Prepared for The Trust for Public Land
by the Conservation Biology Institute

Conservation Strategy for The

Sierra Checkerboard Initiative

Donner Lake photo by Phil Schermeister

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CONSERVATION STRATEGY
for Implementing the
SIERRA CHECKERBOARD INITIATIVE

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The Conservation Biology Institute provides scientific expertise to support conservation and recovery of biological diversity in its natural state through applied research, education, planning, and community service.

We need wilderness preserved – as much of it as is still left, and as many kinds – because it was the challenge against which our character as a people was formed. The remainder and the reassurance that it is still there is good for our spiritual health even if we never once in ten years set foot in it. It is good for us when we are young, because of the incomparable sanity it can bring briefly, as vacation and rest, into our insane lives. It is important to us when we are old simply because it is there – important, that is, simply as an idea.

We simply need that wild country available to us, even if we never do more than drive to its edge and look in. For it can be a means of reassuring ourselves of our sanity as creatures, a part of the geography of hope.

- Wallace Stegner, *Wilderness Letter*, December 3, 1960

We are a species that thrives by trading and thereby sharing goods and services – it is this collaboration for survival that distinguishes us from other species. Our future will be determined by whether we can find ways to use these skills to enhance the quality of life and the relationships between people and the natural systems of earth….Commerce, properly incentivized and structured, is perhaps our best hope for a tool powerful enough to create and sustain communities in a new harmony with the rest of the biodiversity of this planet.

- William J. Ginn, *Investing in Nature*

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1. INTRODUCTION

The Sierra Nevada has been an integral part of the heritage of California and has played a profound role in the history of the nation. However, the extensive and varied resource values of the Sierra Nevada, so essential to the lives and well-being of the citizens of the state, are increasingly threatened by conflicting land management objectives resulting from the checkerboard ownership pattern, expanding residential development, and threat of catastrophic fires that are a product of the private-public land ownership patterns in the north-central Sierra. In recognition of threats to the rich legacy of the Sierra Nevada, The Trust for Public Land (TPL) is implementing a conservation vision for this landscape—the *Sierra Checkerboard Initiative*—to produce a more sustainable landscape in the north-central Sierra. TPL and its partners—the Sierra Forest Legacy (formerly Sierra Nevada Forest Protection Campaign) and the Truckee Donner Land Trust—share a set of common goals and wish to address resource and development issues at a scale not previously undertaken in the region. These issues include watershed protection, wildlife and wilderness values, recreation and open space, adaptation to climate change, sequestration of greenhouse gases, sustainable timber harvest, and appropriate development.

The goals of the Sierra Checkerboard Initiative are:

- Maintain and enhance natural resource condition and integrity;
- Improve non-motorized recreational opportunities; and
- Support sustainable forestry and fire management, consistent with species, ecosystem, and recreation needs.

By achieving these goals, the Sierra Checkerboard Initiative will create a healthy forest ecosystem that buffers our forests from rural sprawl, maintains a clean water supply, protects communities and forests from catastrophic wildfire, provides for healthy local economies, maintains scenic open space, creates recreational opportunities for a rapidly growing population, and provides an intact landscape to allow responses to changing climate.

The Sierra Checkerboard Initiative will:

- Preserve a dramatic and ecologically diverse 1.5 million-acre landscape comprised of the two largest watersheds in the north-central Sierra, flowing from the steep granite slopes of the Sierran crest to San Francisco Bay─a significant contribution to California's drinking and agricultural water supplies;
- Ensure access to more than 100 miles of the most popular sections of the Pacific Crest Trail in the Sierra;
- Protect, conserve, and manage mixed conifer forests that can store over 100 metric tons of carbon dioxide per acre and can reduce atmospheric carbon dioxide by another 1-3 metric tons per acres per year;

- Conserve high value habitat for California spotted owls, mule deer, mountain lions, wild trout, and a host of rare and threatened plants and animals;
- Protect the Desolation Wilderness, Granite Chief Wilderness, Castle Peak, Grouse Lakes, Donner Summit, and the Sierra Buttes—iconic gems of the Sierra Nevada landscape that are threatened by inappropriate rural development;
- Enhance opportunities for swimming, fishing, hiking, and rafting on all major branches of the American, Yuba, and Rubicon rivers;
- Sustain a local economy that is dependent on its natural environment for tourism, recreation, and sustainable forestry; and
- Reduce the risk of catastrophic wildfires and corresponding threats to life and property, as well as impacts associated with changing climates.

Background

The ownership pattern in the north-central Sierra Nevada is a *checkerboard* of public and private lands covering approximately 1.5 million acres (Figure 1). This ownership pattern is a result of the United States government granting alternate square miles of land to the Central Pacific Railroad during the building of the transcontinental railroad in the 1860s. Over time, ownership of these lands has changed, and many private individuals and companies now own these land grants, which are interspersed in a checkerboard pattern with public land administered by the U.S. Forest Service (USFS).

Land acquisition with subsequent transfer to public ownership has been a common conservation approach in the study area. To date, some consolidation of ownership in the north-central Sierra checkerboard has occurred via private land acquisitions that have been transferred to public ownership and public-private land exchanges; much of this has been a result of the strong working relationship between TPL, Sierra Pacific Industries (the largest private land owner in the study area), and the USFS. However, much of the checkerboard ownership pattern, and the land management challenges it creates, still remains.

The checkerboard ownership pattern of the Sierra Nevada challenges the effectiveness of regional land management efforts in various ways. To be effective, land management efforts should be implemented across the landscape in a manner consistent with the needs of various resources. Land management objectives and practices, land use, public access, road construction and maintenance, fuel and fire management, and vegetation restoration often differ on public and private lands. This has resulted in fragmented habitats, irregular access for public recreation, and conflicts over timber harvest. If we do not invest wisely in the Sierra Checkerboard now, the growing human population and continued expansion of residential development into the forest land of the north-central Sierra over the next 20 years will further diminish resource values and complicate sustainable resource management by fragmenting habitats, introducing nonnative species, degrading water quality, changing hydrological processes, altering fire regimes,

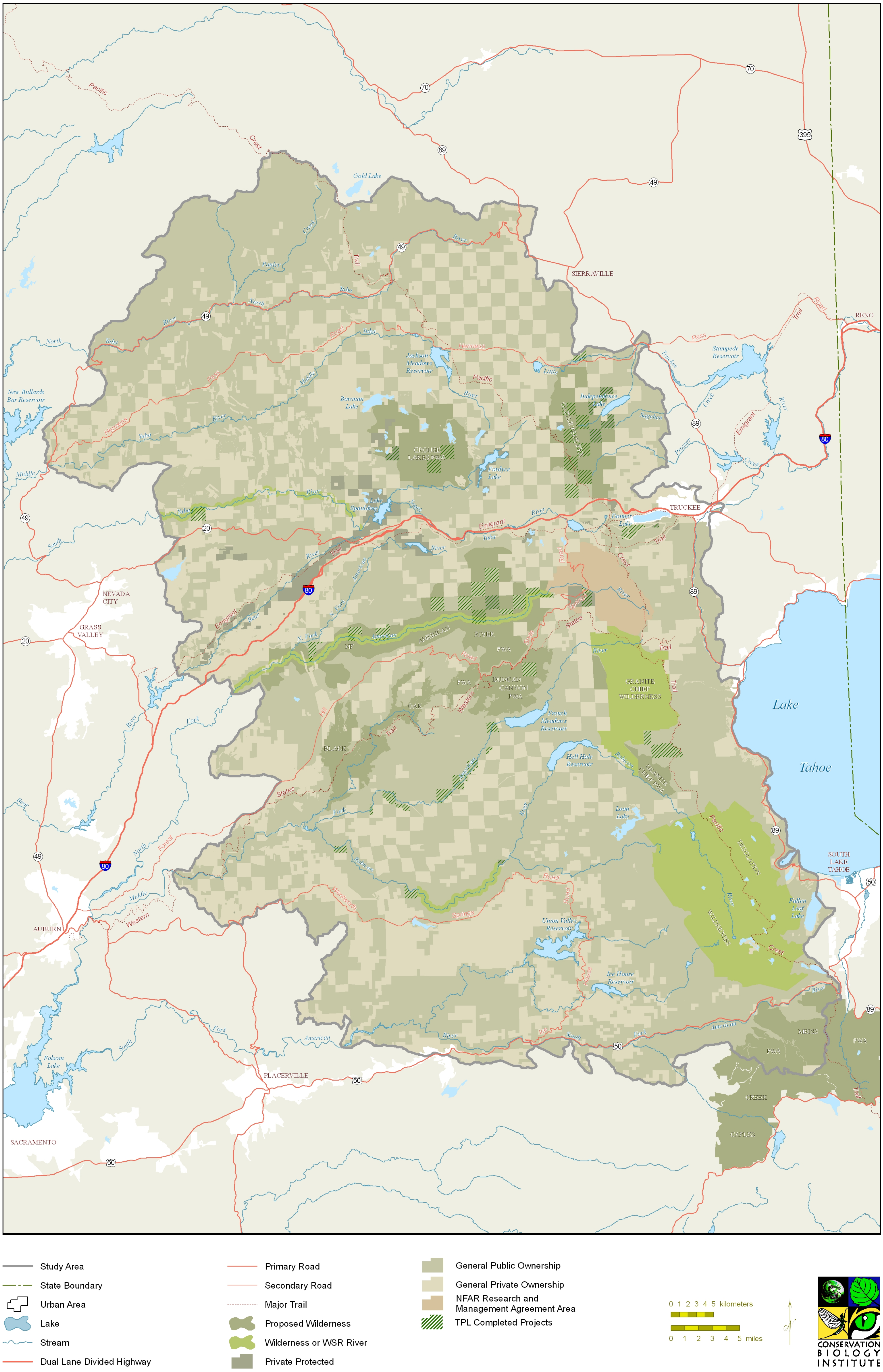

Figure 1. Sierra Checkerboard Initiative study area.

jeopardizing ecosystem adaptations to climate changes, and increasing conflicting land use practices. Phase I of the Sierra Checkerboard Initiative, the Science Assessment (White et al. 2005), was predicated on the belief that strategies for land conservation and management must rely on a sound scientific foundation. The Science Assessment focused on identifying areas of high resource values—biodiversity, mature forest connectivity, and passive recreation—as well as areas under threat from development, unnatural fire regimes, and management incompatible with conservation of mature forests. Areas that both support high resource values and are highly threatened were considered as candidate areas for inclusion in the conservation plan developed in Phase II—the conservation planning phase—of the Sierra Checkerboard Initiative (Figure 2). We envision these focal areas, termed *resource areas*, to be a network of wilderness and other highly protected areas, public lands managed to provide important natural resource functions and public recreational opportunities, and working lands with management regimes compatible with conservation objectives.

In developing the preliminary conservation plan for the Sierra Checkerboard Initiative, we used the results from the Phase I Science Assessment in an objective reserve selection process (Appendix A). This preliminary conservation plan was then refined by consulting with various governmental and non-governmental stakeholders on resource conditions, threats, and priorities. From these meetings, we obtained information on important areas that may not have been completely captured by our quantitative analyses. Once resource areas were established—17 in all—we developed desired future conditions for these areas to maintain their specific conservation values and guide conservation implementation actions in Phase III of the Initiative.

As part of Phase II, TPL and its partners are developing land realignment and management strategies to maintain and enhance resource values in light of the threats they face. Through coalitions with other nonprofit organizations, government agencies, landowners, and other stakeholders, TPL and its partners are also developing funding and political strategies to implement the identified strategies. In Phase III—the implementation phase—TPL will work with its partners and supporters, along with willing landowners, to implement the site-specific conservation strategies developed during Phase II.

A Future without the Sierra Checkerboard Initiative

What does the future hold for the north-central Sierra if the conservation vision advocated by the Sierra Checkerboard Initiative is not realized? Nothing less than the loss of a huge swath of the Sierra Nevada as we know it─loss of the beauty and majesty of John Muir's Range of Light that is cherished by so many; degradation and loss of a crucial water supply for much of California's people and agriculture; loss and fragmentation of the forests and other habitats that support myriad species; loss of forests that sequester vast amounts of carbon associated with global climate changes; loss of life and property from catastrophic fires, and loss of the opportunity to restore fire as a natural process in the Sierra; loss of future options for responding to changing climates; and loss of the rural character of local economies dependent on tourism and sustainable forestry.

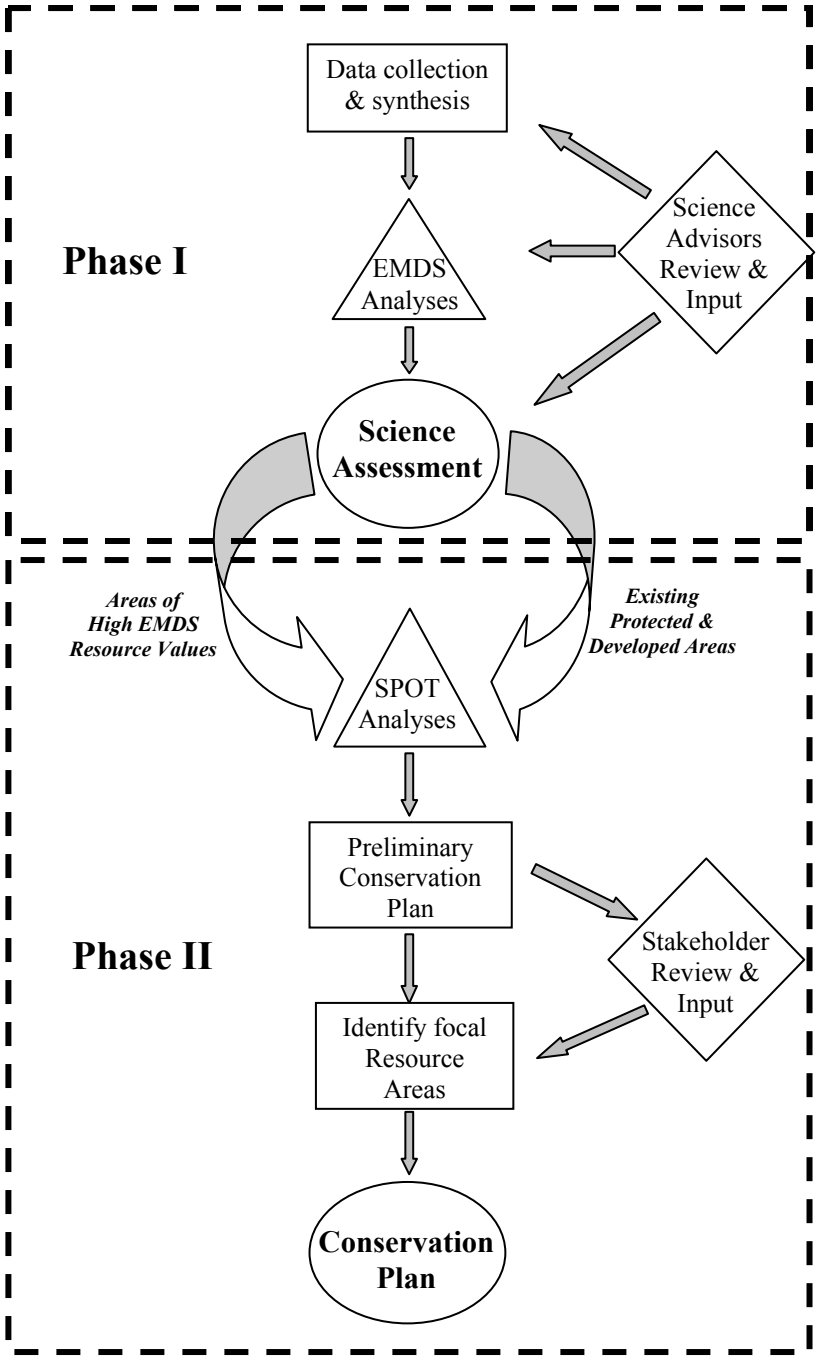

Figure 2. Flow chart illustrating the general technical approach used in developing the Sierra Checkerboard Initiative Conservation Plan. See White et al. 2005 for discussion of the Ecosystem Management Decision Support (EMDS) System, and Appendix A for further information on Phase II and the use of the Spatial Portfolio Optimization Tool (SPOT).

Three threats of particular concern to conservation values in the study area—rural subdivision and development, threat of unnatural and catastrophic wildfires, and climate change—are discussed in the following sections.

