It is an iterative process of evaluating and refining management based on the results of management activities and the status of the managed resource. Consequently, the integral components of adaptive management include:

- selecting indicators of ecosystem functions or habitat values,
- setting measurable or observable targets (numerical or descriptive) for the indicators,
- monitoring the indicators,
- documenting management practices,
- using monitoring results to evaluate management practices, and
- revising management practices as necessary to attain targets in response to monitoring data.

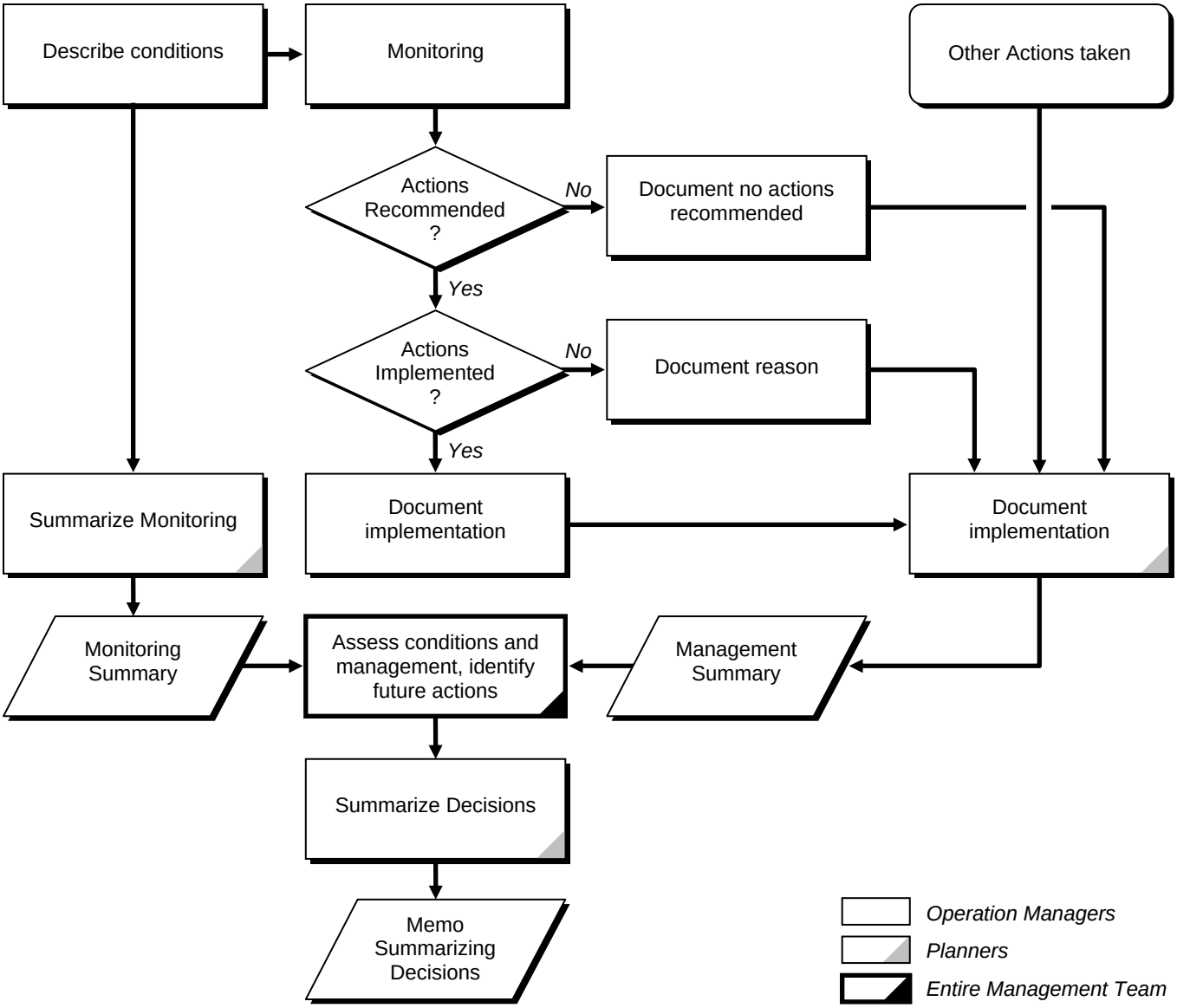
Plans for adaptive management of resources should contain each of these components. More specifically, they should contain a monitoring plan that describes how monitoring data will trigger revisions of management practices (i.e., the feedback loop between monitoring and management) and how adaptive management decisions will be documented and reported.

For this HMP, the adaptive management process includes monitoring and reporting components that together constitute the monitoring and reporting plan as outlined in Attachment M. Exhibit 6-1 diagrams the process for:

- monitoring attainment of targets,
- identifying, implementing and documenting management actions, and
- decision-making based on monitoring data and records of management actions.

Table 6-1 identifies the parties responsible for each of these components of the adaptive management process. Table 6-1 also identifies the Northstar staff responsible for all aspects of implementing the HMP.

For the HMP, monitoring will be conducted if required for compliance with the terms and conditions of environmental permits resulting from Northstar projects, or if stable or improving conditions have not been attained on a monitored stream. Other monitoring also may be used to satisfy both the HMP and County requirements, or other regional monitoring or reporting efforts. This monitoring and records of management actions taken by Northstar will be summarized each year. Northstar staff will review this information in a meeting and make decisions regarding necessary changes in practices, if any. They will also prepare an annual memorandum summarizing monitoring and management information, adaptive management decisions, and the basis for those decisions.




**Northstar HMP Adaptive Management Process** **Exhibit 6-1**

| Table 6-1<br>HMP Implementation Responsibilities and Timing | | |
|---|---|---|
| Item | Responsibility | Timing |
| **Wildlife Monitoring** | | |
| Northern Goshawk | Third party consultant | Every 5 years |
| California Spotted Owl | Third party consultant | Every 5 years |
| Mule Deer | Third party consultant | Every 5 years |
| **Water Quality Monitoring** | | |
| Zone A-C - Lahontan Board Order | Northstar - Env. Coord. | Ongoing[1] |
| Zone A-E - Real Time Monitoring Stations | NMP | Ongoing[1] |
| Zone D & E - IBI Water Quality (Schaffer Creek) | Third party consultant | Every 5 years[2] |
| Stream Assessments | Northstar - Env. Coord. | Annual |
| **Stream and Riparian Area Condition Monitoring** | | |
| Stream Assessments | Northstar - Env. Coord. | Annual |
| **Forestry Monitoring and Prescriptions** | | |
| Periodic Timber GIS update | Third party consultant and/or Forester | Every 5 years |
| Manage forested areas in accordance with the Northstar Community Service District (NCSD) fuel silviculture prescriptions for the protection of human safety and forest health and, to the extent practicable given these objectives, maintain and enhance natural resources to the extent practicable (without compromising human safety or forest health). (Zone A) | NCSD; All property owners | As required |
| Manage forests for forest health, and to maintain and enhance natural resources to the extent practicable; includes fuel reduction and habitat enhancement treatments (Zones B–E) | Forester | Annual |
| **Resort Management** | | |
| Conduct annual monitoring and maintenance of the road and trail system. | Northstar - Env. Coord. | Annual |
| Maintain all culverts, waterbars, and other drainage structures in a fully functional condition. | Northstar - Env. Coord. | Annual |
| Implement additional, feasible drainage and erosion control measures as needed to prevent discharge of runoff and sediment from the road directly into the active floodplain of watercourses. | Northstar - Env. Coord. | As required |
| Reshape the road surface as needed to maintain proper surface drainage. | Northstar - Env. Coord. | Annual or as required |
| Restore roads that are not necessary for forest management to native vegetation. | Northstar- Env. Coord. | As required |
| Establish native vegetation on slopes where grading and/or smoothing has taken place along roads or where trails have been established. | Northstar- Env. Coord. | As required |
| Support USFS efforts to maintain and improve FSR O6 and associated stream crossings. | Northstar- Env. Coord. | As required |
| Manage ski runs and associated facilities to maintain, or to move towards attainment of the appropriate CAREC or other qualified professionals recommendations and/or required by Placer County and the Lahontan RWQCB. | Northstar - Env. Coord.and/or Construction manager | To be addressed with the phased construction of proposed projects |

