Chapter 3 – Affected Environment and Environmental Consequences

3.1. Introduction

This chapter describes current conditions and trends in the Plan area and analyzes the environmental consequences expected to result from adopting a plan based on one of the action alternatives (Alternative B, C or D), or taking no action (Alternative A). Each of the national forest activities and uses likely to have an effect on a given resource is discussed in general terms. Together, these descriptions form the scientific and analytical basis for the comparison of effects table found at the end of Chapter 2.

It is important to keep in mind that this Environmental Impact Statement is programmatic in nature and discusses only the general types of effects that may occur during plan implementation. The environmental effects of specific actions or activities are not discussed. Future project-specific environmental analysis will disclose the specific effects of each project or activity. Analysis of site-specific variables is beyond the scope of this programmatic EIS.

3.2. Organization of the Analysis

The description of the affected environment and the analysis of direct and indirect effects are organized into sections based on the major resource areas in the Draft Plan. The resource areas included in this analysis are:

Access & Travel Management, Air Quality, Aquatic Wildlife: Habitat and Species, Botanical Resources, Built Environment, Climate Change, Economics, Fire and Fuels, Forest Vegetation, Heritage Resources & Tribal Relations, Interpretive Services & Conservation Education, Lands Special Uses, Natural Hazards, Noise, Recreation, Scenic Quality, Terrestrial Wildlife: Habitat and Species, Water Quality and Soil Erosion, Water Quantity, Watershed Condition, Soil Resources, and Wilderness,

This chapter provides a summary analysis for each of these resource areas. In some instances there is a specialist report prepared for a resource which includes a complete analysis. Specialist reports are available in the project record. Cumulative effects for all resources are discussed in Section 3.5 of this chapter.

The analysis for each resource in Section 3.4 includes the following:

3.2.1. Introduction and Scope of the Analysis

The resource is introduced, the temporal and spatial boundaries of the analysis are set, and the rationale for choosing the boundaries is presented. For most resources, the time period for the analysis is the 10-15 years the Plan is expected to be in effect, but a longer time period is considered for some resources. The spatial boundary, or area of consideration, describes the area where the effects would occur, and varies with the resource.

3.2.2. Methodology

This section includes the indicators of effect plus brief descriptions of any models or other analysis tools that were used. The indicators of effect are the descriptions of the metrics used to illustrate the differences between alternatives. They provide the basis for the analysis of environmental consequences and for describing the differences between alternatives. They may be qualitative, quantitative or a mixture of both, depending on the resource.

3.2.3. Assumptions

This section lists assumptions specific to the analysis for each resource. For resources with no specific assumptions, this section is omitted. Assumptions common to all resources are listed below in Section 3.3.

3.2.4. Overview of the Affected Environment

This section provides a summary description of the existing conditions or status of the resource, focusing on aspects with the potential to be affected by implementation of the alternatives. Current trends are described where applicable.

3.2.5. Environmental Consequences

The direct and indirect environmental consequences to the resource are analyzed here. Each of the general types of national forest activities and uses likely to have an effect on the resource is discussed in terms of the indicators identified for that resource (see Chapter 2, Table 2.3 for a list of indicators by resource).

In some sections the environmental consequences are organized by activity area with a discussion of all alternatives grouped under the activity area subheading. In other sections the environmental consequences are organized by activity area and then further broken down by alternative.

To clarify the differences among alternatives, the consequences of actions are analyzed assuming full implementation of each of the alternatives. However, due to budgetary and other constraints

not known at this time, it is very possible that not all the actions described in a given alternative would be implemented.

In addition to the actions described in Chapter 2, the analysis of the No Action alternative (Alternative A) includes the consequences of ongoing activities and uses, providing a basis for comparison with the action alternatives (Alternatives B, C, and D). Ongoing activities and uses are the day to day management activities and uses of NFS lands that occur apart from specific project work. They include things like the use and maintenance of picnic areas and facilities, and are listed in Table 3-1.

3.2.6. Analytical Conclusions

This section is included to provide a brief summary of the analysis and to clarify the conclusions of the environmental effects analysis for each resource. This section presents whether or not there are significant environmental impacts.

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Table 3-1. Ongoing Activities and Uses

Activities & Uses*	Potential Actions	Unit of Measure	Quantity	Map
Recreation:				
Dispersed Recreation (Summer)	Non-motorized: Picnicking, dispersed camping, mountain biking, cross-country hiking, rock climbing, hunting, fishing, wildlife, plant and fish viewing (i.e., bird watching), barbequing, beach play, and water play. Motorized: Pleasure driving, off highway vehicle (OHV) use (e.g., quads, dirt bikes).	visits/activity/year & acres available	154,830	
Dispersed Recreation (Winter)	Non-motorized: Cross-country skiing, snowshoeing, back-country skiing, snow play, sledding, snow camping.	visits/activity/year & acres available	154,830	
Over Snow Vehicle Travel (dispersed in open areas, non-guided)	Snowmobiling	acres available	74,671	X [1]
[1] See Snowmobile Guide				
Developed Recreation: Public and Private				
Resorts and Lodges	Initial Site Construction (Grading of sites for campsites and parking spurs) Clearing of vegetation (Tree removal) Asphalt and concrete installation (non-permeable surfaces such as roads, parking lots and structures. Trenching for utilities, site maintenance and cleaning of structures and other improvements, Adding additions to the structures. Adding additional structures, roadways, landscaping, water diversions and wells, and septic systems.	number/acres	7	X
Campgrounds	Campground expansion: Initial site construction (Grading of sites for roads, campsites and parking spurs) Clearing of vegetation (Tree removal) Asphalt and concrete installation (non-permeable surfaces such as roads, parking lots, and structures. Trenching for utilities, site maintenance and cleaning visitor uses such as: camping, campfires, lights, picnicking, hiking and biking around developed sites, noise, pets, collecting rocks, plants and creatures.	Sites/ use numbers	9/423	X

Activities & Uses*	Potential Actions	Unit of Measure	Quantity	Map
Winter – Outfitter Guide	Snowmobiling, cross country skiing	miles of trails (CC)/ miles of trails (OSV)	35.7 and 7 Miles	X
Winter – Ski Areas Heavenly Homewood/ partial Diamond Peak/partial	Maintenance of cleared slopes (annual brushing, mowing, grubbing; removal of hazard trees); Erosion control activities (culverts, culvert maintenance, slope contouring, sediment basin installation/maintenance, water bar maintenance and installation); Snow-blowing (including generator operation); Grooming of snow-covered slopes (including operation of heavy equipment during the day and at night); Snow-making (including development/maintenance of water storage ponds and water diversions); Night lighting of slopes; Summer use activities (hiking, mountain biking events); Operation and maintenance of facilities on site (restaurants, ski lift towers/terminals, administrative offices, radio towers, etc.); back country gates allow access (cc skiing, downhill skiing, snowboarding, etc.) outside operational and permit boundaries.	number of facilities & acres	3/7,703	X
Winter – Snow Parks	Snow play, sledding, cross country skiing, snowshoeing, back country skiing, snowmobiling (functions as trailhead for snowmobiles).	Sites	2	
Recreation Residences	Recreation residence tracts generally consist of small privately owned cabins situated on National Forest System lands. They are often situated in or near riparian areas. Use of public land by the cabin owners is authorized by permit for up to 20 years. Cabins are intended for weekend, vacation, or seasonal recreation use but not for full time residency. Activities, other than occupancy, related to the cabin and surrounding lands that can occur include: maintenance of the structures and other improvements, adding additions to the structure, adding additional structures and roadways, landscaping, water diversions and wells, and septic systems.	number of residences	594	

Activities & Uses*	Potential Actions	Unit of Measure	Quantity	Map
Organization Camps	Organization camps are both under permit on National Forest System lands and on adjacent private lands. Organization camps concentrate use and impacts in a small area, similar to campgrounds. Camps are affiliated with YMCAs, scout groups, churches, colleges/universities, and other large organizations. A typical organization camp includes a number of facilities including cabins, platform tents, administrative offices, kitchen/dining building, bathrooms, parking areas, swimming pools, ball fields, buildings for activities (crafts, nature, etc.), stables for horses, a campfire ceremony amphitheater, archery/rifle ranges, tennis courts, hiking trails, horseback trails, mountain biking trails, water play areas. Camp capacities range from 70 to 300. Most operate seasonally, generally in summer. Year-round camps may accommodate conferences and meetings as well as family camping and employ a year-round on-site manager. Outdoor education programs for school groups also use organization camps on the national forests for their programs.	number of camps	4	
Outfitter and Guide Service (Non-winter)	Outfitter-guide activities are authorized by special-use permit. Limitations on activities that potentially damage or disrupt sensitive species and habitat areas are generally included as conditions for permit approval. Many outfitter-guides operate on existing trails or National Forest System roads. Activities involved under this category include jeep tours, horse pack trips (day trips or overnight camping); horseback rides (part or full day), guided fishing and hunting trips, orienteering, and guided mountain bike tours.			
Day Use Sites	Activities associated with the use, maintenance or construction of day use and other developed recreation sites (i.e., picnic areas, trail heads) includes: initial site construction, clearing of vegetation, grading of sites, asphalt and concrete installation (non-permeable surfaces); site maintenance and cleaning; visitor uses such as camping, BBQ's , lights, picnicking, fishing, water play, photography, playing of radios/music; pets; hiking and biking in and around the developed site.			
Infrastructure:				

Activities & Uses*	Potential Actions	Unit of Measure	Quantity	Map
Administrative Facilities	Meyers work center, SO, fire stations. Activities: parking/vehicle storage, general facilities maintenance and repairs (tree removal, general storage, landscaping), noise.	number of facilities	31	
Access & Travel Management: (see motor vehicle use guide)				
Level I Roads **Closed Road**	Maintenance activities are generally not required for level 1 road. These are administratively closed roads.	miles	30	X
Level II Roads High Clearance Vehicle Road	Maintenance activities would include use of heavy equipment to grade, clean drainages, replace culverts, replace bridges, and could include importing materials.	miles	148	X
Level III Roads Passenger Car Road Low User Comfort	Maintenance activities would include use of heavy equipment to grade, clean drainages, replace culverts, replace bridges, and could include importing materials.	miles	64	X
Level IV Roads Passenger Car Road Moderate User Comfort	Maintenance activities would include use of heavy equipment to grade, clean drainages, replace culverts, replace bridges, and repaving or resurfacing.	miles	20	X
Level V Roads Passenger Car Road High User Comfort	Maintenance activities would include use of heavy equipment to grade, clean drainages, replace culverts, replace bridges, and repaving or resurfacing. This is the highest maintenance level for NFSR roads. The LTBMU does not have any of this maintenance level on the forest.	miles	0	X
Motorized Use of Roads	Open to motor vehicles	miles	115	
Trails				

Activities & Uses*	Potential Actions	Unit of Measure	Quantity	Map
Motorized Use of Trails	Maintenance activities would include primarily be accomplished with hand crews and could include use of motorized borrows, mini excavators or comparable equipment.	miles	15	X
Mechanized Use of Trails	Maintenance activities would include primarily be accomplished with hand crews and could include use of motorized borrows, mini excavators or comparable equipment.	miles	217	X
Non-motorized, Non-mechanized Trails	Maintenance activities would include primarily be accomplished with hand crews and could include use of motorized borrows, mini excavators or comparable equipment.	miles	92	X
Permitted Uses – Lands				
Communication Sites	Ongoing maintenance with vehicle access, vegetation clearing. Fencing around facilities.	number of sites	8	X
Utilities	Trenches for underground utilities, vegetation clearing for overhead lines, vehicular access for maintenance and inspection of overhead lines, digging of wells, diversion of springs, water storage, fencing.	authorizations	8	
Urban Stormwater Treatment	Soil removal and vegetation clearing for new basins and other structures, alteration of natural water flows, fencing.	authorizations	30	
Community Use and Public Information	Ongoing maintenance with vehicle access, vegetation clearing. Fencing around facilities.	Authorizations	5	
Production Livestock Grazing	Fence installation, salting, herding, upland water source development, spring development, water drafting, hazard tree cutting.	authorizations	0	
Research and Monitoring	Digging of monitoring wells, vehicular access during installation of equipment.	authorizations	9	
Permitted Temporary Activities	Artificial lighting (temporary during filming), noise from participants and spectators, temporary fencing	authorizations (average per year)	5	

* Definitions of suitable uses and management activities are located in Draft Forest Plan, Part 2. Strategies.

3.3. Assumptions Common to All Alternatives

The relationship between possible future actions and their consequences is not always known or quantifiable, especially in a programmatic analysis such as this one. A set of assumptions is used to reduce the unknowns in this analysis. Assumptions common to all resources and alternatives are listed below; assumptions specific to a given resource are listed in the effects section for the resource.

- Alternatives are implemented in compliance with all
    - Forest Plan Standards and Guidelines,
    - Best Management Practices (BMP's),
    - Policies (FSH FSM, others),
    - Regulations
    - Laws
- The above will be followed and will be effective.
- The timeframe is within the next 15 years (planning horizon established by NFMA for Forest Plans). Other timeframes may be analyzed depending on the resource for example vegetation modeling, climate change.
- Site specific activities would only be conducted after appropriate project level NEPA analysis, as required.
- Wilderness recommendations in Alternatives C and D are assumed to have been adopted by Congress for this analysis.
- Best available science would be used to inform management decisions.
- Budget –
    - Appropriated funding will remain constant or decrease, consistent with historic trends.
    - SNPLMA funding will decrease and will likely be fully expended by the end of the planning period.
- Climate Change –Assumptions regarding climate change are described in detail in Appendix D – Climate Change.
- Demographics –
    - Visitation is expected to follow US census population trends. Based on this assumption, visitation is expected to grow 1.4% annually or 21% in the next 15 years.

In addition to the above assumptions, this analysis assumes that projects in the planning or implementation stage or which have guaranteed funding would be implemented as described in the project documentation, regardless of which alternative is chosen. Current projects and commitments under the Environmental Improvement Program (EIP) would continue until completed. Projects for which funding has been approved under the Southern Nevada Public

Lands Management Act (SNPLMA) would be implemented as proposed, and any projects specifically funded by the Lake Tahoe Restoration Act (LTRA) would be implemented.

Projects would be planned and implemented as described, even if some aspects of the project conflict with one or more elements of the chosen alternative. All projects proposed after the Revised Forest Plan would be designed to be consistent with the Forest Plan unless a site specific Forest Plan Amendment is approved.

3.4. Affected Environment and Environmental Consequences by Resource Area

3.4.1. Access and Travel Management

3.4.1.1. Introduction

This section evaluates and discloses the potential environmental consequences from Alternatives A, B, C and D on access and travel management.

Effects on access and travel management to National Forest System lands from changes to the road, trail, and parking facilities as well as delineation of access as it pertains to various vehicle types and season is detailed within the section.

Methodology

The methodology used started with identification of the primary differences between alternatives that affect access and travel management. Analysis questions were developed to target the key differences between alternatives. Indicators were developed to quantify differences between alternatives and reflect trends. Indicators provide a best estimate but are not exact. This is a broad overview of access and travel management needs, and it is expected that these needs will change based upon site specific conditions. Both the analysis questions and indicators are listed below.

Analysis Questions

This analysis will answer:

1. How access is affected by designation of new wilderness.
2. How uses are predicted to shift as a result of the alternatives.
3. How the alternatives address the need for change.
4. How other program direction would affect access to NFS lands.

Indicators

1. **Indicator 1** - Miles Roads Open to Passenger Vehicles
2. **Indicator 2** - Miles roads Open to High-clearance Vehicles
3. **Indicator 3** - Miles Road Open to OHV
4. **Indicator 4** - Miles Trails Open to Motorized Use
5. **Indicator 5** - Miles Non-motorized, non-mechanized trails
6. **Indicator 6** - Miles of mountain bike design trails
7. **Indicator 7** - Transit Use to Access NF Lands
8. **Indicator 8** - vehicle parking capacity/managed parking volume
9. **Indicator 9** - Dispersed winter parking capacity

Assumptions

In the analysis for this resource, the following assumptions have been made:

1. Existing unauthorized roads or trails would be added to the system or closed and ecologically restored.
2. Existing unauthorized roads provide needed access such as utility easements that are included under special use permits and would be added to the managed road system in the future.
3. Opportunities for aquatic organism passage will be prioritized inventorying all stream crossings and identifying the crossings that have the greatest impact for aquatic organism passage.
4. Opportunities for best management practices will be identified and prioritized for funding, analysis and implementation.
5. Changes to road maintenance levels would affect surface conditions and best management practices would be maintained regardless of changes to maintenance levels.
6. Roads and trails will be relocated out of sensitive areas where possible.
7. Existing parking area capacities are estimated using counts from specific areas and projecting the use across the LTBMU.

Roads

The transportation goal outlined in the 1988 Forest Plan seeks to improve water quality by applying BMPs to forest roads and the decommissioning of surplus roads. In addition the Forest Plan provides for the participation in a robust effort to encourage public transit to and from recreation sites and activities, bicycle and pedestrian improvements for recreation use, converting roads to trails, and raising employee awareness. The Access and Travel Management Plan identifies a specific road system and sets a general standard for place based planning.

Current Conditions and Trends - Roads

The majority of the managed road system has been improved with additional BMP's as a result of the Road Access and Travel Management Plan (ATM) that was completed in 1999. The Road ATM focused on water quality and the need for roads. A water quality risk assessment was completed before and after the road work; results are discussed in the Water Quality section of this document. The Road ATM inventoried, assessed, prioritized and implemented road projects for capital improvements and maintenance. The LTBMU was divided into 12 "Transportationsheds" for NEPA analysis, budgeting, and implementation.

Beginning in 2001, one or two transportationsheds were analyzed each year until the ATM was complete. Improvements on roads were designed to meet Forest Service, state and local standards for the protection of the clarity of Lake Tahoe and other forest resources. Actions from the Road ATM include:

- 271 miles of road were retrofitted to meet current BMP standards.
- 80 miles were decommissioned
- miles were rerouted
- 12 miles were converted to trails

The existing road system and forest plan direction is relevant today. While the Road ATM has been completed, there are issues that are unresolved, including utility access and private land access.

Increased coordination with TRPA as the Tahoe Metropolitan Planning Organization (TMPO) to develop and manage transit and increase non-auto mode share is expected.

The ATM process is ongoing and dynamic. In the future the Travel Analysis Process (TAP) will establish a minimum road system by analyzing access needs versus resource impacts. The TAP will replace the Road Analysis Process which was very similar except that the TAP also includes maintenance level 1 and 2 roads. The ATM process has followed a similar process for analyzing needs versus resource impacts and the current LTBMU road system is anticipated to closely reflect the minimum road system.

Performance Measures - Roads

- Miles of road constructed/reconstructed
- Miles of road meeting standards
- Total miles of roads per maintenance levels (see Table 3-2)
- Miles of road decommissioned
- Percent non-auto mode share to rec. sites.

Table 3-2. LTBMU Road System description, by Maintenance Level

Maintenance Level	ML1	ML2	ML3	ML4	ML5
User Comfort	Closed to motor vehicle access	High Clearance Vehicles	Low User Comfort	Moderate Degree User Comfort	High Degree User Comfort
Lanes	NA	1	1-2	2-1	2
Surface Type	NA	Native	Aggregate or Native	Paved or Aggregate	Paved or Chip Seal

Major Changes Since 1988 - Roads

Funded through Presidential Deliverables, beginning in 1997, the completion of the ATM provides the LTBMU with clear direction of access needs on NFS lands. Public transit was in early stages of development around the basin in 1988, during the previous forest plan. Today much of the basin is serviced by public transit. Demand, political willpower and changes in expectations are anticipated to fuel more efficient and higher capability public transit in the future. Many planning efforts have taken place that explore the greatest potential for public transit development and key infrastructure such as bus turnouts, transit shelters, bike lanes, sidewalks and bike paths are being added to communities to enable convenient and safe transit opportunities. The Forest, through SNPLMA, is funding public transit to recreation sites around the lake. This gives the existing public transit agencies the ability to provide this much needed service.

While dispersed camping is limited to designated areas, SUV touring is on the rise, and OHV use has increased dramatically since 1988. The overall result is an increased demand on forest roads within the basin. As roads become more heavily used, maintenance frequency and maintenance standards may also need to increase for protection of forest resources. Roads that provide challenge for OHV's may be reduced overall, but developed to a higher standard to meet recreation needs while protecting forest resources.

3.4.1.2. Overview of the Affected Environment

Trails and Trailheads

Status of 1988 Forest Plan Desired Future Condition and Objectives

The Forest Plan describes the Desired Future Condition for trails while Trail ATM Plans identify specific trail systems. The role of the Forest Plan for trails is to set general standards and to provide the setting for place based planning. The role of a Trail ATM is to identify, prioritize, and implement site-specific trail improvement projects.

Current Conditions and Trends - Trails

The amount of use and overall use has changed substantially since the 1988 Forest Plan was published. Mountain biking has become a very popular form of recreation that has changed management needs. User conflicts, trail maintenance and trail design are key issues. OHV use has experienced 274% growth from 1993 to 2003 according to the Off Highway Vehicle Recreation in the United States, Regions and States, June 2005. Trail use by hikers is expected to continue to increase. Equestrian use in the basin remains relatively constant, but that could change with improved trailhead access. Opportunities were identified in the existing plan to create loops and adopt approximately 78 miles of existing unmanaged trails into the managed trail system and approximately 40 miles of trails have been adopted and upgraded to meet standards to date.

In 2001 the Trail ATM Planning process was initiated to assess the condition of the existing trail system and prioritize upgrades for analysis, budgeting, and implementation. Specifically, the ATM process has resulted in many unauthorized trails being obliterated, adopted and/or rerouted. Additionally, system trails are being redesigned to meet Forest Service Standards defined by the Trail Management Handbook and Standard Specifications for Construction.

National OHV Route Designation requirements have changed the way the LTBMU manages OHV's, but not to the extent on other forests. The Forest Plan will only change in the reference to the new OHV plan. The LTBMU has managed the OHV system as a designated system since the 1976 ORV Plan was completed. Additionally, the ATM planning process has addressed user created routes and decommissioned or upgraded those routes. The LTBMU will continue to manage the OHV system as a designated route system.

Performance Measures - Trails

- Miles of trail constructed/reconstructed
- Miles of trail meeting standards
- Total miles of trail per trail class, including OHV designated routes. (see Table 3-3)
- Percent of trails signed

Table 3-3. Trail Classes and Attributes

Trail Attributes	Trail Class 1	Trail Class 2	Trail Class 3	Trail Class 4	Trail Class 5
Elements	Minimum structures, no bridges	Limited structures, bridges for resource protection	Structures may be common, bridges for resource protection	Frequent structures, Bridges for resource protection and user convenience	Frequent structures, imported material, bridges, boardwalks, handrails and amenities.
Signs	Route signing at junctions.	Route signing at junctions, interpretive signing not common.	Route signing as needed. Interpretive signing may be present.	Route signing for reassurance. Interpretive signing may be common.	Route signing for reassurance. Interpretive signs common.
Rec. Environment	Primitive to roaded natural	Primitive to roaded natural	Primitive to roaded natural	Primitive to rural	Roaded Natural to Urban
Tread	Native, intermittent	Native, continuous, rough	Native or imported, obvious	Native or imported, wide, smooth	Hardened, wide, smooth
Obstacles	Common	May be common	May be common but not substantial	Infrequent	Not present

Current Conditions and Trends – Trailheads

The existing Forest Plan calls for improving trailheads to provide dispersed recreation opportunities outside of Desolation Wilderness. Most trails do not currently have planned trailheads or parking areas and many have native surface, user created parking. There have been strides to improve trailheads and many more opportunities for dispersed use trailheads exist. Where roadside parking is allowed there are dispersed use opportunities, however, roadside parking causes other problems such as congestion and erosion of road shoulders. Further, roadside parking areas tend to grow if barriers are not installed. Lastly, most roadside parking opportunities are not available during the winter season for dispersed use.

The Trail ATM does address summer needs for dispersed trailheads and Best Management Practices upgrades. The Trail ATM does not address winter trailhead needs or problems. There are many areas that are not accessible even after snow removal has been completed depending upon county ordinances for winter parking. Specifically many county snow removal and winter parking ordinances do not allow for roadside parking when snow is present which has eliminated many winter dispersed recreation opportunities such as backcountry skiing, snowshoeing, and snowmobiling. A Winter ATM is needed to address these issues, this planning and work may be combined with the 2nd phase of the Road ATM.

Performance Measures – Trailheads

- Percent of trails with planned parking/trailheads
- Percent trailheads meeting BMP standards
- Percent trailheads with informative signage
- Number of plowed winter access locations by user type

3.4.1.3. Environmental Consequences

Implementation of ATMs has resulted in an overall reduction in impacts to natural and historic resources and has resulted in an improvement in the quality of recreation opportunities. In addition, road and trail facilities have become more logical and organized for management and thus management to standards is more attainable.

ATMs have not been implemented without controversy and controversy has driven issues. Issues have ranged from use conflicts, to improved access, to loss of recreation opportunities due to resource concerns, to new managed parking areas and existing managed parking areas. Choices for access improvements will continue to be controversial both within and outside of the agency and while resources may improve from improvements, individual perspectives tend to drive the issues.

As a baseline, access would continue along current trends in alternative A. Connectivity and loops would be improved and an increase in managed trails would result as unauthorized trails are adopted or decommissioned. A net decrease in unauthorized trails would result.

Multi-Modal Transportation would improve as bike paths and parking areas are integrated. Areas will be developed and managed to incorporate transit opportunities as feasible.

Stream Channel and Habitat Restoration

The effects of stream channel and habitat restoration include loss of parking and forest access routes from restoration where existing routes have adverse impacts that do not meet management area objectives for ecosystem management. This could involve reduction in parking for access to both dispersed and develop recreation opportunities. In addition, restoration could include decommissioning of unauthorized routes and reroutes of authorized routes. Depending upon the trade-offs of management area goals and objectives, access could be selected over other resources or vice-versa.

Alternative D would result in the most roads and trails rerouted or decommissioned. Alternatives A and B would result in less roads and trails rerouted or decommissioned than D and more than C. Alternative C would result in the least amount of roads and trails rerouted or decommissioned. In Alternative C, roads and trails would be upgraded in place except where mitigation does not offset impacts to the degree necessary to meet resource protection objectives.

Vegetation and Fuels Management

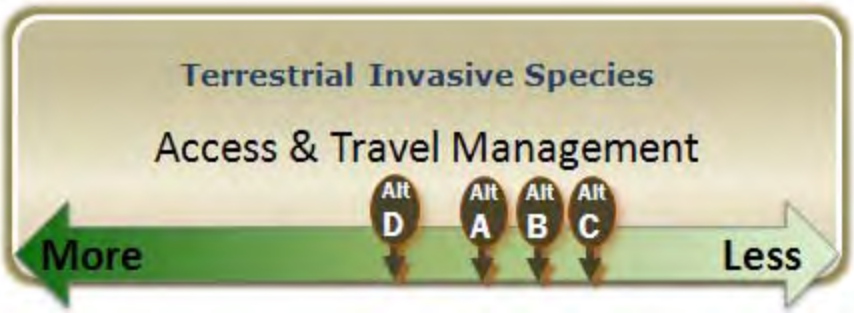
The effects from vegetation and fuels management objectives will include removal of timber. The effect on forest access will be an opening of the forest which will allow for additional roadside parking and an increase in forest access. Areas will be much more open and traversing "cross country" through the forest will become easier in areas that are treated. Routed delineation and unauthorized route restoration, will be necessary in areas receiving vegetation and fuels management treatment.

Alternatives A and B would have similar effects for road building and road use that are currently occurring for mechanized fuel treatments.

Alternative C would result in slightly more road building and larger or additional landings in order to meet the greater mechanical targets. In addition, these alternatives would require greater road maintenance as a result of additional road use (hauling) to meet targets. Treatments will require a variety of methods including the use of skidding, helicopter removal, forwarders, yoders and cut to length. All methods have different access needs and would require modification of the existing road system or existing landings.

Alternative D would require more access for hand treatments and for pile burning activities than other alternatives and would not require the same degree of road or landing construction and maintenance.

Terrestrial Invasive Species



Construction activities could become more restricted as BMPs for terrestrial invasive species evolve. Engineers and botanical noxious weeds specialists will continue to work closely to develop methods that are effective and efficient.

Alternatives A and B would have similar effects to terrestrial invasive species.

Alternative C could result in more opportunities for terrestrial invasive species to become established because it would allow the most managed or developed access to NFS lands.

Alternative D would result in the least amount of managed or developed access to areas and as a result there would be less opportunity for invasive species. Consequently Alternative D would have the most impact to road and trail access in order to prevent terrestrial invasive species.

Aquatic Invasive Species Management

Routes could be closed to motor vehicles that provide access to water bodies or boat launches. Preferably if areas were closed ,other similar access to National Forest System lands or Lake Tahoe would be provided. Alternative D would have the most impact to trail access in order to prevent aquatic invasive species spread. Roads and trails with lower capacity or no trails minimize access to locations that are currently infested or that are venerable to AIS.

Developed Recreation Sites

In general developed recreation sites would tend to shift towards consolidated access routes and parking facilities that would incorporate mode transfer (i.e. bus to bike, shuttle to foot, car to foot, etc.) to promote use of transit or bike path systems over the private automobile. In areas where roadside parking is reduced or eliminated some of the parking demand would be absorbed within managed recreation sites and creating associated parking facilities. All alternatives would result in a reduction in overall parking as roadside parking is eliminated and access shifts toward transit and bike path systems. Alternative C would result in greater opportunities over other alternatives to maximize trail access by upgrading trails and constructing new trails. Upgrades could include trail widening, trail surfacing, directional signage, trailhead development and other site specific upgrades.