Rural subdivision and development

The subdivision and development of private forest land is perhaps the most profound and irreversible threat facing the north-central Sierra Nevada that can be addressed by the Sierra Checkerboard Initiative. Human population in and around the Sierra Checkerboard Initiative study area accounts for approximately 40% of the total within the entire Sierra Nevada, and it has been projected to increase by 179% over the time period 1990 to 2040 (Duane 1996a). The California Department of Finance (2007) estimates a total population of 1.4 million people in Nevada, Placer, and El Dorado counties by 2040, an increase of over 200% from the tri-county population of 500,000 people in 2000. Development has wide-ranging implications to the health and sustainability of the Sierra—much greater than the direct loss of forests. Residential development and road-building have been cited as threats to virtually every natural resource in the Sierra (e.g., White et al. 2005 and references therein). Development and its associated infrastructure destroy and fragment habitats, alter watershed characteristics and decrease water quality, increase ignition sources and the resources required for fire threat reduction and response at the wildland-urban interface, increase the risk of loss of human life and property when fires do occur, decrease the potential for sustainable forestry practices as timberland is taken out of forest management, and alter the scenic character of the landscape and restrict recreational access. The threat of rural residential sprawl in the study area is a real and present danger as evidenced by the following examples:

- There is growing pressure for larger developments in the region, such as the nearly 2,000 new units associated with resort-style developments under construction in the Martis Valley just east of the study area. Even more recently, in early 2007 developers proposed 950 resort units on 3,000 acres of land around Serene Lakes on the Donner Summit. Portions of this proposed development project abut USFS-designated Areas of Late Successional Emphasis (areas emphasized for old forest management) and are surrounded by land within the USFS' forest carnivore network (land emphasized as important for the protection of forest carnivore species). As such, development in this area would potentially exacerbate management conflicts for mature forests and associated species in a very sensitive part of the study area. In addition, residential development of this scale has the potential to exert a variety of negative direct and indirect environmental impacts, such as altering stream and meadow hydrology, adversely affecting water quality, and changing the scenic character of the area.
- Figure 3 depicts housing density (dwelling units per acre) within the study area (information for areas outside of the study area is not shown in this figure). Areas of higher density development are scattered along the eastern and western margins of the study area and along major highway corridors such as Interstates 80 and 50. However, extensive portions of the study area have already been subdivided and/or support rural residential development. Existing developments with housing density greater than

1 dwelling unit per 40 acres comprise the *urban-wildland intermix zone* (USFS 2001). The USFS initiates a fire threat reduction response entailing fuel treatments within a 1.5-mile buffer zone around these developments. The California Department of Forestry and Fire Protection (CAL FIRE) considers development at a density of 1 dwelling unit per 20 acres to form the *wildland-urban interface* (FRAP 2003), triggering fuel treatments consistent with those of the USFS. Figure 3 also shows the existing parcelization of private land in the study area. With few exceptions, County General Plans allow a landowner to develop at least 1 dwelling unit per legal parcel, even if the resulting density would be greater than the land use zoning for the area. Thus, there is a high potential for greatly expanding the acreage of urban-wildland intermix zone (wildland-urban interface) and associated fuel management requirements. This in turn reduces the overall flexibility of land managers to achieve landscape-scale management objectives.

- Timberland Production Zone (TPZ) is a land use designation under the Forest Taxation Reform Act of 1976 that lowers the taxable value of timberlands as a means of maintaining California's privately owned forest lands in timber production. Implementing land uses other than those compatible with timber production on private properties in TPZ requires a conversion permit from CAL FIRE. As such, applications for TPZ conversion permits are a measure of a landowner's intent to alter the land uses on private timberlands in the future. Between 1969 and 1998, approximately 113,000 acres of the State's 5.5 million acres of private land in TPZ were converted to other land uses. Prior to 1978 the purpose of the conversions was primarily shifting timberlands to grazing uses, whereas since 1979 the predominant purpose of the conversions has been for subdivision (Shih 2002). Recently, 20,000 acres of TPZ within in Sierra County in the study area has been proposed for conversion.
- Industrial timber companies are increasingly adding residential development of forest lands as an element of their business portfolios. Development may occur through a real estate arm of the timber company or sale of land to individuals or other developers. While strategically located development in the Sierra should be compatible with maintaining resource values, a dramatic increase in real estate development by industrial timber companies or other landowners during downturns in the timber market would significantly elevate threats associated with rural sprawl in the study area.

In the Science Assessment (White et al. 2005), the risk of exurban development was assumed to be greatest for private land that had been subdivided into smaller parcels and was close to existing development or roads. When assessed this way, private land with very high development threat is distributed throughout the study area (Figure 4), often occurring in clusters of sections of land. However, even very low density residential development can cause adverse effects on natural resources and limit land management options. Development of even a small percentage of the private properties in particular portions of the study area could dramatically change the land conservation and management landscape of the north-central Sierra; preventing this conversion is a major emphasis of the Sierra Checkerboard Initiative.

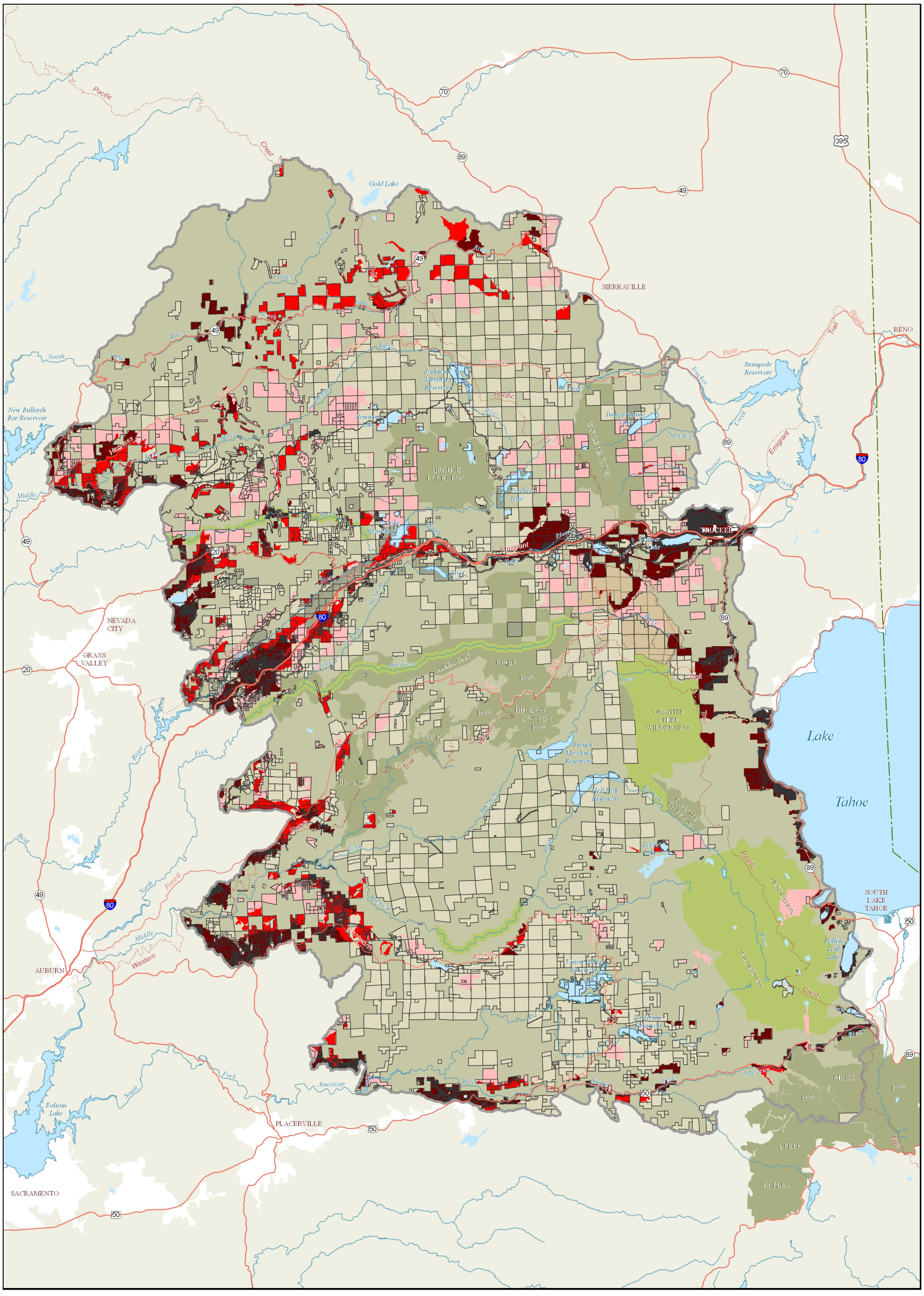

Figure 3. Existing parcelization of private land and development density in the Sierra Checkerboard Initiative study area. Note: areas appear black because of a high density of small parcels.

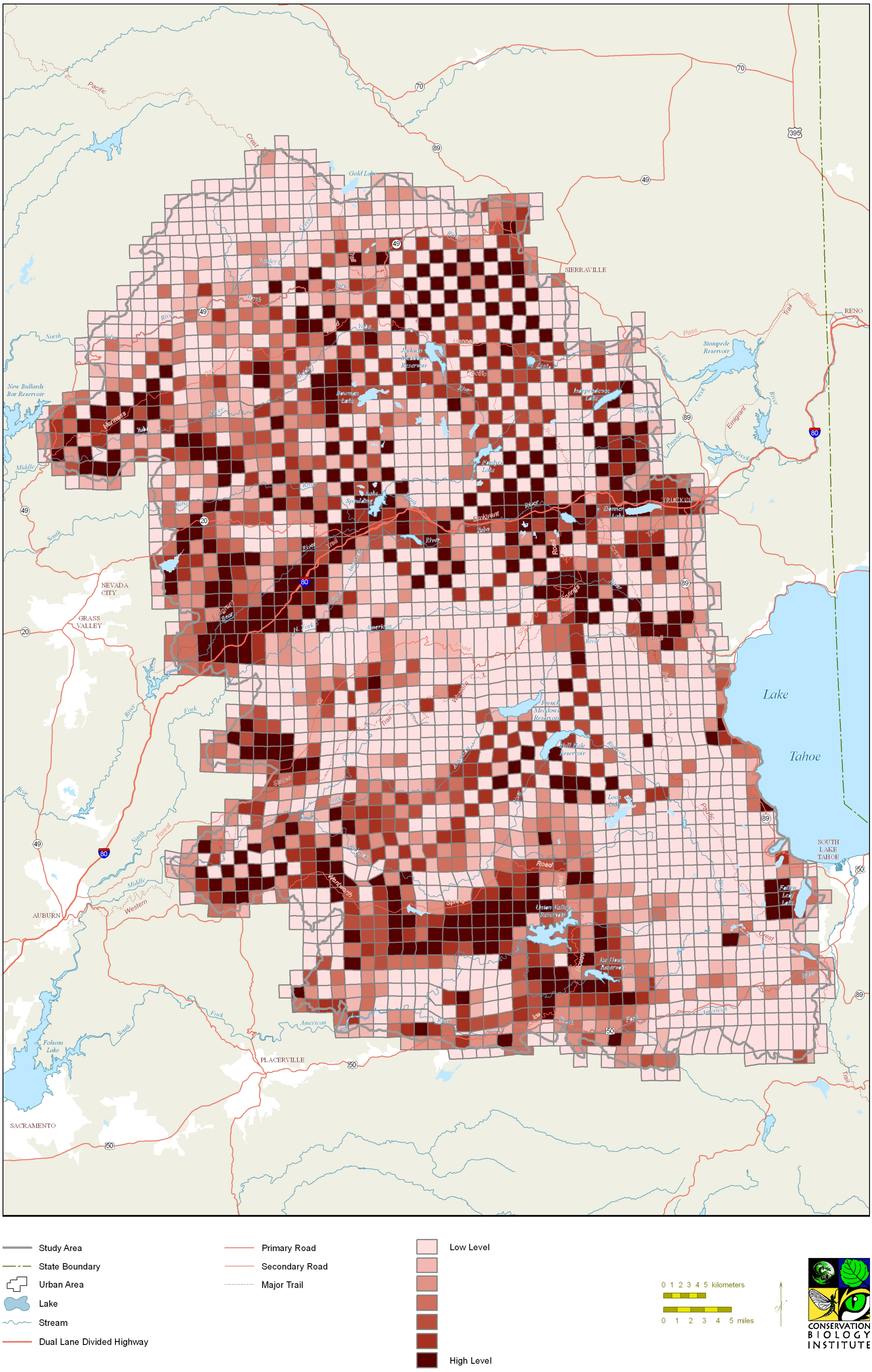

Figure 4. EMDS model results for development threat, where dark red represents the highest level of threat and pink the lowest.

Threat of catastrophic wildfire

Catastrophic wildfire releases large amounts of carbon into the atmosphere and is a profound threat because of its potential negative impacts on conservation values. Fire has always been an important ecological process in the Sierra Nevada—it stimulates reproduction of certain vegetation species, regulates fuel accumulation, and recycles nutrients. Catastrophic fires, on the other hand, are fire events that burn larger contiguous areas at higher intensities than is typical under historic fire regimes. These fires are harder to control and cause greater destruction than low or moderate severity fires. In addition to causing potentially devastating impacts to human life and property, such as occurred in the Angora Fire at South Lake Tahoe in the summer of 2007, catastrophic wildfires are capable of causing severe ecological damage by consuming a majority of the larger trees, and under extreme circumstances, sterilizing and mineralizing soils and prolonging normal recovery time.

CAL FIRE ranks approximately 40% of the forested acres of the Sierra Checkerboard Initiative study area as having high risk of losing key ecosystem components from altered fire regimes (White et al. 2005, Figure 5, page 15). Historical factors that have contributed to the drastic changes in fires regimes in the Sierra Nevada began in the mid 19th century and were related to practices associated with mining, logging, and grazing, as well as fire suppression policies (Skinner and Chang 1996). The primary contributing factors today, as detailed below, are the lack of more realistic land use planning that considers landscape-scale ecological processes and a lack of adequate fuels treatment on a sustained basis (Irwin 1994):

- Far more fires are now caused by humans than by lightning. Increased human use of the forest, in the form of more development, associated roads and infrastructure, and increased recreational use, has become the primary source of wildfire ignition (CAL FIRE 2006, Figure 6, page 14). By preventing fragmented development of forest environments and creating appropriate seasonal restrictions to recreational access, the risk of human-caused fires can be reduced.

- Residential development in forest environments draws fire suppression resources and investment away from protecting other forest areas that could benefit from fire management activities. Scattered development and buildings dictate locations of fuel management activities and change the choices that fire fighters must make about where to set up their defensive positions. The result is that publicly and privately owned forests are generally not managed comprehensively for fuels and fire regimes, and fire fighters are forced to fight fires where they have less chance of success in stopping a catastrophic event. Local governments and planning agencies have not assimilated nor institutionalized the fundamentals of fire behavior and suppression requirements (Irwin 1994). Coordinated education and communication with local planning departments, as well as stronger incentives for landowners, can be utilized to restrain development in such a manner that fires can be managed more strategically at a landscape level.

Appropriate management and reduction of specific types and levels of fuels in the forest can decrease fire intensity and create more fire-resilient forests, such as the conditions considered to

be present in pre-settlement mid-montane forests in the study area (Skinner and Chang 1996). Key principles to create fire resistance include reducing surface fuels, increasing the height between surface and crown fuels, decreasing crown density, and retaining big trees of fire-resistant species (Agee and Skinner 2005). Fuel reduction strategies are generally more effective and cost-efficient if planned across ownerships and linked to geography such as ridgelines. Residential development and its related infrastructure often limit the tools used to manage fuels and create conflicts over methodologies such as controlled burning or thinning. The potential for conflict and risks of catastrophic fires can be reduced by coordinating and supporting appropriate forest and fuels management across ownerships and by preserving larger forested areas where forest management and restoration of natural fire regimes are the primary objectives.

By addressing these management issues, the Sierra Checkerboard Initiative can decrease the number of human-caused fires and reduce the amount and type of fuel that can cause fires to become catastrophic in nature.