**Table 6-1**
**HMP Implementation Responsibilities and Timing**

| Item | Responsibility | Timing |
|---|---|---|
| **Invasive Plant Treatment** | | |
| Provide outreach regarding control efforts. | Northstar- Env. Coord<br>NMP | Annual |
| Monitor hot spots of introduction on Northstar properties to enable early detection and rapid eradication of invasive plants (e.g., roadsides, parking areas, construction sites, disturbed areas). | Northstar- Env. Coord (Zones B–E)<br>NMP (Zone A) | Ongoing |
| Monitor the interface of Zone A and other zones with the intent of preventing invasive exotic species from entering into Zones B, C, D, and E. | Northstar- Env. Coord (Zones B–E)<br>NMP (Zone A) | Ongoing |
| Eradicate detected infestations of invasive plants on Northstar properties while infestations are still small and control is feasible. | Northstar- Env. Coord (Zones B–E)<br>NMP (Zone A) | As required |
| Periodically evaluate effectiveness of monitoring and control methods and adjust methods as needed. | Northstar - Env. Coord (Zones B–E)<br>NMP (Zone A) | Annual |
| Coordinate with and support regional control efforts. | Northstar- Env. Coord (Zones B–E)<br>NMP (Zone A) | Ongoing |
| **Access and Use** | | |
| Inform the public of use restrictions within the zone by including these restrictions in relevant materials distributed by Northstar, and through signage at the major access points to this zone. | Northstar- Env. Coord | Ongoing |
| Enforce use restrictions as needed and practicable. | Northstar- Env. Coord | Ongoing |
| Maintain locked gates and signs (identifying Northstar ownership) on Northstar-maintained roads at the major access points into Zone E from outside of Northstar properties. | Northstar- Env. Coord<br>Northstar Security | Ongoing |
| Identify locations where illegal uses of Northstar property (e.g., unauthorized ORV use, dumping) are occurring or have occurred, and implement measures (e.g., patrols, signage, barriers) to reduce future illegal uses. | Northstar- Env. Coord<br>Northstar Security<br>NCSD | Ongoing |
| **HMP Document Management** | | |
| Annual memo summarizing monitoring and management | Northstar- Env. Coord<br>NMP | Annual |
| 5 year review and update | Northstar and NMP | Every 5 years |

Notes –

[1] Currently ongoing as a permit requirement. If ongoing monitoring is no longer required, and water quality data are not available from other sources, benthic macroinvertebrates may be monitored at 3–5 year intervals as a substitute for monitoring of water quality constituents This monitoring would be conducted only for Schaffer Creek (in Zones B, D, or E), and would be the responsibility of a third party consultant. If IBI based on benthic macroinvertebrates indicates stable or improving, non-degraded conditions for a 3–5 year period, and development projects or intensive use are not ongoing, then the water quality objective would be attained, and additional monitoring would not be performed.

[2] Only necessary if ongoing water quality monitoring is not a permit condition and data are not otherwise available. If IBI indicates stable or improving, non-degraded conditions for a 3–5 year period, and development projects or intensive use are not ongoing, then the water quality objective would be attained, and additional monitoring would not be performed.

The following sections describe this adaptive management process, and especially the monitoring program, in greater detail.

# MONITORING

Adaptive management decisions are based on monitoring data, and thus the design of monitoring measures and programs has a substantial influence on the effectiveness of adaptive management. The general objectives of monitoring programs are to:

- ensure logistical and technical feasibility,
- maximize efficiency of monitoring protocols,
- provide information sufficient to support adaptive management decisions, and
- summarize and interpret data in a technically appropriate manner that is responsive to management needs and supports future use of the data.

To fulfill these objectives, monitoring plans should include descriptions of:

- variables to be monitored,
- protocols for monitoring these indicators, and
- content and frequency of reports summarizing monitoring data.

This section of the HMP describes the monitoring procedures for water quality targets, stream and riparian area targets, forest structure targets, and focal wildlife species. It is important to note that, while procedures are outlined below, this HMP allows flexibility for or possible incorporation of potential future monitoring required by the Martis Valley Community Plan (MVCP), Lahontan Regional Water Quality Control Board (RWQCB), and/or Placer County. The monitoring approach is intended to have reasonable and appropriate costs (of management, monitoring, and reporting) relative to applicable public agency and industry-wide standards.

## MONITORING FOR WATER QUALITY TARGETS

For water quality targets, monitoring to support adaptive management and evaluations of the attainment of water quality targets may differ between zones. In some zones of the resort, water quality constituents are monitored for permit compliance. And in the future, other monitoring of water quality constituents may be required by the Lahontan RWQCB or by Placer County. While the monitoring of water quality constituents does not measure the condition of aquatic communities directly, it does measure a potentially significant effect on these communities.

For zones in which water quality monitoring is being conducted on an on-going basis for regulatory compliance or is otherwise available (e.g., from a regional monitoring program), the HMP may rely on this monitoring. For zones in which water quality monitoring is not being conducted, the HMP may rely on monitoring of stream and riparian area condition together with monitoring of aquatic invertebrates based on the California Department of Fish and Game's (DFG) California Stream Bioassessment Procedure. The monitoring of stream and riparian area condition will guide management that affects water quality, and this monitoring is described in the next section (*Stream and Riparian Condition Monitoring*); the ongoing water quality monitoring and the California Stream Bioassessment Procedure are described below.

For evaluation of conformity with water quality objectives, the Lahontan RWQCB has established monitoring and reporting requirements. Currently, as components of Highlands Project permitting, NMP's monitoring is being performed at six locations. These locations are shown on Exhibit 6-2. At these locations, monitoring includes water quality constituents and aquatic invertebrates. This monitoring is described in detail in the Monitoring and

Reporting Program (MRP) associated with the Highlands project, which is attached as Appendix E, and is summarized below.

At four of the five monitoring sites shown on Exhibit 6-2, equipment has been installed to record flow, turbidity, conductivity, pH, and temperature 1–4 times each hour. (This information is not being recorded at the site on West Martis Creek above Highlands View Drive.) At all five sites, grab samples are taken each week and analyzed for total phosphorus, total nitrogen, nitrate-nitrogen, ammonium-nitrogen, total Kjeldahl nitrogen, and particulate organic nitrogen. Grab samples are analyzed for total suspended solids each month. Four times per year, grab samples are also analyzed for chloride, sulfate, total petroleum hydrocarbons, and applied pesticides. In addition to this monitoring of water quality constituents, aquatic invertebrate assemblages are sampled as part of an annual bioassessment procedure.