Alternative D would result in a reduction in developed recreation sites which could result in reduced parking facilities and vehicle access to sites that are removed creating additional demand for alternative transportation.

Dispersed Recreation Management

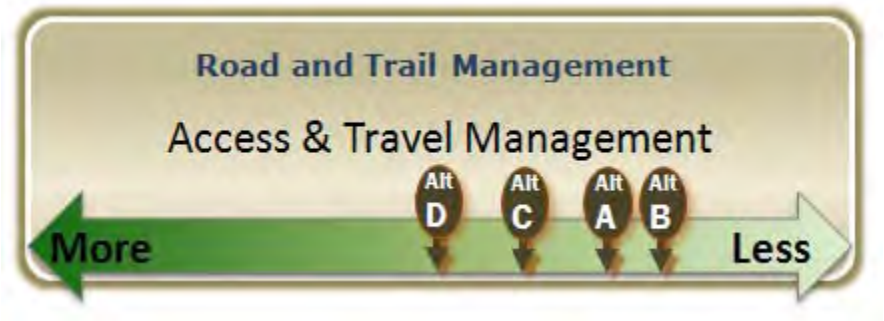
Dispersed recreation management is closely tied to area management and wilderness direction. As a result alternatives C and D increase wilderness areas and have the greatest potential changes to access. Specifically, the changes to access would be a reduction in motorized and mechanized trail access.

Alternatives A and B would continue the current trend of dispersed recreation management. Some trails would be adopted for management under this alternative as Trail Access and Travel Management Plans (ATMs) are completed. Road and Trail ATMs would additionally address parking where dispersed parking is causing impacts that do not meet management objectives.

Alternative C would result in providing more access for passenger car vehicles by increasing maintenance levels of more miles of roads and by providing more managed parking than other alternatives.

Alternative D would result in providing more mileage of roads open to non-licensed OHV's and high clearance vehicles and decreasing access for passenger car vehicles by reducing management objectives via reducing road maintenance levels.

Road and Trail Management



Impacts to forest access vary to a small degree between alternatives and the nature of the changes would be in the distribution and location of motorized and mechanized uses.

Road and trail management overlap with dispersed recreation management with changes in wilderness designations and area management objectives would affect the road and trail system.

Passenger car access and motorized trail use would see the greatest reduction in Alternative D, however, motorized access for high clearance vehicles and unlicensed vehicles would increase the most as compared to other alternatives. Alternative C would slightly increase motorized trail opportunities and reduce OHV and high clearance vehicle access. Alternatives A and B would continue along existing trends, keeping OHV, high clearance vehicles and passenger car vehicles mileage consistent with current designations.

For Alternative B:

Miles of roads managed for passenger car, high clearance vehicles and would remain consistent with current levels of use.

Miles of trails open to mechanized use primarily affects mountain bike use of trails. Mechanized trails would be increased in alterative B by redeveloping existing trails or constructing new trails.

Miles of hiking trails would remain the same as in alternative A.

Miles by trail class would remain the same as in Alternative A, trail class indicates the level of construction or maintenance of a trail.

For Alternative C:

Miles of roads managed for passenger cars would increase and miles of roads open to high clearance vehicles and OHVs would decrease. Mechanized trails would decrease in alterative C and trails that are important to mountain bikes would be closed due to wilderness designation. Miles by trail class shift to a higher maintenance level over Alternative A.

For Alternative D:

Miles of roads managed for passenger cars would decrease and miles of roads open to high clearance vehicles and OHVs would increase. Miles of trails open to mechanized use primarily affects mountain bike use of trails and mechanized trails would be decreased the greatest amount alterative D by the creation of two new wilderness areas.

Miles of hiking trails would remain the same as in alternative A, however more of those miles of trails would be hiking and equestrian only trails.

Miles by trail class would see a downward shift to lower maintenance levels compared to Alternative A. Trail class indicates the level of construction or maintenance of a trail.

Mechanized trail use would see the greatest reduction in Alternative D.

Land Allocation Changes

Land allocation changes have variable effects on access to the National Forest and effects have been mentioned in the above sections. The effects are not upon the miles of roads and trails, but upon the type of uses allowed. Additional Wilderness designations would eliminate current mechanized trail users in Alternatives C and D. Alternative D would also increase miles of roads open to high clearance vehicles and OHV's as a result of downgrading road maintenance levels. Additional backcountry areas in Alternative D would reduce the miles of OHV trails open to motorized users (not to be confused with the increase in miles of roads open to OHV).

Effects Common to All Alternatives

The effect upon multi-modal opportunities; including transit, bike paths, “park once” development, etc., are expected to change slightly between alternatives, however site specific analysis will be required for implementation. Generally areas that are suitable for multi-modal opportunities will continue to be suitable.

Parking Management

Parking and trailhead development will vary between alternatives. Alternative C would accommodate the most managed parking and alternative D would accommodate the least. Parking is expected to continue to shift towards managed parking in areas of high use.

Parking capacity in Alternative B would remain the same as alternative A, however, more of that parking would be managed in the future. Parking capacity in Alternative C would increase over alternative A, with a shift to more managed parking in the future. Parking capacity in Alternative D would reduce over alternative A with a shift to more managed parking in the future. While more areas could be converted to managed parking or added as managed parking to address changes in developed recreation in the future, Alternative D would add the least.

Other Activities

Utilities Maintenance and Construction

The alternatives would generally minimally affect utilities maintenance and construction. However, Alternative D would propose a wilderness area that would be adjacent to, and a backcountry area that would include, the main power line that feeds South Lake Tahoe. Access for utility maintenance and construction would be affected and could be further restricted.

Current restrictions for cell tower and water tower construction and maintenance would remain relatively unchanged except for the same effects under Alternative D as noted above.

Other Considerations

Use Conflict

Effects upon use conflict would be relatively consistent between alternatives. In Alternative A and B, use conflict would continue along current trends and may decline as miles of unauthorized trails decrease. More use would be focused on managed trails, however those trails have informational signage and trail designs that minimize conflict.

Alternative D would focus mountain bike and OHV use into less area as a result of wilderness designation. In addition, less developed parking areas would provide less opportunity to provide education about trail sharing and etiquette. Alternative C would increase road maintenance levels and reduce roads open to OHVs which would increase OHV use of the remaining roads. Increasing use could cause an increase in use conflict. Alternative C would also allow for more

managed parking areas and more educational opportunities to mitigate use conflicts.

3.4.1.4. Analytical Conclusions

Effects upon access between alternatives are for the most part minor. Transit opportunities would have different emphasis between alternatives; however, differences would likely be minor as a result of access needs and development limitations. Alternative D would have the greatest impacts to access due to creation of wilderness which would mainly affect mechanized (mountain bike) trail access. It may also affect administrative road access for forest management and utilities in the south shore area.

Comparison of Consequences by Alternative

Alternative A

Alternative A would continue the existing trends of access on NFS lands.

Alternative B

Similar to Alternative A this alternative would continue along existing trends with minor changes to the road system and an increase in mechanized trail access. This alternative balances public access needs with economic impacts and resource goals. Alternative B would encourage the adoption of unmanaged parking areas for management which will require additional funding and will provide an opportunity for interpretation and education.

Alternative C

Alternative C would increase passenger car road access, develop the highest degree of transit facilities, provide the most developed trail system, and have the greatest cost. Trails would be affected by increasing mechanized trails and reducing non-mechanized trails. The most managed parking would be added in the shortest time frames in this alternative.

Alternative D

This alternative would restrict passenger car vehicles the most, however, OHV opportunities on roads would increase. Mechanized trail use would decrease the most while non-mechanized trails would increase the most. Roadside parking would be decrease over time and not necessarily replaced. Alternative D is the least costly alternative.

How the Alternatives Maintain or Achieve the Desired Conditions

All alternatives would meet the desired conditions; however, there are differences in timing, economics, and the extent to which the desired conditions would be met.

Alterative A is trending towards meeting desired conditions.

Alternative B would best meet the desired conditions in the shortest time frames of all the alternatives. This alternative balances the economic impacts with public access needs.

Alternative C would meet the desired conditions for more managed campgrounds most quickly; however, other alternatives address public access needs more economically.

In Alternative D, more areas would become wilderness which would further restrict mechanized and motorized use. While there are no public motorized roads or trails in the proposed wilderness, there are administratively accessed areas for forest and utility access that could be affected. This alternative would also take longer to meet the desired condition as for managing parking and staging area than other alternatives because resource conditions would trigger the need for site management. Conversely in Alternative D, because road levels would decrease, more funding could be available to focus upon maintenance of BMPs that protect water quality, which would better meet desired conditions.

3.4.2. Air Quality

3.4.2.1. Introduction

This report evaluates the potential environmental consequences on air quality resources that may result with the adoption of a revised land management plan. It examines, in detail, four alternatives for revising the 1988 Lake Tahoe Basin Management Unit Land and Resource Management Plan. Planned Forest activities will result in the generation of varying amounts of pollutant emissions. Air Quality is affected via two types of pollutants, viz., primary, secondary, and greenhouse gases that can pollute the air for human health, forest health, visibility, acid deposition, and climate change. Primary pollutants such as particulate matter (PM), volatile organic compounds (VOCs), carbon monoxide (CO), nitrogen oxides (NOx), and sulfur oxides (SOx) that can affect human health, are directly generated from sources such as industrial facilities, autos and other mobile sources, and forest processes and activities including fire. Secondary pollutants, for example ozone (O_3), are chemically transformed from the primary pollutants VOCs and NOx. Forest fire emissions in addition to primary pollutants that affect human and forest health, also include the carcinogenic air toxics like acrolein, benzene, mercury, and formaldehyde. Black carbon (BC) and Greenhouse Gases (GHGs) including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) impact climate. Pollutants are easily transported long distances away from the point of origin which adds complexity to when attempting to restore non-attainment areas to attainment and improving visibility for Class I areas.

Different air regulatory agencies, viz., federal, state, and local, have created laws, rules and regulations for control and reduction of the air pollutants. Pollutants like sulfate (SO_4), nitrate (NO_3), organic, and elemental carbon (soot) reduce visibility. The EPA requires all states to develop attainment plans (State Implementation Plans - SIPs) to improve air quality in non-attainment areas and improve visibility in Class I areas. California has developed SIPs for ozone and $PM_{2.5}$ non-attainment areas and visibility for all 29 Class I areas that are located in the state. The EPA approved the visibility plan submitted by CA state in April 2011. Lake Tahoe Basin (LTB) has one Class I area (Desolation Wilderness) and is in nonattainment for ozone (Eldorado and Placer county areas). The forest is required to comply to both SIP requirements for all its projects and plans (see Table of Issues and Indicators).

Forest conditions for the LTB before Euro-American settlement were strongly shaped by fire. Historic ecological data on these fire-adapted forests provide a highly useful template for designing future forest conditions (structures, compositions, processes, etc.) that are more likely to be resilient to warming climates and intensifying wildfire activity (Veg. Report). Jeffrey pine-dominated forest types in the LTB have experienced 100+ years of heavy logging, grazing, and fire exclusion (Sugihara et al. 2006). Fuel loads are extremely high in the forests of LTB in large part because of the suppression policy followed by the agency during the early twentieth century. Wildfires are increasing in intensity and size. Estimated pre-1800 fire emissions of carbon dioxide from forests in California range from 23.1 to 62.6 terragrams (Tg) of carbon dioxide per year (Stephens et al. 2007). The average annual estimate of carbon dioxide emissions from fire in California from 2001 to 2008 was 17.8 Tg carbon dioxide per year. However, 2008 had substantially higher emissions (54.5 Tg carbon dioxide) as a result of a large number of

lightning-ignited fires (Wiedinmyer and Hurteau 2010). Although recent annual fire emissions are either below or within the range of historical emissions of carbon dioxide in California, they are well below the upper bound.

To reduce the intensity and size of future wildland fires, fires burning within historic normal are needed to protect public and forest health and reduce the overall contribution of GHG emissions to climate change from the high amounts of smoke and pollutants that are generated during high intensity wildland fires.

Wildland fires can be a major source of air pollution emissions. The EPA has set standards for criteria pollutants (that include PM_{10}, $PM_{2.5}$, CO, NOx, SOx, VOCs, ozone, and lead) to protect public health. Wildland fires are also a source of Black Carbon which is known to contribute to increased melting of glaciers and polar ice.

The concept of carbon carrying capacity, the amount of carbon that can be stored in a system by watershed condition units (HUC6) as a function of prevailing climatic conditions and natural disturbance regimes, has been proposed as a potential foundation for carbon management plans (Keith et al. 2009, 2010, Hurteau et al. 2010). Managing within the carbon carrying capacity for forests requires incorporating an understanding of fire and stand dynamics (North et al. 2009). Altering forest structure by thinning smaller trees and then carrying out prescribed burning aggregates carbon into fewer larger trees and reduces the potential for high-severity fire (Stephens and Moghaddas, 2005; Finkral and Evans, 2008; Hurteau and North, 2009; North et al., 2009). These actions may reduce the amount of standing carbon in trees, but they will improve the stability of these carbon stocks over time. Management objectives (to achieve fire resiliency) in this context could be focused on achieving a balance between carbon stock size and carbon stabilization that falls within the carbon carrying capacity of the forest.

Regular prescribed fires or other management fires are necessary following thinning treatments to manage surface fuels and maintain high-severity fire resistance (Hurteau and North 2009). Although understanding the short-term effects of fire on a system and the emissions associated with fire are important for managing air quality, these effects need to be viewed over the long term to better account for the effects of fire on carbon stocks (Hurteau 2011). Over the long term, fire effects on terrestrial carbon stocks are a function of the balance between carbon loss from direct fire emissions and decomposition and carbon gain from vegetation regrowth. If the successional pathway that resulted in the pre-fire forest remains unchanged, the recovering forest will transition from a carbon source to a carbon sink, and with sufficient time, the forest will re-sequester all of the carbon lost from both direct and indirect sources. Another forest service practice of slash-for-fire to slash-for-Biochar could be considered because it sequesters carbon over a longer time period and minimizes the risk of release through forest fires. In addition, Biochar can alter soil structure, soil productivity, and nutrient and water retention.

If milling waste is used as biofuel to generate electricity, the carbon contained in this material can be used to offset fossil fuel based energy.

Since the original Forest Plan was written, many new laws, regulations, and rules have been implemented that impact the management of air quality and forest ecosystem. Forest actions must comply with these new regulations. A new regional fuel strategic plan (under development)

seeks to treat half a million acres out of 20 million acres managed by FS in California per year. Public support for planned and unplanned fires is essential to reduce nuisance calls and the health impacts of smoke. Revising the Forest Plan provides the opportunity to incorporate policies and practices directly into the guiding documents supplying goals, strategies, objectives, and standards and guidelines based on new science and regulations not available when the 1988 Forest Plan was developed.

Issues, Indicators, and Methodology

For air quality analysis and understanding, NEPA documents need to describe the laws, rules, and regulations released by the air regulatory agencies. Air emissions do not stop at jurisdictional boundaries, but are transported long distances from their point of origin. Released pollutants can impact human health, forest health, visibility, climate change and aerosol deposition. The air quality issues, indicators, and methodology are as follows:

Air Quality Issues

Key issues related to air quality impacts include the following:

1. Human health impacts.
2. Forest health impacts.
3. Climate change (GHGs emissions and CO_2 sequestration, black carbon).
4. Impacts to visibility.
5. In addition, effects of acid, N compounds and mercury deposition on terrestrial forest health are of concern; however, the alternatives would not materially affect deposition so this issue is not analyzed in detail.
6. Conformity (for nonattainment areas) with SIPs.
7. Ozone injury.

Air Quality Indicators

The following Indicators are used to quantify impacts for each issue (Table 3-4).

1. Amount of pollutant emissions resulting from prescribed burning and wildland fire.
2. Amount of black carbon emissions resulting from prescribed burning and wildland fire.
3. Amount of greenhouse gas emissions resulting from prescribed burning and wildland fire.
4. Amount of emissions averted.
5. Amount of carbon sequestered.
6. Tons of biomass removed for potential wood products, bioenergy, and/or biochar production.
7. State Implementation Plan for ozone and visibility, and ozone injury trend.

Table 3-4. Summary of Air Quality Issues and Indicators

Issues	Indicators
1. Human health	1,4,5
2. Forest health	1,3,4,5,6
3. Climate change	2,3
4. Visibility	1,4,5,6
5. Deposition	External sources
6. Conformity	7
7. Ozone injury	7

Methodology

The management of air quality involves the identification of the sources of pollutants emitted into the air, the quantitative estimation of emission rates of the pollutants, the understanding of the transport from the source, and the knowledge of the physical and chemical transformation processes that can occur during the transport. These elements can then be combined to produce a mathematical model that can be used to estimate the changes in observable air borne concentrations that might be expected to occur if various actions are taken. The atmosphere is a very complex system and it is necessary to greatly simplify some processes in order to produce a mathematical model capable of being calculated on the largest and fastest computers. These steps and simplifications lead to further uncertainties.

The emissions from forest fires were estimated on the basis of forest biomass burned or removed. The largest uncertainties relating to emission calculations are fuel loading and burn efficiency. The formula used to calculate emissions, assumptions made, and mitigation measures for the air quality analysis are given below.

Formula

The biomass data (bone dry tons) utilized under different alternatives for each treatment was supplied by the Regional Analyst/Modeler. Emissions for criteria pollutants, greenhouse gases, and air toxics are calculated from the provided data using the following formula:

$$\mathrm{PE}_i = \mathrm{DBC} \times \mathrm{EF}_i \times {}^{1}/_{2000}$$

PE_i = Pollutant emissions of type *i* (tons)
DBC = Dry biomass consumed (bone dry tons) supplied by Regional Analyst/Modeler
EF_i = Emissions Factor for *i* species in lbs/ton of biomass consumed

Assumptions

The following assumptions with uncertainties as described above were made in this air quality analysis:

- Emissions are based on modeled outputs for biomass consumed or removed.
- This section analyzes the effects of alternative strategies, and not site-specific project designs; fuel treatments are assumed to be effective at conditions for which they were designed. Therefore, unless otherwise specified, treated biomass is assumed to be as effective as treated biomass in any other alternative.
- Weather, resource availability, smoke dispersion, and other conditions necessary for implementation of a prescribed fire are based on models that have associated uncertainties. Any project acres of prescribed or wildland fire managed to meet resource benefits or objectives are based on the assumption that the smoke management plan/burn plan has been submitted and authorization has been received from the applicable regulatory agency.
- For site specific projects, outputs from models like PFIRS and Blue Sky (available from Desert Research Institute (DRI), University of Nevada Reno) are utilized to determine plume location and pollutant concentration and released to the public and various agencies to reduce nuisance calls and impacts on public and forest health.
- Passive monitoring every 3-5 years is conducted to monitor trends of ozone, acid and nitrogen (N) deposition. The biomass removed for bioenergy and wood products is used to calculate GHGs and black carbon emissions averted.
- Mitigation measures to minimize adverse air quality impacts are determined during project planning for application during project implementation.
- Watershed assessments, to prioritize restoration actions over time, are done and improvements evaluated.
- The IMPROVE monitoring site at Bliss is maintained to monitor visibility for the Desolation Wilderness (a Class I area) as required under the state SIP.
- An accounting for watershed (HUC6 units) carbon budget for GHGs released vs. sequestered is tracked and compared over time to calculate the carbon footprint and the possibility for offset credits with collaborators under cap-and-trade. A trade-off

between emissions produced with and without application of emission reduction techniques (ERTs) is calculated and utilized for a change in management strategies.

- Emissions shown for prescribed burn include all planned ignitions. Wildfire emissions are from unplanned ignitions.

Mitigation

In addition to the modeling assumptions outlined above, the air quality analysis assumes that the mitigation measures described would be implemented.

Mitigations common to all alternatives are:

- Fuel load reduction.
- Appropriate fuel moisture content.

Mitigations for minimizing PM_{10}/ $PM_{2.5}$ emissions include:

- Dust abatement during project implementation.
- Allowing for adequate cure time before igniting slash material.
- Covering of hand-piled slash for more efficient burning conditions.

Mitigation measures for fugitive dust:

- Speed reduction.
- Water application.
- Use of dust abatement surfacing material application.

Mitigation measures for greenhouse gases.

Emissions or sinks for GHGs at the forest level are too small to provide meaningful information to translate the information into global climate change. Mitigation strategies that the agency can use include the following:

- Overstocking reduction.
- Encourage species that are tolerant to climate change.
- Degraded ecosystem restoration.
- Increase carbon sequestration through the implementation of applicable ERTs.
- Consider non-burning alternatives for fuel reduction when possible (mechanical treatment, biomass for co-generation, and biochar where economically viable and technically feasible).
- Consider harvesting timber for wood products that increases residence time of sequestered carbon. The strategies that have been proposed for using forests to slow the amount of CO_2 entering the air (Ryan et. al, 2010) include avoidance of deforestation, afforestation, forest management (decreasing carbon loss, increasing

forest growth, thinning to reduce fire threat), urban forestry, biomass energy production, carbon storage in forest products.

- Consider slash-for-biochar in place of slash-for-burn (storage of carbon as biochar). An existing approach to removing carbon from the atmosphere is to grow plants that sequester CO_2 in their biomass. Methods for sequestering CO_2 through afforestation have already been accepted as tradable "carbon offsets" under the Kyoto Protocol and CARB through its Cap-and-trade policy (2011). This sequestration can be taken a little further by heating the plant biomass without oxygen (a process known as low-temperature pyrolysis). Pyrolysis converts tree, grasses or crop residue into biochar, with a twofold higher carbon content than ordinary biomass. Moreover, biochar locks up rapidly decomposing carbon in plant biomass in a much more durable form that remains 100's to 1000's of years. Whether biochar remains in soils for hundreds or thousands of years, it would be considered a long term sink for the purposes of reducing CO_2 emissions. In addition, biochar is a lower-risk strategy compared to other sequestration options, in which stored carbon can be released by forest fires, by converting no tillage lands to tillage, or by leaks from geological carbon storage. Once biochar is incorporated into soil, it is difficult to imagine any incident or change in practice that would cause a sudden loss of stored carbon. Plant biomass decomposes in a relatively short period of time, whereas biochar is orders of magnitudes more stable. Biochar has been shown to improve the structure and fertility of soils, thereby improving biomass production. Biochar not only enhances the retention and thereby efficiency of fertilizers but may, by the same mechanism, also decrease fertilizer run-off (helps in improving water quality). Although this process is not currently utilized it would be considered if developed for use in forest management.
  Emissions from fossil fuels are the largest contributors to the anthropogenic greenhouse effect. The process that reduces CO_2 must be long term and substantial, must be accountable, and must have a low risk of large-scale leakage (Lehmann and Johnnes, 2007). Biochar-sequestration can meet these criteria. When combined with bioenergy production, it is a clean energy technology, which reduces emissions as well as sequesters carbon.

Mitigations for Black Carbon:

- Mitigation measures that are applicable to GHG reduction also help in reducing black carbon production. The largest forest generated emissions of black carbon are from wildland fire. These emissions are typically generated in the summer and fall. The short residence time (2 weeks) of BC and the timing of emissions minimize the impacts of BC emissions to climate change and enhanced snowmelt.

3.4.2.2. Overview of the Affected Environment

Existing Regulatory and Ambient Air Quality

Jurisdictional

The LTBMU area falls under the jurisdiction of both California and Nevada. For air quality management, California is divided into fifteen air basins, the boundaries of which are based on geographical and meteorological considerations, and follow political boundaries to the extent practicable. Several jurisdictions are responsible for the management and enforcement of air quality standards for the LTBMU. The California portion of the LTBMU is in two air basins, viz. Lake Tahoe (parts of the Eldorado and Placer counties) and Great Basin (parts of Alpine county).

The Nevada portion of the LTBMU falls in Washoe, Douglas, and Carson City counties. For purposes of the SIP, Nevada is divided into three jurisdictions: Nevada Division of Environmental Protection (NDEP), Clark County (which houses Las Vegas), and Washoe County (which houses the Reno-Sparks metropolitan area). The Clark County Department of Air Quality and Environmental Management, as well as the Washoe County District Health Department Division of Air Quality Management, have been delegated the responsibility to complete SIP requirements for their respective county areas. NDEP is responsible for the rest of the state of Nevada. Figure 3-1 shows the Lake Tahoe area with the air quality management jurisdictional boundaries.

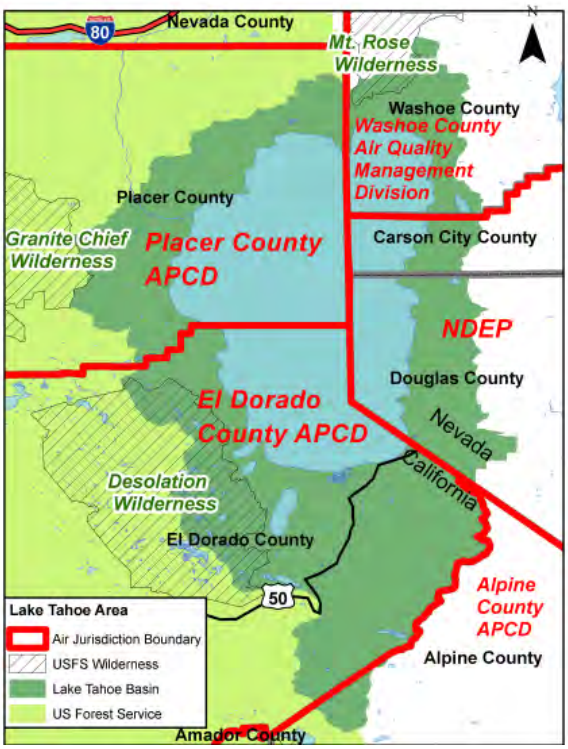


Figure 3-1 Air Quality Jurisdictions for LTBMU Area

Pollutants from anthropogenic and natural sources are ubiquitous to the air resource. Typically, anthropogenic sources such as vehicle exhaust and industrial emissions have the most adverse effects to human and ecosystem health. Wildland fire can be an important contributor to exposure for the public, particularly those that recreate in or live near the forest. Public health effects are dependent on pollutant type and concentration (dose) and on the sensitivity of the person (receptor). The primary regulated pollutants are: Particulate Matter (PM10/2.5), Ozone (O_3), Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Sulfur Dioxide (SO_2), Lead (Pb), Sulfate (SO_4), Hydrogen Sulfide (H_2S), Vinyl Chloride, and Toxic Air Contaminants (TAC).

National Ambient Air Quality Standards (NAAQS)

To protect human health and welfare, the EPA established primary and secondary NAAQS for the six Criteria Pollutants: Particulate Matter (PM_{10}, $PM_{2.5}$), Ozone (O_3), Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Carbon Monoxide (CO), and Lead (Pb).

Federal and California standards for these pollutants are shown in Table 3-5.

Table 3-5. National and State Ambient Air Quality Standards (µg m^{-3} (ppm))

Primary Standards			
Pollutant	**Averaging Time**	**Federal**	**State**
PM_{10}	Annual	-	20
	24 hour	150	50
$PM_{2.5}$	Annual	15.0	12
	24 hour	35	-
CO	8 hour	10 mg/m^3 (9)	10 mg/m^3 (9.0)
	1 hour	40 mg/m^3 (35)	23 mg/m^3 (20)
	8 hour (Lake Tahoe)	-	7 mg/m^3 (6)
NO_2	Annual	100 (0.053)	57 (0.030)
	1 hour	188 (0.100)	339 (0.18)
SO_2	24 hour	-	105 (0.04)
	3 hour	1300 (0.5)	-
	1 hour	196 (.075)	655 (0.25)
Pb	30 day average	-	1.5
	Calendar Quarter	1.5	-
	Rolling 3-mo ave.	0.15	-
O_3	1 hour	-	180 (0.09)
	8 hour	147 (0.075)	137 (0.070)

Primary Standards			
Pollutant	**Averaging Time**	**Federal**	**State**
Sulfates	24 Hour	**For California Only**	25
Hydrogen Sulfide	1 hour	**For California Only**	42 (0.03)
Vinyl Chloride	24 hour	**For California Only**	26 (0.01)
Visibility Reducing Particles	8 hour	**For California Only** Extinction coefficient of 0.23 per km - visibility of ten miles or more (0.07-30 miles or more for Lake Tahoe) due to particles when relative humidity is less than 70%	
• *Annual standards are never to be exceeded. Other standards are not to be exceeded more than once a year* CARB (11/17/2008) **Key- PM_{10}/$PM_{2.5}$=** Particulate Matter ; **CO**=Carbon Monoxide**; NO_2=**Nitrogen Dioxide ; **SO_2=**Sulfur Dioxide ; **Pb**=Lead **; O_3=**Ozone			

Nonattainment Area and Conformity

If federal standards are violated in any area that area is designated as “non-attainment” for that pollutant and the state must develop a plan for bringing that area back into “attainment”.
El Dorado and Placer counties are designated 8-hour ozone nonattainment areas for both the federal (Figure 3-2 and California standards Figure 3-3). The federal agencies must make conformity determinations for projects to be implemented in nonattainment areas.