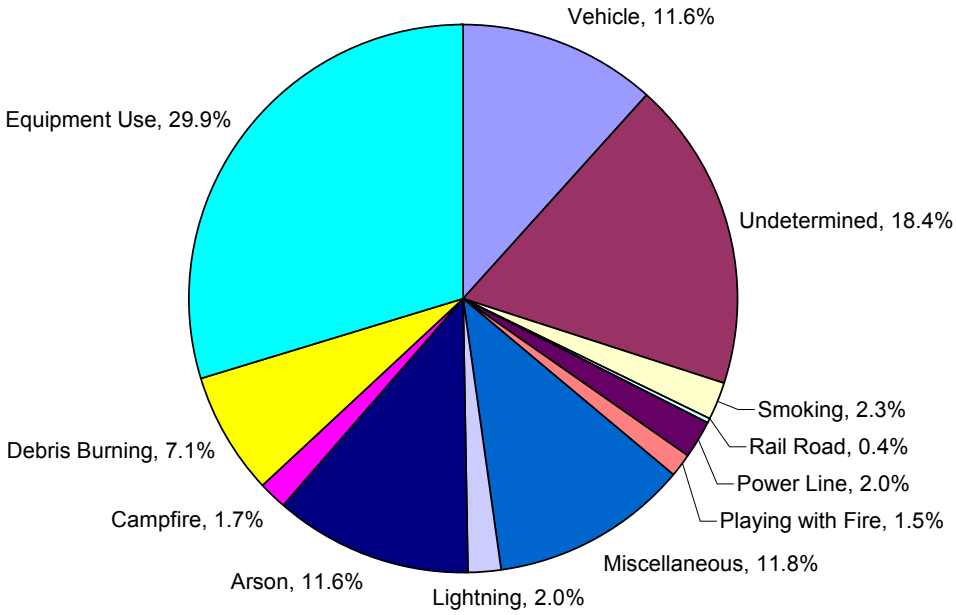

Figure 6. Causes of wildfires within CAL FIRE jurisdiction. Source: CAL FIRE 2006.

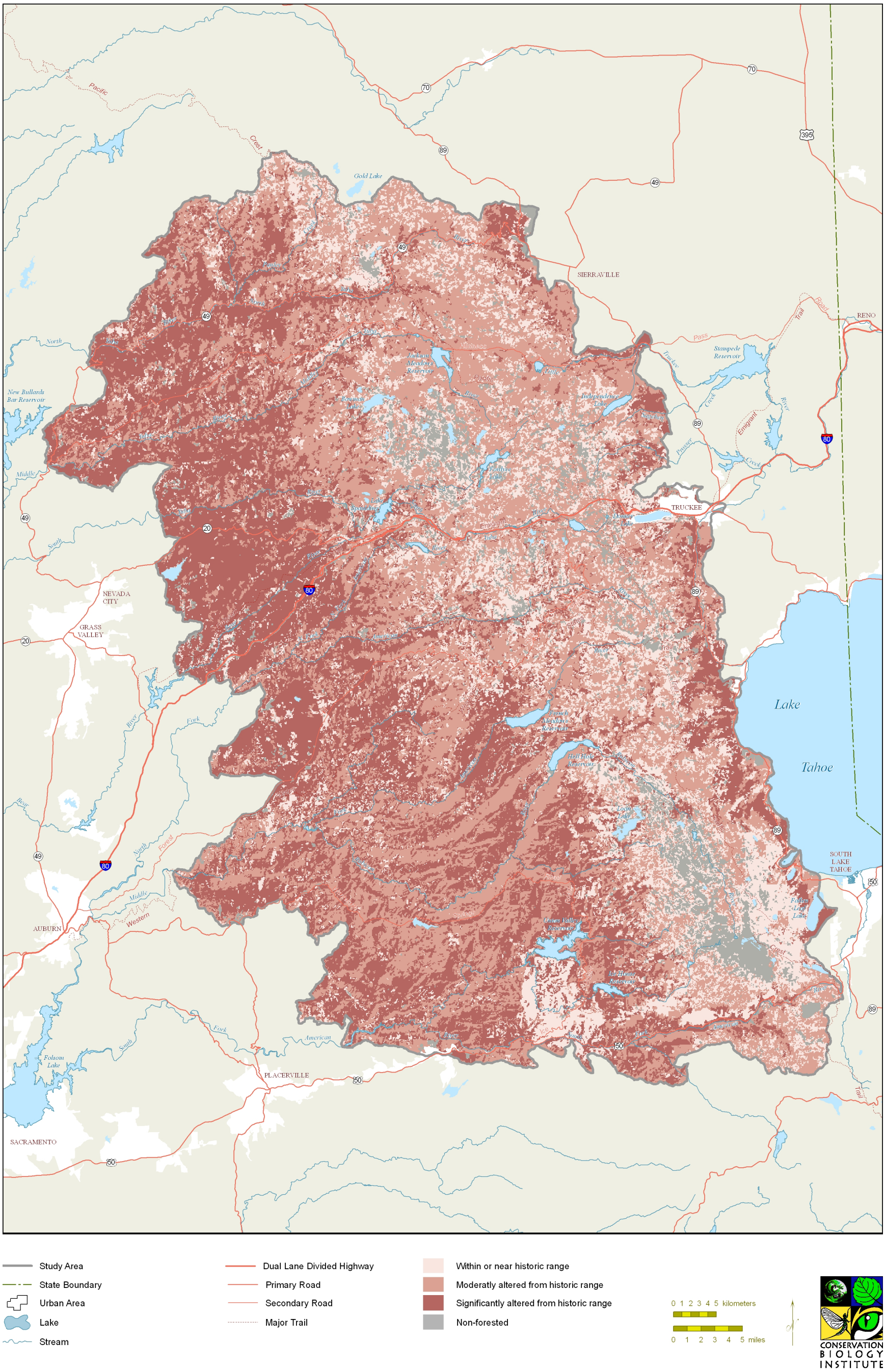

Figure 5. Alteration of fire regimes from historic conditions and threat of losing key ecosystem components. Source: FRAP 2003.

Climate Change in the Sierra Nevada

It has become evident that climate patterns around the world are changing, and the scientific community is convinced that these changes are associated with increasing quantities of anthropogenic greenhouse gases in the atmosphere (Parry et al. 2007). These changes serve as a backdrop to any conservation program, but particularly one conducted at the scale of the Sierra Checkerboard Initiative. Increasing global temperatures and sea levels have been rigorously documented (Parry et al. 2007), as have a variety of biological responses to these changes (Parmesan 2006). A great deal of research is focused on predicting future climates and their consequences to both natural systems and society. While there are still uncertainties associated with these predictions, there is a high certainty that average annual temperatures in California will increase by at least 3-4 ºF to as much as 8-10 ºF by 2100 (Cayan et al. 2006). Predictions of precipitation changes through 2100 are less certain, with some models predicting more annual rainfall and some less, but a consistent prediction is that snowpack in the Sierra Nevada is expected to decrease by 30% to as much as 90% with rising temperatures (Hayhoe et al. 2004).

Climate change will likely produce ecosystem-level changes in the Sierra Nevada. For example, there is already evidence of hydrologic alterations of river systems associated with warming (Field et al. 1999). The loss of snowpack from warmer climates would further alter runoff patterns in Sierran streams and rivers, with a relatively greater proportion of stream flow likely to occur in fall and winter and relatively less in spring and summer than currently occurs (Field et al. 1999). A shift in winter precipitation from snowfall to rainfall would also tend to produce numerous flood events associated with individual winter storms rather than a spring flood associated with snow melt. These changes have significant implications to the water supply and power generation systems dependent on Sierran rivers, as well as species that are adapted to the historic hydrologic regimes of these systems.

The distribution of vegetation communities and their associated wildlife species is largely a product of climate patterns, geology, and soils, as well as human land uses and other human modifications such as forestry practices and fire suppression. Recent studies are documenting changes in species distributions resulting from climate changes, with many species exhibiting range shifts northward and to higher elevations (Parmesan 2006). Models of vegetation community responses to climate change in California are generally predicting vegetation communities shifting to higher elevations relative to their current distribution. One of the most likely scenarios is an expansion of grassy savanna communities into areas currently occupied by shrub communities, such as chaparral, and an expansion of shrublands into areas currently dominated by conifers (Field et al. 1999, Miller and Urban 1999, Lenihan et al. 2006). Alpine and subalpine communities may be restricted to the highest elevations of the Sierra Nevada, effectively eliminating these communities from the Sierra Checkerboard study area (Lenihan et al. 2006).

Changing climates and associated vegetation community responses are also likely to affect fire regimes in the Sierra Nevada. Fire regimes can be altered directly by decreasing fuel moisture, which would tend to increase fire frequency, or indirectly by increasing the amount, structure,

and connectivity of fuels, which can produce larger fires (Miller and Urban 1999). In the Sierra Nevada, vegetation models predict communities prone to more frequent fires such as grassland, chaparral, and mixed conifer forest expanding to higher elevations, while communities at high elevations that currently experience reduced fire frequencies, such as red fir forests, are predicted to shrink in distribution (Field et al. 1999, Miller and Urban 1999). The predicted net effect is larger and more frequent wildfires throughout much of the Sierra. This would also result in increased greenhouse gas emissions from fires, thereby exacerbating climate change in a positive feedback cycle. For example, the combined CO_2 emissions from the 2007 Moonlight and Wheeler fires in Plumas and Lassen counties were estimated to be equivalent to the annual emissions from 1 million cars.

Human alterations of natural landscapes can modify the effects and consequences of climate change in ways that exacerbate adverse consequences and negatively affect conservation values. For example, as previously discussed, some floral and faunal species may shift their distributions over time in response to changing climates. However, alteration and fragmentation of the landscape by development, roads, and other human land cover changes may effectively block migration and colonization by many plant and animal species. This may result in local extirpations of species that are particularly sensitive to fragmentation and other human modifications. In the Sierra, fire regimes are not only a product of climate and vegetation characteristics but of management regimes that affect composition and structure of vegetation communities. Forests that are managed without a long-term view of ecosystem functions in light of changing climates can become prone to catastrophic wildfires and/or loss of conservation values.

The Sierra Checkerboard Initiative seeks to conserve and facilitate the management of large and biologically valuable areas of the study area. Conservation of large, intact blocks of land is critical to allow biological systems to adapt and maintain resiliency in the face of changing ecological process, such as fire and hydrologic regimes, produced by climate change. By conserving forests that sequester carbon, preventing loss and fragmentation of habitats, and facilitating sustainable forestry practices, the Initiative seeks to ameliorate the adverse effects of changes climates on natural resources and preserve flexibility for future land managers and public officials to address the consequences of climate change.

2. SIERRA CHECKERBOARD RESOURCE AREAS

Resource areas, the focal areas for conservation actions, have been organized according to four conservation values or themes—river corridors, upper watersheds, mature forests, and recreation and visual resources. Individual resource areas in different conservation themes may overlap, as portions of the study area support multiple conservation values. Recent research demonstrates the overlap between ecosystem services, such as water supply, carbon sequestration, recreation, and biodiversity protection (Chan et al. 2006). Thus, targeting areas for protection of ecosystem services can be complementary to the biodiversity conservation objectives of the Sierra Checkerboard Initiative. Identifying portions of the study area as resource areas does not imply that these lands should be moved into public ownership—conservation activities on private lands can also achieve the conservation objectives of the Initiative, as discussed further in Section 3. That portions of the study area are not designated as resource areas does not imply that these areas are not valuable or worthy of conservation action but rather recognizes that the local conservation objectives for these areas are not central to the objectives or strategies of the Sierra Checkerboard Initiative. Conservation targets will be assessed iteratively as implementation proceeds to account for changes in conditions and ownership and land use patterns.

The following sections describe the primary conservation values supported by the resource areas within the four conservation themes, as well as the desired future conditions for these areas. Desired future conditions, in conjunction with land use and ownership patterns, specific landowner interests, and funding, will determine the land management options and potential implementation strategies for each resource area. Potential implementation strategies are discussed in Section 3. Specific management and implementation strategies must be developed at a parcel level, considering site-specific physical, climate, and biological factors and existing land uses. TPL will undertake this step in Phase III of the Sierra Checkerboard Initiative.

River Corridors

The north-central Sierra supports major east-west trending rivers in the Yuba River and American River watersheds, smaller drainages in the Little Truckee River watershed, and other eastern Sierra watersheds. River systems such as those in the Sierra Nevada sustain diverse aquatic and terrestrial flora and fauna (e.g., Wright et al. 2004). Rivers are also focal points for human recreation, support key scenic corridors, and are conduits for human water supplies. The Sierra Checkerboard Initiative has targeted five key river corridors as resource areas for the Initiative (Figure 7):

- North Yuba River
- Middle Yuba River
- South Yuba River
- Middle Fork American River
- Rubicon River

[Note: the North Fork American River and the Little Truckee River are captured in the upper watersheds conservation theme.]

These major west-slope river corridors convey the majority of runoff from their watersheds to downstream water supply and power generating reservoirs. A variety of recreational opportunities are associated with these river corridors, including hiking on the South Yuba Trail and in Malakoff Diggins State Park and the Rubicon Trail, and swimming, angling, and white water rafting on the North, Middle, and South Yuba rivers. The USFS considers these corridors important visual resource areas. Reaches of the South Yuba River are designated by the State of California as Wild and Scenic, and reaches of the Rubicon River have been reserved by the USFS and are under consideration for federal Wild and Scenic status.

These river corridors are generally roadless, including USFS inventoried roadless areas along the Middle Yuba River and Rubicon River. They support high biodiversity, serve as essential components of the USFS' network of old forest emphasis areas, and are important for maintaining connectivity for both mature forest and aquatic species (White et al. 2005). Reaches in several of these rivers (e.g., North Yuba River, Middle Yuba, and Rubicon River) are designated as special management waters for wild trout, and all of the rivers support high quality cold water fisheries habitat.

Desired future conditions

Recreational and scenic resources are important conservation values in the river corridor theme; therefore, enhancing these resources should be a focus, e.g., expanding parkways on the South Yuba River, expanding trail systems, and conservation and management to protect visual resources. Conserving habitat integrity along major river corridors is important for a variety of terrestrial, wetland, and aquatic species, as well as for natural watershed functions. Because of restrictions on certain management activities on public lands along river corridors, these resource areas may be appropriate targets for creating east-west trending mature forest management areas to connect to resource areas in the mature forest conservation theme.

Implementing the Sierra Checkerboard Initiative in the five river corridor resource areas will require two major actions:

- Restrict subdivision and development of private land.
- Implement environmentally sensitive road-building practices, if and where appropriate, that respect riparian, recreational, and visual resources.

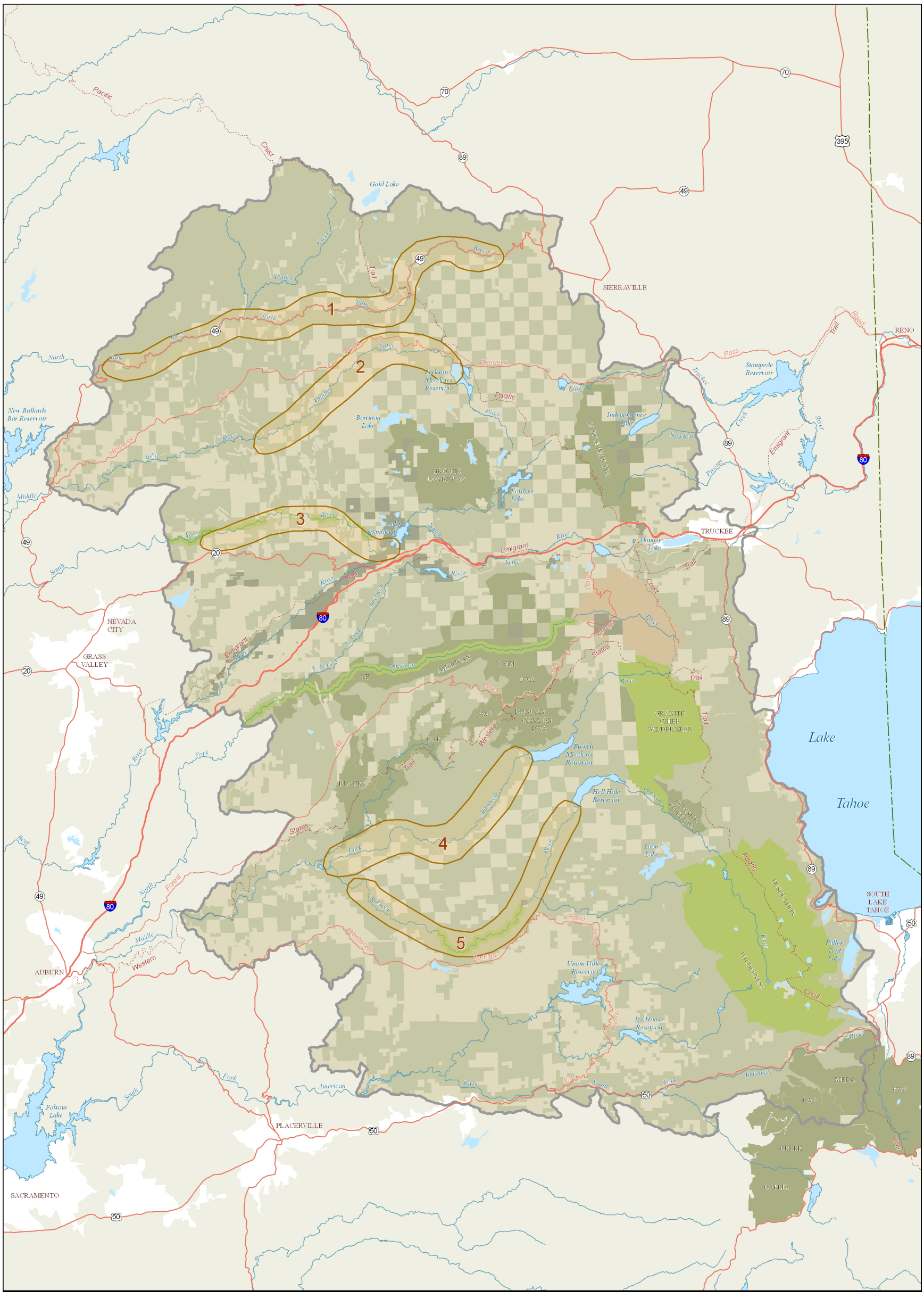

Figure 7. River corridor resource areas.