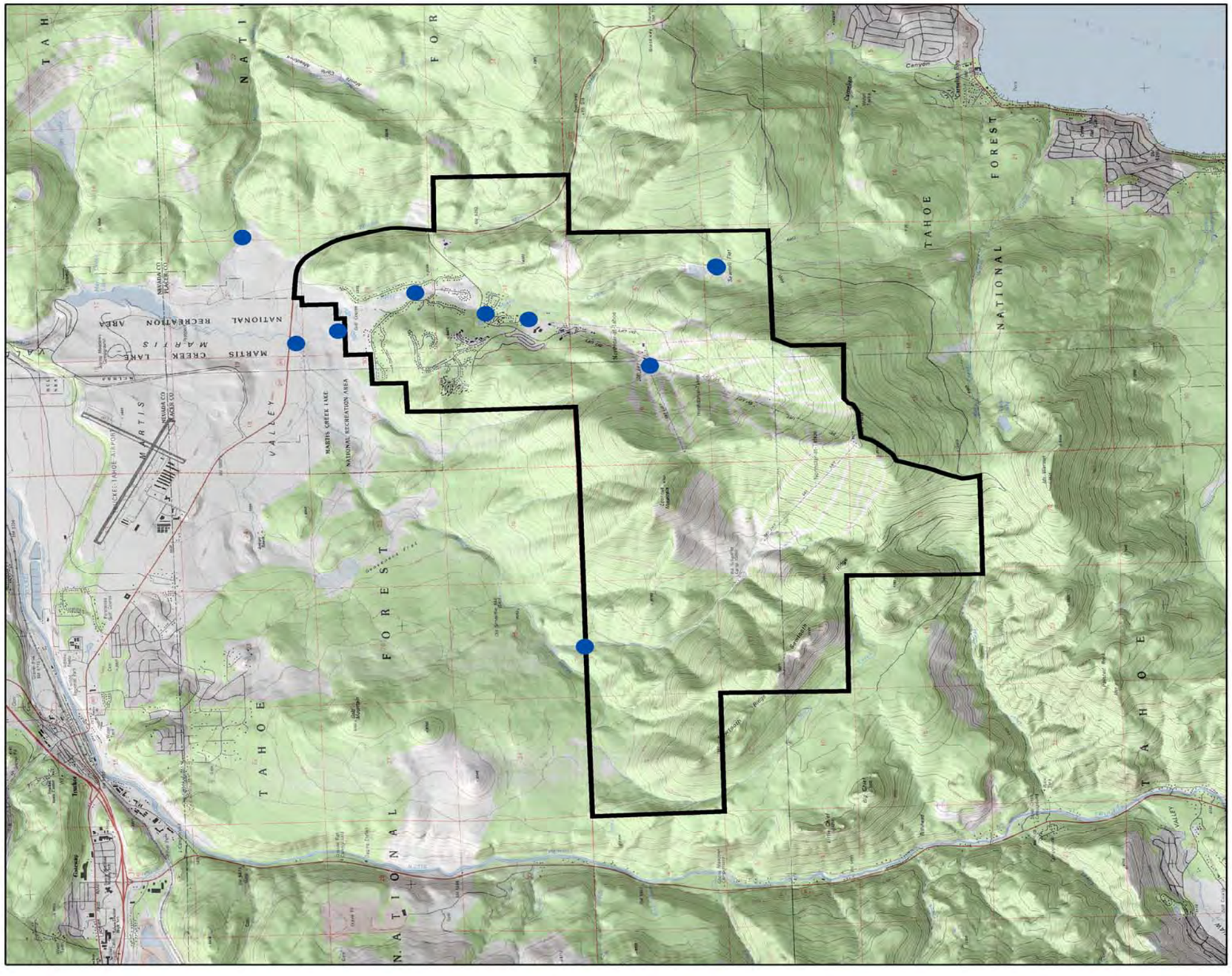
Additional water quality monitoring is conducted by Northstar resort at the three monitoring sites in Zones A and B. During April–June, samples are collected on a weekly basis from each location whenever the observed flow in the west branch of Martis Creek is above 5 cubic feet per second (cfs); during the rest of the year, samples are collected during each significant rainfall event during which the observed flow in the west branch of Martis Creek is above 1 cfs. These samples are analyzed for turbidity, suspended sediment, total dissolved solids, nitrogen, phosphorus, and total recoverable oil and grease. Each month, these data are summarized in a report that is submitted to the RWQCB.

For zones of Northstar properties in which on-going monitoring is being implemented, the monitoring of water quality constituents may be used as the monitoring of water quality for the HMP; and, evaluations of the attainment of the HMP's water quality target may be based on this monitoring. For the foreseeable future, it is anticipated that on-going monitoring as part of the implementation of the Highlands MRP and the Lahontan RWQCB Board Order will be sufficient to guide implementation of the HMP in all zones.

However, in Zones D and E, monitoring may not be performed throughout the foreseeable future; and, it is not known if other water quality monitoring will be required by Lahontan RWQCB or Placer County, or if water quality data will be available from other sources. If monitoring of water quality is not performed to fulfill a permit requirement, and if comparable data are not available from other sources, then, in addition to stream and riparian condition monitoring, the California Stream Bioassessment Procedure (CSBP) (Harrington 2002; Aquatic Bioassessment Laboratory, in prep.) may be used to monitor the condition of the aquatic ecosystem at the downstream end of Schaffer Creek (a tributary to Martis Creek) where it flows out of Zone D.(However, if water quality data are available from a Lahontan RWQCB monitoring site on Schaffer Creek, those data will be used instead of the CSBP.) The CSBP monitoring would be conducted at 5-year intervals, to support evaluation of the effectiveness of the HMP. If these monitoring data indicate stable or improving, non-degraded conditions for a 5-year period, then this objective would be attained, and additional monitoring would not be performed.

The CSBP is a bioassessment procedure that uses samples of the stream's benthic macroinvertebrate (BMI) community, select water quality parameters, and its physical/habitat characteristics to determine the stream's biological, chemical, and physical integrity. A regional index of biological integrity (IBI) developed by Herbst (2001) will be used to interpret the biological data. Following this standardized protocol and regional IBI will ensure data and analyses are comparable to other assessments conducted within the region.

A preliminary draft of the data collection forms and the protocol are attached to Appendix F, which provides additional discussion of aquatic ecosystems and bioassessment. (The protocol and forms are currently under revision by DFG.)




**LEGEND**

- Planning Area
- Water Quality Monitoring Location

T06110031.01 062

N

0 2,300 4,600 9,200 FEET

SOURCE: USGS, EDAW 2007

# Northstar Habitat Management Plan

## Exhibit 6-2
## Water Quality Monitoring Locations

April 3, 2008

## MONITORING FOR STREAM AND RIPARIAN AREA CONDITION TARGETS

A rapid visual assessment of channel, bank, and riparian area conditions has been designed specifically for the Northstar HMP. It is designed to provide information that can directly guide remedial actions to improve stream and riparian conditions, and be readily applied in a cost-effective, yet rigorous, manner. Assessments will be performed annually from the year preceding construction through to (and including) the year following construction; if the assessment following construction indicates that stream and/or riparian conditions have been adversely affected by construction activities, then additional years of assessments will be performed until conditions have become improved and stable. These assessments also will provide a quantitative score that will be used to track stream and riparian area conditions over time.

The resource management targets in Chapter 4 identify three streams that would be assessed. These streams are: Martis Creek (in Zone E), Schaffer Creek (in Zones B, D, and E), and West Martis Creek (in Zones A, B, and C). Tributaries to these streams would only be assessed if prior assessment results indicated that they were adversely affecting attainment of an HMP target for stream and riparian condition.