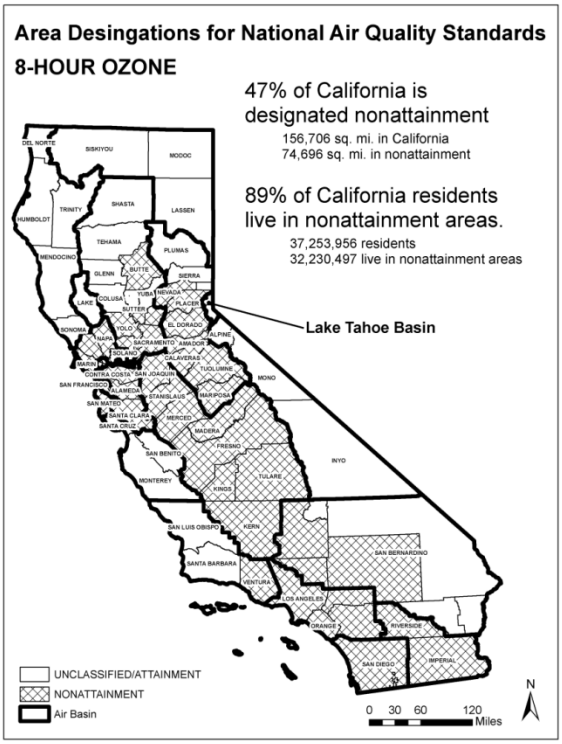


Figure 3-2 Area designations for federal 8-hour ozone

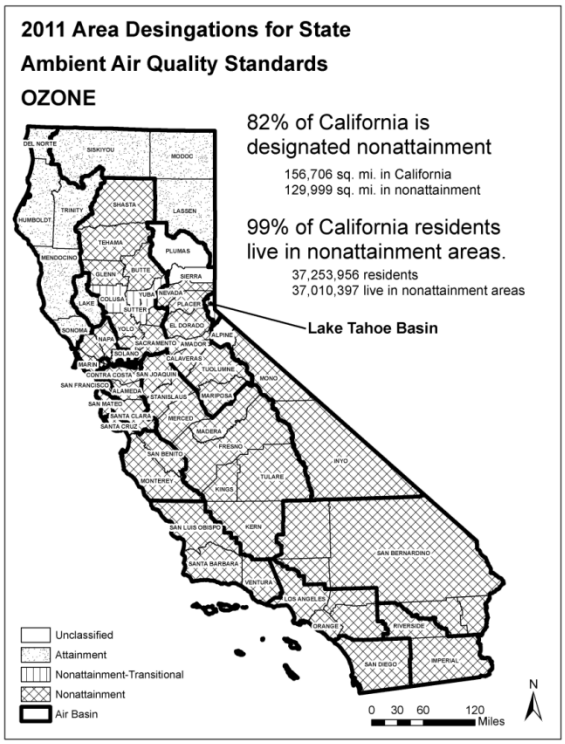


Figure 3-3 Area designations for state 8-hour ozone

Prescribed and Wildland Fire and Conformity

The Lake Tahoe Basin Management Unit follows Title 17 of the California Code of Regulation – Subchapter 2, Smoke Management Guidelines for Agriculture and Prescribed Burning. Implementation of prescribed burning will only occur after approval from the appropriate state or county air regulator. The new conformity rule states that "*the prescribed burns conducted in accordance with a smoke management program (SMP) which meets the requirements of the EPA's Interim Air Quality Policy on Wildland and Prescribed Fires or an equivalent replacement EPA policy" are considered as "presumed to conform.*" The EPA has approved California's revised Title 17 regulations as an equivalent of a SMP. Therefore, the projects will fall under "presumed to conform" for implementing prescribed burning. Therefore, the conformity determination requirement will be met for all burns under these conditions.

The most recent large wildfire in the Lake Tahoe Basin occurred in 2007 (Table 3-6).

Table 3-6 Wildland fire acres in the Lake Tahoe Basin from 2001 to 2010

Year	Acres
2007	3,128
2008	5
2009	8
2010	8

Smoke impacts were widespread historically in California with smoke impact in recent years well below typical (Stephens et al., 2007).

Naturally Occurring Asbestos (NOA)

Figure 3-4 shows the areas most likely to contain Naturally Occurring Asbestos (NOA) in areas of California nearest to the Lake Tahoe Basin. The nearest NOA area is 22mile from the forest boundary.

Figure 3-4 Areas likely to contain NOA in the Lake Tahoe Area

Existing Emissions

Emissions are tracked by county, air basin, and state. Statewide (CA), Lake Tahoe Air Basin, the El Dorado portion of the Lake Tahoe Basin, the Placer County portion of the Lake Tahoe Basin, and Alpine County (Great Basin Valleys Air Pollution Control District) estimated annual average emissions in tons per day for natural sources (including wildfire) are shown in Table 3-7.

Table 3-7. 2010 Estimated annual average emissions (tons/day) for natural sources (including wildfire)

Area	TOG	ROG	CO	NOx	SOx	PM	PM_{10}	$PM_{2.5}$
Statewide (CA)	2563.9	2226.2	2481.7	79.4	24.5	263.7	253.4	215.0
Lake Tahoe Air Basin	3.0	2.8	0.9	0.0	0.0	0.1	0.1	0.1
El Dorado County*	2.2	2.0	0.8	0.0	0.0	0.1	0.1	0.1
Placer County*	0.8	0.8	0.2	0.0	0.0	0.0	0.0	0.0
Alpine County*	9.1	8.6	0.1	0.0	0.0	0.0	0.0	0.0
*portions of individual counties that are in the Lake Tahoe Air Basin.								

Deposition

Table 3-8 and Figure 3-5 through Figure 3-10 compare of the years 2002, 2006, and 2010 passive sampling in the Lake Tahoe Basin for O_3 (Figure 3-5 and Figure 3-6), NH_3 (**Figure 3-7**Figure 3-7 and Figure 3-8), and NHO_3 (Figure 3-9 and Figure 3-10). The results for 2010 were lower than in previous years. The reason may be that 2010 summer was cooler than the typical summer. Comparison of HNO_3 concentrations showed that HNO_3 concentrations for 2002 and 2010 were similar while the highest levels were in 2006. NH_3 concentrations were lower in 2010 than in 2006. NOx concentrations were similar for the Basin and ranged between 226ug N/m3. NO/NO_2 ratio ranged from 1 to 8. High NO/NO_2 ratio indicates that N pollution in the Basin originates from the local emission sources (mobile sources). The 2010 concentrations are lower than 2002 and 2006 (attributable to the fact that summer of 2010 was much cooler than a typical year).

Table 3-8. Average concentration of NH3, HNO3, and O3 for 2002, 2006, and 2010

Site	2002			2006			2010		
	O_3	NH_3	HNO_3	O_3	NH_3	HNO_3	O_3	NH_3	HNO_3
Valhalla	45.7	ND	0.9	46.4	3.2	2.5	41.7	2.82	1.01
Sugar Pine	42.8	ND	0.7	42.7	3.4	3.0	35.9	2.01	1.23
Crystal Towers (ICN)	52.5	ND	0.9	51.3	3.0	2.9	51.5	1.13	2.40
Cave Rock	51.7	ND	1.1	55.3	2.7	2.6	46.4	1.58	0.84
White Cloud	66.1	ND	1.7	ND	ND	ND	41.7	1.57	0.86

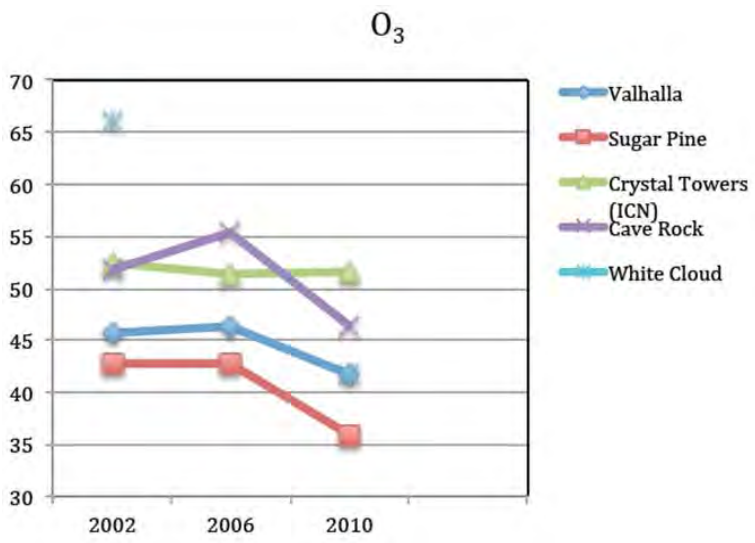


Figure 3-5. Passive samplers average O_3

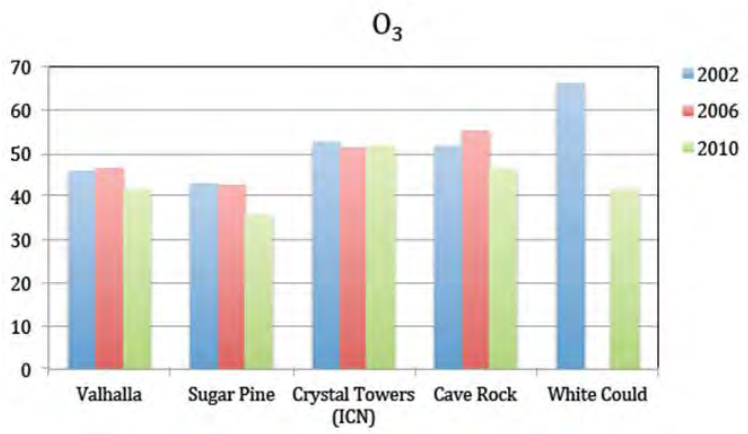


Figure 3-6. Passive samplers average O_3

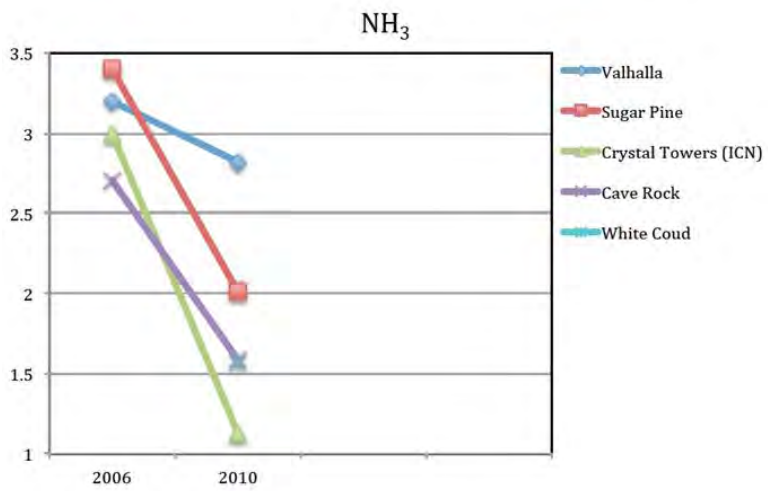


Figure 3-7. Passive samplers average NH_3

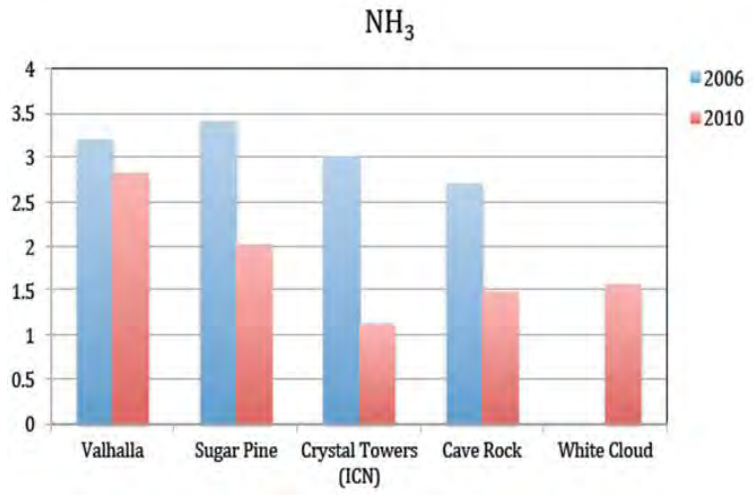


Figure 3-8. Passive samplers average NH_3

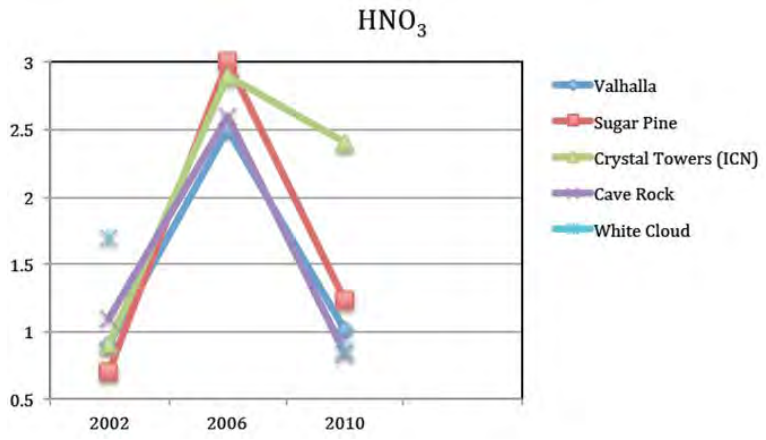


Figure 3-9. Passive samplers average HNO_3

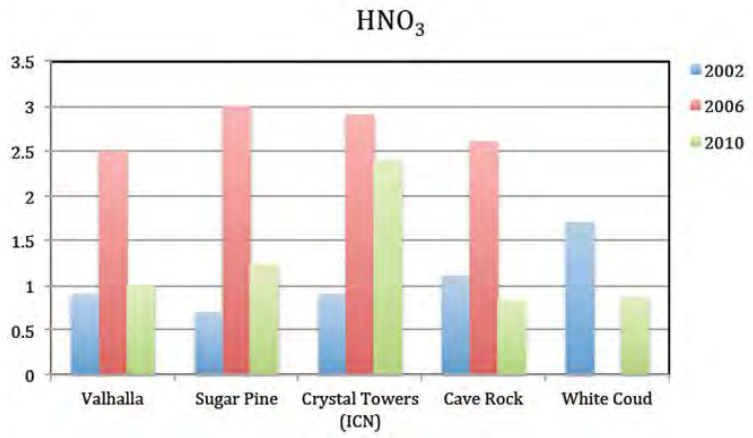


Figure 3-10. Passive samplers average HNO_3

Predictive spatial representation by Kriging for the 2-week period ending on August 1, shows the highest concentrations during this period west of the LTB with higher concentrations located on the south and east of Lake Tahoe in the most developed areas (Figure 3-11).

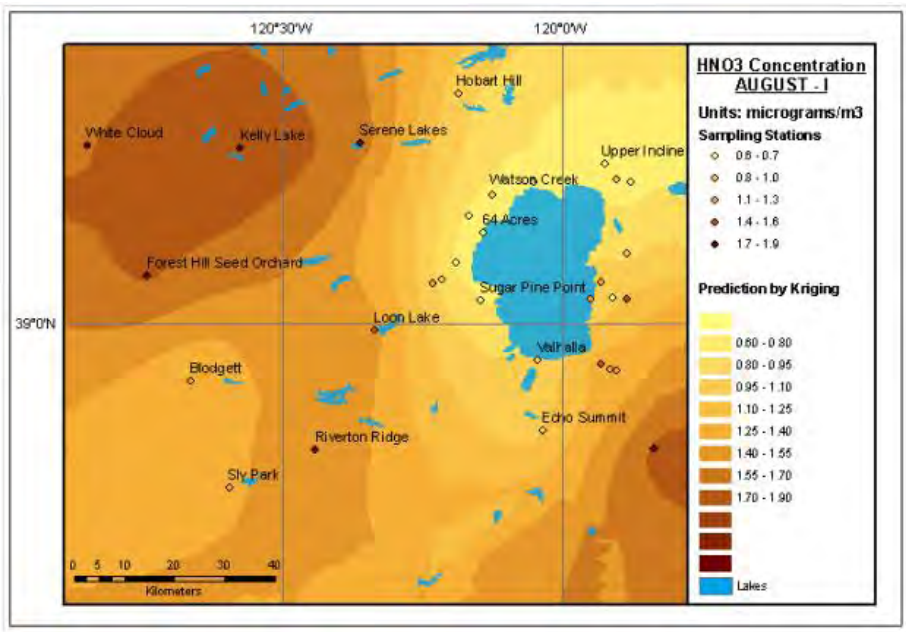


Figure 3-11. Concentration of HNO3 for 2 weeks period ending Aug. 1, 2002 (Adapted from Bytnerowicz 2011)

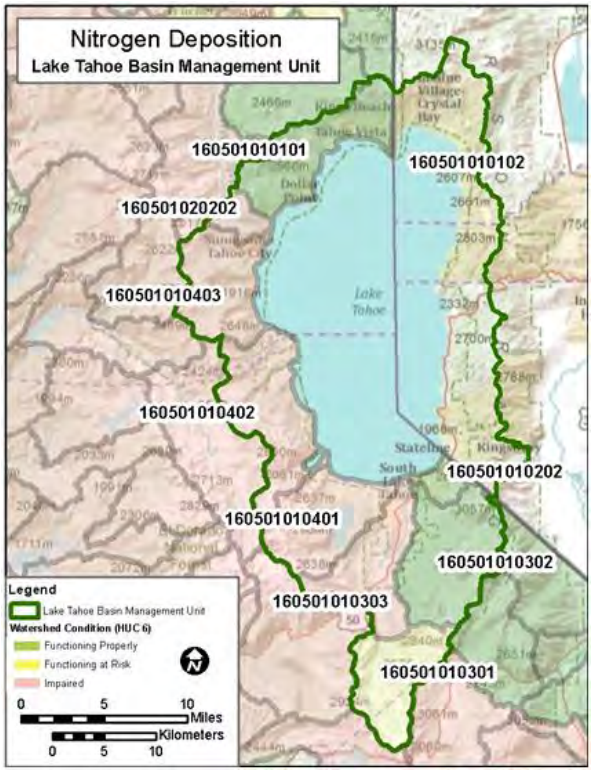


Figure 3-12. Watershed condition for HUC6

Current levels of N deposition to the terrestrial catchments in the valley are not leading to 'N saturation' of the terrestrial watersheds and thus do not induce elevated levels of nitrate runoff. However, N deposition and gaseous N pollutant exposures within and immediately upwind of the mountainous area are within the range at which strong nutrient enrichment-induced changes in epiphytic lichen communities occur in the Sierra Nevada (Fenn et al., 2008). Anthropogenic emissions of nitrogen are currently the largest contributor to N deposition in LTBMU and will remain the primary driver and concern for N deposition more so than any change in nitrogen deposition from the alternatives. Hydrological Unit Code 6 (HUC6) watersheds in the Lake Tahoe Basin range in size from 235 to 25,963 acres. The assessment of the condition of the watershed to handle N deposition ranges from functioning properly to impaired (Table 3-9 and Figure 3-12).

Table 3-9. LTBMU acreages by Watershed Assessment Units (HUC6) and condition for grouping for N deposition

HUC 6	HUC6 Name	Acreage	Condition Grouping
160501020202	Squaw Creek-Truckee River	4,290	Impaired
160501010102	Incline Lake-Frontal Lake Tahoe	235	Unclassified
160501010301	Big Meadow Creek-Upper Truckee River	17,496	Functioning at risk
160501010302	Trout Creek	25,963	Functioning properly
160501010303	Angora Creek-Upper Truckee River	19,182	Impaired
160501010401	Fallen Leaf Lake-Frontal Lake Tahoe	20,205	Impaired
160501010402	General Creek-Frontal Lake Tahoe	24,958	Impaired
160501010202	Zephyr Cove-Frontal Lake Tahoe	3,881	Functioning properly
160501010403	Ward Creek-Frontal Lake Tahoe	19,106	Impaired
160501010101	Burton Creek-Frontal Lake Tahoe	20,292	Functioning properly

Atmospheric deposition is the dominant if not the sole source of inorganic N in Sierra Nevada lakes and therefore a concern at the LTBMU. A critical load of 4.0 kg per ha per year for acidification was exceeded in western mountains in only a few places (Williams and Tonnesson 2000, Fenn et al. 2003). Atmospheric N deposition that exceeds the nutrient enrichment critical load of 1.0 to 3.0 kg N per ha per year is more widespread.

A model was recently completed which estimates the nitrogen-critical loads for lichens (Geiser et al. 2010) along with a monograph on nitrogen-critical loads by ecological region (Pardo et al. 2011). The model contains recommended parameters for applying the model to other EPA Level I ecological regions of the US to assess the impact of nitrogen deposition on lichens at the 6th level HUC. This paper describes the process used for the analysis.

- Good if Maximum Total Nitrogen Deposition < CLmax - 1
- Poor if Maximum Total Nitrogen Deposition > CLmin + 1
- Fair, anything between the good and poor ratings above.

Some watersheds are listed with an "Unknown" rating because there is no CL model available for those Eco-regions. Although the CL model was not applied to the North American Deserts region by Pardo et al. (2011), a CL of 3 kg N/ha/y provided by Pardo et al. (2011) based on other eco-regional studies was used here. Using this analysis, most of Lake Tahoe Basin is in "fair" condition for nutrient nitrogen critical load.

Ozone injury to Jeffrey and Ponderosa Pine

Forest health, resiliency, and sustainability in the LTBMU is dependent on multiple factors. Anthropogenic emissions impact human health (i.e. unhealthy criteria pollutants), forest health through physical damage (i.e. ozone), changes to nutrient cycles (i.e. nitrogen deposition), and altering climate (i.e. CO_2 emissions).

Chlorotic mottle on pine needles (Figure 3-13) was used to assess ozone injury in study plots throughout the Basin. The Watershed Condition (HUC6) or the southern and most of the western units in terms of O_3 damage is Functioning at Risk while the north portion of LTB is Functioning Properly. There is clear separation of O_3 concentration distribution on the western side of Desolation Wilderness due to emissions coming from the California Central Valley. There is also high O_3 concentration on the Nevada side of the LTB. High concentrations were at high elevations, both on the Genoa and Heavenly elevational transects. Ozone concentration was high in the middle of the lake, which could be due to high concentrations of O_3 precursors, a high rate of photochemical reactions (increase in solar radiation from reflection off the lake surface), and possibly a lower rate of titration of NO (Andrzej Bytnerowicz, 2011).

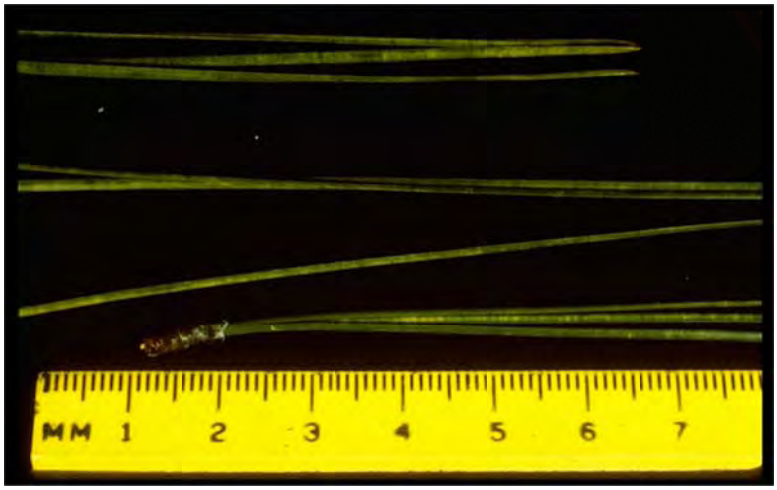


Figure 3-13 Ozone damage to pine needles

Visibility for Class I Areas (Desolation Wilderness)

The EPA established the Regional Haze Rule (RHR) in 1999, a major effort to improve air quality in national parks and wilderness areas. The RHR calls for state and federal agencies to collaborate to improve visibility in federal Class I areas. The RHR specifies a default method to track progress towards the national visibility goal of no anthropogenic visibility impairment. The

RHR focuses on reducing pollution on the 20% worst visibility days each year while allowing no degradation of the 20% best visibility days. Central to the RHR is the concept of the uniform rate of progress (URP). The URP is the yearly rate of change required to achieve natural deciview (a measurement scale representing perceptible changes in visibility) conditions by 2064 in a linear fashion beginning in 2004. The URP provides a reference to evaluate progress made in the context of the change required to reach natural conditions in 60 years (IMPROVE 2011).

The IMPROVE (Interagency Monitoring of Protected Visual Environments) is a cooperative measurement effort between the EPA, federal land management agencies, and state agencies. The network is designed to establish current visibility and aerosol conditions in the 156 mandatory Class I areas, identify chemical species and emission sources responsible for existing anthropogenic visibility impairment, document long-term trends for assessing progress towards the national visibility goal, and, with the enactment of the RHR, provide regional haze monitoring representing all visibility-protected federal Class I areas where practical.

The Haze Algorithm differentiates between large and small aerosols, with large organic aerosols having slightly more than twice the capacity to extinguish light than the smaller organic aerosols. Potential sources are wildfires, prescribed fires, agricultural fires, and other biomass combustion sources, including residential wood smoke. Industrial areas and motor vehicle sources contribute VOCs, which can coalesce to form organic aerosols. Natural biogenic emissions by plants contribute to the primary and secondary aerosol loadings; any of these can be transported from outside the immediate area. The wind pattern moves pollutants along the Willamette Valley, offshore, and back on-shore through the San Francisco Bay Area, across the Central Valley and up into the Sierra Nevada mountain range. Vehicle transportation corridors follow river valleys, which also serve as inter-basin transport corridors. “Backslider” circulation patterns occasionally rotate Nevada air into the Sierra Nevada Mountains. Almost 60% of elemental carbon is from natural fires on the worst days. The only reductions expected are from mobile sources (~2.5%).

An IMPROVE site (BLIS1) is located at Bliss State Park. The Bliss IMPROVE site covers Desolation Wilderness. The monitor is located at 38.9761 north latitude, 120.1035 west longitude, near the western shore of Lake Tahoe at an elevation of 2,131meters, about 219 meters above the shore of Lake Tahoe and near the lowest elevations on the eastern slopes of Desolation Wilderness (Figure 3-14). The collected samples are analyzed for PM_{10}, $PM_{2.5}$, SO_4, NO_3, organic carbon, elemental carbon, dust, and soot. The data helps identify sources that generate pollutants for visibility degradation.

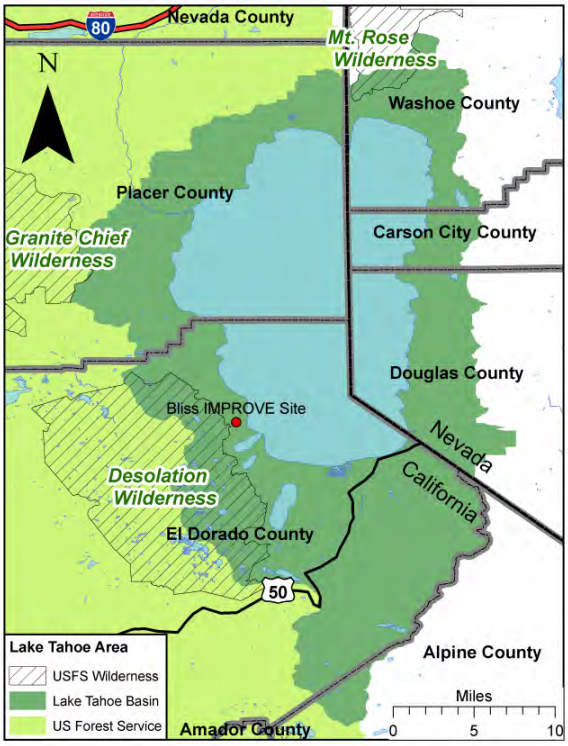


Figure 3-14 Bliss IMPROVE site location

The BLIS1 IMPROVE site is more susceptible to local trapped emissions in the Tahoe Basin that do not extend to higher Desolation Wilderness elevations. It is most representative of Desolation Wilderness locations on the lower eastern slopes facing Lake Tahoe that may be the worst case conditions overall during conditions of uniform regional haze. The closest source region with emissions that could contribute to haze in the Desolation Wilderness is the Lake Tahoe Basin. The more distant Central Valley of California near Sacramento, from which emissions could be transported to Desolation Wilderness, is about 50 miles southwest, linked to Desolation Wilderness by the American and Rubicon Rivers. The Reno, Nevada area is about the same distance to the northeast but is generally downwind for prevailing wind directions and in a distant air shed. Potential emission transport from source regions in the California Central Valley occur mainly in the summer. Locally, eastern wilderness locations may be predominantly influenced by emissions within the Tahoe Basin. Highest summertime measured concentrations at BLIS1 are associated with regional forest fire events. In the absence of such regional events there is likely to be a significant contribution from vehicle traffic in the Tahoe Basin to aerosol measures at BLIS1. In the fall and winter there may be wood smoke impacts associated with prescribed burns and residential burning in the Tahoe Basin (CARB, 2009 Visibility SIP).

Natural visibility represents the visibility condition that would be experienced in the absence of human-caused impairment. Based on EPA guidance, CARB calculated the natural visibility for

the BLIS1 monitor at 0.4 deciviews for the 20% best days and 6.1 deciviews for the 20% worst days. It is possible that the natural conditions deciview value for 2064 could change in the future as more is learned about natural plant emissions and wildfire impacts.

Baseline visibility was determined from BLIS1 IMPROVE monitoring data for the 20% best and the 20% worst days for the years 2000 through 2004. The baseline visibility for the BLIS1 monitor is calculated at 2.5 deciviews for the 20% best days and 12.6 deciviews for the 20% worst days. Figure 3-15 shows the uniform rate of progress or “glide slope.” The glide slope is the rate of reduction in the 20% worst days deciview average that would have to be achieved to reach natural conditions at a uniform pace in the 60 years following the baseline period.