Upper Watersheds

Watershed basins are important conservation units in the Sierra Nevada. Snowpack and runoff from watersheds dictate the quantity and quality of water supplies, which are influenced by the degree of land use changes within individual watershed basins. Relatively low levels of watershed modification can adversely alter runoff characteristics, water quality, and biological integrity (Hirsch et al. 1990, Arnold and Gibbons 1996, Moyle 1996, Poff et al. 1997). The terrestrial portion of a watershed ecosystem can exert strong influences on the aquatic portion (Naiman and Decamps 1997). Because individual watershed basins have varying topography, aspect, soils, and underlying geology, they support mosaics of forest community composition and structure and thus can serve as useful units for framing landscape-scale forest conservation objectives. Given their scale, they also support regionally important recreational and visual resources. The Sierra Checkerboard Initiative has targeted five high quality upper watersheds as resource areas (Figure 8):

- North Fork American River watershed
- Upper Middle Fork American River watershed
- Crystal basin
- Fordyce Creek watershed
- Truckee River watershed

The North Fork American River watershed is the largest of the resource areas within this conservation theme, encompassing the area upstream of the confluence with the North Fork of the North Fork American River. The North Fork American River has been federally designated as Wild and Scenic. The watershed supports a USFS inventoried roadless area that has been proposed as a wilderness area, and it ranks high and very high in mature forest connectivity and watershed condition (White et al. 2005). The North Fork American River watershed is part of the USFS' old forest emphasis area network and supports high scenic and recreational values.

The Upper Middle Fork American River watershed resource area includes the basin above French Meadows Reservoir and the basin of the Rubicon River above Hell Hole Reservoir. These reservoirs provide water and power for local communities in the Sierra and ultimately drain to Folsom Lake, a federal water storage facility distributing water to a larger number of regional consumers. The Upper Middle Fork American River watershed resource area also supports high and very high watershed and landscape condition and passive recreation values (White et al. 2005).

The Crystal basin watershed resource area is located in the Silver Creek basin of the South Fork American River watershed. It drains the alpine peaks of the Crystal Range at the edge of the Desolation Wilderness above Union Valley and Ice House reservoirs. The Crystal basin is a highly intact watershed, largely comprised of a USFS inventoried roadless area, supporting high and very high watershed condition (White et al. 2005) and scenic and wilderness values.

Fordyce Creek is a tributary of the South Yuba River, and its upper watershed basin is located largely between the Castle Peak and Grouse Lakes proposed wilderness areas. Fordyce Creek drains into Fordyce Lake, then crosses the Grouse Lakes proposed wilderness area and drains to Lake Spaulding. Fordyce Lake and Lake Spaulding are both Pacific Gas & Electric-operated power generation facilities. The Fordyce Creek Watershed resource area includes the watershed area above Lake Spaulding. It supports high and very high aquatic biodiversity, watershed condition, and passive recreational values (White et al. 2005).

The Truckee River Watershed resource area drains the Castle Peak proposed wilderness area and the Donner Lake area on the east slope of the Sierra. It includes the upper Little Truckee River, Independence Creek and Independence Lake, Sagehen Creek, Prosser Creek, Perazzo Meadows, Carpenter Ridge and Carpenter Valley, Donner Lake, and Coldstream Canyon. This resource area supports high and very high aquatic species biodiversity values (White et al. 2005), including habitat for native aquatic species, and many reaches have been designated special management waters and wild trout streams. Protection of water bodies in this resource area is important to recovery of the federally Threatened Lahontan cutthroat trout (*Onchorhynchus clarki henshawi*). Independence Lake and Independence Creek, the trout's sole spawning tributary stream, supports the only self-sustaining lacustrine (lake-dwelling) population of Lahontan cutthroat trout in the Truckee River watershed (USFWS 1995). The Truckee River Watershed resource area also supports high recreational and scenic values.

Desired future conditions

Conservation and management of these resource areas should maintain the integrity of the watershed basins to preserve ecosystem services, sensitive species habitat, and natural watershed processes. Protecting the condition of these watershed basins is crucial for maintaining high quality water supplies, as well as high aquatic and terrestrial biodiversity, particularly in the face of changing climates. These conservation objectives are complementary to protecting many of the recreational and visual icons, as well as buffering and connecting existing and proposed wilderness areas, such as Granite Chief Wilderness Area, Desolation Wilderness Area, and North Fork American River, Grouse Lakes, and Castle Peak proposed wilderness areas.

To achieve these objectives in the five upper watershed resource areas, the Sierra Checkerboard Initiative should:

- Prevent new subdivision and development of private land, including road-building, mining, waste-disposal, agriculture and timber plantations, and expansion of utilities.
- Manage forests for restoration and enhancement purposes, with an emphasis on maintaining or restoring natural ecosystem processes.
- Implement forest management practices to maintain visual quality objectives.

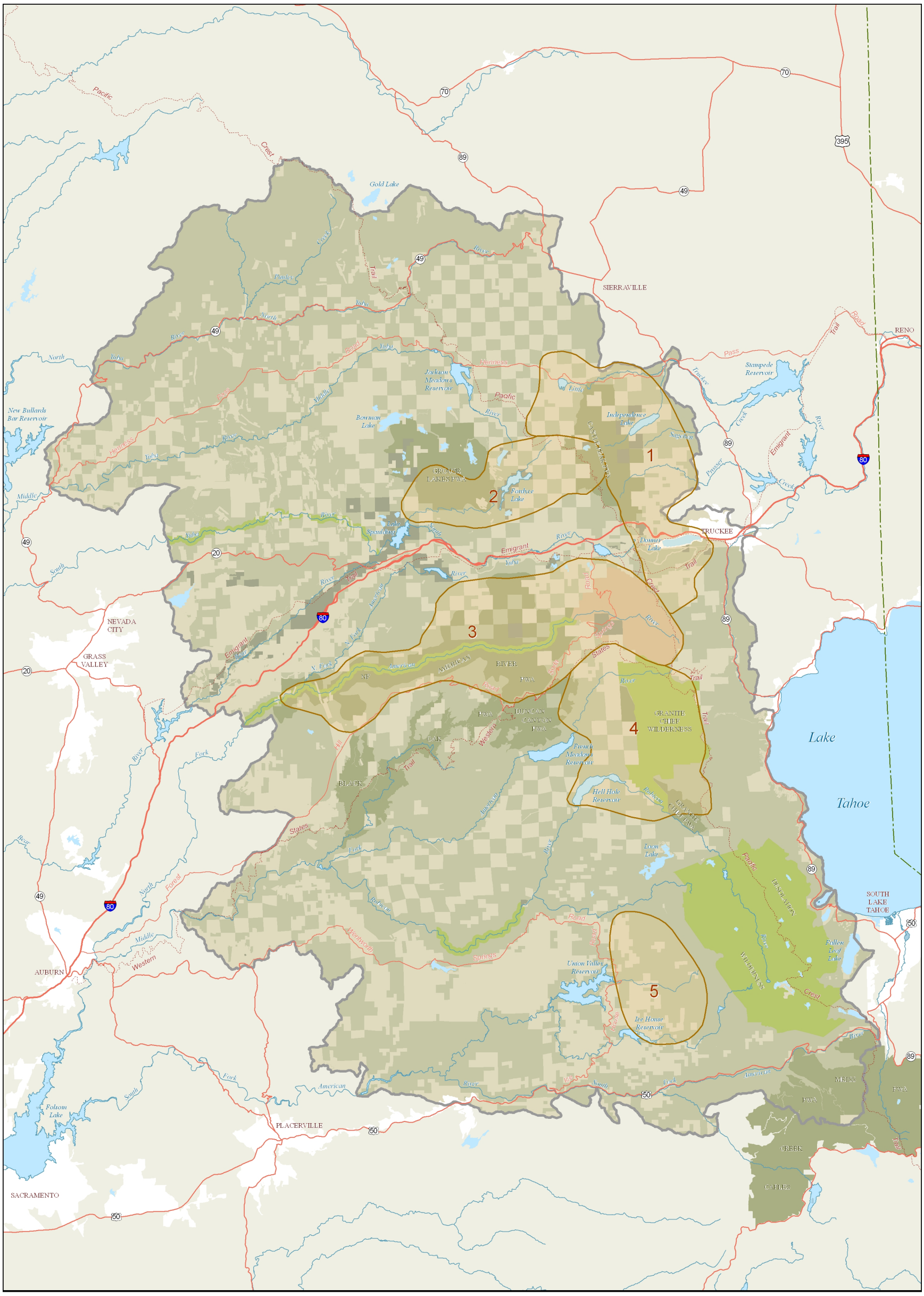

Figure 8. Watershed resource areas.

Mature Forests

Late-successional forests—those developing over hundreds of years and characterized by large old-growth trees, down logs, and snags—provide a variety of important ecosystems functions (Franklin and Fites-Kaufmann 1996), such as sequestering vast amounts of carbon. They are targeted for protection and compatible management in forest conservation efforts throughout the world (Lindenmayer and Franklin 2002). In the Sierra Nevada, commercially important forests are particularly deficient in late-successional forest characteristics relative to pre-settlement conditions (Franklin and Fites-Kaufmann 1996). The Sierra Checkerboard Initiative Science Assessment (White et al. 2005) uses the term *mature forests* to distinguish forest stands that may be younger than true late-successional forests, but which possess characteristics (e.g., larger tree diameters and more closed canopies) that are important for late-successional forest species. The Initiative has targeted four resource areas emphasizing mature forests (Figure 9):

- Yuba River mature forest
- American River mature forest
- North Crest mature forest
- South Crest mature forest

The Yuba River and American River mature forest resource areas traverse north to south across the west slope of the study area, within 5- to 12-mile wide belts of mid-montane forests (mixed conifer forests), at elevations ranging from about 3,000 to 6,500 ft. These resource areas emphasize management for mature forest values to ensure north-south connectivity from the large block of roadless, mature forests in the North Yuba River watershed and its tributaries (i.e., Pauley Creek, Lavezolla Creek, and Downie Creek), south to the confluence of Slab Creek and the South Fork American River. These resource areas integrate with mature forests and roadless areas associated with the Middle and South Yuba rivers, North and Middle Fork American rivers, and Rubicon River. They are within the USFS' old forest emphasis area and include important parts of its forest carnivore network. However, in conjunction with these public lands, appropriately managed private lands can also contribute to enhancing mature forest functions.

The North and South Crest mature forest resource areas traverse north to south at higher elevations through the study area (6,500 to 8,500 ft), within approximately 6-mile wide belts of upper montane forests (red and white fir forests). These resource areas emphasize management for mature forest values to ensure north-south connectivity from the upper North Yuba River watershed to the South Fork American River watershed, and integrate with mature forests and roadless areas associated with the upper North Yuba River and its Howard Creek tributary, Fordyce Creek watershed, upper North Fork American River watershed, upper Middle American River watershed, upper Rubicon River watershed, and the Crystal Basin backcountry. Much of these mature forests are within the USFS' old forest emphasis area and forest carnivore network.

Desired future conditions

The primary conservation objective of this theme is managing for mature forest functions, particularly habitat and landscape-scale habitat connectivity for mature forest species, but mature forests also sequester vast amounts of carbon associated with climate change. The USFS has identified the American marten, northern goshawk, California spotted owl, and Pacific fisher as management indicator species for old forest ecosystems, although it is proposing to modify this list of late-seral forest indicator species to include the California spotted owl, American marten, northern flying squirrel, fox sparrow, and golden-mantled ground squirrel (USFS 2007). The desired future condition is enhanced north-south connectivity through lower elevation, mid-montane mixed conifer forest and higher elevation, upper montane fir forests. These resource areas are also connected by older forests and roadless areas along east-west-trending river corridors on the west slope of the study area. This is an important consideration because major rivers can be a barrier to movements of forest carnivores and other species that cannot swim or fly across them.

Recognizing the value and essential role of private working forests, the desired future conditions for the mature forest resource areas will include a mix of public and private lands, such as in the two westerly resource areas where private timber operations are most concentrated. For example, Sierra Pacific Industries owns much of the land in the southern portion of the American River mature forest resource area. Conservation and management of these resource areas should emphasize protection of existing areas dominated by mature forests, such as forests within USFS old forest emphasis areas, and adjacent areas to increase their extent and overall connectivity. Late-successional forest conditions will not be appropriate for all parcels because of variability in terrain, aspect, soil types, and existing land uses. A mosaic of forest structures is an appropriate target for these resource areas, as long as the structure and distribution of the mature forest elements are suitable for sensitive mature forest focal species. Many parts of these resource areas currently lack adequate late-successional characteristics; thus, providing incentives to private land owners to emphasize mature forest management is essential to successfully achieving desired future conditions.

To achieve these objectives in the four mature forest resource areas, the Sierra Checkerboard Initiative should:

- Manage for appropriate mature forest structure. The Sierra Nevada Forest Plan Amendment (USFS 2001) describes a range of alternatives, each with varying resource emphases. The theme of Alternative 6 is *Integrate desired conditions for old forest and hardwood ecosystems with fire and fuels management goals. Reintroduce fire into Sierra Nevada forest ecosystems* (USFS 2001). This alternative describes a landscape mosaic with patches or stands of old forest as a desired future condition, including descriptions of stand structure and tree species composition for various forest types in the Sierra. These desired future forest conditions are the targets for these resource areas.