Exhibit 6-3 is a field data form for this assessment, and illustrates the information recorded, and to a large degree the protocol involved. The assessment is based in large part on the stream bioassessment procedure developed by the EPA for nationwide use in a wide variety of situations.

The first time a stream segment (i.e., reach) is evaluated, additional information should be recorded in addition to the visual assessment data. This information characterizes the reach, and should include:

- directions for access to the stream reach;
- geographic coordinates for the upstream and downstream ends of the reach, and for photo documentation points (if any);
- tree, shrub, and herbaceous species accounting for greater than 10% of total plant cover in the tree, shrub or herbaceous layers;
- invasive plants present (if any) and their location and abundance; and
- a description of adjacent land uses and road and trail crossings that could potentially affect the condition of the stream and riparian corridor.

This information will be referred to during subsequent assessments, and thus should be archived in an accessible and well-documented location.

### PROCEDURE FOR PERFORMING VISUAL ASSESSMENTS

1. Perform the visual assessment on the same streams from which the bioassessment and/or water quality sampling is conducted. Some parameters require an observation of a broader section of the drainage than just the sampling reach. (In general, within a zone, the entire perennial length of monitored streams should be assessed, although streams may be treated as two or more separate segments that are each relatively homogenous; the minimum length of stream for the visual assessment is 500 feet.)

2. Record the station identification section, name of data collector(s), and date on each field data sheet and visual assessment form.

| Assessment of Stream and Riparian Condition (Reach Wide) | | | | |
|---|---|---|---|---|
| **Habitat Parameter** | Optimal | Suboptimal | Marginal | **Poor** |
| **1. Epifaunal Substrate/ Available Cover** | Greater than 70% of substrate favorable for epifaunal colonization and fish cover; most favorable is a mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient). | 40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale). | 20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. | Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking. |
| **SCORE ___** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **2. Sediment Deposition** | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition. | Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools. | Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. |
| **SCORE ___** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **3. Embeddedness** | Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. | Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. | Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment. | Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment. |
| **SCORE ___** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **4. Bank Stability** (score each bank) Note: determine left or right side by facing downstream. | Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems; <5% of bank affected. | Moderately stable; infrequent, small areas of erosion mostly healed over; 5-30% of bank in reach has areas of erosion. | Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods. | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. |
| **SCORE (LB) ___** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **SCORE (RB) ___** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **5. Vegetative Protection** | More than 90% of the streambank surfaces and immediately adjacent riparian zone covered by vegetation in the herbaceous and/or shrub layers. | 70-90% of the streambank surfaces covered by vegetation in the herbaceous and/or shrub layers. | 50-70% of the streambank surfaces covered by vegetation in the herbaceous and/or shrub layers. | Less than 50% of the streambank surfaces covered by vegetation in the herbaceous and/or shrub layers. |
| **SCORE (LB) ___** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **SCORE (RB)** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **6. Riparian Surface Stability** | Nearly 95-100% of ground covered by undisturbed herbaceous vegetation, litter and duff, rock, or woody debris; rill erosion and sediment deposition absent. | 80-95% of ground covered by undisturbed herbaceous vegetation, litter and duff, rock, or woody debris; rill erosion and sediment deposition absent. | 80-95% of ground covered by undisturbed herbaceous vegetation, litter and duff, rock, or woody debris; rill erosion and/or sediment deposition present. | Less than 80% of ground covered by undisturbed herbaceous vegetation, litter and duff, rock, or woody debris; rill or gully erosion and/or sediment deposition present. |
| **SCORE** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **7. Riparian Shrub Layer** **(Growing along banks and active floodplain/terraces)** | Nearly continuous shrub layer along channel or shrub layer with 50-90% cover and multiple species and size/age classes, and/or some regeneration of tree species; no extensive mortality or die-back of shoots, no extensive cutting or damage. | Shrub layer discontinuous (cover 30-90%), but with multiple species and size/age classes, and/or some regeneration of tree species; no extensive mortality or die-back of shoots, no extensive cutting or damage. | Shrub layer discontinuous (cover 30-90%); may be monospecific, consist of a single size/age class; may lack tree regeneration; and have extensive mortality or die-back, or extensive cutting or damage. | Shrub layer, and understory layer sparse or absent (cover <30%), and may be monospecific, consist of a single size/age class; may lack tree regeneration; and have extensive mortality or die-back, or extensive cutting or damage. |
| **SCORE** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **8. Riparian Zone Tree Layer** **(Growing on or within 100 feet** | Tree cover >60%, canopy dominated by trees >24 inches in DBH, and snag density >5 per acre | Tree cover >60%, canopy dominated by trees <24 inches in DBH or 5 or less snags per acre | Tree cover 40-60%, may be dominated by trees <24 inches in DBH, and snags may be 5 or less per acre | Tree cover <40%, may be dominated by trees <24 inches in DBH, and snags may be 5 or less per acre |
| **SCORE ___** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |

Comments and Recommended Management Actions are recorded on back of form.

**Example Stream and Riparian Visual Assessment Form** **Exhibit 6-3**

3. Closely examine stream and riparian features to make an adequate assessment. If the stream and riparian assessment is done at the same location and before any biological sampling (e.g., bioassessment or water quality sampling), care must be taken to avoid disturbing the sampling habitat.

4. Complete the visual assessment field data sheet, in a team of at least 2 who come to a consensus on determination of quality. Those parameters to be evaluated on a scale greater than a sampling reach require traversing the stream corridor to the extent deemed necessary to assess the stream and riparian features. As a general rule-of-thumb, walk the lengths of the sampling reach twice to assess these parameters.

5. On the back of the data form, sketch a map of the sampling reach and record comments and recommended management actions.

6. Name photographs of assessed reaches with a reach identifier, location coordinates, compass bearing, and date.

## QUALITY ASSURANCE PROCEDURES

1. Each resource monitor will be familiar with the description of the visual-based technique that is provided in this section for the stream and riparian condition assessments.

2. The assessment criteria for each assessment parameter will be calibrated for the streams classes being assessed as necessary.

3. Assessment results will be periodically checked using photographs of the sampling reach and discussions among the resource monitors and other qualified natural resource specialists.

## MONITORED VARIABLES

Conditions will be assessed on the basis of eight variables:

- epifaunal substrate/available cover,
- sediment deposition,
- embeddedness,
- bank stability,
- vegetative protection of banks,
- riparian surface stability,
- structure of the riparian shrub layer, and
- structure of the riparian tree layer.

The rationale and protocol for monitoring each assessment variable is described below.

### Epifaunal Substrate/Available Cover

Epifaunal substrate and available cover includes the relative quantity and variety of natural structures in the stream, such as cobble (riffles), large rocks, fallen trees, logs and branches, and undercut banks, that are available as refugia, feeding, or rearing sites for spawning and nursery functions of aquatic organisms. A wide variety of and/or abundance of submerged structures in the stream provides macroinvertebrates and fish with a large number of niches, thus increasing habitat availability and diversity. As variety and abundance of cover decreases, habitat structure becomes monotonous, diversity decreases, and the potential for recovery following disturbances decreases.

Riffles and runs are critical for maintaining a variety and abundance of insects in most high-gradient streams and serving as spawning, rearing and feeding refugia for certain fish. The extent and quality of the riffle are important

factors in the support of high quality habitats in high-gradient streams. Riffles and runs offer a diversity of habitat through variety of particle size, and, in many small high-gradient streams, will provide the most stable habitat. Snags and submerged logs are among the most productive habitat structures for macroinvertebrate colonization and fish refugia in low-gradient streams, however, “new fall” of woody debris into streams will not be available for colonization immediately and should be assessed as such.