The EPA approved the California haze plan in April,. Comprehensive SIP revisions are required every 10 years. The initial planning period of the Regional Haze Rule is 2008 through 2018. The first benchmark along the path towards achieving natural conditions occurs in 2018. The glide slope shows that the 2018 benchmark for the 20% worst days is 11.10 deciviews. According to the Regional Haze Rule, the 20% best days baseline visibility of 2.5 deciviews must be maintained or improved by 2018, the end of the first planning period.

Each pollutant species (PM_{10}, $PM_{2.5}$, SO_4, NO_3, O_3, EC, dust, and soot) causes light extinction but contribution differs on best and worst days. Figure 3-16 shows the contribution of each species for the 20% best and worst days in the baseline years at BLIS1.

As shown in Figure 3-16 and Table 3-10, organic matter, sulfates, and elemental carbon have the strongest contributions to degrading visibility on worst days at the BLIS1 monitor. Organic matter dominates the worst days, while the best days are dominated by sulfate.

Figure 3-16 depicts the individual species contribution to worst days in 2002. Organic matter increases in the summer while sulfates increase slightly in the spring. The occurrence of elevated elemental carbon concentrations is sporadic throughout the year. Organic matter clearly dominates the other haze species on worst days, but sulfates, nitrates, elemental carbon, and coarse mass also contribute to the worst days. Sea salt has a very small contribution to haze at the BLIS1 monitor. Marine shipping and other long-range transport sources affect SOx contributions but are “uncontrollable” by California.

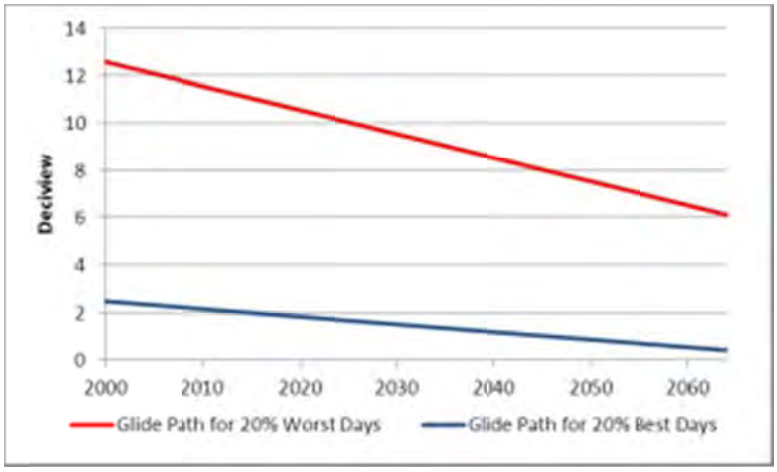


Figure 3-15. Glide path proposed in the visibility SIP

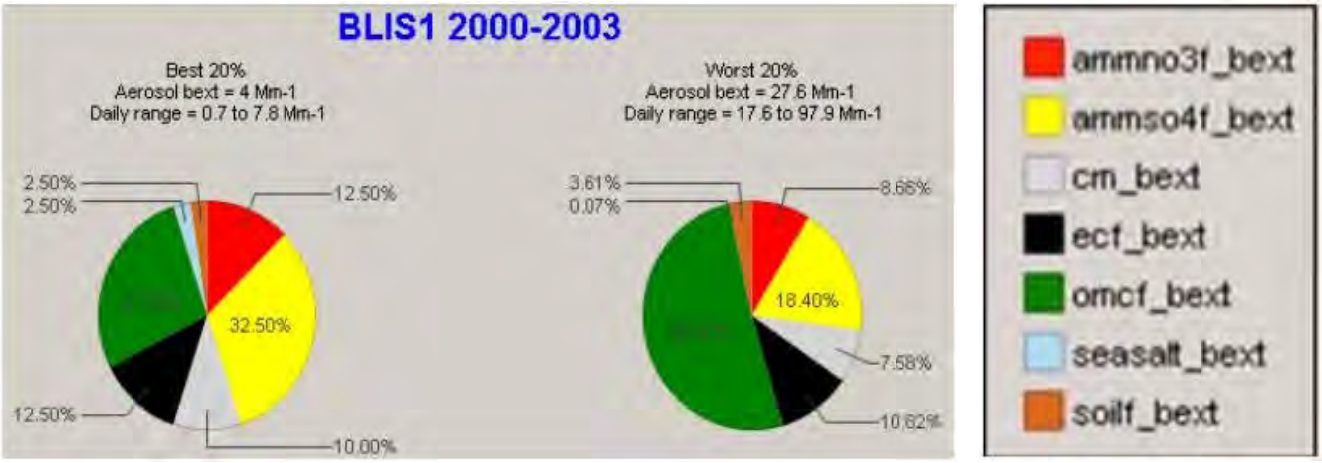


Figure 3-16. BLIS1 pollutant species for the best and worst 20%

Table 3-10. Baseline (2000-2004) vs. 2005-2009 data from the Bliss IMPROVE site showing the trend for worst visibility days

	Sulfate Bext	Nitrate Bext	POM Bext	EC Bext	Soil Bext	Coarse Mass Bext	Sea Salt Bext
2000-2004	5.1	2.4	14.1	3	1	2.1	0
2005	6.9	1.8	11.3	3.1	0.5	1.9	0.1
2006	6.3	1.4	14.4	2.8	0.9	2.4	0.1
2007	5.8	3.7	22.7	3.9	0.8	2.2	0.1
2008	6.3	2.1	49.2	6.3	0.9	2.3	0.1
2009	4.9	1.7	13.5	2.4	0.7	2	0.1
*Light Extinction (B_{ext}) is the attenuation of light due to scattering and absorption as it passes through a medium.							

Particulate organic matter mass concentration (POM) is the main contributor to worst visibility days (Figure 3-17). 11 and 8 show that wildfires are the source of worst visibility days. Historic and projected deciview for the worst 20% days is shown in Figure 3-19.

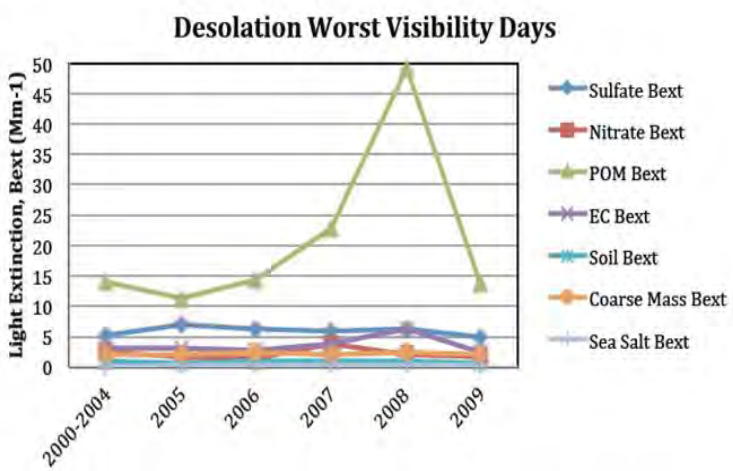


Figure 3-17. Light extinction from each pollutant on worst visibility days at BLIS1

Table 3-11. Baseline (2000-2004) vs. 2005-2009 data from the Bliss IMPROVE site showing the trend for the best visibility days

	Sulfate Bext	Nitrate Bext	POM Bext	EC Bext	Soil Bext	Course Mass Bext	Sea Salt Bext
2000-2004	1.3	0.5	1.1	0.5	0.1	0.4	0.1
2005	1.4	0.4	0.9	0.3	0.1	0.3	0.1
2006	1.4	0.3	0.7	0.3	0.1	0.4	0.1
2007	1.5	0.5	1.1	0.3	0.1	0.5	0.1
2008	1.2	0.3	1	0.2	0.1	0.5	0.1
2009	1.1	0.3	0.8	0.3	0.1	0.4	0.1

*Light Extinction (B_{ext}) is the attenuation of light due to scattering and absorption as it passes through a medium.

Sulfate and POM are the main contributors on best visibility days. Best visibility days occur when levels of organic carbon are the lowest (Figure 3-18 and Table 3-11.2). Historic and projected deciview for the best 20% of days is shown in Figure 3-19.

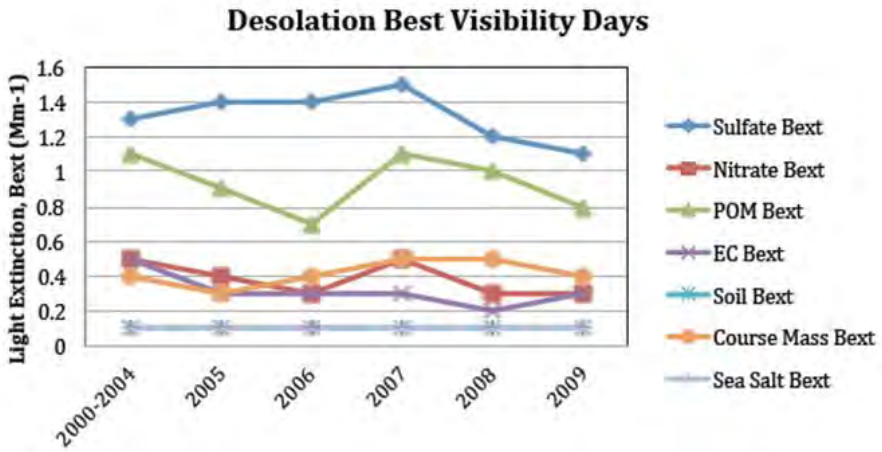


Figure 3-18. Light extinction from each pollutant on best visibility days at BLIS1

Both natural and man-made sources contribute to the calculated deciview levels made by haze pollutants at BLIS1. Some haze species arise from sources that are within the control of the State of California and neighboring states. Others arise from natural, uncontrollable situations such as wildfires, sea salt, or dust storms in natural areas. Finally, other uncontrollable, man-made sources are those industrial pollutants and other manmade (anthropogenic) emissions transported from outside the United States. The largest contributor to primary organic carbon at the BLIS1 monitor is from fire sources.

Regional contributions to sulfate on the 20% worst days in 2002 and 2018 at BLIS1 is set at 20%. The Outside Domain region represents 41% of the sulfate contributions in 2002 and 2018, followed by the emissions from the WRAP Region (39%) and the Pacific Offshore Region (13%). California contributes 20% of the total sulfate emissions seen at the BLIS1 monitor. Individually, emissions from outside the modeling domain contribute the most sulfate concentrations at the BLIS1 monitor. The next largest contributor to sulfate concentration is area sources in the Pacific Offshore Region. Natural fire occurrences within California contribute the highest concentration of elemental carbon at the BLIS1 monitor. California is responsible for 70% of the elemental carbon emissions from wild-fires, followed by Nevada wild fire emissions at 25%.

Table 3-1 shows the existing 5 years (2000-2004) average deciview value (i.e. existing value calculated from IMPROVE monitoring data and the CA state calculated natural visibility values that need to be achieved by the year 2064 for best and worst days. These attainment values are described in the state prepared visibility SIP approved by the EPA in April 2011.

Table 3-12. Best and worst deciviews for the glide path

Year	Best	Worst
2000-2004	2.5	12.6
2064	0.4	6.1

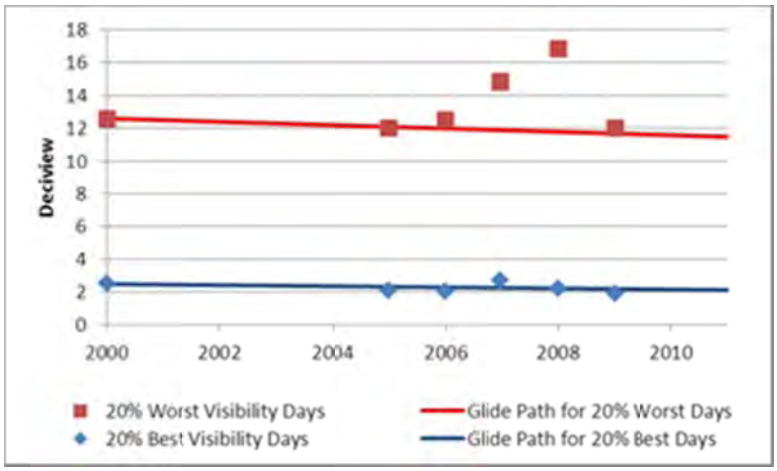


Figure 3-19. Worst and best 20% visibility days

By looking at the worst visibility graph (Figure 3-19) it is clear that organic carbon from wildfires play the major role in causing the decline in worst visibility at the BLIS1 site.

3.4.2.3. Environmental Consequences

Impacts on Air Quality

This section analyzes potential air quality impacts under the proposed alternatives on human health and forest health, resiliency, and sustainability. In addition, impacts of the alternatives on visibility and climate change (as indicated by greenhouse gas and black carbon emissions as well as carbon sequestration) are discussed. Because the proposed management strategies under each alternative can have short and long-term adverse or beneficial impacts to air quality locally, regionally, and globally, analysis of environmental consequences to air quality necessarily must attempt to balance short-term adverse impacts and long-term beneficial impacts. Emissions and deposition from implementation of the activities projected under the alternatives are often orders of magnitude less than those generated from sources outside the scope of this plan.

Outcomes are determined as beneficial or adverse. Beneficial outcomes reduce emissions or provide benefits to human health; forest health, resiliency, and sustainability; visibility; and climate change, while adverse increases emissions or have adverse impacts.

Air quality assessment of alternatives considers the environmental consequences of alternatives over time. Impacts that occur during an event are considered short-term impacts while long-term impacts consider future emission changes from management practices. Potential short-term adverse impacts may occur while generating long-term beneficial impacts. Short-term impacts include emissions and impacts associated with events, such as increased pollutant concentration during a fire, while long-term impacts consider future impacts to emissions, such as increased potential to mitigate future fire emissions through beneficial changes to forest health, resiliency, and sustainability (i.e. carbon sequestration stabilization) and visibility. Change in the natural ecological role of smoke in Sierra Nevada forest health, resiliency, and sustainability is considered.

Present and future gaseous pollutants and airborne particulate matter would continue to be present and dependent on life span (e.g. CO_2 has a life span of 200+ years while CH_4, O_3 and black carbon have short life spans and their control can result in CO_2 reduction in the short term). Primary emissions sources include wood burning stoves, motor vehicle exhaust, emissions from recreational campfires, emissions associated with development of private lands, prescribed fire, fugitive dust, and wildfires. Burning associated with foreseeable actions, as well as burns occurring outside of the managed area can impact air quality and have short-term effects.

While fire suppression can provide short-term beneficial impacts to local air quality and public health, this short-term benefit is balanced with the inherent lack of sustainability and the likelihood of adverse long-term impacts from larger, more intense wildfires on air quality, public health, and climate change. Fire suppression and the subsequent fuel accumulation generate a potential for negative long-term adverse impacts to air quality in the LTBMU. Controlled release of the backlog of emissions from fuel accumulation from fire suppression on the LTBMU has the greatest potential to alleviate long-term adverse impacts from fuel accumulation and provide long-term benefits to air quality that comes from a sustainable forest ecosystem. This method can be complemented with use of excess biomass for bioenergy (which generates much less pollutants than wood burning) and biochar (which conserves the carbon in a relatively stable state).

The concept of carbon carrying capacity, the amount of carbon that can be stored in a system by watershed condition units (HUC6) as a function of prevailing climatic conditions and natural disturbance regimes, has been proposed as a potential foundation for carbon management plans. Managing within the carbon carrying capacity for forests requires incorporating an understanding of fire and stand dynamics. Altering forest structure by thinning smaller trees and then carrying out prescribed burning aggregates carbon into fewer larger trees and reduces the potential for high severity fire. These actions may reduce the amount of standing carbon in trees, but they will improve the stability of these carbon stocks over time. Management objectives in this context focus on achieving a balance between carbon stock size and carbon stabilization that falls within the carbon carrying capacity of the forest.

Forests provide a suite of ecosystem services, including carbon sequestration for mitigating human-caused climate change. However, even if forest-based carbon sequestration were maximized to achieve the 1 giga-ton of carbon per year required to mitigate one-seventh of the global emissions projected by Pacala and Socolow (2004), reduced fossil-fuel consumption would still be required to lower atmospheric carbon dioxide concentration. Thus, forests offer a bridging strategy and are only part of the climate change mitigation portfolio (McCarl and Sands 2007). Although forest carbon sequestration does carry a risk of reversal, even impermanent carbon offsets generated by increasing above ground forest carbon stocks can serve to reduce compliance costs in a cap-and-trade system, and in the case of fire, this risk can be reduced (Hurteau et al. 2009, Mignone et al. 2009). However, mitigating fire risk and maintaining forest health and ecological function in a fire adapted ecosystem requires periodic carbon emissions from prescribed and natural ignition fires. Therefore this is insignificant on a global scale.

Biomass removal and timber harvest can reduce forest fuel loading from non-resilient and ecologically non-functional forest landscapes and can lead to resiliency and sustainability. Prescribed fire is an “anthropogenic” source, except where it is utilized to maintain an ecosystem that is currently in an ecologically functional and fire resilient condition, in which case it is classified as a “natural” source (WRAP 2007). This can also result in less intense wildfires and reduce organic matter carbon (OMC) contribution to worst visibility days. Biochar can reduce runoff and increase sub-surface water retention to help fulfill ecological restoration goals aimed at restoring degraded forest meadows to improve their habitat, function, and ability to hold water longer into the summer, and deliver clean water when most needed.

Pollutant Emissions from Fire

Emissions are projected through 5 periods with each period consisting of 10 years.

Because of the difficulty in projecting both acres and emissions from wildfire, particularly over a 50 year period, the analysis focuses on emissions from Period 1 (the first 10 years) under each alternative.

Pollutant emissions for prescribed fire are the lowest for Alternative B, increasing under Alternative A followed by Alternatives D and C (Table 3-13. and Figure 3-20).

Table 3-13. Pollutant emissions from prescribed fire for Period 1 (tons)

Alternative	PM_{10}	$PM_{2.5}$	CO	NMHC	NOx
A	3,562	3,188	31,671	2,551	1,028
B	2,802	2,542	26,312	1,643	816
C	4,464	3,996	39,695	3,197	1,289
D	3,822	3,477	36,307	2,130	1,114

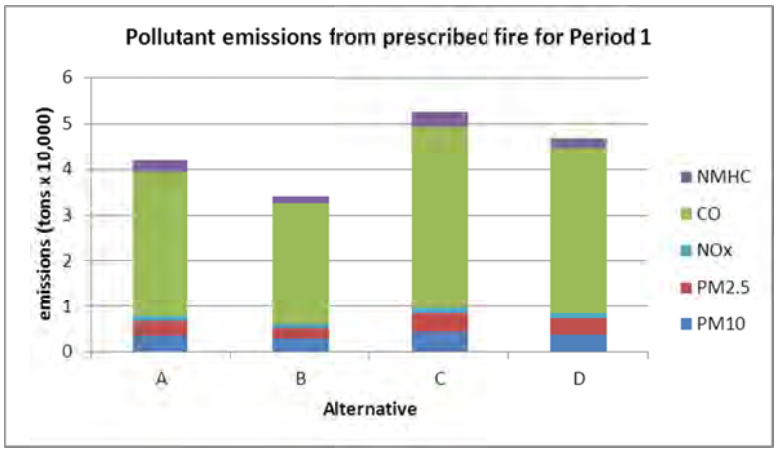


Figure 3-20 Pollutant emissions from prescribed fire for Period 1 (tons)

Pollutant emissions from wildfire are similar for all alternatives, with Alternative A showing the lowest emissions levels and Alternative C highest (Table 3-14. and Figure 3-21).

Table 3-14. Pollutant emissions from wildfire for Period 1 (tons)

Pollutant / Alternative	PM_{10}	$PM_{2.5}$	CO	NMHC	NOx
A	1,275	1,169	12,502	609	373
B	1,418	1,300	13,909	678	415
C	1,528	1,401	14,984	730	447
D	1,466	1,345	14,381	701	429

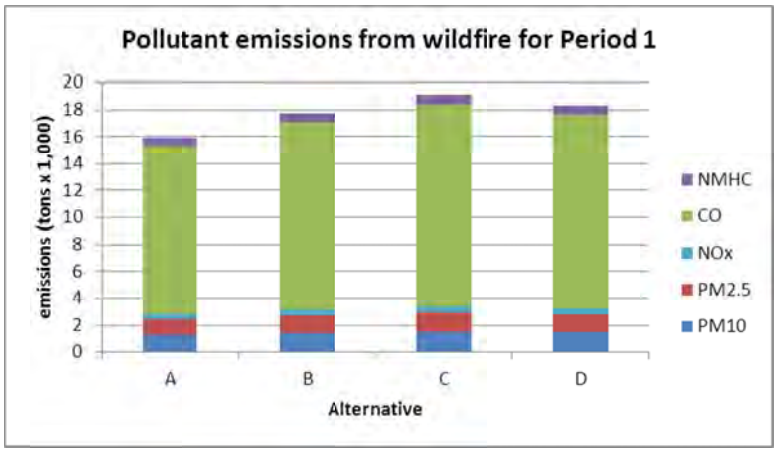


Figure 3-21. Pollutant emissions from wildfire for Period 1 (tons)

Total pollutant emissions from prescribed and wildland fire for Period 1 are lowest under Alternative B. Emissions increase from Alternative B to A to D to C, being highest under Alternative C.

Table 3-15. and Figure 3-22). Risk of public exposure to pollutant emissions from burning and wildland fire would be least under Alternative B and highest under Alternative C.

Table 3-15. Total pollutant emissions (prescribed and wildfire) for Period 1 (tons)

Pollutant / Alternative	PM_{10}	$PM_{2.5}$	CO	NMHC	NOx
A	4,837	4,357	44,173	3,160	1,401
B	4,220	3,842	40,221	2,321	1,231
C	5,992	5,397	54,679	3,927	1,736
D	5,288	4,822	50,688	2,831	1,543

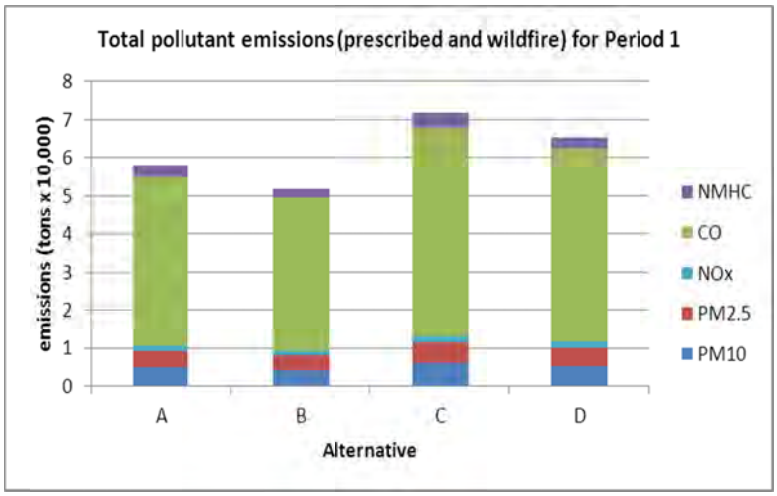


Figure 3-22 Total pollutant emissions (prescribed and wildland) for Period 1 (tons)

Alternative B has the lowest emissions of air toxics (Figure 3-23). The highest toxics would occur under Alternative C. Public exposure to air toxics from prescribed and wildland fire combined would be least under Alternative B and highest under Alternative C. Impacts from air toxic exposure are most applicable to those closest to the source of emissions, which are typically firefighters. Wildfire emissions typically occur during one or two events, where nearly all emissions are released in a short time period (typically less than two weeks) with little or no control over the timing of these emissions. Prescribed fires (planned ignitions) occur on declared burn-day designations under favorable environmental conditions, including good dispersal and defined parameters such as size, fuel moisture, temperature, etc. to control emission amounts and timing. Planned ignitions allow for flexibility in the timing of the emissions allowing avoidance of high use times, thereby minimizing exposure to air toxics. Emission rates and timing need to be considered when determining impacts from management actions. Maximum impact to public health occurs under wildfire.

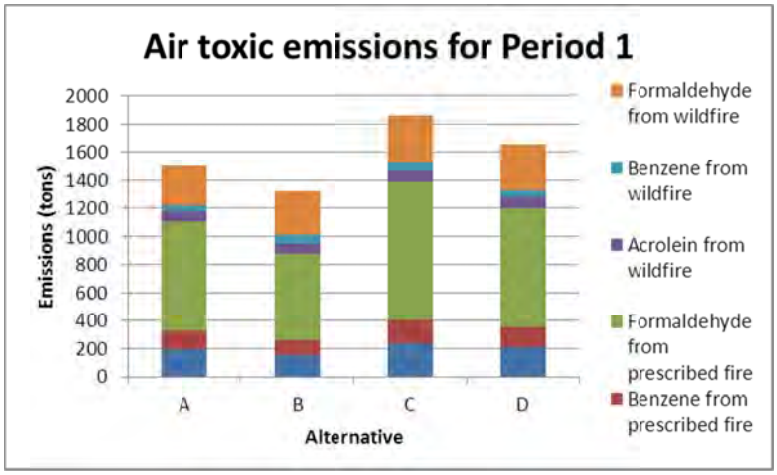


Figure 3-23. Air toxic emissions for Period 1 (tons)

Black Carbon Emissions from Fire

Figure 3-24 shows total black carbon emissions for prescribed fire and wildfire for each alternative for Period 1.

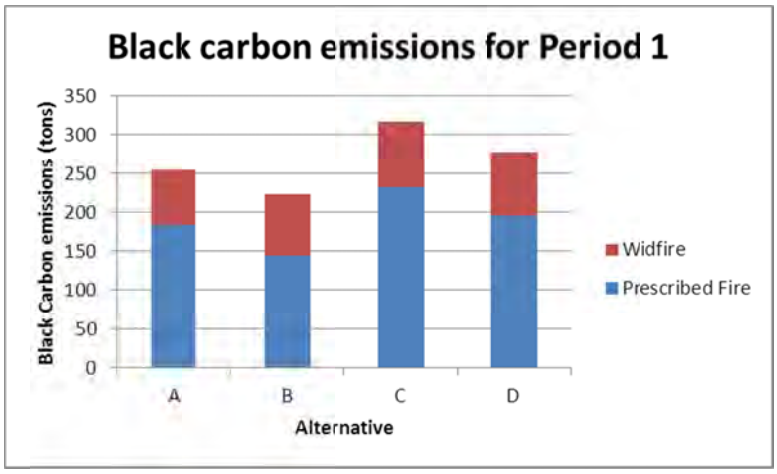


Figure 3-24. Period 1 black carbon emissions (tons)

During Period 1, the maximum black carbon is released under Alternative C followed by Alternative D, A, and B. Total black carbon emissions are lowest under Alternative B. Black carbon, when deposited on snow covered areas especially in the spring, can be a major contributor to increased melting, particularly in the Arctic, thereby contributing to climate change. Because the lifetime of black carbon is approximately one to four weeks in the atmosphere, climate effects from black carbon are typically localized. Historic emissions from wildland fire limit the distance of transport of black carbon; however, increased fire size and intensity or timing of emissions can increase the effects of black carbon on climate change. Total black carbon emissions are lowest under Alternative B and highest in Alternative C. However,

the differences in black carbon emissions between alternatives are very small and expected to have little impact on snow melt.

Greenhouse Gas Emissions from Fire

CO_2, CH_4, and N_20 are the primary greenhouse gases (GHGs) emitted from land management actions. Total GHG emissions are calculated as CO_2 equivalents. Alternative B has the lowest GHG emissions for prescribed fire and wildfire. Total projected GHG emissions are highest under Alternative C. Alternative B has the lowest total projected GHG emissions in Period 1 (Figure 3-25).

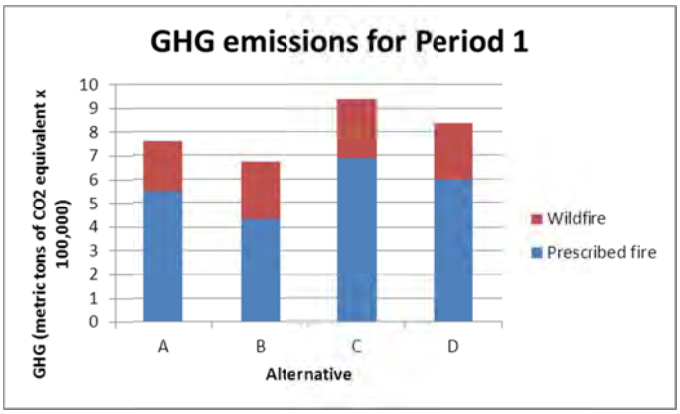


Figure 3-25 GHG emissions for Period 1 (metric tons of CO_2 equivalents)

Promoting forest health helps to limit GHG emissions, supporting a resilient ecological system that mitigates natural release of GHGs. For Period 1, the highest CO_2 emissions to the atmosphere are projected under Alternative C, followed in decreasing order by Alternative D, A, and then B.

Broadly speaking, there are two approaches for carbon sequestration in dry temperate forests: carbon maximization and carbon stabilization. Carbon maximization can be achieved by increasing the carbon density, on a relative scale, per unit of land area. However, the carbon maximization approach neglects the influence of changing climatic conditions and stand density on fire weather, fire behavior, fire severity, and tree mortality, and ultimately the potential for a very slow forest recovery or vegetation-type conversion (Hurteau 2011).