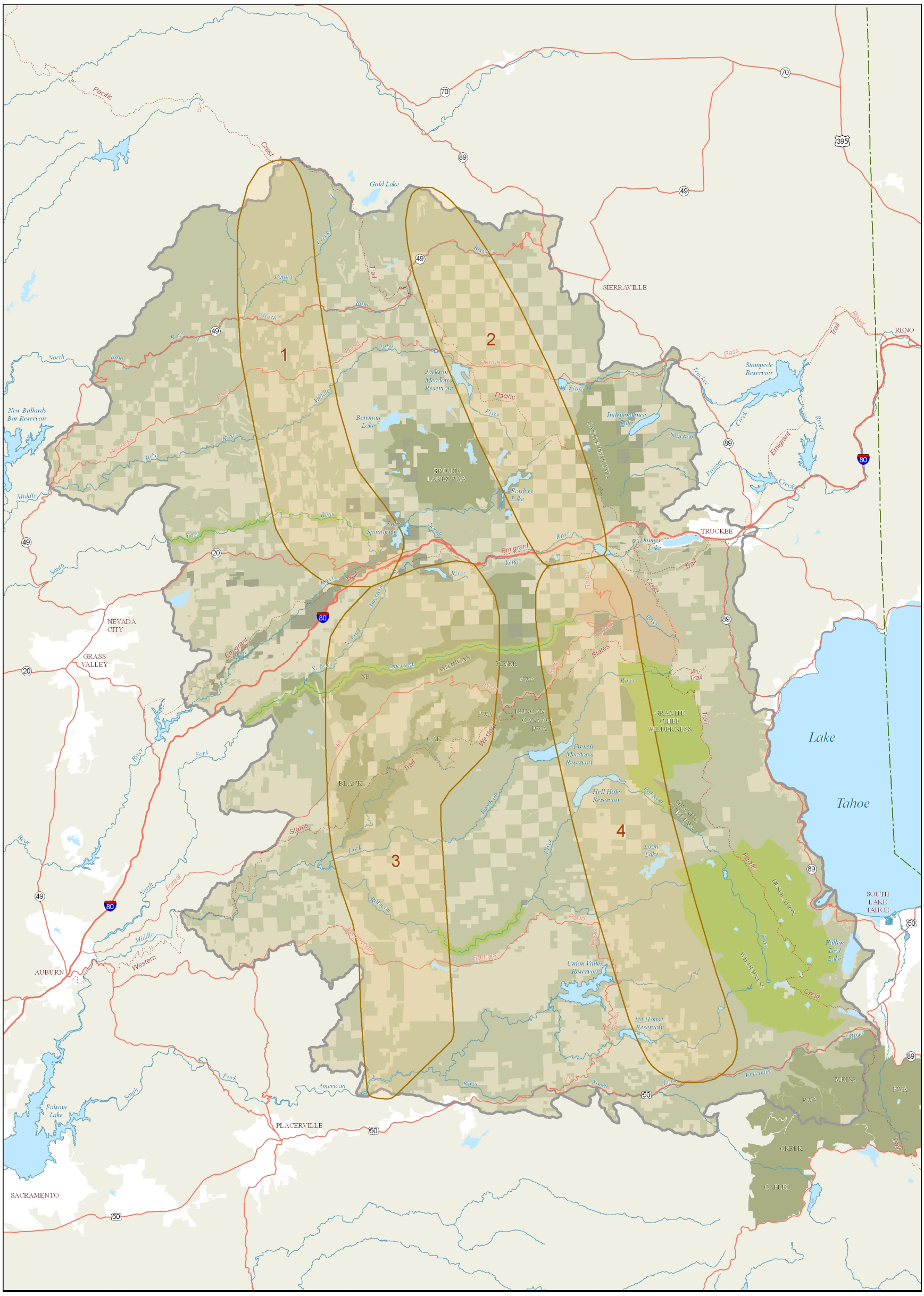

Figure 9. Mature forest resource areas.

- Reduce the threat of catastrophic fire. Achieving this condition will require return to a fire regime within the natural range of variability for the area. Alternative 6 of the Sierra Nevada Forest Plan Amendment describes a fire management strategy to reduce the potential for uncharacteristically severe wildfires (USFS 2001). This strategy prioritizes reducing surface fuels, maintaining sufficient distances between ladder fuels and crown fuels, and, where necessary, maintaining adequate distances between crown fuels. Mechanical fuel treatments are strategically placed in the landscape to prevent the spread of uncharacteristically severe wildfires, and the use of prescribed fire is emphasized. Fire hazard reduction is emphasized in the urban-wildland intermix zone, where housing densities are 1 dwelling unit per 40 acres or higher. These desired future fuel and fire hazard conditions are included in TPL's target conservation objectives for these resource areas.
- Prevent further subdivision and exurban development of private lands outside of existing development clusters.
- Manage land in these resource areas, including private forest land, to achieve goals for maintaining or improving late-successional forest structure, protecting sensitive habitat, wetlands, and water bodies, reducing risk of uncharacteristically severe fires, and sequestering carbon. Forest Stewardship Council (FSC) certified forestry practices could serve as a model for private forest management. Thus, road-building should be limited to only those necessary for management purposes, and even-aged plantation forests and agriculture should be eliminated in these resource areas, whenever appropriate.

Recreation and Visual Resources

The Sierra Nevada's scenic beauty is world-renowned, and recreation is a significant activity in the Sierra Checkerboard Initiative study area. Passive recreational activities, such as camping, hiking, horseback riding, bicycling, fishing, hunting, bird-watching, and nature study account for a large proportion of recreation in the Sierra (Duane 1996b). Recreationists are generally seeking the outstanding natural features of the Sierra, such as its lakes and streams, dramatic vistas and landforms, old growth forests, and meadows. There are numerous well-used trail corridors in the study area, such as the Western States 100 Trail, Tevis Cup Trail, Donner Rim Trail, Tahoe Rim Trail, Rubicon Trail, South Yuba Trail, and the iconic Pacific Crest Trail (PCT). Working with land managers with the Tahoe and Eldorado National Forests, the Sierra Checkerboard Initiative has targeted three resource areas emphasizing recreational and visual resources (Figure 10):

- Pacific Crest Trail corridor
- Tahoe National Forest recreation and scenic priorities
- Eldorado National Forest recreation and scenic priorities

The PCT is a 2,650-mile long national scenic trail that runs from the Mexican border to the Canadian border through the states of California, Oregon, and Washington. About 114 miles of

the PCT runs through the Sierra Checkerboard Initiative study area. The northern half of the PCT within the study area is encompassed within the PCT resource area.

During stakeholder meetings conducted for the Sierra Checkerboard Initiative, Tahoe and Eldorado National Forest staff identified several recreational and scenic priority areas. In the Tahoe National Forest these include: land around the Sierra Buttes (including inholdings in the North Yuba River watershed), areas around the Grouse Lakes proposed wilderness area, areas within the Fordyce Creek and upper Middle Yuba River watersheds, areas around Independence Lake and the Little Truckee River, and areas bordering the Granite Chief Wilderness Area. In the Eldorado National Forest these include: areas along Ice House Road and around Union Valley Reservoir, the Stumpy Meadows area, and the Rock Creek area. These areas are considered high priorities for maintaining and improving passive recreational uses and preserving the scenic beauty of iconic areas of the Sierra Nevada.

Desired future conditions

The primary conservation objective is to preserve and enhance passive recreational opportunities and experiences compatible with natural resource preservation objectives. An important conservation action for TPL is securing the PCT corridor for public use, including maintaining and, where feasible, enhancing its viewshed. Maintaining and enhancing recreational opportunities and visual resources in other resource areas are also objectives of the Initiative.

To achieve these objectives in the three recreation and visual resource areas, the Sierra Checkerboard Initiative should:

- Manage forests per California forest practice regulations with only limited, sensitively planned road-building in less-sensitive portions of these resource areas (e.g., areas outside of roadless areas, existing and proposed wilderness areas, etc.).
- Manage land such that management activities are (a) visually subordinate for the PCT resource area, (b) not evident in areas such as Sierra Buttes and the Ice House Road corridor, and (c) only evident in the form of ecological changes in highly sensitive visual resource areas such as Granite Chief Wilderness Area and Grouse Lake proposed wilderness area.
- Increase the availability of wilderness experiences, including expanses of roadless forests, through working with private landowners to protect parcels in various ways.
- Prevent land subdivision and exurban development of private land to ensure that recreational access and uses are maintained and scenic vistas are preserved.
- Implement public outreach and education efforts regarding the natural environment for recreational users.

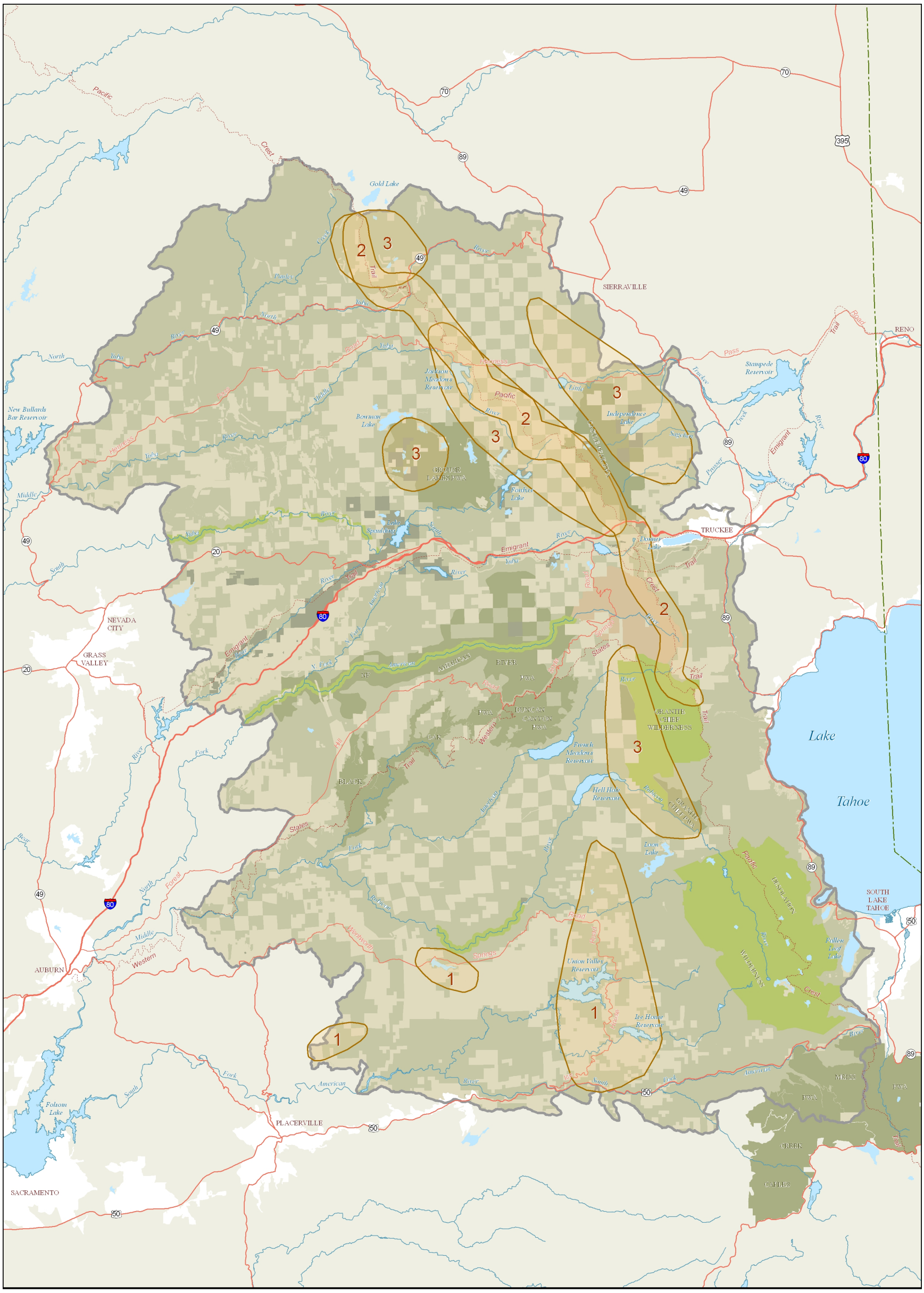

Figure 10. Recreation and visual resource areas.

3. POTENTIAL IMPLEMENTATION STRATEGIES—LANDOWNER INCENTIVES AND FUNDING MECHANISMS

The historical ownership pattern in the Sierra Checkerboard Initiative study area has contributed directly to fragmented development and land management, constraints on fuel and fire management, loss of sensitive habitat, and loss of watershed function. However, changes in ownership patterns are only one of many potentially effective ways to address these threats and protect resource values. Over the past two decades, conservation tools have been developed and utilized that reward private landowners for acting on behalf of the public interest. This section discusses tools to protect and enhance the targeted resource values, using funds from a variety of public agencies and collaborations with ongoing projects on public lands.

The 1.53 million-acre Sierra Checkerboard Initiative study area supports 1.20 million acres of forest lands (78% of the study area). Approximately 34% of the study area is privately owned (Table 1). About half of the privately owned forest lands are within the focal resource areas identified for the Sierra Checkerboard Initiative and thus are important for meeting its conservation and recreation objectives. The initial implementation strategy for the Sierra Checkerboard Initiative focuses on private lands because they face the most immediate threat of subdivision and development.

Table 1. Ownership in the study area.

Ownership	Total study area (acres)	% of study area
U.S. Forest Service	947,000	62%
Other public agencies	57,000	4%
Total public ownership	1,004,000	66%
Industrial timber companies	272,000	18%
Other private owners	251,000	16%
Total private ownership	523,000	34%
Total study area	**1,527,000**	

Rationale for Voluntary Landowner Conservation Incentives

Acquisition of private land and subsequent transfer to public ownership has been a common conservation tool utilized in the study area. Since 1980, over 28,000 acres of private land in and adjacent to the study area have been purchased by land trusts and transferred to public

ownership. However, the Sierra Checkerboard Initiative is focusing on incentives for private landowner conservation to supplement land acquisition because of: (1) the general preference in rural communities for voluntary incentives that keep land in private ownership, (2) the capacity, in many instances, of sustainable forestry practices to achieve conservation objectives on private forestlands, and (3) the greater cost efficiency relative to fee-title acquisition.

Voluntary incentives appeal to a greater numbers of private landowners and are likely to build a wide coalition of community support. Although communities will benefit from increased recreational opportunities available on public lands, loss of private ownership could potentially lower the local property tax base. In addition, while the transfer of private land to public ownership often consolidates public holdings and creates management efficiencies, in some cases the overall increase in acreage could also increase the total amount of funding needed for land management activities, such as fuels reduction, tree-planting, and road maintenance. Conservation efforts to keep contiguous forestland intact and healthy are likely to be more successful with broad-based collaboration across different kinds of ownerships.

Sustainable Forestry is commonly defined as *the practice of managing dynamic forest ecosystems to provide ecological, economic, social and cultural benefits for present and future generations* (Wisconsin DNR 2006). It is a departure from past practices on private lands that maximized economic returns from forest management. Sustainable forestry is active forest management that provides respectable returns while restoring wildlife habitat and watershed function, and reducing risks of catastrophic fire. It includes activities such as tree planting, timber harvesting, prescribed fire, and thinning that can reestablish native forest stands by improving species mix, spacing, and multiple age characteristics. Brush clearing, weed control, and fuels reduction projects slow the spread of wildfires. Storm-proofing roads, bank stabilization, and placement of in-stream woody debris reduce erosion and restore in-stream habitat. Sustainable forestry projects can be part of approved timber harvest plans on private forestlands.

Sustainable forestry practices have shown enough success in combining economics with conservation that organizations such as The Conservation Fund acquire acreage where sustainable forestry is the ongoing management practice. In its October-December 2006 newsletter, Larry Selzer, Chief Executive Officer (CEO) of The Conservation Fund, states *In California, we're demonstrating that sustainable forestry can be used as an effective tool to protect water, wildlife, and jobs*. Sustainable forestry practiced on private land in conjunction with conservation easements, third-party forest certification, and other contractual incentives is a viable way to meet a number of important conservation objectives.

Landowner incentives have the potential of achieving major conservation objectives in the checkerboard study area at less cost than an *acquisition only* strategy. This is particularly true as appraised land values increase with the region's growing population and building activity. Incentives such as purchase of development rights or public access to a private property, which compensate landowners for specific elements of land values that are a high conservation priority

rather than a fee-title acquisition, have the ability to protect larger numbers of important landscapes (Ingerson 2004).

Incentives Available to Landowners to Protect and Enhance Forest Values

Tables 2 and 3 list 20 tools and incentives potentially available to help implement the conservation vision of the Sierra Checkerboard Initiative on private forestlands. These tools range from permanent loss of significant property rights to annual recreation contracts representing little impact on the range of rights retained by the landowner. The tools are listed in rough order of how much autonomy and property rights would be relinquished by the landowner (Table 2). The order also reflects the decreasing monetary benefit for the landowner, which could range anywhere from $3,000+ per acre for the sale of a conservation easement to less than $100 per acre for an annual recreation contract. Monetary benefits to the landowner will depend on location, size of the tract of land, and other property attributes.

Tables 2 and 3 include six incentives involving permanent relinquishment of property rights and two that involve temporary encumbrances on the property. Six involve transactions of ecosystem services that are often combined with permanent restrictions such as perpetual conservation easements. Three incentives represent programs established by local, state, and federal agencies to compensate landowners for voluntary participation in stewardship and restoration work. The agencies provide technical expertise to the landowner and cost-sharing for investments and reductions in productive capacity. Community insurance programs have typically been funded by private nonprofit organizations, such as more than $700,000 paid by Defenders of Wildlife since 1987 for livestock losses in western states. The last three incentives are associated with extractive and recreation industries when their operations are performed in a sustainable way. Some of the incentives listed in these tables, such as conservation easements, have been used for land conservation for many years. Others, such as transferring development rights, transactions involving ecosystem services, and biomass/ethanol production, are under development or need enabling state legislation, but are beginning to become available.