Stream attributes that are most favorable and thus result in high ranking would include a mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient). Attributes that would generate a low score would include obvious lack of substrate or unstable substrates.

### Embeddedness

Embeddedness refers to the extent to which rocks (e.g., gravel, cobble, and boulders) and snags are covered or sunken into the silt, sand, or mud of the stream bottom. Generally, as rocks become embedded, the surface area available to macroinvertebrates and fish (shelter, spawning, and egg incubation) is decreased. Embeddedness is a result of large-scale sediment movement and deposition, and is a parameter evaluated in the riffles and runs of high gradient streams.

For the purpose of this assessment, we define embeddedness as the volume of course particles (e.g., gravel, cobble, and boulders) that is buried by fine particles (e.g., sand and silt). The rating of this parameter may be variable depending on where the observations are taken. To avoid confusion with sediment deposition (another evaluation parameter), observations of embeddedness should be taken in the upstream and central portions of riffles and cobble substrate areas. Conditions that would receive high assessment rating would be characterized as course particles that are layered and not surrounded by fine sediment. Attributes that would generate a low score include course particles that are largely surrounded by fine sediment and lack interstitial spaces between particles.

### Sediment Deposition

Sediment deposition refers to the amount of sediment that has accumulated in pools and the changes that have occurred to the stream bottom as a result of deposition. Deposition occurs from large-scale movement of sediment. Sediment deposition may cause the formation of islands, point bars (areas of increased deposition usually at the beginning of a meander [i.e., bend] that increase in size as the channel is diverted toward the outer bank) or shoals, or result in the filling of runs and pools. Usually deposition is evident in areas that are obstructed by natural or manmade debris and areas where the velocity of stream flow changes, such as bends. High levels of sediment deposition are symptoms of an unstable and continually changing environment that becomes unsuitable for many organisms.

Attributes that would generate high ranking would generally include little or no enlargement of islands or point bars and very little of the stream bottom visually affected by sediment deposition. Attributes that would generate a low score would generally include noticeable heavy deposits of fine material, increased bar development; large portion of the stream bottom changing frequently; and pools almost absent due to substantial sediment deposition.

### Bank Stability

Bank stability refers to the condition of the stream banks and measures whether the stream banks are eroded (or have the potential for erosion). Steep banks are more likely to collapse and suffer from erosion than are gently sloping banks, and are therefore considered to be unstable. Signs of erosion include crumbling, unvegetated banks, exposed tree roots, and exposed soil. Eroded banks indicate extensive (and thus problematic) sediment movement and deposition, and suggest a scarcity of cover and organic input to streams.

Each bank is evaluated separately and the cumulative score (right and left) is used for this assessment parameter. Attributes that would generate a high ranking would generally include stable banks with evidence of erosion or

bank failure absent (or affecting only a small portion of the banks), and thus little potential for future problems. Attributes that would generate a low score would generally include unstable banks with many eroded areas and obvious bank sloughing, and a large percentage of bank having erosional scars.

### Bank Vegetative Protection

Bank vegetation protection refers to the amount of vegetative protection afforded to the stream bank and the near-stream portion of the riparian zone. The root systems of plants growing on stream banks help hold soil in place, thereby reducing the amount of erosion that is likely to occur. This parameter supplies information on the ability of the bank to resist erosion as well as some additional information on the uptake of nutrients by the plants, the control of instream scouring, and stream shading. Banks that have full, natural plant growth are better for fish and macroinvertebrates than are banks without vegetative protection or those shored up with concrete or riprap.

Each bank is evaluated separately and the cumulative score (right and left) is used for this parameter. Attributes that would generate a high ranking would generally include a very large portion of the streambank surfaces and immediately adjacent riparian zone covered by vegetation in the herbaceous and/or shrub layers. Attributes that would generate a low score would generally include less than half of the streambank surfaces covered by vegetation in the herbaceous and/or shrub layers.

### Riparian Surface Stability

Riparian vegetation has a strong influence on the composition of stream communities through its roles in directly and indirectly controlling the food base, moderating sediment inputs, and acting as a buffer between the stream channel and the surrounding environment. Riparian surface stability along with the structure of the shrub and tree layers within the riparian corridor (see below) provide parameters to assess the condition of the riparian corridor and its ability to provide these necessary functions.

Riparian surface stability refers to the amount of vegetative protection afforded to the riparian zone. The function of this parameter is similar to that explained above for bank vegetative protection (e.g., riparian area coverage help hold soil in place, thereby reducing the amount of erosion that is likely to occur). This parameter supplies information on the ability of the riparian area to resist erosion as well as some additional information on the uptake of nutrients by the plants and stream shading. Riparian areas that have full, surface coverage are ultimately better than are bare or otherwise disturbed areas.

This parameter is made more effective by defining the native vegetation for the area and stream type. The introduction of non-native species can lead to the virtually replacement of all native vegetation, and therefore the value of nonnative vegetation to the quality of the habitat structure and its contributions to the stream ecosystem may need to be considered in this parameter along with others (see riparian parameters below). In areas where development activities disrupt the riparian zone, the growth of a natural plant community can be impeded and can extend to the bank vegetative protection zone.

Like above, the riparian area associated with each bank is evaluated separately and the cumulative score (right and left) is used for this parameter. Attributes that would generate a high ranking would generally include a very large portion of the riparian ground area covered by undisturbed herbaceous vegetation, litter and duff, rock, or woody debris with erosion and sediment deposition absent. Attributes that would generate a low score would generally include moderate areas of ground not covered by undisturbed herbaceous vegetation, litter and duff, rock, or woody debris; or have gully erosion and/or sediment deposition present.

### Structure of the Riparian Shrub Layer

The riparian shrub layer (also referred to as the “under story”) is the second layer and contains smaller trees and bushes. The riparian shrub layer provides the riparian vegetation functions described above and provides habitat

for a diversity of animals. Among the diverse animals found in the shrub layer are fungi, invertebrates, amphibians, birds, and mammals.

Structure of the riparian shrub layer refers to the amount (i.e., area covered), type (e.g., species and age class diversity), and general health (e.g., new growth, regeneration, and/or die off) of shrub vegetation growing along banks and active floodplain terraces within the riparian zone. The function of this parameter is similar to that explained above for bank vegetative protection (e.g., riparian area coverage help hold soil in place, thereby reducing the amount of erosion that is likely to occur). This parameter supplies information on the ability of the riparian area to resist erosion as well as some additional information on the uptake of nutrients by the plants and stream shading. Riparian areas that have full, surface coverage are ultimately better than are bare or otherwise disturbed areas.

The structure of the riparian shrub layer associated with each bank is evaluated separately and the cumulative score (right and left) is used for this parameter. Attributes that would generate a high ranking would generally include a nearly continuous shrub layer along the channel or shrub layer with high amounts of cover and multiple species and size/age classes, and/or some regeneration of tree species; no extensive mortality or die-back of shoots and no extensive cutting or damage would be present. Attributes that would generate a low score would generally include a sparse or absent shrub layer, be monospecific (e.g., consist of a species and single size/age class), lack tree regeneration, and have extensive mortality or die-back and/or extensive cutting or damage. Like other parameters described above, this parameter is made more effective by also considering the presence of invasive vegetation for the area and stream type.