Trees sequester carbon; therefore, well-managed forests can act as a sink for carbon rather than an emission source. According to Mittal (2009), not all carbon is converted to CO_2 during wildland fires: black carbon and charcoal are also released and then deposited onto the soil. This material can remain in the soil a long time as additional sequestered carbon. The detailed research is lacking; however, according to the author, this material can account for up to 30% of the CO_2 released in a wildland fire.

Fire suppression policies, dating back over a hundred years, have altered the forests of the LTBMU. Climate change projection trends show that the region will become more water stressed due to the effects of higher temperatures on evaporation rates (Seager et al. 2007). Fuels have accumulated as the interval between fires has increased beyond the intervals associated with an

active fire regime. This combination of warmer temperatures and accumulated fuels has the potential to reduce carbon stocks and net ecosystem productivity if the successional pathway of forested ecosystems is continually altered by stand-replacing fires. Such forest ecosystems more frequently transition into drought-tolerant grassland and shrub vegetation types.

Based on review of the best available science, potential impacts on climate change from prescribed burning are too small to be significant especially since national level estimates are so low. The best available science shows that considering all forest management operations (including prescribed fire) in conjunction with forest vegetation inventories, the overall effect can be forest conditions that provide a net sink of CO_2, thereby reducing carbon dioxide levels in the atmosphere. Maintaining healthy, resilient forest ecosystems is a key to off-setting CO_2 emissions. Prescribed fire is a key tool in restoring and maintaining the health and resiliency of forest ecosystems.

Because smaller fuels typically drive wildland fire behavior, the level of biomass removed under each alternative provides another indication of the potential for GHG emissions. The emissions under wildfires are generally very high and will vary depending upon the extent and intensity of wildfires. The release of GHGs to the atmosphere for a given wildfire year can be greater than the carbon sequestration for that area. Figure 3-26 shows the biomass removed under each alternative. Forest thinning and follow-up fuels treatments that reduce the accumulation of forest fuels lead to smaller and lower intensity wildfires. This can result in reduced emissions of GHGs. Greater amounts of biomass removal are projected under Alternatives B and C as compared to Alternative A (no action).

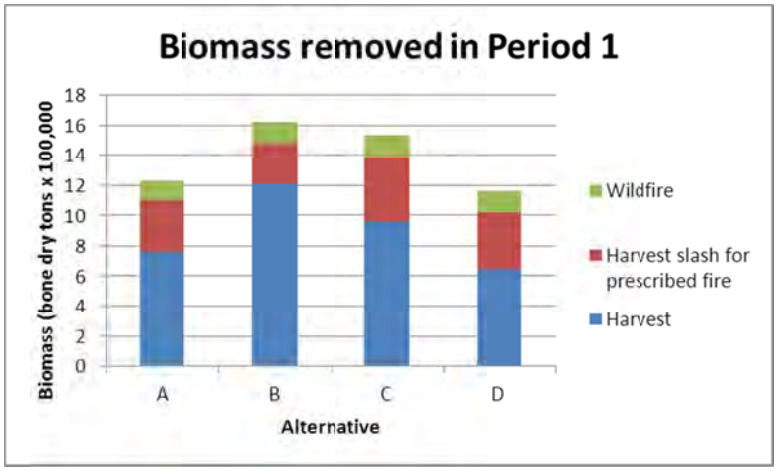


Figure 3-26. Biomass removed in Period 1 (bone dry tons)

During the first period, the maximum biomass is removed under Alternative B, followed by Alternatives C, A, and D.

Emissions Averted

Timber and biomass removal through mechanical or hand treatments and use of the harvested material for wood products, and, in the case of biomass, bio-energy and biochar averts emissions

from burning and wildland fires. The emissions averted can vary depending on how biomass is utilized. The removal of biomass through harvest or other means reduces the amount of emissions that would have been generated during wildfire or prescribed fire (Table 3-16 and Figure 3-27). Mill waste from harvested material is generally greater than 40% but the emissions table is based on total biomass transported to the mill. Therefore, emissions averted may be less than shown unless waste is used for bioenergy or biochar.

Table 3-16. Pollutant emissions averted by harvest for Period 1 (tons)

Alternative	PM_{10}	$PM_{2.5}$	CO	NMHC	NOx
A	7,795	7,148	76,425	3,726	2,281
B	12,390	11,363	121,485	5,923	3,626
C	9,801	8,988	96,097	4,685	2,869
D	6,615	6,067	64,864	3,163	1,936

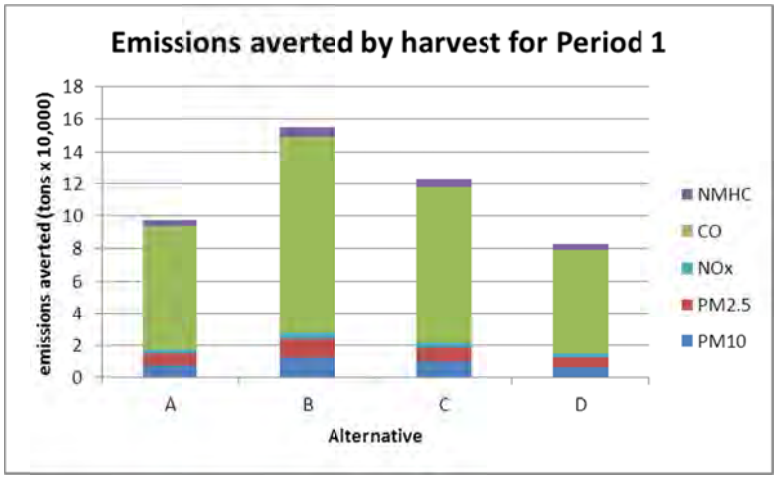


Figure 3-27 Pollutant emissions averted by harvest for Period 1 (tons)

For Period 1, Alternative B has the greatest amount of emissions averted for pollutants and air toxics, with Alternative D having the least (Table 3-17 and Figure 3-28).

Table 3-17. Air toxic emissions averted by harvest for Period 1 (tons of CO2 equivalent)

Alternative	Acrolein	Benzene	Formaldehyde	GHG	Black Carbon
A	426	297	1,726	1,218,403	395
B	677	471	2,744	1,936,765	629
C	535	373	2,171	1,532,019	497
D	361	252	1,465	1,034,091	336

Total GHG emissions averted is greatest under Alternative C with Alternative D having the least. Period 1 black carbon and GHG emissions averted are greatest for Alternative B and least for Alternative D. The greatest total of black carbon emissions averted are under Alternative C and the least with Alternative D. For Period 1, Alternative B has the largest emissions averted while Alternative D has the least. The calculated emissions averted account for removal of carbon through timber and biomass harvest. In the event of a change to more extreme fire behavior, these emissions averted estimates will lose relevancy.

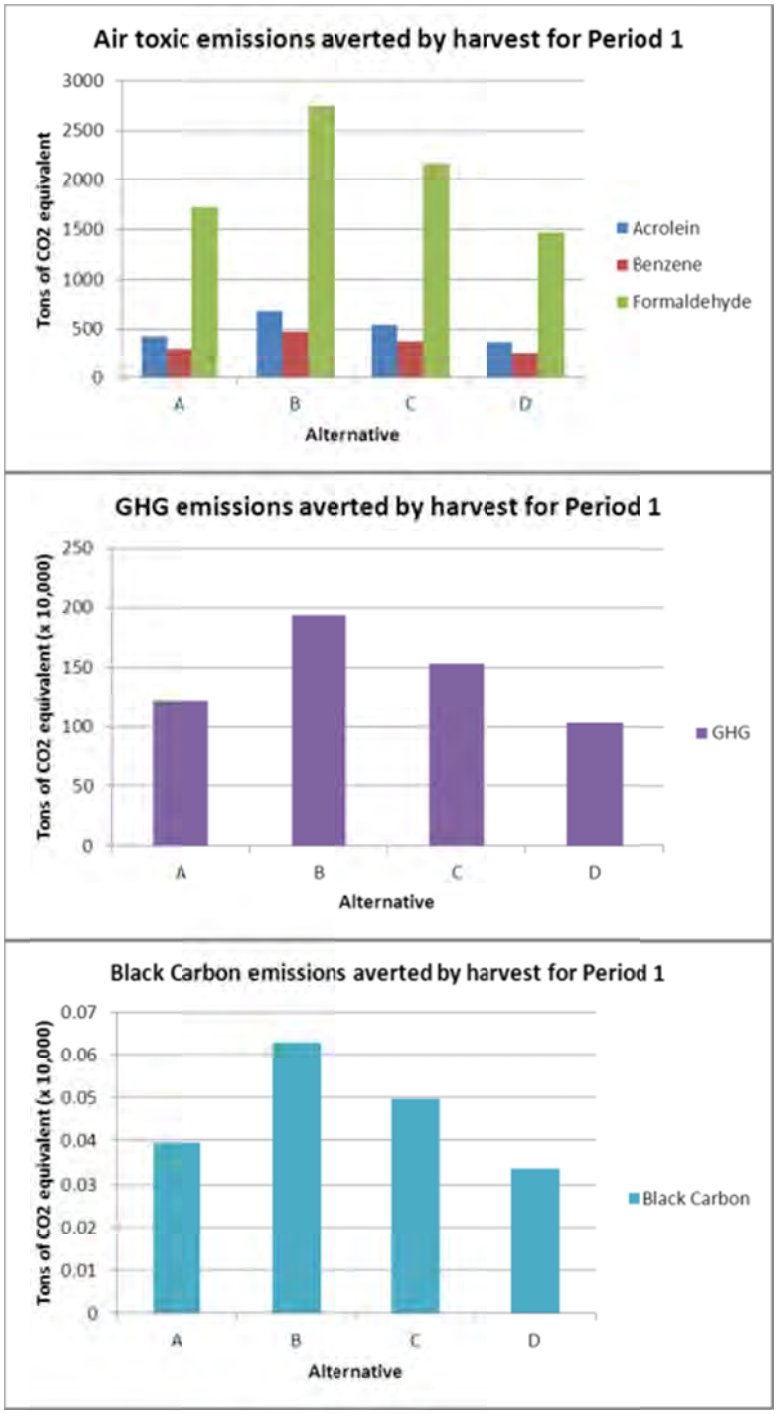


Figure 3-28. Air toxic emissions averted by harvest for Period 1 (tons of CO_2 equivalents)

Carbon Sequestered

Above ground biomass is expected to be similar for all alternatives in Period 1, with Alternatives C and B having the lowest over the five periods (Figure 3-29). There is a less than a 1% difference between alternatives in above ground biomass for Period 1.

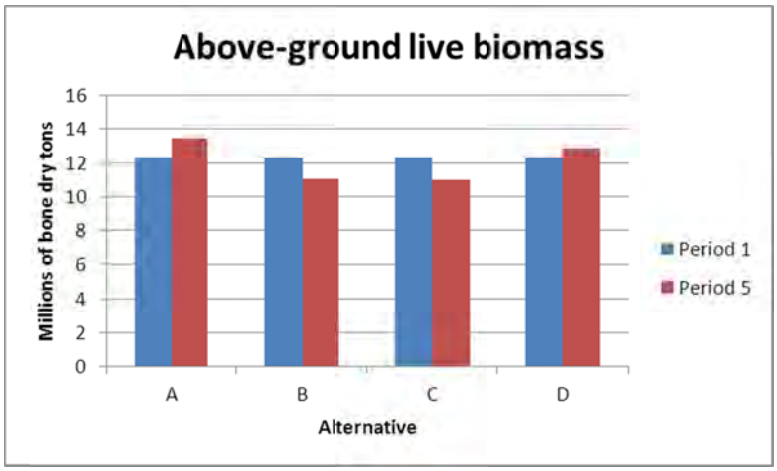


Figure 3-29 Above-ground live biomass (bone dry tons)

To estimate carbon sequestration under each alternative, only above ground biomass is considered (Figure 3-30).

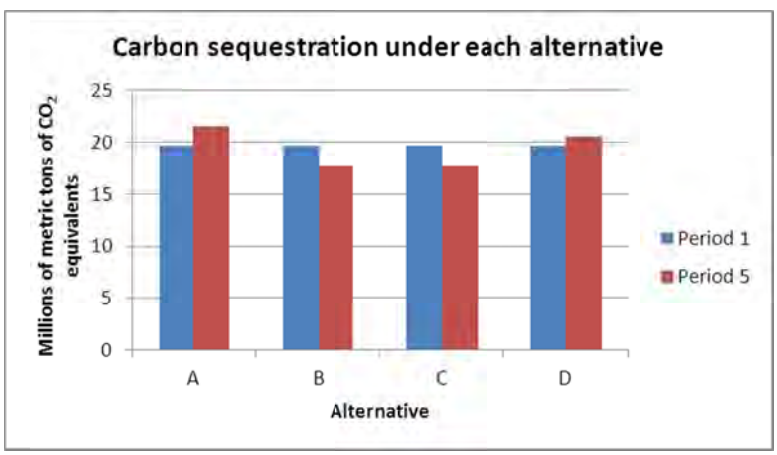


Figure 3-30 Carbon sequestration under each alternative (equivalents of CO_2 in metric tons)

The maximum amount of projected carbon sequestration occurs under Alternative A, followed by Alternatives D, B, and C. Sequestration of carbon under this estimation is based solely on forest growth projections and assumes that stand replacing fire does not occur under Alternative A. Large, uncharacteristically severe wildland fire would significantly alter the capacity and

amount of carbon sequestration on the LTBMU. Alternatives B and C have lower total carbon sequestration through the five periods, with a relatively small difference in the first and second periods. Ensuring forest health and resiliency are key to stabilizing carbon sequestration in forest ecosystems. Carbon sequestration would be more stable under Alternatives B and C.

The fate of harvested tree carbon can be central to the carbon balance. For example, using thinned trees from forests for firewood and accounting for the reduction in fossil fuel used for home heating can result in a net carbon loss of 3.11 mega grams (Mg, equal to 1,000 kilograms or 1 metric ton) carbon per hectare (ha), whereas using the thinned material for longer-lived wood products results in a net gain of 3.35 Mg carbon per ha (Finkral and Evans 2008). In Sierra Nevada mixed-conifer forests, understory tree removal can yield a substantial number of trees that are appropriate for dimensional lumber production, with lumber being equivalent to 6.4% to 8.9% of the total post treatment carbon pool (North et al. 2009). North and colleagues (2009) reported that the waste associated with milling inefficiency is second only to prescribed fire emissions in understory thinning. If the milling waste is used as biofuel to generate electricity, the carbon contained in this material can be used to offset fossil fuel-based energy. Assuming some percentage of the waste can be converted to biochar, the carbon converted can remain in that form for thousands of years, and can also increase soil productivity.

Hansen et al (2008) showed that improved forestry practices offer a more natural way to draw down CO_2. Deforestation contributed a net CO_2 emission of 60 ±30 ppm over the past few hundred years, of which ~20 ppm CO_2 remains in the air today. Reforestation could absorb a substantial fraction of the 60 ±30 ppm net deforestation emission. Forest wildfires and prescribed fires generate GHGs that can be recouped through plant sequestration partially or completely through management strategies.

Carbon sequestration in soil also has significant potential. Biochar, produced in pyrolysis of residues from forest waste, can be used to increase soil fertility while storing carbon for centuries to millennia. Biochar helps soil retain nutrients and fertilizers, reducing emission of GHGs, such as N_20. Use of agricultural and forestry wastes for biochar production could provide a CO_2 drawdown of ~8 ppm or more in half a century.

Comparison of Consequences by Alternative

Effects Common to All Alternatives

Future wildfire frequency is expected to continue as it has been observed in the past. Future large wildfires could have negative cumulative effects on air quality, depending upon the size and intensity of the fire. Visibility impairment and hazardous health impacts, due to sudden and dramatic releases of emissions, are likely with a large, high intensity wildland fire event. Such events may temporarily reduce visibility and air quality. In addition, they release high amounts of GHGs and reduce carbon sequestration from impacted areas for several years following fires. The cumulative effects are unknown, because the intensity and size of a wildfire is unknown. Research has indicated that wildfires can produce nearly twice the amount of smoke as prescribed fire (General Technical Report PNW-GTR-355).

In the event that population, energy consumption patterns, and vehicle travel remain at present levels or continue to increase, both short and long-term adverse impacts would continue from anthropogenic emissions prevalent in the region and would continue to dominate adverse impacts to air resources on the Lake Tahoe Management Basin Unit.

Alternative A

Alternative A would continue prescribed burning at current levels. It would allow management of wildfires to meet resource-desired conditions and objectives only in the Desolation Wilderness, leading to increased accumulations of surface fuels in the other areas of the LTBMU with an associated increased potential for high intensity wildfires in the future and higher potential for air quality degradation. Currently, 91% of the Basin is in FRI condition class II or III and only 9% is in condition class I. Pollutants, black carbon, and GHG emissions from fire are primarily from prescribed fire. Fuel loads can be expected to increase similar to historic levels of increase with fire suppression policies.

Under Alternative A (the no action alternative), short-term adverse impacts to human health would be negligible assuming fire activity and smoke generation is similar to those experienced in recent years. Short-term changes to NAAQS standard violations would be negligible because prescribed burns adhere to smoke management programs established by California's Air Pollution Control Districts (APCDs) and the Nevada Division of Environmental Protection (NDEP). Under the no action alternative, GHG emissions would remain largely unchanged from the recent past. Large wildfires are known to result in high levels of emissions, reduced visibility, and associated NAAQS violations. The potential for an unplanned ignition leading to uncharacteristically large and intense wildland fire events would continue to increase, as it has throughout the Sierra Nevada, leading to increased emissions; therefore long-term adverse impacts to human health are moderate under Alternative A.

Alternative A would have negligible short and long-term adverse impacts with pollutant emissions similar to recent years. Impacts to forest health from anthropogenic emission sources of air pollutants would continue to be the primary air pollutant stressor to forest health. Alternative A would have negligible short-term adverse impacts on air quality Moderate long-term adverse impacts are expected primarily caused by decreased control of emissions during wildfire events driven by excessive fuel accumulations and the lack of management strategies for adapting to a changing climate, reducing GHGs, and enhancing carbon sequestration.

Alternative B

Alternative B includes management strategies to adapt to climate change and preserves, perpetuates, and promotes old growth forests to reduce wildfire emissions. Wildland fire management for resource objectives is allowed in all Fire Management Units except WUI Defense Zones. Alternative B promotes forest resiliency to fire, changing climate through more stable environments for carbon sequestration, disease, and insects. Black carbon emissions under Alternative B for Period 1 are 52% for prescribed fire, 35% for wildfire, and 12% for brush. Period 1 pollutants, air toxics, and GHG emissions from fire are primarily from prescribed fire (55%). Biomass is primarily removed through harvest during Period 1 (75% of the total biomass

removed). Alternative B reduces the potential large, high intensity wildland fire by managing forest health for a changing climate and fire resistance.

Comparison of Alternative B to Alternative A shows more total acres treated for all periods. Wildfire acreage projections are 17% more under Alternative B compared to Alternative A because wildland fire management for resource objectives is allowed in all Fire Management Units except WUI Defense Zones. In Period 1, pollutant emissions are 9 to 27% less under Alternative B compared to Alternative A, air toxic emissions are 64% less, GHG emissions for Period 1 are 12% less. Black carbon emissions are 13% below Alternative A. Biomass removal is 32% more in Period 1 under Alternative B compared to Alternative A and 32% more in total for all periods. Emissions reduced through harvest in Period 1 are 59% more than Alternative A.

Under Alternative B, short-term beneficial impacts to human health would be negligible based on the decreased acres burned, assuming fire activity and smoke generation is similar to levels experienced in recent years. Short-term changes to NAAQS violations would be negligible as a result of protocols implemented through the APCD and NDEP. Prescribed burning activities would comply with California's Smoke Management Plan to mitigate potential impacts from smoke and minimize nuisance complaints. Anthropogenic emissions would continue to dominate pollutant violation levels. Large wildfires are known to result in high levels of emissions with associated NAAQS violations and degraded visibility. The potential for an unplanned ignition leading to a large, uncharacteristically severe wildland fire event would be limited by management actions leading to decreased GHGs, pollutants, air toxics, and black carbon emissions. Long-term beneficial impacts to human health are moderate under Alternative B but slightly better than Alternative A.

Alternative B would have minor short-term adverse impacts, with smoke emissions below that of Alternative A and below historic emissions. Impacts to forest health from anthropogenic emission sources of air pollutants would continue to be the primary air pollutant stressor to forest health. Biomass removal would increase both in Period 1 and for all periods. Total carbon sequestration is 9% less under Alternative B compared to Alternative A, although the level of carbon sequestration is the same for both alternatives in Period 1.

LTMBU actions in Alternative B would have negligible short-term beneficial impacts to air quality with increased ability to control fire emission timing and quantity to mitigate human health impacts. Moderate long-term beneficial impacts are expected primarily through increased biomass removal and reduction of GHG emissions and increased fire resiliency enabling a higher probability of maintaining carbon in the forest biomass. Long-term beneficial effects would also be realized through Alternative B's utilization of management strategies that adapt to changing climate. Alternative B would have minor short-term adverse impacts as overall emissions from this alternative are below the historic normal. Emissions from this alternative are minor in comparison to anthropogenic emission stressors. Negligible long-term beneficial impacts on forest health, resiliency, and sustainability are expected from the higher probability of carbon remaining sequestered by promoting forest resiliency to fire.

Alternative C

Alternative C includes management strategies to adapt to climate change and preserves, perpetuates, and promotes old growth forests to reduce wildfire emissions. Wildland fire management for resource objectives is allowed in all Fire Management Units except WUI Defense Zone. Alternative C promotes forest resiliency to fire, changing climate, disease, and insects. Vegetation treatments are designed to reduce the number of entries needed to meet desired conditions by thinning to the lower range of desired tree stocking levels, reducing stand densities more than in Alternatives A and B. Black carbon emissions for Period 1 are 43% for prescribed fire, 30% for pile burning, and 27% for wildfire, with approximately the same total amount of black carbon emissions for all periods. Period 1 pollutant, air toxics, and GHG emissions from fire are primarily from prescribed fire (45%). Biomass is primarily removed through harvest during Period 1.

Alternative C reduces the potential for large, high intensity wildland fire by managing forest health for a changing climate and fire resistance and reducing stand densities to a greater extent than Alternatives A and B.

Wildfire acreage projections are 29% more under Alternative C compared to Alternative A. In Period 1, pollutant emissions are 24% more, air toxic emissions are 23% more, and GHG emissions are 24% more under Alternative C compared to Alternative A because wildland fire management for resource objectives is allowed in all Fire Management Units except WUI Defense Zones. Black carbon emissions are 24% more under Alternative C than Alternative A. Biomass removal under Alternative C is 25% more in Period 1 and 32% more in total for all periods compared to Alternative A. Emissions reduced through harvest in Period 1 are 26% more under Alternative C than Alternative A. Sequestration of carbon under Alternative C is equivalent to Alternative A in Period 1 and 9% less in total for all periods.

Under Alternative C, short-term adverse impacts to human health would be negligible, assuming fire activity and smoke generation is similar to levels experienced in recent years. Large wildfires are known to result in high levels of emissions with associated NAAQS violations and degraded visibility. The potential for an unplanned ignition leading to a large, uncharacteristically severe wildland fire event would be limited through Alternative C's management strategies, including those aimed at reducing stand density. Increased biomass removal would lead to greater forest stand resiliency to fire with increased carbon sequestration over all periods and reduced emissions; however, long-term beneficial impacts to human health are minor under Alternative C.

Alternative C would have minor short-term beneficial impacts with smoke emissions projected to be lower compared to those of recent years. Impacts to forest health from anthropogenic emission sources of air pollutants would continue to be the primary air pollutant stressor to forest health. Biomass removal would increase under Alternative C both in Period 1 and for all periods compared to Alternative A. Total carbon sequestration under Alternative C is less than Alternative A, although the alternatives have similar levels of carbon sequestration in Period 1.

Alternative C would have negligible short-term adverse impacts to human health with increased ability to control fire emission timing and quantity to mitigate human health impacts. Increased fire resiliency enabling a higher probability of maintaining carbon in the forest biomass is a

beneficial aspect of Alternative C with minor long-term beneficial impacts expected to human health. Forest health, resiliency, and sustainability under Alternative C would have minor short-term beneficial impacts as Period 1 emissions under this alternative are closer to the historic range. Emissions from this alternative are minor in comparison to anthropogenic emission stressors. Smoke emissions from wildfires would be reduced as a result of the higher probability of carbon remaining sequestered through Alternative C's emphasis on promoting forest resiliency to fire.

Alternative D

Alternative D largely allows natural systems to adapt to climate change at their own pace. Natural processes are the preferred means to recovery and restoration of disturbed areas. Vegetation treatments are focused in WUI areas. Management of natural ignitions and prescribed burning are the preferred tools. Wildland fire is recognized as an essential ecosystem process in need of restoration, and this alternative utilizes planned and unplanned ignitions to meet the need. As in Alternatives B and C, wildland fire management for resource objectives is allowed in all Fire Management Units except WUI. Black carbon emissions under Alternative D for Period 1 are 60% for prescribed fire, 10% for brush, and 30% for wild fire, and prescribed has the largest (53%) of the total black carbon emissions for all periods. Period 1 pollutants, air toxics, and GHG emissions from fire are primarily from prescribed fire (63%). Biomass is primarily removed through harvest during Period 1 (56% of the total biomass removed). Over all five periods, the biomass removal is nearly equal with wildfire 20%, prescribed fire 19%, harvest 19%, and pile burning 16% of the total biomass removed. CO_2 equivalents removed by harvest are primarily accomplished (75%) in Period 1.

Restoration of fire as an essential ecological process and increased use of natural ignitions is expected to increase the frequency and duration of smoke emissions while fuel accumulated through historic fire suppression is consumed. Smoke emissions typical of pre-suppression are expected. Alternative D reduces the potential for large, uncharacteristically severe wildfire with the emphasis on utilizing fire as a management tool.

Wildfire acreage projections are 29% more under Alternative D compared to Alternative A because wildland fire management for resource objectives is allowed in all Fire Management Units except WUI Defense Zones. In Period 1, pollutant emissions under Alternative D are from 10% less (NMHC) to 15% more (CO) than Alternative A, air toxic emissions are 10% more, and GHG emissions for Period 1 are 10% more. Black carbon emissions under Alternative D are 9% more than Alternative A. Biomass removal under Alternative D is 6% less in Period 1 than Alternative A and 1% more in total for all periods. Emissions reduced through harvest under Alternative D in Period 1 are 15% less than Alternative A. Sequestration of carbon under Alternative D is equivalent to Alternative A in Period 1 and 2% less in total for all periods.

Under Alternative D, short-term adverse impacts to human health would be minor from increased use of fire as a natural process to remove biomass, assuming fire activity is similar to levels experienced in recent years. Short-term changes to NAAQS violations would be negligible because anthropogenic emissions would continue to dominate pollutant violation levels on the LTBMU. Large wildfires are known to result in high levels of emissions with associated NAAQS violations and degraded visibility. The potential for an unplanned ignition leading to a

large, uncharacteristically severe wildland fire event would be limited by management actions, particularly re-introduction of fire as a natural process into the ecosystem. Increased biomass removal in Period 1 would lead to greater resiliency to fire with similar carbon sequestration over all periods and decreased emissions; therefore, long-term adverse impacts to human health are minor under Alternative C.

Alternative D would have moderate short-term beneficial impacts with re-introduction of smoke levels typical in this ecosystem that benefit smoke tolerant biota. Impacts to forest health from anthropogenic emission sources of air pollutants would continue to be the primary air pollutant stressor to forest health. Biomass removal would decrease slightly in Period 1 and remain at approximately the same for all periods. Total carbon sequestration is approximately the same across all periods. Long-term beneficial impacts to forest health, resiliency, and sustainability are moderate under Alternative D from the re-introduction fire and associated smoke emissions.

Alternative D would have minor short-term adverse impacts on human health with increased use of fire. However, careful management of fire would enhance the ability to control fire emission timing and quantity to mitigate human health impacts. Increased fire resiliency enabling a higher probability of maintaining carbon in the forest biomass is a beneficial aspect of Alternative D, but minor long-term adverse impacts are expected to human health through increased emissions. Forest health, resiliency, and sustainability under Alternative D would have moderate short-term beneficial impacts as overall emissions from this alternative increase from Alternative A and are nearer the historic range. Emissions from this alternative are minor in comparison to anthropogenic emission stressors. Moderate long-term beneficial impacts to forest health, resiliency, and sustainability are expected due to the higher probability of carbon remaining sequestered through Alternative D’s emphasis on promoting forest resiliency to fire.

3.4.2.4. Analytical Conclusions

All of the alternatives are aimed at reducing the potential for large uncontrolled wildfires that typically occur under non-resilient forests. Wildfires present a risk to the public and result in damage to both the environment (e.g., increased erosion, air quality degradation) and property. Wildfires are known to result in high levels of emissions and associated air quality problems. Vegetation management treatments provide the opportunity on a long-term basis to reduce the magnitude of wildfire air quality problems.

Comparisons of each alternative to the No Action Alternative are summarized on the next page in Table 3-18.