Table 2. Potential conservation incentives and their implications to landowners.

Conservation Incentive	Implications to Landowner
1. Land Exchange	Relinquish permanent property rights
2. Perpetual Conservation Easement	
3. Working Forest Conservation Easement	
4. Transfer of Development Rights	
5. Limited Development Projects	
6. Permanent Deed Restrictions and Restrictive Covenants	
7. Stewardship Agreements	Temporary property rights restrictions
8. Temporary Deed Restrictions and Restrictive Covenants	
9. Mitigation Credit Banking	Trade in ecosystem services
10. Trade in Carbon Credits	
11. Water Rights Trading/In-Stream Leasing	
12. Water Quality Trading	
13. Payment for Watershed Services	
14. Land Rental	
15. Support for Stewardship/ Restoration/Fuel Projects	Compensation for conservation projects
16. Regulatory Relief	
17. Community Insurance Program	
18. Eco-Labeling and Wood Products Certification	Sustainable extraction businesses
19. Biomass and Ethanol Production	
20. Recreation Contracts/Hunting, Fishing User Fees	

Table 3. Landowner conservation incentives.

Conservation Incentive	Definition	Examples	Benefits for Landowner	Costs for Landowner
1. Land Exchange	Swapping private land with conservation value for public or private land	Silver Pearl Land Exchange, Eldorado National Forest & Sierra Pacific Industries	Consolidate ownership for management efficiencies, reduced road construction, decrease conflicts	Lengthy approval process (3-7 yrs)
2. Perpetual Conservation Easement	Legal agreement between landowner and gov. agency or nonprofit organization that permanently limits development of and activities on the land	Long Ranch, Mariposa Co.; Hannan Wildlife Preserve, Nevada Co.; Martis Camp, Placer Co.	Can be over 50% of fair market value (FMV) while retaining ownership	Perpetual restrictions on use of land, some loss of autonomy over property
3. Working Forest Conservation Easement (WFCE)	Subset of conservation easements that allows for active forest management of land including logging, fuel treatments, etc.	Bascom Pacific, Shasta Co. (Pacific Forest Trust); Garcia Forest, Mendocino Co. (The Conservation Fund and The Nature Conservancy)	Ongoing timber revenues, compensation for lost revenues, reduced risks related to increased regulatory statutes, 30-50% of FMV depending on terms	Perpetual restrictions on use of land, adherence to mutually agreed-upon Forest Management Plan
4. Transfer of Development Rights (TDR)	Transfer right to develop land from one parcel to a different owner, thereby allowing development to be focused outside of resource lands	San Luis Obispo Co, Oxnard, Pacifica, Pismo Beach (CA), Boulder Co. (CO), King Co. (WA)	Payment for development rights without developing land	Complicated transaction, must have authorizing statutes by county
5. Limited Development Projects	Environmentally sensitive land development which helps finance conservation, e.g., protection of open space, heritage sites, and land adjacent to conserved acreage	Northstar Resort and Martis Camp, Placer Co. (CA)	Can help in securing timely approval of project	Currently available, but takes time to develop due to requirements for innovative financing and collaboration

Conservation Incentive	Definition	Examples	Benefits for Landowner	Costs for Landowner
6. Permanent Deed Restrictions and Restrictive Covenants	Deed provisions limiting use of property, typically used by land developers to establish minimum house sizes, setback lines, etc.; may have specific terms or time frame; typically not subject to 3rd-party enforcement.	Martis Camp, Placer Co.; Chickering American River Reserve, Placer Co. (CA)	Enhanced property values, protection from development and stewardship issues on neighbor properties	Permanent encumbrances on property
7. Stewardship Agreement	Contract between landowner and a conservation organization or public entity that outlines conservation protections to be utilized during harvesting, grazing, or other economic activities	Conservation & Research Agreement, N. Fork American River Headwaters Basin, Placer Co. (CA); TNC/ranchers–grazing and noxious weed control on Rocky Mtn Front; TNC/Ducks Unlimited with landowners for habitat enhancement in estuary, Colleton Co.(SC)	Compensation for stewardship work and lower levels of economic activities, regulatory relief, possible product labeling opportunities	Negotiation of contract, additional operating costs, monitoring protocols
8. Temporary Deed Restrictions and Restrictive Covenants	Provisions in a deed limiting use of property, potentially subject to a specific term or time frame	Riverwood Subdivision, El Dorado Co., Conservation and Research Agreement, N. Fork American River Headwaters Basin, Placer Co. (CA)	Enhanced property values, protection from development and stewardship issues on neighbor properties	Temporary encumbrances on property
9. Mitigation Credit Banking	Trade in credits representing set quantities of preserved or restored ecosystem services, e.g., wetlands or wildlife habitat, currently only available for certain species & habitat types	Dolan Ranch Conservation Bank, 252-acre property located near the Sacramento River at Colusa, CA	Can be as much as $25,000/acre +/- ; project-specific	1-2 years to create plan, process application

Conservation Incentive	Definition	Examples	Benefits for Landowner	Costs for Landowner
10. Trade in Carbon Credits	Voluntary or mandatory cap and trade systems allow for CO_2 emitters to offset emissions by purchasing carbon credits from owners of sustainably managed forests	Van Eck Forest Project, Pacific Forest Trust, Humboldt Co.; Garcia Forest, The Conservation Fund & TNC, Mendicino Co; Lompico Forest Carbon Project, Sempervirens Fund, Santa Cruz Co.	Cash ($ per metric ton of CO_2 equivalent removed from atmosphere per acre per fixed time period)	May require permanent dedication of forest land with conservation easement, costs of protocols and certification of carbon credits
11. Water Rights Trading and In-Stream Leasing	Sale or lease of water rights in the form of withdrawals or to allow water to remain *in-stream* to benefit aquatic ecosystems	San Joaquin River Wildlife Refuge (1993), Merced Co. (CA)	Sell, lease or donate water rights (e.g., $$ per acre-ft)	Give up water rights
12. Water Quality Trading	Monetary incentives for water quality improvements resulting from changes in land management practices	California Grasslands Selenium Trading, San Luis Drain, Kesterson Reservoir, Merced Co. (CA)	Cash payments for reductions in Total Maximum Daily Load (TMDL)	Need to invest in land use practices to reduce water quality impacts
13. Payment for Watershed Services	Protect upstream natural storage capacity through purchase of conservation easements and investment in other watershed projects	New York City and Catskill Watershed Development Corporation	Payments for development and appraised values of other restrictions	Limit commercial and residential development and accept other restrictions
14. Land Rental	Land rental payments to landowners who cease agricultural production on erodible or environmentally sensitive lands and establish grasses and trees	Placer County participation in Conservation Reserve Enhancement Program	Annual rental payments at irrigated cropland values for 10-15 years, special incentive payments	Might attract unwanted hunting and associated tourism
15. Support for Stewardship, Restoration, and Fuel Projects	Public programs providing technical assistance and cost-sharing for qualified stewardship, restoration and fuels reduction projects on private forestlands	Traverse Creek EQIP Project, American and Yuba River watersheds	Cost-share, technical assistance, education and loans	Prepare applications and planning for restoration work, investments in restoration and stewardship

Conservation Incentive	Definition	Examples	Benefits for Landowner	Costs for Landowner
16. Regulatory Relief [Candidate Conservation Agreement (CCAA), Safe Harbor Agreement, HCP, NCCP, Private Lands Wildlife Management Program]	Agreements where landowners whose activities result in conservation benefits for qualified species are provided with assurances they will not be constrained by additional restrictions	Placer County NCCP, Lower Mokelumne Watershed Safe Harbor Agreement (USFWS), Amador, Calaveras, Sacramento, and San Joaquin Co., McCloud Redband Trout CCAA	Regulatory assurances if species later becomes listed, incidental take authorization, some regulatory stability	1-3 years to create plan, process application
17. Community Insurance Program	Private and quasi-public insurance programs to protect against losses resulting from conservation activities, e.g., reintroducing large carnivores	Defenders of Wildlife (Bailey Wildlife Foundation Wolf Compensation Trust Fund) WY, ID, MT, Mexico; Snow Leopard Trust, India	Protection from catastrophic loss	May contribute to premium payments; determination of loss may be difficult
18. Eco-Labeling and Wood Products Certification	3rd-party auditors verify that landowners engage in responsible and sustainable forest management	Use of Forest Stewardship Council-labeled wood; earn points for Leadership in Energy & Environmental Design building certification	Position products for favorable negotiations with wholesalers and retailers	Additional operating and marketing costs
19. Biomass and Ethanol Production	Use of forest materials (logging slash, thinnings, understory brush) to produce electricity, fuels, and biomass products	Sierra Pacific Industries (Lincoln, Placer Co. and Loyalton, Sierra Co.), Rio Brava (Rocklin, Placer Co.)	Generate revenue and return through sales of forest biomass products	Investment in extraction equipment/contractors and facilities
20. Recreation Contract, Hunting/Fishing User Fees	Recreational leasing and fee-based private forest recreation	Potlatch Corp., Idaho timber holdings; Timberland Trails and International Paper (NH)	Lease revenue (e.g., $$ per acre per year)	Loss of privacy, high volume impacts on land

Sources: Best and Wayburn 2001, Casey et al. 2006, Defenders of Wildlife 2007, Environmental Defense 2007, Ginn 2005, Ingerson 2004, Levitt 2005

Funding Mechanisms for Landowner Incentives

In most cases, implementing landowner incentives requires funding, and Tables 4 and 5 list 21 potential funding sources. Qualification for funding depends on the specifics of the landowner, the land, and the conservation values to be protected. As the types of funding mechanisms continue to grow, a key need that can be filled by the Sierra Checkerboard Initiative is to configure conservation incentives and funding mechanisms in a streamlined and efficient manner to achieve site-specific conservation objectives. Seven of the listed funding mechanisms come largely from private sources. Several of these represent new ways for private firms to invest in conservation projects and show at least a modest return. Mechanisms like private equity funding have potential to expand the pool of investment available for private forestland conservation (Ginn 2005). Commercial transactions that involve the sale of products such as carbon credits or in-stream water rights are still in early stages of development.

The list of funding sources in Table 4 includes five forms of tax relief which allow landowners to offset the costs of land donations, reduce the pressure to sell or subdivide land to pay for property and estate taxes, and reduce the costs of borrowing money for conservation projects. Public funding mechanisms include large bonds such California Proposition 84 (approved by voters in November 2006), real estate transfer and sales tax surcharges, the Forest Legacy Program specifically targeting working forest conservation easements, water and irrigation districts, and the 16 federal and 11 state cost-share and technical assistance programs administered by a variety of agencies.

Table 4. Funding sources and types.

Funding Sources	Type
1. Private Grants and Contributions	Sources of private capital
2. Private Equity	
3. Commercial Transactions	
4. Excise Taxes or User Fees	
5. Insurance Companies	
6. Private Revolving Loan Funds	
7. Tax-Exempt Bonds	
8. Federal and State Income Tax Deductions for Gifts	Federal and state tax relief
9. Federal and State Income Tax Credits	
10. New Market Tax Credits NMTC (Fed)	
11. Property Tax Relief	
12. Estate Tax Relief	
13. Annual Appropriations, Bonds, Transfer Taxes or Sales Taxes	Sources of public funding
14. Public Forest Legacy Programs	
15. Irrigation and Water Districts	
16. Federal Cost Share - USDA/NRCS	
17. Federal Cost Share - USDA/USFS	
18. Federal Cost Share - USFWS	
19. Federal Cost Share - Other Depts.	
20. California State Cost Share	
21. CA Fuels Reduction & Vegetative Mgmt Programs	

Table 5. Funding sources for landowner incentives.

Funding Source	Definition	Examples	Benefits for Landowner	Costs for Landowner
1. Private Grants and Contributions	Money raised and land donated from individuals and foundations to advance specific objectives	Resources Legacy Fund Foundation, Wal Mart, International Crane Foundation, Paul G. Allen Forest Protection Foundation, The David and Lucile Packard Foundation, Gordon and Betty Moore Foundation	Cash for qualified acquisitions, conservation easements, stewardship agreements	Grant applications, accountability to funders
2. Private Equity	Private investment, investor funds, or dedicated accounts of larger institutions for acquisition and management of forestlands	Usal Redwood Forest (Bank of America), TIMOs, FIMOs, Cascadia Forest Stewardship Investment, Sustainable Land Fund, Socially Responsible Investment Funds, Natural Resource Based Development Investment	Sustainable source of revenues, low-cost financing (*Debt for Nature* deals)	Perpetual easements, limited property rights & future flexibility, established trade-offs of conservation & return on capital
3. Commercial Transactions	Money exchanged for goods and services in the private sector, sometimes with green premiums	Certified wood products, biomass products, carbon credits, in-stream water rights, cellulosic ethanol	Cash from transactions based on somewhat traditional market mechanisms	Obtaining certification for wood products and ecosystem products, requirements for long-term agreements
4. Excise Taxes or User Fees	Fees or taxes collected from persons who use a particular service, as compared to one collected from the public in general	Excise taxes on fishing equipment, motorboat fuels for coastal conservation projects (e.g., Big River, Lake Earl/Talawa Lagoon, Morrow Bay Estuary, etc.), water user fees, St. Johns River Water Management District (FL)	Cash available to pay for conservation easements or acquisition of lands important to water quality and flow	Perpetual easements in some cases
5. Mitigation Funds	Expenditures by insurance, government agencies and private companies on mitigation banking credits or mitigation lands	Caltrans, developers, settlements related to Disaster Mitigation Act of 2000	More competition & active trading in habitat mitigation markets	Enrollment in mitigation banking program

Funding Source	Definition	Examples	Benefits for Landowner	Costs for Landowner
6. Private Revolving Loan Funds	Capital fund established to make loans where principal repayments of loans are re-paid into the fund and re-lent to other borrowers	The Nature Conservancy's Land Preservation Fund, Pacific Forest Trust's Conservation Capital Fund, David and Lucile Packard Foundation PRI program	Increased availability of low-cost capital in short term to facilitate quicker and more competitive transactions	Loan payments need to be generated from public funds, harvest receipts, etc.
7. Tax-Exempt Bonds	A bond, issued by a qualified organization or public agency, whose interest payments are not subject to federal income tax, and sometimes state or local income tax	U.S. Forest Capital, LP	Increased availability of low-cost capital	Property subject to perpetual conservation easements; requires enabling state legislation
8. Federal and State Income Tax Deductions for Gifts	Income tax deductions (subtracted from gross income to arrive at the taxable income) as much as 50% of income (100% for farmers & ranchers) and possible carry-over for 16 years	Federal 2006 Pensions Protection Act (Enhanced income tax deductions expired 12/31/07 but legislation to retroactively make them permanent is currently pending); California Natural Heritage Preservation and Tax Credit Act of 2000	Reduced income taxes	Donate all or part of land or conservation easements to qualifying organization
9. Federal and State Income Tax Credits	Dollar-for-dollar reduction in tax payment in exchange for donation of land	Transferable State Income Tax Credits (CA), The Natural Heritage Preservation Tax Credit Program (CA)	Reduced income taxes	Donate all or part of land or conservation easements to qualifying organization
10. New Market Tax Credits (Fed)	Permits taxpayers to receive a credit against federal income taxes for making qualified investments in low-income communities	Coastal Enterprises Inc.'s Katahdin forest project, north-central Maine	Lower cost of borrowing, low interest money available for investment, 39% federal income tax credit spread over a 10-yr period; can be used to provide returns for tax-paying investors	2-3 years to create plan, process application (program will need to be reauthorized)