### Structure of the Tree Layer of the Riparian Corridor

The tree layer or “canopy” is the highest point of riparian vegetation. Consequently, it receives more sunlight than the other layers of riparian vegetation. Because it receives more sunlight, it also captures more nutrients and water, and produces more biomass. Canopy trees provide habitat for birds, insects, squirrels, and spiders. Decaying or dead trees (known as snags) are especially important as they are used by insects, birds, mammals, and amphibians as sites for perching, resting, roosting, feeding, grooming, hibernating, courting, and laying eggs. A riparian tree can take decades or even centuries to grow, die, and decay. At each stage, it provides important ecological function and habitat for wildlife.

The structure of the riparian tree layer associated with each bank is evaluated separately and the cumulative score (right and left) is used for this parameter. Attributes that would generate a high ranking would generally include high density tree cover, canopy dominated by relatively mature trees, and relatively high snag density.

### Calculation of Assessment Scores

A composite assessment score shall be calculated by adding the scores for each assessment variable. Scores that are equal to or greater than the previous assessment document attainment of the objective for stream and riparian condition. If scores decrease from the previous assessment, then scores for each variable (and field notes) would be reviewed to identify the cause of the decrease in the composite score. If the decrease is the result of human activities, potential management actions to address the effect will be identified and evaluated as part of the adaptive management process.

## Monitoring for Forest Structure Targets

In addition to monitoring and reporting required for Timber Harvest Plans (THPs), or other environmental permits, Northstar staff will maintain a GIS data layer of the forest vegetation and stand structural types in Zones D and E, which have acreage targets for forest stand structural types. For Zone D, this GIS data layer would only be maintained through 2020, to update mapping to reflect forest structure after implementation of the OMMP. This layer will be an updated version of the vegetation data layer produced for this HMP. The methods used to

construct this GIS layer and the data it contains (e.g., vegetation type, CWHR tree size and cover categories) were previously described in Chapter 2.

## WILDLIFE MONITORING

In addition to conducting pre-project surveys within all zones as described in Chapter 4, regular monitoring for focal wildlife species will be conducted in Zone E. Monitoring will be performed to:

- track the occupancy status of target habitats through time;
- evaluate whether Zone E continues to function as suitable and occupied habitat, and conditions there (including the core area) are enhanced as a result of HMP implementation, for focal species over time;
- determine the need for additional seasonal use restrictions, or changes to restrictions, based on the presence or absence of focal wildlife species; and
- identify potential adjustments to the HMP through the adaptive management process.

Because pre-project surveys for several species will be required prior to project implementation, and these surveys are generally costly, monitoring for focal species described here is not comprehensive; it is intended to inform the adaptive management process and track conditions of the habitat conservation area (Zone E) while balancing long-term cost considerations. Changes to wildlife habitat function in Zone E as a result of HMP implementation may be ongoing and not fully realized for several years or decades; therefore, specific success criteria for re-evaluating the timing or duration of wildlife monitoring have not been identified. However, success criteria and an appropriate "sunset clause" for wildlife monitoring could be developed in the future as part of the adaptive management process; this would be considered a "Major Revision", as discussed below in *Basis for Changes to this Plan*.

Wildlife monitoring will focus on three focal wildlife species: Northern Goshawk, California Spotted Owl, and mule deer. These species were selected because they are known to use the study area; and Northern Goshawk nesting, Spotted Owl pairs, and deer fawning have been confirmed in Zones D and E. Therefore, the baseline status of "present" in the study area for these species is known and provides an initial reference condition for adaptive management. Also, much of the HMP objectives and management practices focus on maximizing habitat functions in Zone E2 for these species. Additionally, Northern Goshawk and California Spotted Owl can be monitored efficiently, are good indicators of the HMP's target forest conditions and functions in much of Zone E, and can be used as surrogates for other species associated with late-seral forest (e.g., American marten).

Wildlife monitoring is emphasized in Zone E2 because: (1) based on the initial purpose of delineating this zone, resource objectives and management targets there focus on maximizing habitat values; (2) this zone, along with Zone D2, presently contains some of the most known sensitive habitats and species on the property; and (3) long-term adaptive management of focal species and their habitats is intended to be concentrated there.

The general approaches for monitoring Northern Goshawk, California Spotted Owl, and mule deer are described in the following sections.

### NORTHERN GOSHAWK AND CALIFORNIA SPOTTED OWL

In Zone E2, surveys for Northern Goshawk and California Spotted Owl will be conducted every five years within areas identified as suitable nesting habitat or occupied habitat (i.e., locations where detections of the species have been made). Suitable nesting habitat is preliminarily defined here as Class 2 (moderate breeding value) and 3 (high breeding value) areas shown in Exhibit 3-9. However, these areas were mapped primarily from GIS data, and they may overestimate the amount of suitable breeding habitat (particularly in the "moderate" category). Final

determination of suitability, and whether monitoring there is appropriate, should be based on a reconnaissance field assessment of habitat conditions conducted by a qualified avian biologist.

To maximize efficiency of monitoring surveys for Northern Goshawk and California Spotted Owl, surveys should begin at locations where detections were previously made, in the following order of priority: active nest sites, other activity centers (e.g., documented areas of concentrated use by an individual or pair, regardless of nesting status), and detections of individuals. Because Northern Goshawks are strongly territorial and typically do not nest within a 1-mile radius of a neighboring pair of goshawks during the same year, locating an active nest early in the survey period can eliminate a large area from that year's total survey area. For example, when a goshawk nest is located, the area within one mile of the nest could be eliminated from surveys for that year, because of the low probability of another goshawk pair nesting within that area. The same principle probably applies to California Spotted Owl, but the minimum distance between neighboring nests is not as well known.

Surveys for Northern Goshawks will follow either the broadcast acoustical survey method, intensive survey/stand search, or dawn acoustical survey method described in the *Northern Goshawk Inventory and Monitoring Technical Guide* (Woodbridge and Hargis 2006). The period for conducting goshawk surveys using the dawn acoustical method is approximately March 1–April 15; the period using the broadcast acoustical or intensive survey/stand search method is June 1–August 15. The broadcast acoustical survey method is generally most efficient for surveying large areas. Surveys for California Spotted Owl will follow the *Protocol for Surveying for Spotted Owls in Proposed Management Activity Areas and Habitat Conservation Areas* (USDA Forest Service 1993). The period for conducting Spotted Owl surveys is March 1–August 31.

Locations identified as moderate-value, high-value, or occupied habitat for Northern Goshawk or California Spotted Owl are anticipated to change through time, as vegetation and forest structure mapping is periodically updated, forest enhancement projects have been initiated, and additional field surveys are conducted. Any areas identified in the future as moderate-value, high-value, or occupied habitat would be subject to this monitoring program.

Where the locations and timing of pre-project surveys for Northern Goshawk and Spotted owl (see Chapter 4 for pre-project survey requirements) overlap with those described in this monitoring program, pre-project survey results can be used as monitoring data for those locations and time periods (i.e., separate pre-project and monitoring surveys are not required where they would overlap in time and location).

### MULE DEER (FAWNING)

Mule deer fawning at Northstar is known and will continue to be assumed in Zones D2 and E2. In Zone E2, monitoring surveys for mule deer fawning will be conducted every five years within areas identified as high-potential or occupied fawning habitat (Exhibit 3-11; Note: riparian vegetation along Schaffer Creek is mapped as high-value; however, it is not easily seen on Exhibit 3-11 because of overlap with stream and trail features.). Therefore, a spring/early summer seasonal closure to recreation activities and other operational uses during the fawning season will be implemented in much of Zones D2 and E2, and a portion of Zone B along Schaffer Creek (see Exhibit 4-1). Surveys would be conducted during approximately April 15–July 31. Appropriate survey dates within this period should be determined by a qualified biologist during the year of the survey, based on snowpack conditions and deer activity.