Table 3-18. Air Quality Impact summary

Alternative	Issue	Short-term	Long-term
B	Human Health	Negligible beneficial	Moderate beneficial
	Forest Health	Minor adverse	Negligible beneficial
	Visibility	Minor Beneficial	Minor Beneficial
	Climate Change	Minor Beneficial	Minor Beneficial
C	Human Health	Negligible adverse	Minor beneficial
	Forest Health	Minor beneficial	Minor adverse
	Visibility	Minor Beneficial	Minor Beneficial
	Climate Change	Minor Beneficial	Minor Beneficial
D	Human Health	Minor adverse	Minor adverse
	Forest Health	Moderate beneficial	Moderate beneficial
	Visibility	Minor Beneficial	Minor Beneficial
	Climate Change	Minor Beneficial	Minor Beneficial

3.4.3. Aquatic Wildlife Habitat and Species

3.4.3.1. Introduction

The four alternatives (A, B, C, D) under consideration are described in Chapter 2. This analysis evaluates the potential direct and indirect effects of the management activities proposed under the four alternatives on aquatic habitat as well as federally listed aquatic species under the Endangered Species Act of 1973 (as amended) and Region 5 Forest Service Sensitive species. Federally listed and sensitive species have been addressed in detail in the Biological Assessment (BA) and Biological Evaluation (BE), respectively. Management Indicator Species (MIS) and Tahoe Regional Planning Agency (TRPA) special interest species are addressed in separate documents. A summary of listed species and a comparison of the effects of the four alternatives on them are presented in this section. MIS are addressed seperately in this chapter, in Section 3.4.14. Cumulative effects are described in Section 3.5 of this DEIS.

Methodology

The purpose of this section is to evaluate effects on aquatic resources from Alternatives A, B, C and D. The Forest Plan includes unit-wide land management direction for the following program and sub-program areas, which could affect aquatic resources:

3.4.12.1. Watershed and Aquatic Habitat Restoration

3.4.12.2. Biological Resources
- General/Native Species Conservation
- Critical Aquatic Refuges (CARs)/Species Refuge Areas
- Protected Activity Centers (PACs) and Home Range Core Areas (HRCAs)
- Aquatic and Terrestrial Invasive Species

- Forest Vegetation
  - Wildland Urban Interface (WUI)
  - General Forest (Non-WUI)
  - Managed Wildfire
- Recreation
  - Developed
  - Dispersed
  - Wilderness
  - Backcountry
- Access to NFS Roads and Trails
- Permitted Land Uses

The scope of analysis for aquatic resources covers fish, amphibians and invertebrates, and their associated habitats including: streams, lakes, wetlands and meadows. The aquatic resources analysis is driven by both Forest Service and other federal policies, which include various goals to conserve and/or protect species and habitat. The spatial extent of the analysis includes aquatic resources across the entire LTBMU. The following aquatic species and their federal and state listing status' that are specifically addressed in this analysis are:

- **Lahontan Cutthroat Trout** (*Oncorhynchus clarkia henshawi*)
  Endangered Species Act (ESA) Listing Status: *Threatened*
  California State Listing Status: *None*
  Nevada State Listing Status: *Vulnerable to Decline Due to Rarity or Restricted Range*
  US Forest Service, Region 5 Status: *None*
- **Sierra Nevada Yellow-legged Frog** (*Rana sierrae*)
  ESA Listing Status: Candidate
  California State Listing Status: State Candidate Endangered or Threatened
  Nevada State Listing Status: None
  US Forest Service, Region 5 Status: Regional Forester's Sensitive Species
- **Yosemite Toad** (*Bufo canorus*)
  ESA Listing Status: Candidate
  California State Listing Status: Species of Special Concern
  Nevada State Listing Status: None
  US Forest Service, Region 5 Status: None
- **Northern Leopard Frog** (*Rana pipiens*)
  ESA Listing Status: None
  California State Listing Status: None
  Nevada State Listing Status: None
  US Forest Service, Region 5 Status: Regional Forester's Sensitive Species
- **Lahontan Lake Tui Chub** (*Gila bicolor pectinifer*)
  ESA Listing Status: None
  California State Listing Status: None
  Nevada State Listing Status: None
  US Forest Service, Region 5 Status: Regional Forester's Sensitive Species
- **Great Basin Great Basin rams-horn** (*Helisoma newberryi)*
  ESA Listing Status: None
  California State Listing Status: None
  Nevada State Listing Status: None
  US Forest Service, Region 5 Status: Regional Forester's Sensitive Species

Of the aquatic species listed above, Lahontan cutthroat trout, Sierra Nevada yellow-legged frog, and Yosemite toad require consultation with U.S. Fish and Wildlife Service (FWS). Sierra Nevada yellow-legged frog and Yosemite toad, as candidate species, will require technical assistance, while Lahontan cutthroat trout, as a threatened species, will require formal consultation. Coordination began between the LTBMU and FWS, Reno, Nevada and Sacramento, California field offices for these species on June 16, 2010. The process for formal consultation, including requesting technical assistance for candidate species, was discussed. With the changes in Forest Planning rules in late 2010, the

consultation process with FWS was placed on hold until the new DEIS and Revised Draft Forest Plan was (or could be made) available for review (including the draft Biological Assessment and other biological support documents) to the FWS (both Reno and Sacramento field offices). At that time, a formal request for consultation and technical assistance will be reinitiated with the new revised Draft EIS and Draft Forest Plan. Consultation will be completed prior to the Responsible Official issuing a Record of Decision on the Final EIS and Final Forest Plan (planned for late 2012 or early 2013).

The aquatic resource analysis was composed of 2 parts, which include habitat and species. Potential direct and indirect effects on aquatic special-status species and associated habitat were measured by: 1) Status and Trend in Aquatic Habitat and 2) Status and Trend in Species Distribution. The analysis identified: (1) the management activities (stressors) associated with each alternative, (2) the proposed magnitude of change in these activities by alternative, and (3) potential direct and indirect effects from these management activities. Stressors are produced as part of implementing programs and sub-programs, which vary by alternative and factor into the effects on aquatic resources. Each stressor had an estimated duration (time in which habitat or species is exposed to them) and identifies factors causing the stress.

The analysis area for potential effects is defined as all NFS lands within the LTBMU administrative boundary. All measures of effects are evaluated at a basin-wide scale and based on the assumption that the future revised LTBMU Forest Plan will be programmatic in nature and not area-specific and/or project-specific. All effects are evaluated on a 15-year basis for the anticipated life of the Plan; short term effects would be addressed in project-specific NEPA analysis as projects under the revised Forest Plan are initiated.

Assumptions

In addition to universal assumptions (see Section 3.3), the following aquatic resource specific assumptions have been made:

- Increased recreation capacity would cause or result in increased use
- Increased access to NFS lands would result in increased access and increased dispersed recreation activities.
- Creation of new developed recreation sites (e.g., facilities, campgrounds) would be compatible with natural resource objectives.
- Expansion of ski resort operational boundaries under Alternatives A, B, and C means additional ski runs, facilities, lifts and all other infrastructure and activity that occurs in current operational boundaries could occur in the newly expanded boundary area.
- Aquatic Organism Passage (AOP) would continue to be an emphasis of small scale aquatic restoration projects
- Actions comprising each program and sub-program area would be consistent with pertinent aquatic resource federal and state law and current and proposed revised Forest Plan standards and guidelines.

- Current and future actions for threatened, endangered (T&E) and candidate species restoration and recovery would be consistent with the Lahontan cutthroat trout recovery plan and Sierra Nevada yellow-legged frog management strategy, when finalized.

3.4.3.2. Overview of the Affected Environment

Lake Tahoe has a relatively small watershed (800 square kilometers, including the lake) for the size of the lake surface (500 square kilometers). The basin's land area is approximately 205,000 acres, including federal, state, tribal and local government and privately owned lands. The federal ownership is approximately 80 percent of the land area in the basin (Manley et al. 2001). Between 1870 and 1900, the forests of the basin were heavily logged for use in mine shafts at the Comstock Silver Lode in Virginia City, Nevada. Forest stands have largely been left alone to regenerate during the last 100 years, while wildland fires have been aggressively suppressed (USDA 2000). This has led to basin forests that are overcrowded with fuels and fairly uniform in age. Urbanization of the basin has eliminated 75 percent of its marshes, 50 percent of its meadows and 35 percent of its stream zone habitats (USDA, 2000).

Lake Tahoe was created in the late Tertiary Age when a lava flow blocked the glacially formed basin at its north-west extent, allowing it to fill with water (USDA 2000). The Upper Truckee River, Trout Creek, Blackwood Creek, Ward Creek and Taylor Creek provide the primary water sources to Lake Tahoe. Lake Tahoe has a mean depth of 313 meters (1,027 feet) and a maximum depth of 501 meters (1,645 feet). Much of the beauty of the Lake comes from its extraordinary transparency and related deep blue color. Secchi disks were visible at depths of over 40 meters (131 feet) in the 1960's, and the Lake historically transmitted enough light to support beds of mosses and other plants at depths of up to122 meters (400 feet) (USDA 2000). In a study released by the UC Davis Tahoe Environmental Research Center and the Tahoe Regional Planning Agency, scientist's report that water clarity dropped to 19.6 meters (64.4 feet) in 2010, the lowest clarity level ever recorded at Lake Tahoe since 1959, when nutrient loading studies were initiated (USDA 2000). Factors likely contributing to these declines include climate change and algae growth promoted by increased sediments and nutrients.

Efforts to protect Lake Tahoe since the 1960's have been pioneering examples of Watershed Planning and nonpoint source control, but much work remains to be done. Lake Tahoe is a designated "Outstanding National Resource Water" under federal anti-degradation regulations and is one of only two lakes with such a designation in California. The Lake Tahoe basin receives over 20 million visitor days per year, about five times the visitation to Yosemite National Park (USDA 2004). Five million of these visitor days are directly related to outdoor recreation (USDA 2004). The Lake Tahoe basin is recognized as a national priority because of its high resource value and its sensitivity to water quality impacts; however, increased development and watershed disturbance in the Basin continue to impact the Lake and its tributaries in spite of a comprehensive point and nonpoint source control program.

Aquatic Habitat

The Lake Tahoe basin has 11 HUC 6 watersheds encompassing 63 perennial streams and approximately 400 miles of stream (USGS 1994), of which three-quarters are within the LTBMU. The watersheds vary in elevation (1,900 to 3,320m (6,225 to 10,900ft)), size (1195 to 14585 hectares (2953 to 36040 acres)), geology (granitic or volcanic), and level of disturbance. The largest watershed is the Upper Truckee River which contains 14585 hectares (36040 acres), which serves as the main inlet for Lake Tahoe as well as the major source of sediment followed by Blackwood and Ward, respectively (USDA 2000). Watersheds and associated perennial streams vary in topography and precipitation based on orientation (TRPA and USDA 1971). Streams on the west side of the basin are steep and receive an average annual precipitation of 180 to 200 cm (71 to 79 inches) on average. In contrast, streams on the east side of the basin are less steep and typically get approximately 90 to 100 cm (30 to 39 inches) of precipitation on average. Both the north and south side streams and watersheds are intermediate in terms of steepness and precipitation in comparison; however, streams on the south side are the most gradual in slope because the rim of the basin is farther from the lake. Because of this characteristic, streams on the south side of the basin are large with a high diversity in channel morphology specifically towards the mouths of the channel. Between 1993 and 2004 the LTBMU conducted watershed improvement needs (WIN) inventories throughout the Lake Tahoe basin. During these inventories all, trails and stream channels were visited to identify areas of accelerated erosion, and opportunities for restoration. Additionally, all streams in the Basin were classified using the Rosgen Channel Typing protocol (Rosgen 2006).as well as fish habitat typing. This information was used to identify stream reaches exhibiting unstable geomorphic channel characteristics and poor aquatic habitat quality.

There are approximately 325 permanent lakes ranging in size from 0.012 to 49,776 hectares (0.03 to 123,000 acres). Of those 325 lakes, 273 or 84percent are located on NFS lands. More than half of the lakes (186) on NFS lands are less than 1 acre in size. Within the Lake Tahoe basin boundary, there are approximately126, 655 acres of lakes. Of these acres, 122,786 are Lake Tahoe while 2,400 are within the LTBMU jurisdiction with the remaining 1,470 acres in other ownership.

Management of Lake Tahoe falls under the jurisdiction of the States (both California and Nevada); however, restoring and protecting Lake Tahoe, including associated aquatic habitats and species, is a shared responsibility.

Fine sediment (<20 microns) transport to Lake Tahoe, and its effect on Lake Clarity is a primary water quality concern in the Lake Tahoe basin. Nutrient inputs (nitrogen and phosphorus) are also a concern, particularly as it affects near shore clarity. Invasive species in the forms of both aquatic plants and mollusks have also been recently identified as a major contributor to adverse impacts on near shore clarity. Because of the multi- jurisdictional status of Lake, conservation, enhancement and restoration efforts are often multi-agency endeavors.

Regardless of orientation or jurisdiction, aquatic ecosystems in the LTBMU have been influenced by major historic land uses and practices such as Comstock era logging (1860-1920), cattle and sheep grazing (1850’s-1950’s), rapid human development (1960-1980), and fire suppression throughout the basin (1911-present).

During the Comstock Era, many land use practices contributed to the degradation of water quality in both lakes and streams and to the creation of unnatural bodies of water by damming and diversions. At least two-thirds of the basin's forests were clear-cut. Clear-cutting and uncontrolled grazing probably caused the discharge of heavy loads of sediment into regional water bodies (Elliott-Fisk et al. 1997; Heyvaert 1998). In addition, Strong (1984) noted that it was common to dump sawmill waste, such as sawdust, directly into streams and Lake Tahoe. Heyvaert (1998) estimated that sediment deposition rates into Lake Tahoe increased between seven- and 12-fold during this era compared to pre-European deposition rates. Streams and lakes throughout the basin, such as Marlette and Spooner lakes, were dammed and diverted to maintain a supply of water to logging flumes (Strong 1984; Landauer 1995). This practice created artificial water bodies and changed water levels in existing water bodies such that lowland vegetation and riparian communities were presumably converted to aquatic systems. Some historians speculate that the diversion of streams and the deposition of large quantities of sediment and silt in streams and lakes were partially responsible for the decline of native LCT (Gerstung 1988; Elliott-Fisk et al. 1997).

Wetlands and meadows experienced heavy grazing pressure during the late 1800's through 1900's, which likely negatively affected stream environment zones as well as lakeshore habitat. Grazing continues to be an authorized use on the LTBMU; however, all grazing allotments are currently in vacant status. Since the mid 1900s, approximately 75 percent of marshes and 50 percent of meadows have been degraded, and around 25 percent of the basin's marshlands were developed between 1969 and 1979 (Elliott-Fisk et al. 1997). Development includes conversion from wetlands and meadows to housing developments, parking lots, and marinas, for example.

In the 1870s, the first dam on Lake Tahoe was built at the Truckee River outlet, and its use was debated by local residents (Landauer 1995). The dam raised the lake's water level by 2m (6 feet) (Elliott-Fisk et al. 1997). Raised lake levels have altered the dynamics of marshes surrounding the lake. Loss of these once dynamic systems has altered habitats for native species as well as systems that acted as sediment and nutrient sinks, thus protecting the clarity of Lake Tahoe.

Concern for the basin's water quality and aquatic habitat has steadily increased since the 1960s, as research continues to reveal the impacts of urban pollution, particularly sewage and runoff, on the basin's watersheds and on Lake Tahoe itself (Goldman et al 1986). Most sources of pollution have long-lasting effects. For example in the 1970s, Heavenly Creek still carried 60 times the nutrient load of Ward Creek five years after sewage effluent was released around Heavenly Creek (Strong 1984). To address these problems, the Tahoe Regional Planning Agency (TRPA) announced a set of environmental threshold carrying capacities in 1982 that were designed to control nutrient loading and other damage to Lake Tahoe's natural resources (TRPA 1982).

With urbanization came facilities and amenities that encouraged the growth of tourism. The LTBMU is recognized as one of the nation's most popular recreation areas and receives approximately 4.6 million visitors per year. The high concentration of recreation activities and type of recreation activities (i.e., motorized, non-motorized, developed, dispersed) affect the condition of the aquatic habitat and influence abundance, distribution, and community structure of native species. The LTBMU manages campgrounds, resorts and lodges, day use sites, recreation residences, and ski areas, and also provides special use permits for management of developed recreation facilities, outfitter and guide activities and organized events. Recreation activities occur throughout the Basin but many highly concentrated activities occur along the lake shore where there tend to also be a variety of sensitive habitat types (e.g., meadows,

marshes, etc.) and species. This is particularly true of the south shore, an area that has particularly high recreation use and also a high concentration of sensitive wildlife species and habitats.

Since the adoption of the 1988 Forest Plan and the creation of the Environmental Improvement Program (EIP) in 1997, functional characteristics of aquatic habitats have improved as a result of stream and wetland restoration efforts, reduced grazing pressure and/or installation of water quality upgrades at road/trail and recreation facilities. Based on benthic macroinvertebrate results from 2011, the overall quality of most streams is good to excellent with nearly 70 % are in reference condition (i.e. undegraded and therefore in compliance with the Clean Water Act). Restoration efforts to restore physical and biological processes, such as efforts at Blackwood Creek, Trout Creek, and Cold Creek, all of which were Environmental Improvement Projects (EIP), not only improved geomorphic processes but are also improved habitat for native species. Since the creation of the EIP, over 3,000 acres of sensitive land have been acquired, 800 acres of wetlands have been restored, 30 miles of state highways have improved stormwater runoff, 60 miles of dirt roads have been re-vegetated or removed

Of increasing concern, however, is the spread of aquatic invasive plant, animals and disease pathogens throughout Lake Tahoe and its associated water bodies. These species are known to have significant impacts to economic, social and ecologic functions (USACE, 2009). Aquatic invasive species (AIS) may be transported from infested lakes and rivers via a variety of pathways, for example, recreational watercraft, fishing gear, waders, construction machinery, and rafts. These invasive species include: zebra and quagga mussels (*Dreissena polymorpha* and *D. rostriformis bugensis*, respectively), Eurasian watermilfoil (*Myriophyllum spicatum)* and curlyleaf pondweed (*Potamogeton crispus)*, and Asian clams (*Corbicula fluminea*).

Despite public awareness campaigns and regulations prohibiting their introduction, both plant and animal invaders have been found on boats traveling to or preparing to launch in Lake Tahoe and other waterbodies in the basin. The Lake Tahoe basin is not only threatened by new AIS from other waterbodies, but also the expansion of existing populations within Lake Tahoe that expand the threat of further spread with in the Basin to nearby waterbodies. As examples, Eurasian watermilfoil has been spreading from the south to the western shores of Lake Tahoe over the last 15-20 years, and curlyleaf pondweed has begun to expand dramatically at the south end of the Lake over the last three years. Additionally, beds of Asian clams have been established in Lake Tahoe and are degrading water quality and aquatic habitat (USACE, 2009). Populations of warm water fishes such as largemouth bass (*Micropterus salmoides*) and bluegill (*Lepomis macrochirus)* are expanding in the mouths of various tributaries and lagoons, specifically in marinas, which provide optimal habitat for these invasive species (Kamerath et al. 2008). Moreover, global climate change has resulted in warmer water temperatures, likely facilitating the establishment of non-native plants in the nearshore environment and providing increased spawning areas for warm water fishes that compete with desirable species.

Aquatic ecosystems within the LTBMU provide critical habitats for fishes, amphibians, benthic invertebrates and lake plankton. Aquatic ecosystems not only include streams and lakes, but also a complex network of wetlands and meadows that provide hydrated conditions in the form of springs, seeps, swamps/marshes and lagoons AIS threaten the diversity or abundance of native species and the ecological stability of infested waters USACE 2009). Given AIS are commonly

spread by activities such as boating, fishing, hatchery releases, and aquarium dumping, an area such as Lake Tahoe, with the large amount of visitor use, is highly susceptible to invasion.

AOP were assessed in 2010 and 2011. In the summer of 2010 the LTMBU evaluated 112 road/stream crossings. Of these, 61 had full assessments completed and 51 were partial assessments due to factors such as no flow, no structure, the crossing was a bridge, or the crossing was on a decommissioned road. Approximately 82% (50 of 61) of the full assessment on all road crossings do not meet the criteria for fish passage (RED), and are barriers for at least one life stage of salmonid or sculpin. Only 11% of the fully assessed crossings met the passage criteria (GREEN) to fish for both juvenile and adult salmonid life stages. The remaining 7% of fully assessed crossings were undetermined (GREY) for salmonid or sculpin and are candidates for further evaluation. In the summer of 2011, the LTMBU evaluated 204 road-stream crossings. Of these, 117 had full assessments completed and 87 were partial assessments. Approximately 82% (96 out of 117) of the full assessments on all road-stream crossings in the 2011 survey did not meet the criteria for fish passage (red), and were barriers for at least one life stage of salmonid or sculpin. Only 8% (9 out of 117) of the fully assessed crossings met the passage criteria (green) for both juvenile and adult salmonid life stages. The remaining 10% of fully assessed crossings were indeterminate (gray) for either salmonid or sculpin and are candidates for further evaluation.

Aquatic Species

A Basin-wide inventory of native non-game fishes was initiated in 2007 to gain an understanding of the current distribution, relative abundance of species and relative composition of native fish species verses non-native within tributaries and determine the. The monitoring efforts were intended to inform land managers. These baseline conditions will provide information for future watershed and ecosystem level management decisions. To date 26 streams within the Lake Tahoe basin have been surveyed. Data from these monitoring activities revealed that native non-game fishes have been eliminated or drastically reduced in tributaries where wide spread introduction of non-native salmonids have occurred. Of the 26 streams surveyed since 2007, 15 have been dominated by non-native trout. Non-native trout have occupied nearly every habitat in all tributaries surveyed throughout the Fish Assessment and account for approximately 61% of fish surveyed since 2007. Paiute sculpin, speckled dace, and Lahontan reside shiner make up 38% of all fish surveyed, while the other native species and introduced bluegill, brown bullhead, and goldfish make up the remaining 1% (USFS 2011). When native non-game species are found it is typically in the lower third of streams (USFS 2010). Species such as mountain whitefish, Tahoe sucker, Lahontan redside shiner and Paiute sculpin historically dominated Lake Tahoe's species assemblage, along with Lahontan cutthroat trout. Other studies found similar distributions and determined that of the eight native species historically found in the Tahoe Basin, Lahontan cutthroat trout and Lahontan lake tui chub are vulnerable and mountain whitefish is near threatened (Moyle et al. 2011, Moyel et a. 1995, Moyel et a. 1989). Native fish species have also been further depressed by the illegal introductions of invasive warm-water fishes. In 2011, California Department of Fish and Game initiated manual removal efforts of invasive warm-water fishes in the Tahoe Keys and will continue such management in 2012.

Similar monitoring efforts occurred in lentic habitats to determine the status and trends of amphibian and reptile populations from 2002 through 2004 (Manley et al. 2005). Results were consistent with other research that describes this habitat and associated species particularly vulnerable to degradation because of sensitive physical, biological, and chemical balanced

required to sustain the biological integrity. Specifically, amphibians and non-native fish interactions have proven detrimental to native amphibian population throughout the Sierra Nevada's, including Lake Tahoe (Knapp 1996, Knapp et al. 2000a). Results from the basin-wide monitoring effort determined that of the four native amphibians and three native garter snakes species, with the exception of Pacific treefrog, all had low occupancy, and that long-toed salamander, western toad, and Sierra Nevada-yellow legged frog were vulnerable of extinction (Manley et al. 2005). Of the 72 lakes and 16 wet meadows (88 sample units) that were sampled, Pacific tree frogs were present in 43 of the sample units while the remaining native species occurred in only one to eight of the 88 sample units. It is evident from these survey results that native amphibians in the Lake Tahoe basin are at risk of population declines and potential extinction. The number of sites occupied by the American bullfrog, an aquatic invasive species that predates on native species and a vector of infectious disease (*Batrachochytrium dendrobatidis*) has been detected at the majority of low elevation lentic habitats (Manley et al. 2005) and has the potential to spread with rising water temperatures predicted through climate change. Bullfrogs are considered are known to prey on any species smaller than themselves, including other bullfrogs. Eradication of bullfrogs would be required in any native species recovery effort.

Climate Change

Changes in temperature, precipitation, and fire behavior have been occurring in the Lake Tahoe basin and throughout the Sierra Nevada due to fire suppression and a changing climate and are likely influencing aquatic habitat. Mean annual temperature has risen by about 17 degrees Centigrade (two degrees Fahrenheit) and precipitation has increased by 7 inches over the past 98 years; however, there is large interannual variability (DEIS Appendix C, Safford 2010). Overall there appears to be a strong upward trend in air and lake temperature, rainfall intensity, a shift from snow to rain, earlier seasonal snowmelt events, and increased inter-annual variability in the Lake Tahoe basin (Coats 2010). Stewart et al. (2005) showed that the onset of spring thaw in most major streams in the central Sierra Nevada occurred 5-30 days earlier in 2002 than in 1948, and peak streamflow (measured as the center of mass annual flow) occurred 5-15 days earlier. The Sierra Nevada has experienced an increased frequency of fires since the 1980's (Westerling et al. 2006) and an increase in the mean and maximum fire size, total burned area, and fire severity between the early 1980's and 2007 (Miller et al. 2009); increases are attributed to the interaction between climate change and increasing forest fuels.

Changing climate conditions are likely influencing amphibian and fish populations in the Lake Tahoe Basin but our understanding of the effects are not well understood and predictions are limited due to the complexity of biological and physical interactions. Temperature, water quality, food availability, flow regime, and biotic interactions are all critical factors for aquatic species distributions (Wegner et al. 2011). Changes in aquatic habitats will parallel trends in climate changes, streams and lakes will become warmer, flow will be more variable, there will be an increase in extreme events such as flooding, droughts (Rieman and Isaak 2010). Changes in sediment input and recruitment of large woody debris will likely occur due to altered forest and riparian communities and increased fire (Rieman and Isaak 2010, Miller et al. 2007).

Reiman and Isaak (2010) provide examples of aquatic ecological conditions and processes at multiple levels of biological integration from the molecular and physiological to communities and ecosystems. Individual species will respond differently to changing climate, which may

change community composition and lead to the formation of novel communities. Sensitivity to changes in temperature and flow regime varies by species. Trout and salmon require cold water to survive and the warming of the atmosphere will increase water temperatures, making certain sections of streams and rivers uninhabitable for trout and salmon as water temperatures increase. Most climate change models predict increases of approximately 5.4° F by the year 2050. Fish that are already stressed by poor water quality, degraded habitat, and non-native species will have a harder time as these natural disturbances increase and cause additional strain on them (Haak 2010). Additionally, trout are coldwater species that are sensitive to high water flow after spawning (Wenger et al. 2011). Amphibians are more threatened than either birds or mammals due to a combination impacts including: non-native fish introduction (Knapp 1996, Knapp et al. 2000a), disease (Daszak et al. 2003), habitat loss (Davidson et al. 2002) ultraviolet (UV) radiation (Blaustein et al. 1988, Blaustein et al. 2003), climate change (Davidson et al. 2002, Stuart et al. 2004) and pesticide use (Davidson et al. 2002, Boone and Bridges 2003).

In order to survive species have two options, migrate to appropriate conditions or adapt to new environmental conditions (Hawkins et al 2008). Species will only be able to migrate if habitat exists and barriers to dispersal and migration do not (Rieman and Isaak 2010). In addition to the physical habitat qualities, habitat needs to be suitable biologically. It cannot be degraded by competition with or predation by non-native species or disease. Climate may play an indirect role in facilitating disease. Chytridiomycosis is a fungal disease that infects amphibians and has been causing mortality and population declines worldwide (Berger et al. 1999, Daszak et al. 1999, Fellers et al. 2001, Bradley et al. 2002, bell et al. 2004). Fungal habitat is normally influenced by temperature and water availability (Bosch et al. 2007). Bosch et al. (2007) identified a positive correlation between climate change and chytridiomycosis.

Lahontan Cutthroat Trout (Oncorhynchus clarkia henshawi)

Lahontan cutthroat trout (LCT) was listed as an endangered species in 1970 (Federal Register Vol. 35, p.13520). In 1975, under the Endangered Species Act of 1973 as amended (ESA), LCT was reclassified as threatened to facilitate management and to allow for regulated angling (Federal Register Vol. 40, p.29864). In 1995, the U.S. Fish and Wildlife Service (USFWS) released its recovery plan for LCT, encompassing six river basins within LCT historic range, including the Truckee River basin. Endangered Species Act Specific recovery targets related to down listing (i.e. number of self-sustainable sub-populations) have yet to be determined for the basin.

The 2009 LCT 5-year status review recommended the following range-wide actions including: revise the 1995 recovery plan, develop state and tribal hatchery management plans, improve utility of monitoring/accomplishment databases and develop regulations to help conserve LCT. Discussion between both state and federal agencies regarding the revision to the 1995 recovery plan has occurred, but revision has not been formally initiated.

Historically, LCT occurred throughout the Truckee River drainage from lakes and streams within the Lake Tahoe basin downstream to Pyramid Lake, which has no outlet (Gerstung, 1988). The LCT in Pyramid Lake and Lake Tahoe were known regionally as a valuable food source consumed by the Pyramid Lake Paiute Tribe, the Washoe Tribe, early explorers and by commercial fishermen (Fowler and Bath 1981). By 1938 LCT had been

extirpated from the Tahoe Basin. Historically, LCT utilized both lake and stream habitat. Like other native fish species, they preferred cold water habitat but could utilize a wide variety of habitats as long as oxygen levels were high and cover and food were plentiful. Stream dwelling LCT feed on drift, typically a combination of terrestrial and aquatic insects. In lake habitat, small LCT fed on zooplankton or insects, while larger LCT fed on other fish species, historically Lake Tahoe tui chub (Moyle, 2002)

LCT were introduced to the headwaters of the Upper Truckee River in Meiss Meadows in the late 1980's and early 1990's through a cooperative effort between the CDFG, USFS and FWS. The Meiss Meadow population is one of the only high-elevation meadow populations of LCT in the Sierra Nevada Mountain Range and also functions as a source population for LCT in the lower river. This is the only self-sustaining population in the Lake Tahoe basin. Expansion efforts were initiated to increase the range of this population in 2009 and will continue through 2015. Additional recovery actions for LCT are ongoing in Fallen Leaf Lake and Glen Alpine Creek. Future recovery activities could also over the next 10 years in Lake Tahoe, and Third, Blackwood, Meeks, and Taylor creeks.