Funding Source	Definition	Examples	Benefits for Landowner	Costs for Landowner
11. Property Tax Relief	Relief in the amount of tax assessed on real estate by the local government, based on value of property (including the land)	Property Tax Benefits for Wildlife Habitat Contract or Open Space Easement (CA), The Land Conservation Act/Open Space Subvention Program, Williamson Act (1965), and Super Williamson Act (1998), Forest Taxation Reform Act of 1976	Lower property tax assessments	1-2 years to create plan, process application, open space contract with 10-yr minimum
12. Estate Tax Relief	Excluding a percent of the land value from taxable estate with a qualifying conservation easement	The Federal Taxpayers' Relief Act	Lower estate taxes	Cap on benefit amount (e.g., $500,000)
13. Annual Appropriations, Bonds, Real Estate Transfer Taxes, or Sales Tax Surcharges	Annual budget appropriations, issuance of general obligation bonds, taxes paid with sale of new or existing homes and commercial buildings, portions of or additions to general sales tax	Land & Water Conservation Fund, California Proposition 84; Sonoma County Agricultural Protection and Open Space District; Martis Camp, Placer County real estate transfer fee	Cash matching grants and acquisition funding	1-2 years to create plan, process application
14. Public Forest Legacy Programs [CA Forest Legacy Program, USDA Forest Legacy Program]	Pay portion of costs for conservation easement (incl. working forest conservation easements) to protect forest from conversion to non-forest uses	Twinning and Oracle Oak Ranches, Mendocino Co.; Sunny Brae Forest Project, Humboldt Co. (CA)	75% of project costs of a conservation easement or working forest conservation easement	2-3 years to create plan, process application
15. Irrigation and Water Districts	Purchase of land, conservation easements, other watershed services to protect or increase water storage, quality, and flow	Westlands Water District purchase of 3,000 acres on McCloud River, Shasta Co. (CA)	Cash available to pay for conservation easements or acquisition of lands important to water quality and flow	Restrictions on land uses such as perpetual conservation easements

Funding Source	Definition	Examples	Benefits for Landowner	Costs for Landowner
16. Federal Cost Share and Technical Assistance Programs [USDA/Farm Service Agency/Natural Resource Conservation Service]	Provide financial and technical assistance including payments to promote soil and forest conservation	Conservation Reserve Program, Conservation Reserve Enhancement Program, Conservation Security Program, Environmental Quality Incentives Program, Wetlands Reserve Program, Wildlife Habitat Incentives Program, Healthy Forest Reserve Program	Cost share up to 100%	1-2 years to create plan, process application, award based on USDA ranking system
17. Federal Cost Share and Technical Assistance Programs [USDA/USFS]	Provide financial and technical assistance including annual rental payments to promote forest improvement and conservation	Forest Stewardship Program, Forest Land Enhancement Program	Cost share up to 100%, annual land rental payments	1-2 years to create plan, process application
18. Federal Cost Share and Technical Assistance Programs [USFWS]	Provide financial and technical assistance including annual rental payments to promote wildlife habitat improvement and conservation	Partners for Fish and Wildlife Program, Landowner Incentive Programs, Private Stewardship Grant Program, Cooperative Endangered Species Conservation Fund (Section 6 Grants)	Up to 100% of total costs incurred by landowner; expert assistance	1-2 years to create plan, process application
19. Federal Cost Share and Technical Assistance Programs [Other Depts.]	Provide financial and technical assistance including annual rental payments to promote wildlife habitat improvement and conservation	Transportation, Water and Wastewater Infrastructure Programs, National Scenic Byways Program	Cost share cash payments	1-2 years to create plan, process application

Funding Source	Definition	Examples	Benefits for Landowner	Costs for Landowner
20. California State Cost Share and Technical Assistance Programs	Funds to protect high quality timber supplies, related employment, other economic benefits, water quality, wildlife habitat	California Forest Stewardship Program, The Riparian Habitat Conservation Program, The Habitat Conservation Fund, The Fishery Restoration Grants Program, California Forest Improvement Program, Environmental Enhancement and Mitigation Program, Integrated Regional Water Management Program	Cost share cash payments, technical assistance and/or purchase of fee or easement	1-2 years to create plan, process application
21. California Fuels Reduction Program & Vegetation Management Programs	Cost share programs to reduce wildland fuel loadings that pose a threat to watershed resources and water quality and allows landowners to use prescribed fire to accomplish a fire protection	CAL FIRE Proposition 40 grants, CAL FIRE Vegetation Management Program	Cost share cash payments, technical assistance	1-2 years to create plan, process application

Sources: Best and Wayburn 2001, Casey et al. 2006, Defenders of Wildlife 2007, Environmental Defense 2007, Ginn 2005, Ingerson 2004, Levitt 2005

Working Forest Conservation Easements

With a large percentage of the private land in the study area in forested landscapes (78% of the study area), one of the incentives likely to have widespread application for landowners is the Working Forest Conservation Easement (WFCE). The use of WFCEs to protect working forest landscapes has increased significantly in the United States over the past decade. A WFCE is a legal agreement between a grantor (landowner) and grantee (qualifying conservation organization or public agency) where certain property rights are transferred in perpetuity. WFCEs are different from conventional conservation easements in that they apply to privately owned forestlands that will continue to be actively managed for timber extraction.

In general, WFCEs protect private forestlands from conversion to residential and commercial development and from short-term high impact logging such as clear-cutting. Depending on the location and property attributes, other conservation values identified for protection may include water quality, mature forest corridors, and scenic viewsheds. Prescriptive criteria to meet these protections are property-specific and negotiated in each land transaction. WFCEs contain site-specific forestry guidelines for the ongoing management of timber resources and commercial operations. Terms of a WFCE depend on conservation objectives for the specific property (Table 6).

Most land trusts avoid prescriptive language in the body of the WFCE, but include a separate document referred to as the Forest Management Plan to describe these prescriptions. The Plan, usually prepared by professional foresters and other resource experts, sets objectives for a specific forested property and is updated every 5-10 years. This allows the WFCE to adapt to changing environmental conditions on the property and incorporate new developments in forest science and forestry practices. The Forest Management Plan details management and harvesting schedules and provides language for measuring and monitoring objectives. In some cases, obtaining third-party forest certification is an integral part of the process.

The effectiveness of the WFCE as a conservation tool depends on careful identification of indicators for specific objectives and design of monitoring programs that allow for adequate tracking of those indicators (Block et al. 2004). Good landowner relations, use of experienced forestry professionals, and organizational capacity of the grantee are essential to ensure follow-though with adequate monitoring programs. Monitoring ensures enforcement of the landowner's Forest Management Plan and evaluates results to determine if the appropriate indicators were chosen to meet objectives over time.

WFCEs can be combined with other incentives to result in competitive proposals for landowners. In 2006, the Pacific Forest Trust worked with the van Eck Forest Foundation on 2,100 acres in Humboldt County, California, to combine a WFCE with the registration of 500,000 tons of carbon credits with the California Climate Action Registry. The Pacific Forest Trust, the Conservation Fund, and Collins Companies all have additional WFCE/carbon credit projects underway that could potentially amount to over 150,000 additional forested acres protected in Northern California within the next few years.

Table 6. Example terms for Working Forest Conservation Easements.

PROHIBITED	FOREST MANAGEMENT OBJECTIVES
CASE 1 OBJECTIVE: Protect rare habitats and water quality. (example: portions of headwaters of Sagehen Creek in Little Truckee River watershed)	
• Land subdivision • Industrial uses or structures • Residential uses of structures • Agricultural uses (except timber) • Introduction of nonnative vegetation • Dumping or storage of waste • Expansion of utilities • Surface or sub-surface mining • Manipulation of watercourses, wetlands • Road construction • Use of motorized vehicles off roads	• Meadow maintenance and restoration • Riparian area maintenance and restoration • Protection of remnant old growth stands • Hardwood restoration (aspen, black oak, chaparral) • Specific limitations on rate of harvest and silvicultural methods • Climate benefits • Fire risk management plan
CASE 2 OBJECTIVE: Restore corridor with late seral forest characteristics. (example: area between North and South Yuba River between No. Yuba Basin and Emigrant Gap)	

• Land subdivision
• Industrial uses or structures
• Residential uses or structures
• Agricultural uses (except timber)
• Introduction of nonnative vegetation
• Dumping or storage of waste
• Expansion of utilities
• Surface or sub-surface mining
	• Species mix, age class, & tree size inventory goals
	• Riparian area maintenance and restoration
	• Protection of remnant old growth stands
	• Wildlife habitat goals (e.g., snag & downed woody debris)
	• Climate benefits
	• Fire risk management plan
	• Specific operating limitations on
	  o rate of harvest & silvicultural methods
	  o manipulation of watercourses, wetlands
	  o road construction
	  o use of motorized vehicles off roads

CASE 3 OBJECTIVE: Secure public access and intact viewshed. (example: areas adjacent to Pacific Crest Trail)	

• Land subdivision
• Industrial uses or structures
• Residential uses or structures
• Agricultural uses (except timber)
• Introduction of nonnative vegetation
• Dumping or storage of waste
	• Public access, viewshed integrity, forest health
	• Climate benefits
	• Fire risk management plan
	• Specific operating limitations on
	  o rate of harvest & silvicultural methods
	  o manipulation of watercourses, wetlands
	  o road construction
	  o use of motorized vehicles off roads
	  o mining of rock for road surfaces
	  o expansion of utilities

Sources: Lind 2001, Pacific Forest Trust 2006, Block et al. 2004

Reducing the Threat of Catastrophic Wildfire

To reduce the risk of catastrophic wildfire in the study area, the terms of transactions such as conservation easements, stewardship agreements, covenants, offset trades, and cost-share projects must be designed to incorporate requirements that address the major contributing factors to this threat. Specific recommendations should address fuel treatments, wildfire suppression policies, post-fire recovery prescriptions, and land-use planning strategies that lend themselves to more strategic fire management.

Documents such as Working Forest Conservation Easements could include provisions to enforce fuel treatments for forested areas over time. Conservation easements that are part of limited development projects may require developers to address vegetation around structures and buffers for wildland interface, and to integrate long-term monitoring by third party organizations such as a local Fire Safe Council. Projects that impact land-use, including increased recreational access, must allow adequate input of the appropriate fire agencies and community groups.

Table 7 illustrates how considerations for fuel treatments may be incorporated in landowner incentive documents. Best practices for fuel treatments depend on stand density, fuel accumulations, proximity to human dwellings, dominant fire regime, topography, and elevation (Agee and Skinner 2005). The overall objectives of fuel treatments should be to reduce the average size burned by severe fires and restore ecosystem function associated with frequent low to moderate severity fires (McKelvey et al. 1996).

Creating Access to Landowner Incentives and Funding Mechanisms

Implementing a successful strategy to protect targeted areas with landowner incentives and funding mechanisms requires creating better access to these tools for landowners, connecting potential partners, providing interim funding mechanisms, and advocating long term monitoring and research. Many of the incentives have existed for years but are not utilized by landowners or not used in ways that accomplish a geographically specific set of conservation strategies. Regional land trusts, land trust councils, watershed groups, and public agencies can all play a role in assisting with these efforts (for instance, the Sierra Nevada Conservancy is particularly well-positioned to provide this information).

One advantage for the study area is that the Science Assessment and Conservation Plan for the Sierra Checkerboard Initiative established a conservation vision based on a science-driven framework that uses biodiversity, recreation, and land-use objectives to inform conservation priorities. This conservation vision encourages dialogue between collaborating partners such as private landowners, land trusts, environmental organizations, and local, state, and federal agencies. It also provides a baseline from which to derive desirable outcomes and potential conservation returns from different conservation actions.

Table 7. Considerations for forest fuel treatment projects to restore ecosystem integrity and reduce probability of large, high severity wildfires in dry mixed conifer forests.

Reduce Ground and Surface Fuels
• Target surface fuels as first priority in fuel treatment projects. • Use prescribed fire to remove understory vegetation, dead woody fuels, and accumulation of litter from forest floor. • Consider multiple treatments to be effective. • Consider risks of crown-fire initiation. • Consider air quality and aesthetic impacts. • Implement with manual or mechanical removal. • Limit mechanical treatments due to impacts of road networks. • Combine with biomass removal or mastication (crushing and chopping). • Design to become low maintenance over time by eliminating the need to suppress natural wildfires.
Reduce Ladder Fuels
• Perform pre-merchantable thinning of smaller trees and brush that provide link from ground to upper canopy layers. • Perform multiple treatments to be effective. • Minimize soil compaction or erosion impacts of road-building or damage to retained trees. • Consider fuel reduction in areas adjacent to human communities. • Manage thinning to basal area targets and relationship of ground fuel flame length to canopy base height.
Reduce Crown Density
• Plan as third priority to target in fuels reduction program. • Thin post merchantable trees to reduce canopy bulk density and canopy continuity where appropriate. • Manage thinning to canopy bulk density targets as related to modeled rates of crown fire spread. • Retain most vigorous trees of size classes targeted. • Consider reducing crown density in areas adjacent to human communities. • Manage post-harvest residues. • Minimize soil compaction or erosion impacts of road-building or damage to retained trees.
Retain Trees of Fire-Resistant Species
• Plan for retention of larger, more fire-resistant trees in stand, as they protect stand from risk of severe damage to overstory in subsequent fires.

Sources: Agee and Skinner 2005, McKelvey et al. 1996, Noss et al. 2006, Peterson et al. 2005, Stephens 2003

A crucial step in the Implementation Phase (Phase III) of the Sierra Checkerboard Initiative is to connect relevant incentives and funding sources with interested landowners. A proper fit will be determined by landowner willingness, timing, availability of funding, desired level of protections, and landscape and property-specific attributes. Depending on a landowner's specific circumstances, there are likely several available incentives that can be combined in creative ways to achieve conservation objectives and landowner's needs (Ginn 2005). To facilitate landowner access to programs and funding as well as to lower transaction costs, landowners need somewhere to go for information and technical field assistance. In addition to forestry, geology, wildlife biology, hydrology, and fisheries expertise, they are likely to seek assistance with project due diligence, legal, title, survey, tax and financing. These resources may be provided by a network of organizations, with a means to navigate to and around all of them.

Conservation projects in the study area will be augmented by providing for interim financing mechanisms such as external revolving loan funds and bridge loans. Money from these mechanisms is available as direct loans to nonprofit organizations and for advance purchases of qualified land in partnership with public agencies. Interim financing allows land trusts and other nonprofit organizations to respond quickly to opportunities and for conservation projects to be more competitive with commercial development projects (Levitt 2005). Examples of regional mechanisms of this type are The David and Lucile Packard Foundation's Program Related Investment (PRI) program, as administered by the Resources Legacy Fund Foundation, and Pacific Forest Trust's *Conservation Capital Fund* in California.

Long-term success depends on the ability to foster cross-organizational collaboration, enable state legislation, and attract new funding. The region will need representatives to advocate for laws that enhance the incentives and increase transaction efficiencies. Credible scientific criteria must be monitored when adjusting incentive design and conservation investment/benefit trade-offs. Emerging types of transaction activities such as ethanol production and trade in ecosystem services require time and investment. For example, several watersheds in the study are critical for supplying drinking and irrigation water to central California communities, but there is no system of determining how much each land parcel or network of parcels contributes to this service or how to create equitable payments for these services (Chan et al. 2006).

Summary of Landowner Incentives and Funding Mechanisms

Past conservation work in the Sierra Checkerboard Initiative study area has been accomplished largely through land acquisition and transfer to public ownership. These projects have been important for the region, and acquisition for conservation will continue to be a key component for landscape protection. Additional tools are available to expand conservation activities on private lands in the north-central Sierra. These include the sale of different property rights, contractual restrictions, trade in ecosystem services, cost-sharing for restoration, and compensation for sustainable business practices. There are also many ways to fund landowner incentives, including mechanisms that attract private capital, create federal and state tax relief, and provide sources of public funding.

Some tools, such as WFCEs, are likely to receive widespread consideration, while others, such as community insurance programs, are relevant for only a small percentage of properties and landowners. Some landscape objectives, such as reducing risks of catastrophic fires, can be incorporated in a variety of tools, while others, such as protection of rare habitats, need very definitive restriction of land uses. Some incentive programs are readily available, while others need further development or enabling legislation. A key part of this implementation strategy is collaborative work with other organizations and agencies to facilitate landowner access to funding, relevant tools, and any required expertise or bridge financing. Legislation that enhances landowner incentives, supports adequate monitoring, and improves design of emerging transaction concepts should be developed to facilitate use of these conservation tools.

TPL's Sierra Checkerboard Initiative implementation strategy proposes to encompass a broad array of these incentives and funding mechanisms. Our objective is to maximize the opportunity for success of the Initiative by utilizing a comprehensive, voluntary approach that will attract more landowners, sustain economics of working landscapes, and achieve protection with more efficient use of available funding.