Where the locations and timing of pre-project surveys for mule deer (see Chapter 4 for pre-project survey requirements) overlap with those described in this monitoring program, pre-project survey results can be used as monitoring data for those locations and time periods (i.e., separate pre-project and monitoring surveys are not required where they would overlap in time and location).

### OTHER MONITORING

Compliance monitoring for permits related to natural resources includes monitoring that is very valuable for assessing natural resources and that documents management actions implemented by Northstar. Examples of this monitoring include:

- construction monitoring and reporting (varies by project),
- mitigation monitoring and reporting (varies by project), and
- project-related surveys and inventories.

This monitoring will be included in the annual synthesis and review of monitoring and of Northstar management that is described in the following sections.

## DOCUMENTING MANAGEMENT ACTIONS

Records are kept documenting all management actions occurring in the plan area. Documenting management actions is an important component of the adaptive management and monitoring framework described herein as identified in the Northstar HMP Adaptive Management Process flow chart (see Exhibit 6-1). During implementation of this HMP, all records will be incorporated into the annual adaptive management reporting memorandum prepared for the annual meeting (see below).

## DECISION-MAKING PROCESS

Northstar staff will meet annually to review summaries of monitoring data and of records documenting Northstar management. Based on this review, monitoring and management practices will be discussed, and decisions to change practices will be made if necessary.

## REPORTING

### ADAPTIVE MANAGEMENT REPORTING

Each year a memo will be produced that summarizes the monitoring and management conducted by Northstar, key monitoring and pre-project survey results, and changes in monitoring and/or management practices that were adopted at the annual meeting to review the HMP.  These memos will be provided to Sierra Watch and MAPF.

### OTHER REPORTING

Environmental permits will require reporting of compliance monitoring and of management actions conducted by Northstar; agencies and local governments also may conduct their own compliance monitoring of Northstar's management. In addition to adaptive management reporting as part of the HMP, these records will document many of the management actions and conditions at Northstar that are relevant to this HMP.

## BASIS FOR CHANGES TO THIS PLAN

All planning documents eventually become dated and require revision so they can continue to provide practical direction for management. A common and unfortunate situation is that the revision of planning documents is neglected because the revision process is too involved and too cumbersome. To address this problem, this HMP incorporates simple procedures for making minor and major revisions.

This HMP reflects the best information available during the planning process, but it is understood that new information will become available over time and there will be the need to make adjustments to keep this HMP current. Such new information may include:

- feedback generated by adaptive management,
- scientific research that directs improved techniques of habitat management,
- changes in land use or management of adjacent lands, and
- new regulatory requirements.

When the new information dictates a change to this HMP, it is important that there is an appropriate process has been established. A reasonable and clear revision process will facilitate and document changes to this plan, and thus prevent it from becoming outdated and irrelevant.

## MINOR REVISIONS

Minor revisions include all changes to the content of the HMP except for changes to the goal, objectives, resource management targets, the adaptive management decision-making process, and the five-year review process. Examples of minor changes include changes in management practices in response to new regulatory requirements, and changes in monitoring protocols based on the results of the previous year's monitoring. Minor revisions are made during the annual assessment or at any time they become necessary. These changes will be documented in the annual adaptive management report. Minor revisions will not require approval of Sierra Watch and MAPF.

## MAJOR REVISIONS

Major revisions are revisions to the objectives, resource management targets, the adaptive management decision-making process (including the scope or duration of a monitoring program), and the five-year review process. Such changes may be necessary for or otherwise affect attainment of the HMP's goal, and should be considered periodically. Therefore, major revisions to the HMP will be considered during the five-year review (which is described in the following section). Major changes also may be implemented at any time if required by new regulations. Major revisions will require approval of Sierra Watch and MAPF.

## FIVE YEAR PLAN REVIEW

Periodic evaluation and revision of the HMP is important to ensure that the Plan is meeting its goals, and that the plan reflects current management, monitoring, and reporting practices. Therefore, every five years, the plan will be reviewed and updated as necessary and provided to Sierra Watch and MAPF. This update will:

- incorporate all changes to management, monitoring, and reporting practices that were made during the previous five years;

- review, for targets that have not been attained, the adequacy of management practices and their implementation, and revise the HMP as necessary; and

- consider, and incorporate as necessary, other major changes in response to new information or circumstances since the plan was drafted or the previous 5-year review.

This 5-year review will be conducted by Northstar. The products of the review process will be an updated HMP and a memo summarizing the review process.

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# APPENDIX A

Allowable Land Uses and Requirements for Conservation, Natural Resource Management, and Biological Monitoring at Northstar, Martis Valley

# ATTACHMENT M

## *ALLOWABLE LAND USES AND REQUIREMENTS FOR CONSERVATION, NATURAL RESOURCE MANAGEMENT, AND BIOLOGICAL MONITORING AT NORTHSTAR, MARTIS VALLEY*

The issues discussed below are an element of the agreement between Northstar and Sierra Watch. The objective of documenting these natural resource goals, land use concepts, and management requirements is to ensure that the natural resource values of Northstar properties in the Martis Valley are maintained in perpetuity, while allowing for reasonable economic uses of the properties. Natural resources refer to the land, air, and water on the Northstar properties and the flora and fauna they currently support or could reasonably support in the future. Reasonable economic uses refer to specific residential and commercial development and recreational activities such as alpine skiing, snowboarding, cross-country skiing and other snow sliding activities, mountain biking, motorized recreational vehicles, and other recreational activities that could be reasonably supported in the future and determined not to have a substantial adverse effect on natural resource values. The intent of these concepts will be realized via an agreement on (1) sensitive land use planning and construction practices that will avoid or minimize substantial adverse effects to natural resources (hereafter, referred to as *adverse effects* or *adverse impacts*), (2) adaptive natural resources management activities to control or alleviate threats of substantial adverse effects or actual such effects that do occur, and (3) biological monitoring to document the status of natural resources over time and to inform management activities. The terms of the agreement will be embodied in conservation easements or other recorded documents established over the Northstar properties. Details of the natural resources management and monitoring program will be described in a comprehensive Habitat Management and Monitoring Plan to be developed by Northstar cooperatively with the Conservation Biology Institute acting on behalf of Sierra Watch and MAPF and mutually agreed upon by the parties. The Habitat Management and Monitoring Plan will include a discussion of specific and reasonable management targets and measurable objectives, proposed management actions, monitoring program (including field methods, locations, and schedule), and reporting schedule.

### OVERALL GOALS OF LAND USE AND NATURAL RESOURCES MANAGEMENT AT NORTHSTAR

- Maintain and/or enhance natural resources values of Northstar lands while allowing for current and planned future land uses in a manner that is compatible with those values. Current and future planned land uses are identified within zones on the attached Mountain Concept Plan Map (EDAW, March 2004).
- Develop a Habitat Management and Monitoring Plan that describes a natural resources management program to accomplish the above goal.
- Recognize Northstar's role and contribution to natural resources conservation and management in the Martis Valley region.

### LAND USE/RESOURCE MANAGEMENT ZONES

Five land use/resource management zones are defined to establish the types of land uses that will be allowed and the general natural resources management requirements within each zone.

Subzones are defined for specific allowable land uses and conservation and management requirements.