Sierra Nevada Yellow-legged Frog (*Rana sierrae*)

Sierra Nevada (mountain) yellow-legged frog (SNYLF) is a candidate species for listing under the Endangered Species Act (ESA) and a Region 5 Forest Service Sensitive Species (USDA Forest Service 1998). On June 24, 2007, the US Fish and Wildlife Service (FWS) published a 12-month finding on a petition to list the Sierra Nevada distinct population segment of the SNYLF (Federal Register Vol. 72, No. 121). In its finding, the FWS determined that SNYLF was warranted for listing, but precluded due to higher priority species listing determinations for other candidate species. Decisions regarding the listing of SNYLF will be reconsidered during the winter of 2012 by the USFWS and decisions are expected in 2012 or 2013.

SNYLF have been extirpated from over 90% of its historic range. It is recognized that restoration and recovery efforts are needed to restore the species habitat and prevent its range-wide extinction. To date, range-wide conservation activities (including the development of a conservation strategy) for SNYLF have been accomplished in a multi-agency format involving the FWS, National Park Service (NPS), US Forest Service (USFS), CDFG and academic institutions such as the University of California, Berkeley and Sierra Nevada Aquatic Research Laboratory.

SNYLF occupied the majority of lake, pond, marsh, and stream habitats within its historic range, and may have been the most abundant vertebrate in these montane ecosystems (Grinnell and Storer 1924). Because of their abundance, SNYLF played important roles in structuring aquatic ecosystems, nutrient cycling and food web dynamics (Finlay and Vredenburg 2007). Non-native trout, however, that have been introduced to over 90% of historic SNYLF habitat have drastically altered these ecosystems (Knapp et al. 2008, Epanchin et al. 2010). The introduction of fishes into naturally fishless mountain lakes often results in the extirpation of large-bodied zooplankton species (Knapp et al. 2008). In another study comparing 24 fishless and stocked lakes, lakes with fish had 98% fewer mayflies than did fishless lakes (Epanchin et al. 2010). The decline of the SNYLF is being driven primarily by the introduction of non-native fish and the emerging infectious disease, *Batrachochytrium dendrobatidis* (sometimes referred to as Bd or

chytrid fungus) (Knapp et al 2003, Vredenburg 2004, Knapp et al 2007, Vredenburg et al 2010). Within the historical range of SNYLF, most aquatic habitats were naturally fishless due to the presence of natural barriers that prevented the upstream movement of fish from occupied downstream habitats. Starting in the mid-1800s, several species of trout were widely introduced into fishless lakes and streams throughout the Tahoe Basin. Predation by trout on all SNYLF life stages resulted in marked declines of SNYLF across their range (Knapp and Matthews 2000, Vredenburg et al. 2005). These declines caused by introduced trout are now being partially reversed via removal of trout populations from some sites by the NPS, CDFG, and USFS Knapp et al. 2007).

SNYLF has been nearly extirpated from the Lake Tahoe basin. A small remnant population was discovered in Hell Hole Meadow, located in the headwaters of Trout Creek in the 1990's. Monitoring in the last decade has shown that the Hell Hole population is all but extirpated presumably due to prevalence of *Bd* and other factors. In an effort to avoid extirpation from the LTBMU, a recovery effort was initiated in 2008 to restore historic habitat in Desolation Wilderness. Seven lakes were identified in close proximity to source populations on the Eldorado National Forest. A subadult was detected in close proximity to a newly restored lake in 2011. Implementation activities were completed in 2007 and included manual removal of non-native trout, with plans to initiate SNYLF re-introduction efforts in these seven lakes.

Yosemite Toad (*Bufo canorus*)

The Yosemite Toad is currently a candidate (C) species for listing under the Endangered Species Act (ESA) of 1973, as amended. It was determined that listing was "warranted, but precluded" due to higher priority species listing determinations for other candidate species. Decisions regarding the listing of Yosemite Toad (BUCA) will be reconsidered by the USFWS during the winter of 2012 and decisions are expected in 2012 or 2013. Yosemite Toad is also listed by the State of California as a Species of Special Concern. To date, range-wide conservation activities (including the development of a conservation strategy) for BUCA have been accomplished in a multi-agency format involving the FWS, National Park Service (NPS), US Forest Service (USFS), CDFG and academic institutions such as the University of California, Berkeley and Sierra Nevada Aquatic Research Laboratory.

Yosemite toads are endemic to the Sierra Nevada Mountains or Province from Ebetts Pass, Alpine County to the Spanish Springs Mountain area, Fresno County (Karlstrom, 1973; Stebbins 1966) at elevations ranging from 1950 to 3444 m (6398 to 11299 ft). Jennings and Hayes (1994a) estimate that populations have disappeared from 50 percent of historical habitat. Of historical sites, declines have been concentrated in lower elevation locations with greater persistence in higher elevation locations (Davidson et al 2002). Their current range borders the boundary of the Tahoe Basin but, to date, no detections have been recorded. However, habitat for the species, which includes high elevation, open, montane meadows with permanent water sources, does occur throughout the basin. Given projected climate changes impacts, species, such as Yosemite Toad, could expand their current range in response to changing habitat conditions.

Northern Leopard Frog (*Rana pipiens*)

The northern leopard frog is a Region 5 Forest Service Sensitive Species (USDA Forest Service 1998). Historically this species occurred from Newfoundland and southern Quebec to West Virginia and west across the Canadian and northern and central portions of the United States including Oregon, Washington, and Northern California (Stebbins 1985). Reports of extirpation and range contraction are common in the western United States, where the species has disappeared from 95 percent of its historic range in California (Jennings 1995). Northern leopard frogs may be absent where large populations of American bullfrog (*Rana catesbeiana)* occur (Hammerson, 1982b; Jenning and Hayes, 1994b), as is the case in many lower elevation (lake level) habitats in the Tahoe basin. According to Jennings and Hayes (1994b), northern leopard frogs were introduced to the Lake Tahoe basin. Although preferred habitat exists within the Lake Tahoe basin, including streams, wetlands, or ponds as well as upland areas for foraging, to date, there have been no detections of this species.

Lahontan Lake Tui Chub (*Gila bicolor pectinifer*)

Lahontan Lake tui chub is a Region 5 Forest Service Sensitive Species (USDA Forest Service 1998). They occur in open water habitats, such as lakes, lagoons or river mouths and feed primarily on zooplankton. Tui chub populations have presumably declined as a result of introductions of non-native species, specifically kokanee salmon (*Oncorhychus nerka*) and opossum shrimp (*Mysis relicta*), which, through predation and competition, have significantly reduced native zooplankton (Moyle, 2002). Compounding these impacts are the illegal introductions of invasive warm-water fishes, specifically largemouth bass but potentially blue gill, crappie and brown bullhead catfish, which prey on juvenile chubs at their inshore rearing habitats (Kamerath et al. 2008).

Great Basin Great Basin rams-horn (*Helisoma newberryi)*

Great Basin Great Basin rams-horn is a Region 5 Forest Service Sensitive Species (USDA Forest Service 1998). This aquatic pulmonate snail has haemoglobin in its blood and a secondary gill or pseudobranch, allowing it to occupy poorly oxygenated, but cold waters such as cold spring upwellings. It can be almost invisible to the casual observer even when abundant because it may burrow into muddy substrates. This species may be found in larger lakes and slow rivers, including larger spring sources and spring-fed creeks (Taylor 1981). In Eagle Lake, Lassen County, *H. newberryi* commonly occurs on top of sandy substrates at depths greater than 3 meters (10 ft) (Brim Box et al. 2005). Historically the species occurred in Lake Tahoe and the slow flowing outflow into the Lower Truckee River. The population status of Great Basin rams-horn is currently unknown and there are currently no known occupied sites on the Lake Tahoe basin. However, habitat does exist indicating that if populations were detected through survey efforts they would be vulnerable to bed altering activities including, but not limited, to marina dredging and pier replacement.

3.4.3.3. Environmental Consequences

This section will provide a brief discussion of Alternatives A, B, C and D by various program areas and the direct and indirect effects on aquatic resources. A summary of the effects by alternative is displayed in Table 3-19.

Watershed and Aquatic Habitat Restoration

Alternative A

Alternative A is the No-Action alternative and continues current management as described in the 2004 SNFPA FSEIS.

Watershed and aquatic habitat restoration under this alternative continue to protect and conserve aquatic habitat. Alternative A would continue to emphasize the need and importance of healthy watersheds, stable stream channels, and the critical role of Stream Environmental Zones (SEZs) for their contribution to local water quality and lake clarity goals. This alternative would continue to recognize that activities adjacent to SEZs have the potential to deliver sediment to stream channels. Restoration of streams and related watershed processes is primarily linked to decreasing or eliminating sediment sources (stream banks, roads, and other infrastructure) and other non-point pollution sources with improving aquatic habitat conditions as secondary goals. Existing management direction under Alternative A gives the highest priority, if a conflict in management would occur, to 'the protection of water quality and the enhancement of the clarity of water in Lake Tahoe."

Management would continue to utilize the 2004 Sierra Nevada Forest Plan Amendment (SNFPA), Riparian Conservation Areas (RCAs) and Critical Aquatic Refuges (CARs) associated goals, objectives, and Standards and Guidelines in those defined areas, providing opportunities to incorporate protection measures for aquatic species (i.e. mitigation measures, design features,) to minimize risks and impacts to aquatic species and their associated habitat.

Stressors to aquatic habitat and species caused through implementation of watershed and aquatic habitat restoration are typically short-term and mitigated by installation of BMP's, which are standards designed to mitigate and alleviate impacts from stressors. Stressors can include temporary road construction and decommissioning, use of heavy equipment, water drafting, stream dewatering, and new channel construction. These stressors that are actions associated with restoration activities are consistent through all alternatives.

Status and Trend in Aquatic Habitat (Streams, Wetlands, Meadows and Springs)

Aquatic habitat will continue to improve as restoration efforts restore and enhance physical processes of degraded stream channels by constructing new stream channel, reconnecting floodplain connectivity, planting riparian vegetation, and creating habitat conditions needed by native aquatic species. These efforts will reduce sediment and nutrients generated from eroding stream beds and banks, increase stream shade and riparian vegetation, and enhance critical habitat components, such as large wood and pool riffle structure, where new stream channel is created. The construction of temporary roads needed for some implementation activities will degrade conditions by potentially increasing sediment, but these degradations should be short-

term. Standards and Guidelines and Stand Operating Procedures will reduce or eliminate impacts to aquatic habitat.

Status and Trend in Aquatic Habitat (Lakes)

Lake habitat will stay in current conditions or improve where sediment load reductions occur as a result of restoration activities, resulting in improved lake clarity. Stream restoration efforts that restore the connection of the stream to its floodplain contribute in the reduction of sediments and nutrients entering lakes, including Lake Tahoe. If, however, climate change impacts exceed what active management can affect, lake habitat could decrease as clarity decreases with an increase in phytoplankton.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

Where watershed and aquatic restoration efforts include the reclamation or restoration of LCT or SNYLF habitat, species distribution should increase. An outstanding goal of stream restoration is to increase population abundance and distribution through habitat improvements. However, food resource availability (e.g., Ensign et al. 1990), climate (e.g., Clarkson and Wilson 1995), competition (e.g., Budy et al. 2007, Knapp and Mathews 2000, Knapp et al. 2007), and habitat (e.g., Bozek and Rahel 1991, Knapp et al. 2003,) are just a few examples of the factors limiting the distribution and abundance of salmonids and amphibians. In many cases it is a combination of these factors that determine the quality of a habitat. Therefore, the impact of habitat improvement depends on the extent to which habitat, rather than other biological factors such as the presence non-native or invasive species, was the limiting factor before restoration efforts are initiated (Bond and Lake 2003; Lepori et al. 2005). If biological factors are limiting the distribution of LCT or SNYLF, non-native species eradication will be needed in addition to physical habitat restoration.

By restoring aquatic habitat components for various lifestages of each species, range expansion is possible, thus providing opportunities for an increase in distribution. The term habitat includes many variables, such as temperature, water velocity, cover (e.g., deep pools, undercut banks, boulders, overhanging vegetation), substrate, and depth. The relative importance of these different variables often changes over the life history of both LCT and SNYLF. For example, spawning activity for LCT is strongly correlated with depth, water velocity, and substrate size (Thurow and King 1994; Magee et al. 1996; Knapp and Preisler 1999), while rearing habitat is more strongly correlated with cover (Quiñones and Mulligan 2005; House 1996). Similarly, habitat for SNYLF varies based on lifestage. Although both are aquatic dependent, adults do utilize exposed boulders and logs for basking while tadpoles require in-lake habitat for cover as well as basking. Populations of LCT and SNYLF (and Yosemite toad, if detected) as a whole can suffer if the habitat requirements for all life stages are not met (White and Rahel 2008). The abiotic factors limiting populations can potentially be determined by identifying the habitat requirements of individuals of different life stages (Rosenfeld 2003). However, in most cases, even if the abiotic factors are restored, if biotic factors, such as the influence [or presence] of non-native species, are not also addressed, an increase in population distribution will be limited.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog)

Species distribution will increase where aquatic habitat restoration overlaps with biological restoration (i.e. warm-water fish and Eurasian water milfoil removal) and emphasizes or focuses on tui chub habitat needs. Great Basin Great Basin rams-horn distribution will continue to stay in baseline conditions by maintaining and protecting the integrity of springs, spring-influenced and near-shore habitats, and riparian zones.

Alternatives B and C

The emphasis of these alternatives is to protect, conserve and restore aquatic habitat. Although Alternative A provides management direction to protect and conserve, it does not provide clear direction on restoration, unlike Alternative B and C. These alternatives would continue to implement restoration necessary to restore watershed and aquatic habitat conditions. Primary focal areas over the next 5 years would continue to be those projects that decrease sedimentation from actively eroding features (i.e. stream bed and banks) and have measured contributions toward the Lake Tahoe TDML. In addition, restoration would also focus on achieving aquatic organism passage at road crossings, enhancing aquatic habitat structural components/function of streams, lakes and wetlands, and reclaiming meadow boundaries/ecological processes by removing conifers and reintroducing fire. Forest Plan direction would move from a broad approach (tied to Riparian Conservation Objectives {RCOs} in the SNFPA Aquatic Management Strategy (AMS) to a more basin-specific strategy that addresses key aspects of watershed and aquatic habitat restoration (i.e. implementing natural channel design approaches). In Alternatives B and C, the importance of lake clarity and meeting the Lake Tahoe TMDL is equal to habitat restoration

Status and Trend in Aquatic Habitat (Streams, Wetlands, Meadows and Springs)

Aquatic habitat will continue to improve as restoration efforts restore and enhance physical processes to reduce sediment and nutrients generated from eroding stream beds and banks, increase stream shade and riparian vegetation, and enhance habitat components, such as large wood and pool/riffle structure. Sensitive aquatic habitat that has been degraded due to developed recreation will be restored or enhanced. In most cases these types of habitats occur along the shoreline of Lake Tahoe. Any restoration or enhancement effort that improves habitat components along the junction of streams and Lake Tahoe will increase required habitat for native species that utilize the mouths of streams, lagoons, or lake shore wetlands. Basin-wide fish assessments (USFS2011) have determined that the majority of native fish species are found in the lower third of watersheds.

Status and Trend in Aquatic Habitat (Lakes)

Lake habitat will stay in current conditions or improve where sediment load reductions occur resulting in improved lake clarity. Stream restoration efforts that restore the connection of the stream to its floodplain contribute in the reduction of sediments and nutrients entering lakes, including Lake Tahoe by encouraging riparian vegetation to stabilize soils, protect stream banks from erosion, and intercept nutrients that might otherwise enter the lake. If, however, climate change impacts exceed what active management can affect, lake habitat could decrease as clarity decreases with an increase in phytoplankton. Because higher air temperatures can promote an increase in the surface water temperature in lakes, changes in climate can affect the physical and

chemical processes in a body of water and its watershed and, as a result, influence the primary production of waterbodies (Izmest'eva 2009).

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

Where watershed and aquatic restoration efforts include the reclamation or restoration of LCT or SNYLF habitat, species distribution will increase because of increased recovery efforts including both physical and biological habitat restoration. By restoring aquatic habitat components for various lifestages of each species, range expansion is possible thus providing opportunities for an increase in distribution. Alternative B and C provide specific Standards and Guidelines to direct future management of habitat restoration to support all life stages of native assemblages by provided connectivity, appropriate conditions for reproduction and rearing habitat. Additionally, Alternative B and C provide strategies for continued coordination and partnerships to meet the recovery needs of the species. By providing management direction that supports and encourages habitat restoration, rather than merely protection and mitigation, distribution should increase in Alternative B and C.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog)

Will increase where aquatic habitat restoration overlaps with biological restoration (i.e. warm-water fish and Eurasian water milfoil removal) and targets tui chub habitat needs. Great Basin rams horn distribution will continue to stay in baseline condition by maintaining and protecting the integrity of springs, spring-influenced and near-shore habitats, and riparian zones. Restorations activities that restore sensitive near shore habitat that provide spawning and rearing habitat for Lake Tahoe tui chub and Great Basin rams horn will improve the distribution of these species by increasing optimal and, currently, limiting habitat.

Alternative D

Restoration projects that have measurable benefits for the Lake Tahoe TMDL, T&E species recovery and aquatic organism passage related to road upgrades would continue to be implemented. Beyond these activities, this alternative puts less emphasis on active management and restoration and, instead, allows natural processes and system adjustment to occur. This alternative directs land managers to remove potential stressors to a specific system and then allow natural processes, both positive and potentially negative to occur. For instance, in-stream headcuts would not actively be stabilized, thus allowing for natural channel adjustment processes to occur.

Status and Trend in Aquatic Habitat (Streams, Wetlands, Meadows and Springs)

The status and trend of aquatic habitat will continue to improve where planned projects are implemented. In these areas, restoration efforts will reduce sediment and nutrients generated from eroding stream bed and banks, increase stream shade and riparian vegetation, and enhance habitat components, such as large wood and pool/riffle structure, where new channels are designed and constructed. Other aquatic habitat will remain in baseline conditions where currently stable OR degrade where features, such as headcuts migrate upstream and result in channel incision. In these areas, efforts will be made to conserve and protect but no active

restoration will occur, thus any improved habitat conditions would come through natural processes and time, most likely beyond the life of the Forest Plan.

Status and Trend in Aquatic Habitat (Lakes)

Lake habitat will generally stay in baseline conditions OR degrade where structural improvements, such as stream restoration to improve bank stability and reduce sediment and/or nutrient transport, are needed to restore or enhance habitat conditions. Although stressors will be removed to allow natural processes to restore habitat, this passive approach to restoration could lead to reduction in lake clarity and degradation of habitat as temperature or water chemistry exceed critical thresholds for native aquatic species.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

Where watershed and aquatic restoration efforts include the reclamation or restoration of LCT or SNYLF habitat, species distribution will increase. By restoring aquatic habitat components for various lifestages of each species, range expansion is possible thus providing opportunities for an increase in distribution. Because management for TE, candidate and proposed species has the intention of assisting in the recovery and subsequent delisting or downlisting of listed species, the passive management approach in Alternative D will not negatively impact LCT, SNYLF, or Yosemite toad directly, as Recovery Plans are put in place if a species is listed on the Endangered Species Act. However, because other native species could decline due to lack of active management as non-desirable non-native and invasive species could increase because Alternative D will not actively manage (eradicate) these species and conditions for the nondesirable species could improve as habitat conditions shift to more eutrophic conditions. This would indirectly impact the distribution of LCT, SNYLF, and Yosemite toad, if detected.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog)

Species distribution will increase where currently planned aquatic habitat restoration overlaps with biological restoration (i.e. warm-water fish and Eurasian water milfoil removal) and targets tui chub habitat needs. Beyond these planned restoration activities, tui chub distribution will remain in baseline conditions or decline where aquatic habitat is impacted by, for example, urbanization, climate change, or expansion of invasive species. Where these habitat impacts cannot be off-set by restoration, biological and physical habitat quality (water quality) will decline as will species distribution.

Great Basin rams- horn distribution will continue to stay in baseline conditions by maintaining and protecting the integrity of springs, spring-influenced and near-shore habitats, and riparian zones.

Biological Resources

Alternative A

Under Alternative A, the no-action alternative, the 2004 SNFPA AMS would continue to be implemented. The current CAR boundaries and associated Standards and Guidelines would be

maintained. The AMS Standards and Guidelines address aquatic habitat in general context, focused of protection and mitigation, and more related to achieving water quality goals by preventing stream degradation. Special status species (LCT, SNYLF, and Yosemite toad are addressed in the AMS Standards and Guidelines only in the context of grazing management (stream bank disturbance) and pesticide application (i.e. herbicides).While the 2004 SNFPA did include goals and strategies for a wide variety of aquatic ecosystem features as well as Riparian Conservation Objectives (RCOs) and designation of Critical Aquatic Refuges (CARs), this direction was for protection and mitigation of species and habitat aimed to reduce the impacts of other activities. The ability to initiate and participate in proactive approaches for threatened, endangered, and candidate species recovery and management is more tied to FSM 2670 policy, which provides direction for the recovery and delisting of federally listed species and habitat. Because the SNFPA AMS was intended to provide management direction for all National Forest's in the Sierra Nevada, it does not include specific protection or mitigation measures to address native non-special status species, such as Lake Tahoe's native non-game fishes. In addition, the SNFPA and 1988 Plan does not address aquatic invasive species management, as the impacts of these species was not prevalent during the development of the SNFPA.

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands, Meadows, and Springs)

Aquatic habitat will generally stay in baseline conditions, with potential to improve where physical and chemical habitat elements are restored or enhanced to meet threatened, endangered or candidate species life history needs. Current efforts to restore habitat through the removal of nonnative species in selected streams and lakes, as well as, stream restoration efforts that incorporate aquatic habitat components required by various life stages of native species will continue to improve status and trend of aquatic habitat. Restoration efforts that restore and enhance physical processes of degraded stream channels by constructing new stream channel, reconnecting floodplain connectivity, planting riparian vegetation will improve habitat conditions needed by native aquatic species. These efforts will reduce sediment and nutrients generated from eroding stream beds and banks, increase stream shade and riparian vegetation, and enhance critical habitat components, such as large wood and pool riffle structure, where new stream channel is created. Removal of non-native or invasive species improves habitat by reducing threats of predation, competition for food resources as well as spawning and rearing habitat thus improving growth, survivorship and overall distribution.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

LCT distribution will continue to increase in Upper Truckee River, through continuation of habitat expansion efforts down the watershed by manually removing non-native species. Increases in LCT distribution within other basin watersheds may be limited due to conflicts with management area direction or lack of consensus with the multiple agencies that make up the Recovery Implementation Team. SNYLF distribution will increases in Desolation Wilderness in response to fish removal efforts from selected lakes (Knapp et al. 2007). There is a high potential for the SNYLF population in Hell Hole to go extinct due to the presence of chytrid fungus and other factors. Due to in management area direction specifically as it relates to recreational fishing, the presence of non-native fish, and current or proposed California Department of Fish and Game (CDFG) stocking allotment, SNYLF distribution may be limited

in other basin watersheds. If Yosemite toads were detected within the life of the Forest Plan, protection and conservation measures would be taken.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog):

Tui chub distribution may increase or decrease depending on where warm water fish are targeted for removal. Great Basin rams horn distribution will continue to stay in baseline conditions by maintaining and protecting the integrity of springs, spring-influenced and near-shore habitats, and riparian zones. If Northern leopard frogs were detected within the Lake Tahoe basin within the life of the plan, protection and conservation measure would be implemented. Distribution would expand wherever competing or picivorous, warm water fish removal efforts were successful.

Alternatives B and C

Alternatives B and C put forth a revised set of desired conditions, objectives, and Standards and Guidelines that are based on current biological resource needs and anticipated future needs. This set of protection measures shifts from the current species-specific emphasis approach towards a more holistic habitat-based approach that focuses on habitat elements, function, connectivity, climate change, and community-level needs. To shift to this holistic approach, habitat and species management direction was categorized into four biological resource groups that are interrelated. These groups include: 1) General Conservation, (2) Species Refuge Area, (3) Protected Activity Center (PAC)/ Home Range Core Area (HRCA) (discussed in the Terrestrial Wildlife Report), and (4) Invasive Species and Habitat (Table 3-25).

Table 3-19. Biological Resource Groups and Emphasis

Group	Aquatic Resource Type	Management Function as Related to Desired Conditions
General Species Conservation	Native Species (including Region 5 sensitive, TRPA, and species of local concerns) and Habitat Lahontan tui chub, Tahoe sucker, Lahontan Redside, Paiute sculpin, speckled dace, mountain whitefish, western toad, long-toed salamander, Great Basin Great Basin rams-horns, and western pearlshell mussel (*Margaritifera falcata*).	Sets a framework for aquatic habitat management by linking physical conditions/processes to life history needs and concepts necessary to achieve species diversity. Recognizes the unique assemblages of endemic aquatic species and allows for partnership collaboration to conserve species and enhance habitat.
Species Refuge Areas	LCT and SNYLF	Sets desired trajectories for T&E and

Group	Aquatic Resource Type	Management Function as Related to Desired Conditions
	(and others per potential future listing actions)	candidate species recovery.
Invasive Species	Aquatic Invasive Species: Mollusks – Quagga/zebra mussels, New Zealand mudsnail, Asian clam Plants – Eurasian water milfoil, curly leaf pondweed Fishes – Largemouth bass, bluegill, crappie, brown bullhead catfish, goldfish Amphibians – bull frogs Disease/pathogens – Chytrid fungus (Bd), whirling disease	Sets a framework for AIS management (prevention, control, eradication and interagency collaboration) to guard against wide spread ecological, social and economic impacts.

These groups have been ordered in an “umbrella” organization where the General Species Conservation provides overarching, broad direction for the entire LTBMU while the other three groups, also applicable throughout the entire LTBMU, provide more specific direction for certain species and current or potential habitat.

The General Conservation incorporates management direction for all habitat and associated special status species within the LTBMU. It provides general direction in the form of desired conditions, objectives, S&G, and strategies that will guide future decision makers on habitat protection, enhancement, and/or restoration measures needed to maintain and improve the status and habitat of special status species (including Threatened, Endangered, Candidate, Proposed, and R5 Sensitive Species).

The Species Refuge Area (SRA) provides more specific direction for Threatened, Endangered, Candidate, or Proposed species listed under the Endangered Species Act. Unlike the General Conservation Area, the SRA provides decision makers with detailed guidance to aid in the recovery of these species protected under ESA while still providing the flexibility for species that could be listed in the future.

Similar to the Species Refuge Area, both the PAC/HRCA and the Invasive Species Habitat groups provide more detailed direction for species and habitat. Direction within the Invasive Species Group provides direction for prevention, control, and eradication of invasive species that currently degrade terrestrial or aquatic habitat, as well as species that are considered potential threats for future invasion. This direction was not provided in Alternative A. Similarly, direction in the PAC/HRCA group allows for restoration of existing PAC/HRCAs, if needed, to aid in the recovery of these species and habitat rather than protection alone, as directed in Alternative A.

Critical biological resources are shown on the resource overlay maps accompanying the Draft Forest Plan (Volume II). The direction for each of these groups is applicable outside of the mapped polygons, throughout the LTBMU wherever these species occur.

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands and Meadows)

Aquatic habitat will improve where physical and biological habitat elements are restored or enhanced to meet native species life history needs. Where management emphasizes or focuses on the removal of Eurasian milfoil, curly leaf pondweed (i.e. decrease non-native habitat structural components that invasive warm water fish utilize), prevention of non-native mussel introductions, and control or eradication of warm water fish, available habitat will increase for native species. Where restoration activities restore connectivity, aquatic habitat in streams will improve. Alternative B and C recognize the need for both aquatic passage to fulfill various natural history requirements as well as the possible impacts climate change could have on aquatic systems. These alternatives provide direction for insure the connectivity, both spatial and temporal, of aquatic habitats to allow for the unobstructed movement of native species to support migration, reproduction, and dispersal needs.

Current efforts to restore T&E habitat through the removal of nonnative species in selected streams and lakes, as well as, stream restoration efforts that enhance aquatic habitat components required by various life stages of native species, such as large woody debris structures, increased riparian vegetation, and pool riffle ratios that mimic historic conditions (if new stream channel is constructed), will continue to improve status and trend of aquatic habitat.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

Overall LCT distribution increases as recovery targets resident fluvial and lacustrine life histories in multiple watersheds throughout the Lake Tahoe basin. Additionally, LCT distribution would increase in areas where warm-water fish removal occurs and where restoration efforts continue to remove nonnative salmonids that out-compete LCT.

Regardless of additional management direction to aid in the recovery of SNYLF, there is a high potential for the population in Hell Hole to go extinct due to with presence of disease (Bd) and other factors. However, current recovery efforts in Desolation Wilderness will increase the distribution within the wilderness, although relocation techniques will most likely be required. Relocation efforts could be utilized to further increase the distribution of this species into other historic location throughout the basin as future recovery strategies are identified.