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4. SUMMARY

The legacy of the checkerboard ownership pattern in the north-central Sierra Nevada is not only inefficient and uncoordinated management across one of the most spectacular ecological regions of the world, but an elevated threat to natural resources of the Sierra from expanding private land subdivision and development and associated problems such as loss of watershed integrity, removal of carbon-sequestering forest cover, changing climates, increased fire risk, and nonnative species invasions. TPL and its partners wish to address these threats by working with governmental agencies and private landowners to create a more sustainable landscape in the north-central Sierra. TPL's conservation vision—the Sierra Checkerboard Initiative—seeks to address resource and development issues at a scale not previously undertaken. Unless such a vision is implemented soon, the majesty of this critical portion of the Sierra Nevada may be irrevocably lost.

The Sierra Checkerboard Initiative has been developed and implemented in three phases. In Phase I, the scientific foundations of the Initiative were laid in the Science Assessment. In Phase II, the conservation planning phase, portions of the study area that support high priority lands, or *resource areas*, were identified by considering their contributions to several of TPL's priority conservation themes: river corridors, upper watersheds, mature forests, and recreational and visual resources. Desired future conditions have also been described for the resource areas, 17 in all, to ensure that conservation objectives within individual conservation themes are realized. A consequence of identifying priority conservation themes and selecting resource areas for the Initiative was the emphasis on private lands and working forests as critical to securing the conservation values of the Sierra. Thus, the conservation plan describes a variety of potential landowner incentives and funding mechanisms.

In Phase III, TPL will use the information, objectives, and strategies developed in previous phases of the Initiative to implement conservation actions in the study area. While these conservation actions will be guided by the Science Assessment and Conservation Plan, they must be developed on a site-specific basis. Potential partners and implementation strategies are shown for each of the 17 resource areas in Table 8. Only by working with its partners, supporters, and willing landowners in the region can TPL successfully implement the vision of the Sierra Checkerboard Initiative to create a sustainable future for the Range of Light.

Table 8. Potential strategies and partners for Sierra Checkerboard Initiative resource areas.

Resource Area	Potential Partners (Partial List)*	Focus (Near, Medium, or Long Term)	Potential Strategies
North Yuba River	2, 3, 4, 5, 6, 7, 9, 13, 14, 15, 16, 17, 18, 21, 25, 26	Medium	Much of this land is currently checkerboard between USFS-Tahoe NF and Sierra Pacific Industries (SPI). Work with SPI to determine appropriate management policies that can ensure water protection and protection against exurban development.
Middle Yuba River	2, 3, 4, 5, 6, 7, 9, 13, 15, 16, 17, 18, 19, 21, 25, 26	Near	Work with SPI and other private landowners to acquire and/or establish management agreements and conservation easements to create an unbroken protected river corridor.
South Yuba River	2, 3, 4, 5, 6, 7, 9, 13, 15, 16, 17, 18, 19, 21, 25, 26	Near	Work with private landowners to acquire and/or establish management agreements and conservation easements to create an unbroken protected river corridor.
Middle Fork American River	1, 2, 3, 4, 7, 10, 11, 12, 13, 15, 16, 17, 18, 22, 23, 25, 30	Medium	Build on the work that TPL has done with SPI and USFS to create an unbroken protected river corridor. Work with Pacific Forest Trust (PFT) and others to determine appropriate working forest conservation easement (WFCE) language for lands south of the river. Reach out to recreation providers (e.g., rafting companies) to get a sense of what is possible and probable from a conservation perspective.
Rubicon River	2, 3, 4, 5, 7, 8, 12, 13, 15, 16, 17, 18, 24, 25	Long	Build on the work that TPL has done with SPI and USFS to create an unbroken protected river corridor. Work with Pacific Forest Trust and others to determine appropriate WFCE language for priority lands adjacent to river corridor. Reach out to recreation providers (e.g., rafting companies) to get a sense of what is possible and probable from a conservation perspective.
North Fork American River Watershed	1, 2, 3, 4, 7, 9, 10, 11, 12, 13, 15, 16, 17, 18, 21, 22, 23, 25	Near	Endorse the Research Agreement between North Fork Association (The Cedars), USFS, University of California, and Chickering Partnership and use it as a template for other conservation work in the Sierra. Add lands and/or easements contiguous to this area. Introduce new lands to this agreement where appropriate. Build constituent base that can help with larger vision for Sierra.
Upper Middle Fork American River Watershed	1, 2, 3, 4, 7, 10, 11, 12, 13, 15, 16, 17, 18, 22, 23, 25, 30	Medium	Approach landowners to fill in the checkerboard and finish protecting this watershed. Gain a deeper understanding of who key stakeholders are for this area. Work with Consumnes, American, Bear, Yuba (CABY) Integrated Regional Water Management Project and other water agencies to determine appropriate strategies.
Crystal Basin	2, 7, 8, 13, 15, 16, 17, 18, 24	Long	Work with Eldorado NF and private landowners to consolidate holdings and protect viewshed. Monitor situation with off-highway vehicles to protect conservation values.

Resource Area	Potential Partners (Partial List)*	Focus (Near, Medium, or Long Term)	Potential Strategies
Fordyce Creek Watershed	2, 3, 4, 7, 9, 13,15, 16, 17, 18, 25, 28	Medium	Work with landowners and partners to create an integrated ownership/management regime, particularly between Castle Peak and Grouse Lakes Proposed Wilderness Areas
Little Truckee River Watershed	2, 3, 4, 5, 6, 7, 9, 13, 14, 15, 16, 17, 18, 21, 22, 25, 26	Near	Work with private landowners to acquire parcels in or near Perazzo Meadows to ensure protection of willow flycatcher habitat. Assist Truckee Donner Land Trust (TDLT), The Nature Conservancy (TNC) and others working in this region to obtain federal, state, and local grant funds to add to the $2MM already awarded by State Water Resources Control Board for protection in this watershed.
Yuba River Mature Forest	2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 25, 26	Medium	This area contains some very high resource values, but it tends to be highly parcelized. Research these parcels to determine whether ownership is more consolidated that it appears. If there is consolidation, begin to approach landowners to determine their willingness to sell or place easements on their property. Work with PFT and others to determine appropriate WFCE language. Engage current private landowners with this concept.
American River Mature Forest	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 24, 25, 26	Long	This area has some remote regions that are probably best served via a WFCE. Work with PFT, current industrial timber owners, and others to create a WFCE and/or management agreements that obtain as much conservation value as possible.
North Crest Mature Forest	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 25, 26, 27, 28	Near	Most of this land is currently checkerboarded between USFS-Tahoe NF and SPI. Work with SPI to determine appropriate acquisition, easement and/or management policies to ensure fire protection and protection against exurban development, improved mature forest structure and values, and to provide for habitat adaptation to climate change.
South Crest Mature Forest	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 20, 21, 22, 24, 25	Medium	Build on history and track record in this area to accomplish protection of both forests and streams. Much of the land is at high elevation and is poor for timber harvesting, but is threatened by exurban development in places. Given this fact, as well as the proximity to both Granite Chief Wilderness, Desolation Wilderness, and numerous inventoried roadless areas, this area is more suitable for public ownership, probably by USFS. Work with USFS to determine their priorities and funding capabilities.

Resource Area	Potential Partners (Partial List)*	Focus (Near, Medium, or Long Term)	Potential Strategies
Pacific Crest Trail Corridor	All	Near	Ultimate objective is public ownership for the land the trail traverses as well as a good viewshed buffer on both sides of the trail. Work with USFS to create unbroken corridor and protect as much viewshed as possible via conservation easements and agreements with landowners and USFS. The Pacific Crest Trail Association is an excellent source of information, guidance, and collaboration.
Eldorado National Forest Recreation and Scenic Priorities	24	Long	Work with Eldorado NF and private landowners to acquire key recreation holdings and protect viewsheds. Land exchange possible.
Tahoe National Forest Recreation and Scenic Priorities	25	Medium	Work with Tahoe NF and private landowners to acquire key recreation holdings and protect viewsheds. Land exchange possible, but not likely.

***Potential Partner Agencies/Organizations**

1 American River Conservancy (ARC)
2 Audubon Society
3 CA Department of Fish & Game
4 CA Resources Agency
5 CA State Parks
6 Caltrans
7 CABY Integrated Regional Water Management Project
8 El Dorado County
9 Nevada County
10 North Fork Association
11 Pacific Forest Trust (PFT)
12 Placer County
13 Sierra Business Council (SBC)
14 Sierra County
15 Sierra Forest Legacy
16 Sierra Fund
17 Sierra Nevada Alliance
18 Sierra Nevada Conservancy (SNC)
19 South Yuba River Citizens League (SYRCL)
20 The Conservation Fund
21 The Nature Conservancy (TNC)
22 Truckee Donner Land Trust (TDLT)
23 UC Board of Regents
24 USFS-Eldorado National Forest
25 USFS-Tahoe National Forest
26 Yuba County
27 Feather River Land Trust
28 The Wilderness Society
29 Pacific Crest Trail Association
30 Western States Trail Association

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APPENDIX A
PHASE II OBJECTIVES AND APPROACH

1.0 INTRODUCTION

The overall objective for Phase II of the Sierra Checkerboard Initiative is to develop a *Conservation Plan* that accomplishes the regional conservation goals of the Initiative. This entailed identifying focal areas within the 1.5 million-acre study area targeted for conservation and management of specific resource values necessary to achieve these goals. We envisioned these focal areas to consist of a network of lands comprised of wilderness and other highly protected areas, public lands providing important natural resource functions and public recreational opportunities, and working lands with management regimes compatible with conservation objectives.

Our technical approach included identifying contiguous land areas whose resource values and land management objectives complement other existing and proposed protected areas in the study area. An efficient landscape configuration will facilitate accomplishing specific management objectives in specific areas by minimizing habitat fragmentation, avoiding existing developed areas, and capturing areas supporting high value natural resources targeted by the Initiative. We used the Phase I Science Assessment resource value results from the Ecosystem Management Decision Support (EMDS) System model (White et al. 2005) as quantitative metrics in constructing a landscape-scale configuration of land units protected and managed to achieve the objectives of the Sierra Checkerboard Initiative. EMDS produced rankings of resource values, as defined by various spatially explicit physical and biological characteristics for each section of land within the study area, within a knowledge-based logic model. While EMDS assessed values for every *section of land* independently of adjacent sections, in Phase II we identified a *network of land* that achieves our conservation goals.

To objectively select sections of land within a target landscape configuration or *portfolio*, we used a reserve design algorithm—the Spatial Portfolio Optimization Tool (SPOT) developed by The Nature Conservancy (TNC 2003). SPOT uses resource value data generated from the EMDS logic model and other inputs to derive conservation portfolios within an ArcView 3.x GIS platform. In each run, SPOT forms and analyzes millions of conservation portfolios, while searching for the most efficient portfolio. The most efficient portfolio is one that meets the conservation goals established by the user with: (1) the minimum area, (2) least fragmentation (as measured by the perimeter of the portfolio), and (3) lowest cost (as measured by the amount of development in the portfolio).

2.0 TECHNICAL APPROACH

2.1 Conservation Goals

SPOT uses conservation goals to determine how much of each conservation target should be included in a portfolio. For this study, conservation targets were major resource value categories from the EMDS logic model created in the Science Assessment (i.e., biodiversity value, mature forest connectivity value, and passive recreation value), the Pacific Crest Trail (PCT) corridor, and roadless areas mapped during Phase I of the Sierra Checkerboard Initiative. For the SPOT analysis, conservation goals were defined as percentages of the total area of the sections of land with the highest EMDS scores (i.e., those falling within the High and Very High categories in the Science Assessment), total length of the PCT, and total roadless area within the study area. Thus, SPOT used these goals to develop portfolios that would include the targeted percentage of sections of land supporting each resource value in the most efficient configuration.

The conservation targets and their goals used in the selected SPOT run for the study area are:

- Pacific Crest Trail—100% of trail length.
- EMDS Biodiversity Value results—75% of the total area of sections ranked Very High and High.
- EMDS Mature Forest Connectivity results—75% of the total area of sections ranked Very High and High.
- EMDS Passive Recreation Value results—75% of the total area of sections ranked Very High and High.
- Existing roadless areas—50% of the total area of calculated roadless areas.

2.2 SPOT Parameters

SPOT considers the suitability of specific sections of land for inclusion in the conservation portfolio by evaluating their cost, which is often not expressed in monetary terms but as compatibility with conservation objectives. For the purposes of this analysis, costs for the SPOT runs were created using the California Fire and Resource Protection (FRAP) *development footprint* data set, referred to as FRAP_DEVELOP in the Sierra Checkerboard Initiative Science Assessment metadata catalog (http://www.consbio.org/sierra_checkerboard/annotated_data.htm). Measures of development used by FRAP included 2000 census block data for housing, 2000 land ownership data for identifying uninhabited public lands, 1990s USGS National Landcover Data, and 2000 Census Urbanized Area data. FRAP used 30 m x 30 m cells in the analysis, with each cell assigned a combined development score ranging from 1 (*not developed*) to 10 (v*ery highly developed*). The cost surface used in the SPOT analysis was calculated as an area-weighted average development score for each section, which ranged from 1.00 to 7.76 in the study area. SPOT portfolios that include sections of land with greater development footprint areas are more costly (i.e., have lower potential of being compatible with conservation objectives) than

portfolios with sections of land with lower development footprint areas and, thus, are selected only as necessary to meet conservation goals.

SPOT also includes an analysis of spatial fragmentation of a conservation portfolio. The amount of fragmentation is calculated using the total perimeter length around each non-contiguous group of selected analysis units (i.e., sections of land in this analysis). The total perimeter can also be modified in SPOT with a factor called the *boundary length modifier*. The boundary length modifier is used to scale the boundary length and can be an indicator of relative fragmentation in a conservation portfolio. The boundary length modifier also has an effect on the spatial arrangement of the optimal conservation portfolio. For example, a boundary length modifier of 0 means that SPOT will select analysis units with no regard to fragmentation, while a boundary length modifier with a greater value will result in a more compact arrangement of analysis units since SPOT is trying to minimize perimeter length. In the SPOT run selected for the preliminary conservation plan, we used a boundary length modifier = 2.

2.3 SPOT Portfolio

We conducted a series of SPOT runs varying conservation targets and goals and other SPOT parameters. We forced SPOT to include existing protected areas (i.e., wilderness areas, special management areas, and USFS inventoried roadless areas) within the study area in each portfolio. Thus, the portfolio selected by SPOT included the 75% of the highest value sections of land from the Science Assessment, 100% of the PCT corridor, and 50% of the roadless areas within a network that is anchored by existing protected areas within the study area. The final SPOT portfolio that we considered in the preliminary conservation plan totaled approximately 679,000 acres of the study area, of which 500,000 acres were public land.

2.4 Stakeholder Review and Input

The preliminary conservation plan was the starting point for developing the Initiative's Conservation Plan where applications of various implementation tools on private land, such as fee title acquisition, conservation easements, and management agreements would be considered to achieve geographically specific conservation objectives. The preliminary conservation plan for the Sierra Checkerboard Initiative was refined by consulting with various governmental and non-governmental stakeholders in the study area. The purpose of these discussions was to obtain finer scale information on resource conditions and threats, as well as the priorities of these entities, that would help to inform the development of TPL's Conservation Plan. From these meetings, we obtained information on important areas that may not have been captured by our quantitative analyses. Priority areas that were identified by these organizations often overlapped with areas identified by our analyses, but in areas that they did not, they were considered for inclusion in the final Sierra Checkerboard Conservation Plan.

(Left) The June, 2007 Angora fire devastated areas in South Lake Tahoe; (right) former U.S. Forest Service Ranger Rich Johnson on the North Fork of the American River. Left image by Cathleen Allison/Nevada Appeal and right image by Phil Schermeister.

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THE TRUST for PUBLIC LAND
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Founded in 1972, the Trust for Public Land (TPL) is a national nonprofit organization that conserves land for people to enjoy as parks, gardens, and other natural places, ensuring livable communities for generations to come.

TPL's experienced staff use real estate and fundraising expertise to help local communities and government agencies protect lands of scenic, recreational, and ecological significance.

To date, TPL has acquired and protected more land in the Sierra Nevada than any other nonprofit organization— more than 135,000 acres, with a fair market value of more than $80 million. In the process, TPL has developed strong relationships and credibility with public agencies, major landowners, and local conservation groups. For more information about The Trust for Public Land and our work in the Sierra Nevada, please visit our web site at www.tpl.org/california.

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