**Zone A—Developed Community**

- Design development/land uses to avoid or minimize adverse biological effects to adjacent areas, with particular emphasis on controlling and minimizing the adverse impacts of storm water runoff into downstream water bodies.
- Develop and implement management practices to minimize and/or mitigate adverse impacts, and monitor and control potential sources of threats to natural resources, including the use of native landscaping and control/elimination of invasive non-native plants in native habitat areas under Northstar's purview. This requirement recognizes that portions of Zone A are privately owned and not under the control of Northstar. However, the expectation is that monitoring and management activities would take place at the interface of Zone A and other zones, with the intent of preventing invasive exotic species from spreading into Zones B, C, D, and E.
- Monitor water quality at points upstream and downstream of Zone A in watercourses receiving runoff from Zone A areas. This agreement recognizes that portions of Zone A are privately owned and not under the control of Northstar. However, the expectation is that monitoring and management activities would take place at the interface of Zone A, with the intent of preventing impairment of downstream waterbodies.
- Manage forested areas in accordance with the Northstar Community Service District (NCSD) fuel silvaculture prescriptions for the protection of human and forest health and, to the extent practicable with these objectives, maintain and enhance natural resources values. Zone A is the only zone that NCSD has jurisdiction for fuel management.

**Zone B—Intensive Ski Area Development**

- Design development/land uses to avoid or minimize adverse biological effects within Zone B and to adjacent Zones C, D, and E.
- Develop and implement management practices to minimize and/or mitigate adverse impacts, and monitor and control potential sources of threats to natural resources. Establish native vegetation communities on slopes where grading and or smoothing has taken place, to minimize the risk of erosion.
- Identify and monitor use of Zone B areas by deer for fawning. Based on this information, restrict access to potential deer fawning areas during fawning season, as specified in the Habitat Management and Monitoring Plan.
- Manage forested areas in conformance with CA Forest Practice Rules Title 14. Natural Resources, Division 1.5. Department of Forestry and Fire Protection for the protection of human and forest health and, to the extent practicable with these objectives, maintain and enhance natural resources values.
- Monitor streams for water quality at points upstream and downstream of Zone B in major watercourses (as specified in the Habitat Management and Monitoring Plan) receiving runoff from Zone B areas.

- Monitor the success of native revegetation areas, as specified in the Habitat Management and Monitoring Plan.
- Prohibit summertime motorized recreational uses.

**Zone C—Intensive Recreation Use Area**

- Restrict summertime motorized recreational uses to Zone C, and manage Zone C to minimize adverse natural resources effects within Zone C and adjacent zones.
- Develop and implement management practices to minimize and/or mitigate adverse impacts, and monitor and control potential sources of threats to natural resources. Minimize the risk of erosion in areas where trails have been established.
- Identify and monitor use of Zone C areas by deer for fawning. Based on this information, restrict access to potential deer fawning areas during fawning season, as specified in the Habitat Management and Monitoring Plan.
- Monitor water quality at points upstream and downstream of Zone C in major watercourses (as specified in the Habitat Management and Monitoring Plan) receiving runoff from Zone C areas.

**Zone D—Recreation Use/Habitat Transition Area**

- Design development/land uses to avoid and/or minimize adverse biological effects within Zone D and to adjacent Zone E areas. Island and glade ski run designs will be used to emphasize protecting natural resources values, particularly late seral stage forest values. Future environmental camp described in the Martis Valley Community Plan is proposed for subzone D1.
- Develop and implement management practices to minimize and/or mitigate adverse impacts, and monitor and control potential sources of threats to natural resources. Establish native vegetation communities on slopes where grading or smoothing has taken place, to minimize the risk of erosion.
- Avoid new road construction. For construction of trails and lift towers and terminals, use existing roads, or use a helicopter where existing road access is unavailable.
- Manage forested areas in conformance with CA Forest Practice Rules Title 14. Natural Resources, Division 1.5. Department of Forestry and Fire Protection for the protection of human and forest health and, to the extent practicable with these objectives, retain and enhance natural resources values. Prohibit new roads except where necessary to comply with fuel management regulations and to protect human and forest health.
- Where roads are not necessary for forest management, restore roaded areas to native habitat.
- Identify and monitor use of Zone D by deer for fawning. Based on this information, prohibit access to potential deer fawning areas during fawning season, as specified in the Habitat Management and Monitoring Plan.

- Restrict use of Zone D areas to non-mechanized recreational uses only (e.g., skiing, hiking, biking), except in the winter time for guided snowmobile tours.
- Monitor and enforce restrictions on uses of Zone D areas, including off-season uses.
- Monitor water quality at points upstream and downstream of Zone D in major watercourses (as specified in the Habitat Management and Monitoring Plan) receiving runoff from Zone D areas.
- Monitor forest/habitat condition, as specified in the Habitat Management and Monitoring Plan.
- Monitor target wildlife species, as specified in the Habitat Management and Monitoring Plan.
- Monitor the success of native revegetation areas, as specified in the Habitat Management and Monitoring Plan.

**Zone E—Habitat Conservation Area**

- Prohibit all development except for surface lift Z.
- Restrict use of Zone E areas to non-mechanized uses only (e.g., cross-country skiing, alpine tree skiing in the vicinity of lift Z, hiking, biking).
- Manage forested areas in conformance with CA Forest Practice Rules Title 14. Natural Resources, Division 1.5. Department of Forestry and Fire Protection for the protection of forest and human health and, to the extent practicable with these objectives, maximize natural resources values for late seral stage forest associated wildlife species. This includes retention of large trees and large diameter dead wood (both standing and down). Prohibit new roads except where necessary to assist with fuel management and for habitat management.
- Restore all roads not necessary for forest management to native habitat.
- Identify and monitor use of Zone E areas by deer for fawning. Based on this information, prohibit access to potential deer fawning areas during fawning season, as specified in the Habitat Management and Monitoring Plan.
- Monitor and enforce restrictions on uses of Zone E areas.
- Monitor water quality at points specified in the Habitat Management and Monitoring Plan.
- Monitor forest/habitat condition, as specified in the Habitat Management and Monitoring Plan.
- Monitor target wildlife species in Zone E areas, as specified in the Habitat Management and Monitoring Plan
- Monitor the success of native revegetation areas, as specified in the Habitat Management and Monitoring Plan.

## LAND USE/RESOURCE MANAGEMENT SUBZONES

Proposed subzones and their respective allowable land uses, conservation requirements, and natural resources management objectives are described below. All general zone requirements, as specified above, apply to each subzone, with the exceptions specified below. The Habitat Management and Monitoring Plan will explicitly define natural resources management targets of each subzone. Adaptive management of natural resources at Northstar may result in modifying natural resources targets within subzones in the future.

| Subzone Number | Management Zone | Allowable Land Uses and Conservation and Management Requirements |
|---|---|---|
| A | Developed Community | All Zone A requirements apply. |
| B | Intensive Ski Area Development | All Zone B requirements apply. |
| C1 & C2 | Intensive Recreation Use Area | All Zone C requirements apply. |
| D1 | Recreation Use/Habitat Transition Area | All Zone D requirements apply. Future environmental camp sited in this zone. No new roads will be constructed for development of the environmental camp. |
| D2 | Recreation Use/Habitat Transition Area | Design ski facilities to protect late seral stage forest values. |
| D3 | Recreation Use/Habitat Transition Area | Two developed ski runs. Evaluate *Systospera* outbreak and determine appropriate and feasible mitigation measures. |
| E1 | Habitat Conservation Area | Includes existing "Fiberboard Freeway" forest road. Prohibit motorized uses beyond road right-of-way. |
| E2 | Habitat Conservation Area (Includes section of Trimont land to the west.) | Design Lift Z as a surface lift with maximum habitat preservation. |
| E3 | Habitat Conservation Area | All Zone E requirements apply. |