If Yosemite toads were detected within the LTBMU, conservation, enhancement, and restoration measures would be implemented to insure actions were consistent with recovery strategies. These actions would insure that species distribution would be maintained or improved.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog)

As the emphasis on near shore habitat management and restoration increases such as the control and removal of warm water fish and aquatic invasive weeds, as well as, the restoration of geomorphic conditions and barrier beach formation that support marsh and lagoon habitat, native tui chub distribution will increase.

Efforts that restore slow moving water such as lakeshore lagoons, wetlands, and barrier beaches, which are rare and important habitats, and occur where fluvial systems interface with Lake Tahoe will maintain or increase Great Basin rams-horn as well as Lake Tahoe tui chub distribution. Additionally, efforts to control and remove Eurasian water milfoil and curly leaf

pond weed will maintain or increase the distribution by improving water chemistry conditions and removing optimal habitat for warm water invasive fish.

If Northern leopard frogs were detected within the Lake Tahoe basin within the life of the plan, protection and conservation measure would be implemented. Distribution would increase where warm water fish removal efforts were targeted.

Alternative D

This alternative implements a more passive approach to management of native and aquatic invasive species. Recovery programs for T&E and candidate species would continue to occur in order to meet ESA and FSM 2670 policies. Only prevention and control for high priority species (quagga/zebra mussels, New Zealand mudsnail, Eurasian milfoil and curlyleaf pond weed) are implemented. Otherwise, current invasive species populations will be allowed to persist, compete with native aquatic ecosystems and/or succumb to environmental and anthropogenic factors. Desired Conditions and Standards and Guidelines in Alternative D are the same as Alternative B and C; however, objectives that recommend active restoration beyond those projects that are already planned, would not occur in Alternative D.

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands and Meadows)

Aquatic habitat will generally stay in baseline conditions, with potential to improve where physical/chemical habitat elements are restored during restoration efforts that are already planned. Aquatic habitat that is degraded or lacking components needed for life history requirements of native species will be managed passively. Known stressors, which are contributing to limited functionality, will be removed and the system will be allowed recover through time. Aquatic habitat status and trend could decline through the life of the plan as there is a potential for a reduction in water quality/chemistry, lack of flood plain connectivity and associated stream shade, increased w/d ratios, increase of warm water fish and other medium to low priority AIS species, such as bullfrogs. Improvements, beyond just removing known long term stressors, to physical, chemical, or biological habitat elements would only be employed in cases that are needed to restore TE, candidate, or proposed species life history traits.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

Overall LCT distribution increases as recovery actions target resident fluvial and lacustrine life histories in multiple watersheds throughout the Lake Tahoe basin. Because Alternative D utilizes the passive management approach, eradication and control measures for some AIS would not occur and instead natural selection processes would be allowed to determine species composition. This would indirectly impact the distribution of LCT, SNYLF, and Yosemite toad (if detected), as most AIS reduce both the abundance and distribution of native species that provide food sources and reduce the quality of habitat by altering water quality (i.e. temperature, dissolved oxygen, pH).

There is a potential for SNYLF distribution to increase in other basin watersheds as future recovery strategies are identified and coordination with partner agencies continues. However,

SNYLF distribution may decrease due to lack of targeted bull frog population reduction if such species expands to higher elevation habitats (factor being climate change). If Yosemite toads were detected within the LTBMU, conservation measures would be implemented to insure actions were consistent with recovery strategies.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog): Tui chub distribution may decline where invasive warm water fishes are not treated on NFS lands. Where active restoration is unacceptable, nearshore habitat may decline, thus further reducing the habitat and distribution of tui chub.

Great Basin Great Basin rams-horn distribution will be maintained at current levels through the protection of spring habitat, spring-influenced and near-shore habitats, and riparian zones. Distribution in slow moving water habitat could decline when active restoration is needed yet unacceptable and leads to increased sediment or reduction in water quality and chemistry required for species survival.

If Northern leopard frogs are detected, conservation measures would be incorporated to maintain distribution. Where warm water fish interact with population, distribution may decrease.

Forest Vegetation

Forest vegetation management practices occur within various stream environment zones (SEZs) where management is usually adjusted to prevent long-term erosional processes, measurable decreases in stream shade and undesired adjustments to channel form and function.

In all alternatives there are risks of adverse resource effects associated with wildfire, which could result in degradation of overall aquatic habitat and watershed condition. Because of the extreme unpredictability of either wildfire occurrence or level of effects, it is not useful to speculate regarding the level of effects on resources attributes that could occur under the various alternatives as a result of wildfire. However it can be assumed that there is a heightened level of risk of adverse effects on resources, associated with the elevated level of risk of catastrophic wildfire that would lead to the loss of vegetation, increased stream temperatures, and increased erosion that would contribute to decreases in water quality.

Treatment types and vegetation prescriptions vary between the alternatives and each pose some level of short term risk of soil erosion and subsequent impacts to aquatic habitat. These risks will be managed by a variety of established best management practices (BMP), and the standards and guidelines presented in the Draft Forest Plan.

Stressors to aquatic habitat and species in the course of conduction forest vegetation management include temporary road construction, permanent road construction, road decommissioning, mechanical equipment use, landings, piles, use of foam, and water drafting. Beyond the potential impacts of permanent roads, the environment consequences for aquatic resources would be short-term and mitigated by BMPs or project level design features.

Alternative A

Status and Trend in Aquatic Habitat (Streams, Wetlands, and Meadows)

Stream habitat will generally stay in baseline condition. Habitat will improve where forest vegetation treatments improve the structure of riparian vegetation structure in SEZ's thus floodplain processes that trap sediments and nutrients and provide stream shade and bank stability. The construction of temporary and permanent roads needed due to lack of road access in WUI and general forest could degrade conditions by potentially increasing sediment, at least short-term, because roads can create linear conduits for concentrating flows and eroded sediments. Additionally, temporary roads could increase the establishment of invasive species and create, potentially short term, passage issues for aquatic species. However implementation of BMPs and standards and guidelines would adequately manage this risk.,

Depending on wildfire behavior (severity) there are potential effects on riparian vegetation and sediment, habitat structure (i.e. large wood recruitment) and base flows. Baseflows could increase as riparian and adjacent upland vegetation decrease. Alterations in baseflows could effect spawning and rearing habitat of aquatic species.

Wetland habitat will stay in baseline conditions or decline with more potential to change site hydrologic characteristics as road construction could affect the quantity and/or timing of ground water delivery. Depending on wildfire behavior (severity) there are potential effects on riparian vegetation and sediment storage, habitat structure (i.e. large wood recruitment) and possibly ground water availability. If riparian and herbaceous vegetation decreases due to severe fire intensity, wetland functions, such as sediment storage, will decrease leading to decrease in water quality.

Similar effects could be seen in meadow habitat from road construction. However, meadow habitat will improve where removal of encroaching conifers is included in forest health treatments. Where forest vegetation treatments overlap with SEZ habitat and remove upland species from within and along meadow edges, habitat for riparian dependent species will improve. These efforts will increase meadow size,and improve vegetative composition and/or site hydrologic characteristics.

Status and Trend in Aquatic Habitat (Lakes)

Lake structure, depth, and clarity generally stay in baseline conditions as any potential excess sediment reaching lake habitat from forest management activities is not expected to be measurable. Wildfire would increase the potential for short-term impacts to water quality due to ash and fine sediment deposition with increasing benthic/plankton production resulting from input of nutrients.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

Forest vegetation treatment under Alternative A will not change the distribution of LCT, SNYLF, or Yosemite toad. Recovery efforts will continue as directed by Recovery Plans and Recovery Strategies. Forest activities will not delay future LCT or SNYLF increase in distribution resulting from restoration/recovery actions. There is potential for short-term impacts

to LCT sub-populations from increased sediment or escaped fire followed by recovery due to stocking and/or natural recruitment from connected occupied drainages. Where fire moves into occupied SNYLF or Yosemite toad habitat, there is potential for short-term local extirpation where high - moderate burn severities occur.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog)

No change in the distribution of tui chub or Great Basin rams-horn are expected due to forest vegetation treatments under Alternative A. Rather, the status and trend of these species is dependent on effectiveness of future AIS and aquatic habitat management. There could be short-term impacts from temporary roads that contribute sediment to stream channels; however, BMPs would be in place to mitigate the effects. Vegetation treatments that improve meadow habitat, see in status of meadow habitat, will improve the distribution of Northern leopard frog, if they are detected.

Alternatives B and C

In Alternatives B and C trees greater than 30 inches in diameter could be removed under certain limited circumstances. While canopy closure limits would only be retained for PACs and HRCAs, emphasis would be placed on maintaining and improving late seral habitats. Openings up to 10 acres can be created under these alternatives. However, cutting large trees or thinning to lower densities would be implemented where the objective is to enhance the promotion of mid seral, longevity of late seral stands, or the resiliency of any stand. There is allowance for the creation of openings within the mid seral stage of up to 10 acres in size to establish early seral habitat. Therefore, vegetation treatments under Alternatives B and C could remove the largest diameter trees under limited circumstances and open up the canopy beyond 40% and 50% closure, respectively. Alternative C differs from Alternative B in that a greater number of treatment acres would be implemented annually and more acres would be treated using mechanized equipment if possible. All other factors are the same.

Status and Trend in Aquatic Habitat (Streams, Wetlands, and Meadows)

Similar to Alternative A, stream habitat will generally stay in baseline condition in Alternative B and C. Habitat will improve where forest vegetation treatments improve the structure of riparian vegetation structure in SEZ's thus floodplain processes that trap sediments and nutrients and provide stream shade and bank stability. Because Alternative C proposed the treatment of more acres as well as more mechanical treatment (Table 2.1: Forest Vegetation Management section), more temporary and permanent roads will be needed. These could degrade conditions by potentially increasing sediment, at least short-term, because roads can create linear conduits for concentrating flows and eroded sediments. Additionally, temporary roads could increase the establishment of invasive species and create, potentially short term, passage issues for aquatic species. However implementation of BMPs and standards and guidelines would adequately manage this risk.

Both Alternative B and C provide direction for reintroducing fire into meadows, specifically if encroaching conifers have been removed. Where forest vegetation treatments overlap with SEZ habitat and remove upland species from within and along meadow edges, habitat for riparian

dependent species will improve. These efforts will increase meadow size, vegetative composition and/or site hydrologic characteristics. These actions would benefit aquatic habitat by restoring the vigor and diversity of riparian and herbaceous vegetation, improving water storage, and reducing the likelihood of catastrophic fire.

Status and Trend in Aquatic Habitat (Lakes)

Same as Alternative A except Alternative C, which proposes slightly more acres to be treated and burned , could have greater risk of short-term impacts to water quality due to ash and fine sediment deposition with increasing benthic/plankton production resulting from input of nutrients.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

Same as Alternative A.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog): Same as Alternative A.

Alternative D

Alternative D would follow the same canopy closure limit and opening acreage as Alternative A but is further limited in the size of trees that could be removed (dbh limit of 12 inches).

Alternative D focuses more heavily than the other alternatives on the use of fire in management of forest vegetation. This alternative would also emphasize hand thinning more than the other alternatives.

Status and Trend in Aquatic Habitat (Streams, Wetlands, and Meadows)

Stream, Wetland and Meadow habitat would stay in baseline condition or decline as limited Forest Vegetation projects would overlap with SEZs, thus conifer encroachment within these habitats could continue to degrade conditions as riparian and herbaceous vegetation is replaced by upland species. As forest health declines through lack of active management and increased beetle infestations, the likelihood of catastrophic fire increases. Depending on fire behavior (severity)there is potential foreffects on riparian vegetation, erosion, and possibly base flows. Baseflows are expected to increase as riparian and adjacent upland vegetation decrease. Alterations in baseflows could affect spawning and rearing habitat of aquatic species.

Because of the 12 in. diameter limit set in Alternative D, most areas will be treated using hand removal methods, which require either the creation of burn piles or underburns with the material lop and scattered through the unit. This could result in temporary impacts to riparian habitats, and delay vegetation rejuvenation after burns due to soil damage..

Status and Trend in Aquatic Habitat (Lakes)

Alternative D has the greatest potential to cause excess sediment transport to lake habitat due to the increase likelihood of unplanned, catastrophic fire. Additionally, water quality could further decline as the potential for ash and fine sediment deposition increases in Alternative D leading to increases in benthic/plankton production resulting from input of nutrients.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad): Forest vegetation treatment will not affect the distribution of LCT, SNYLF, or Yosemite toad. Recovery efforts will continue as directed by Recovery Plans and Recovery Strategies. However, as the risk of catastrophic fire increases risk of sedimentation into streams and lakes, increased benthic and plankton production could occur in Alternative D, and LCT, SNYLF, and Yosemite toad distribution could decline as habitat is degraded or lost. Where fire moves into occupied LCT, SNYLF or Yosemite toad habitat, there is potential for short-term local extirpation where high - moderate burn severities occur.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog): As the risk of catastrophic fire, increased sediment loads into streams and lakes, increase benthic and plankton production could occur in Alternative D, indirectly Lake Tahoe tui chub, Great Basin rams-horn, and Northern leopard frog distribution could decline as habitat is degraded or lost.. Where fire moves into occupied habitat, there is potential for short-term local extirpation where high - moderate burn severities occur.

Recreation

Managed and unmanaged recreation has varying degrees of impacts on aquatic resources, especially where activities occur in or near Stream Environment Zones (SEZs). Facilities, including parking lots, marinas, roads, and trails, pending the use, location, and site specific characteristics can impede the hydrologic characteristics of these sites, alter the vegetative composition and reduce the quality of habitat for native species.

It is expected that habitat condition and species distribution have the potential to trend negatively under Alternatives A, B, and C, depending on specific sites that would be expanded and /or have new facilities created. All three alternatives allow some degree of expansion. Typically the areas that provide recreational opportunities overlap with some of the most sensitive and rare habitat found in the Lake Tahoe basin, which includes lake shore wetlands, lagoons, meadows, barrier beaches, and stream mouths.

Alternative A

Alternative A allows for 10% expansion within the designated permit area and into the general forest. Alternative A also identifies a number of site-specific areas where recreation facilities could be expanded and new recreation facilities could be developed based on direction from the 1988 LTBMU Forest Plan (as amended). SNFPA provides general direction for avoiding adverse effects from ground disturbing activities, designing management to meeting habitat and species goals and implementing mitigations to prevent further declines of aquatic habitat conditions. For instance, a new Fallen Leaf Lake boat launch facility was identified as desirable for construction. If pursued, new facilities such as this pose high risk for both expansion of existing AIS and new introductions where developed recreation sites expand and provide direct/indirect access to waterbodies.

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands, Meadows, and Springs)

Where campgrounds and parking areas are expanded adjacent to SEZs, local hydrologic processes/characteristics may change, thereby affecting water quality and aquatic habitat parameters. However, standards and guidelines would rquire that project design incorporate

measures to mitigate effects to SEZs. Otherwise, where campgrounds and parking areas are expanded in dry upland areas, there would be no expected change in baseline conditions. The risk of decrease in stream, wetland and meadow condition where resort, ski area, new trail crossings, etc. expansion results in modification of hydrologic function, impact to water quality parameters affecting habitat and/or direct modification of habitat would be required to be mitigated. There is potential for aquatic habitat to improve (physical form and function) where facilities are moved out of SEZs.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad)

LCT distribution will generally stay in baseline conditions as recreation site expansion shouldn't preclude recovery actions; however expansion of recreation may result in an increase in human disturbance on the species and increase threat of new AIS infestation.

LCT will continue to occupy habitat in the Upper Truckee River within the recommended Wild and Scenic River (WSR) segment that is self-sustaining and reproducing with elements of source sub-populations. Individual LCT will continue to migrate downstream to lower UTR segments that are outside of the WSR designation as expansion efforts continue.

Recreation activities may directly disturb SNYLF in all life stages, specifically tadpoles and juveniles that have the potential to be injured or killed by bikers, hikers, OHVs, and packstock. Stocking of high elevation lakes with non-native fish to support recreational fishing has had the greatest impact on this species, because all life stages are preyed upon by the fish (Bradford 1989, Feller and Drost 1993). With the potential to increase recreation facilities by 10 percent, direct and indirect impacts could decrease the abundance and distribution of SNYLF. Emphasis on SNYLF recovery in the Desolation Wilderness will continue (per Wilderness Act and FS wilderness policy), but this species will continue to face extinction and local extirpation threats which include: Bd disease and human impacts on the quantity and quality of historic and current habitat. SNYLF will continue to be at risk of local extirpation in Hell Hole due to disease and other factors. Similar responses would apply to Yosemite toad distribution if the species was detected in the LTBMU.

Status and Trend in Species Distribution (Tui chub, rams-horn, and Northern leopard frog): Tui chub and rams-horn distribution will generally stay in baseline conditions; however disturbance from recreation site expansion may result in a decrease of habitat quality by potentially increasing access to sensitive aquatic habitats. Site expansion and associated increased visitor use could also increase the threats of new AIS introduction through both motorized and non-motorized boat use. This would further reduce habitat and distribution of tui chub and potentially Great Basin rams-horn and Northern leopard frog (if detected).

Alternative B

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands, Meadows): Where campgrounds and parking areas are expanded adjacent to SEZs, local hydrologic processes will risk decline if soil compaction, vegetative compositions, and ground water characteristics decline and affect water quality and aquatic habitat parameters. However, standards and guidelines would rquire that project design incorporate measures to mitigate effects to SEZs. These

potential direct and indirect impacts would be less than Alternative A as the potential for expansion decreases 5 percent in this Alternative. Where campgrounds and parking areas are expanded in drier site upland areas no expected change in baseline conditions. The potential for a decrease in stream, wetland and meadow condition where resort, ski area and new trail crossing expansion results in modification of hydrologic function, water quality and habitat would be mitigated as required by the standards and guidelines. Alternative B allows for the relocation of developed recreational sites that are located in sensitive habitats. Where developed recreation facilities are modified or relocated in order to restore habitat parameters that resemble historic conditions, aquatic habitat will improve (physical form and function). Sensitive habitats such as SEZ's, wetlands, and barrier beaches not only provide dynamic and rare habitat for aquatic species but also filter fine sediments and nutrients thus protect water quality parameters of both streams and lakes.

Status and Trend in Species Distribution (LCT and SNYLF): The potential recreational impacts to LCT and SNYLF are the same as Alternative A.

Status and Trend in Species Distribution (Tui chub/rams-horn): Tui chub and Great Basin rams-horn distribution will generally stay in baseline conditions, however disturbance from recreation site expansion may result in a decrease of habitat quality by potentially increasing access to sensitive aquatic habitats.

Alternative C

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands, Meadows): As in Alternative A and B, where campgrounds and parking areas are adjacent to SEZs, local hydrologic processes/characteristics could change as potential soil compaction increases, infiltration decreases, vegetation diversity decreases, and erosion increases, thereby affecting water quality and aquatic habitat parameters. However, standards and guidelines would rquire that project design incorporate measures to mitigate effects to SEZs. Alternative C allows for the greatest amount of expansion, therefore has the greatest potential impacts to the status and trend of aquatic habitat. Otherwise, where developed recreation is expanded in drier site upland areas, conditions will remain in baseline or decrease as visit use and associate impacts increase. There is a potential for decrease in stream, wetland and meadow condition where resort, ski area, new trail crossings, etc. expansion results in modification of hydrologic function. These impacts could impact to water quality parameters affecting habitat and/or direct modification of habitat. However, similar the Alternative B, Alternative C provides directions for the relocation, if deemed. There is potential for aquatic habitat to improve (physical form and function) where facilities are moved out of SEZ; however, as recreational sites increase by 15%, unforeseen human disturbance is expected to increase thus degrading habitat conditions.

Status and Trend in Species Distribution (LCT and SNYLF): LCT and SNYLF distribution will generally stay in baseline conditions as recreation site expansion shouldn't preclude recovery actions; however expansion may result in an increase in human disturbance on the species. Potential disturbance and habitat degradation is the greatest in Alternative C as the recreation footprint can increase by 15 percent.

Status and Trend in Species Distribution (Tui chub/rams-horn): Tui chub and Great Basin rams-horn distribution will generally stay in baseline conditions, however disturbance from recreation site expansion may result in a decrease of habitat quality by potentially increasing access to sensitive aquatic habitats. Increased recreational facilities and associated use could increase fine sediment into streams and lakes and contribute to new infestations of AIS.

Alternative D

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands, and Meadows): Where campgrounds and parking areas or other developed recreation facilities are reduced by 15%, in SEZs, water quality and aquatic habitat parameters has the potential to improve in both form and function. Removal of developed sites in sensitive areas where streams intersect with Lake Tahoe will improve lake clarity and water chemistry. These areas, if restored, trap sediments and nutrients. These areas also offer access to Lake Tahoe. If this access is removed, unmanaged recreation could occur and have unanticipated negative impacts such as excess trash, waste and user created trails in these sensitive habitats.

Status and Trend in Species Distribution (LCT, SNYLF, Yosemite toad): LCT and SNYLF distribution will generally stay in baseline conditions as recreation site reduction shouldn't influence recovery actions; however this reduction may result in a decrease in human disturbance on the species. Reduction in recreation in sensitive habitats along the lakeshore of Lake Tahoe could increase the distribution of native non-game fish. By aiding in the recovery of the historic foodweb, distribution of LCT will be improved.

Status and Trend in Species Distribution (Tui chub/rams-horn): Tui chub and Great Basin rams-horn distribution will increase as the removal of recreation sites may result in an improvement of habitat quality by decreasing human disturbance and access to sensitive aquatic habitats. Restoration that removes developed recreation from mouths of creeks will increase available habitat for both species. However, because this alternative proposes active management, the benefits of the reduction in developed recreation could be offset by the unintended consequences of this passive approach, such as, increase distribution of AIS and the impacts of unmanaged recreation (increase trash, waste, and user created trails).

Access to NFS Roads and Trails

Alternative A and B

Stream connectivity is a critical component of a healthy stream by allowing fish species to migrate to fulfill various life history needs (Fairfull and Witherridge 2003). The potential direct and indirect effects of impeding fish passage include interrupting spawning or season migrations, restricting access to preferred habitat and available food, reducing genetic flow between populations, increasing susceptibility to predation, and fragmenting previously continuous populations (NSW Department of Primary Industries 2006). Additionally the effects of roads on aquatic habitat can include increased fine sediment (Weaver and Fraley 1993, Young et al. 1991), changes in streamflow (Fairfull and Witheridge 2003), changes in water temperature by loss of shade cover, migration barriers, vectors for diseases, invasive fish introduction, channel reconfiguration and increased fishing pressure.

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands, and Meadows): Aquatic habitat would generally stay in baseline conditions or improve where roads and trails were restored or where BMPs were implemented to improve aquatic resource conditions.

Culverts can result in significant modification to channel bed form and flow conditions due to increased flow velocities, turbulence and reduced flow depth through the structure. Warren and Pardew (1998) observed that fish passage success at waterway crossings was inversely related to flow velocity, in addition to culvert structures exhibiting the highest velocities of crossing types assessed. High water velocities and excessive headloss (otherwise known as the waterfall effect) are of particular importance to many native native fish. Culverts can further restrict fish movement due to insufficient lighting within culvert, and from debris build-up at the opening, which physically blocks fish passage. Where AOP issues are addressed by replacing or re-engineering problem road crossings and enhancing form and function of the stream, habitat will increase in both quantity and quality. Hydrologic characteristics of stream channels will improve aquatic habitat by decreasing factors that contribute to erosion, contribute fine sediments and nutrients to aquatic habitat and reduce water quality.

By addressing the unauthorized trails either through adoption or decommissioning, condition of habitat in close proximity will most likely benefit by reducing potential sediment from unmanaged trails. There is a potential for an increase in stream, wetland and meadow condition where upgrades to the road or trail system results in modification of hydrologic function, impacts to water quality affecting habitat and/or direct modification of habitat (i.e. new trail crossings at streams). By decommissioning or adopting and installing appropriate BMP's there would be an expected reduction in soil compaction, erosion, and loss of vegetative compositions that is seen on unmanaged trails.

Where off-road highway vehicles are permitted, aquatic habitat conditions could deteriorate where soil compaction and erosion increase, reducing ground water characteristics, water quality, vegetative compositions and overall habitat quality. As riparian vegetation decreases water quality often decreases as this type of vegetation captures sediment and nutrients. Additionally, infiltration capacity of compacted soils is reduced increasing the likelihood of overland flow during high rain events. If riparian and herbaceous vegetation is lacking, there is a greater potential for sediments and nutrient to enter stream channels and other aquatic habitat.

Status and Trend in Species Distribution (LCT, SNYLF, Yosemite toad): Species distribution will generally stay in baseline conditions or continue to increase as road management shouldn't preclude recovery and restoration actions. Wherever connectivity is restored through the reengineering of problem stream crossings, increased distribution should occur. In some cases, however, these barriers could restrict non-desirable aquatic species from occupied habitat. Removal of barriers to organism passage may elevate the risk of spreading invasive species and depressing the abundance and distribution of these species. These situations would be addressed during project level analysis.

The potential increase in trails may increase human disturbance and increase potential for illegal fish introduction in LCT or SNYLF occupied habitat. New trails could also increase sediment loads, increased fishing pressure, or increased potential for disease (e.g. Bd) to spread in occupied or potential SNYLF habitat.

Status and Trend in Species Distribution (Tui chub, rams-horn, and Northern leopard frog): Distribution will generally stay in baseline conditions or increase where AOP increases habitat connectivity. If Northern leopard frogs were detected near existing OHV trails, distribution could decrease due to degraded habitat conditions and increased disturbance.

Alternative C

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands, Meadows): Aquatic habitat has the potential to decrease in amount and quality as miles of road open to passenger vehicles increases. Some part of these could be paved roads, which create impervious surfaces where surface runoff of substances such as motor oil, gasoline, heavy metals, as well as toxic substance used in de-icing programs can reach aquatic habitats (Noss, 1995). However, an aggressive BMP retrofit program has disconnected most roads from stream channels. There will be similar aquatic habitat benefits as stated in Alternative B when AOP issues are addressed and when unauthorized roads are decommissioned.

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad): Distribution will generally stay in baseline conditions or continue to increase as road management shouldn't preclude recovery/restoration actions. The potential increase in trails and road miles will increase human disturbance and increase potential for illegal fish introduction in LCT or SNYLF occupied habitat. New trails could also increase fishing pressure or potential for disease (e.g. Bd) to spread in occupied or potential SNYLF habitat. These impacts will be greater in Alternative C than other alternatives.

Status and Trend in Species Distribution (Tui chub, Great Basin rams-horn, and Northern leopard frog): Species distribution will generally stay in baseline conditions or increase where AOP increases habitat connectivity. Disturbance from potential road and trail expansion may result in a decrease of habitat quality by potentially increasing access to sensitive aquatic habitats (more than Alternative A and B) where species occur. Increased sediment from increased road and trails could further reduce habitat and water quality, but would be prevented through measures required by the standards and guidelines.

Alternative D

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands, Meadows): Potential to decrease (same as or slightly less than Alternative C) due to an increase in total road mileage for high clearance vehicles and OHV. Where OHV use increases,there is a potential for accelerated habitat degradation. Because of their weight, off-road vehicles compress and compact soil, altering its ability to absorb and retain water and nutrients thus concentrating the surface flow of water and increasing erosion (Dregne, 1983). OHV use is only allowed on designated routes and areas, and trail design and maintenance controls runoff, minimizing impacts.

Status and Trend in Species Distribution (LCT and SNYLF): Generally stay in baseline conditions or continue to increase as road management shouldn't preclude recovery/restoration actions. Potential increase in roads and trails may increase human disturbance and increase potential for illegal fish introduction in LCT/SNYLF occupied habitat (same as or slightly less than Alternative C).

Status and Trend in Species Distribution (Tui chub, rams-horn, and Northern leopard): The effects to species distribution would be slightly greater than other alternative because of the increase in high clearance vehicles and OHV use.

Permitted Land Uses

Alternatives A, B, C and D

Status and Trend in Aquatic Habitat (Streams, Lakes, Wetlands, Meadows): Aquatic habitat will generally stay in baseline conditions or decrease where activities impact SEZs. Level of impact to aquatic habitat is dependent on duration of activity and spatial extent which occurs. However, developed standards and guidelines should eliminate or minimize any direct or indirect effects to aquatic habitat.

Alternative A considers livestock grazing as a suitable use; however, it is given the lowest priority when conflicts arise. Highest priority is given to the protection of water quality and the enhancement of clarity in Lake Tahoe

Alternative B, C, and D also consider livestock grazing as a permitted use although site specific environmental analysis is needed to determine the suitability of this activity on the single vacant grazing allotment on the LTBMU. Any authorized livestock grazing is, however, expected to have impacts to stream, wetland and meadow form and function within a designated allotment. Livestock grazing has been known to widen channels, reducing the amount of pool habitat and raising water temperatures thus reducing dissolved oxygen (Hubert et al. 1984, Stuber 1985). These alterations in channel form and function reduce spawning habitat for salmonids and other aquatic organisms. Sediments blanket spawning gravel, entombing or suffocating fish embryos and juveniles (Stevens et al. 1992).

Status and Trend in Species Distribution (LCT, SNYLF, and Yosemite toad): Beyond livestock grazing, permitted land uses will generally have no direct or indirect effects on LCT, SNYLF or, if detected, Yosemite toad. Developed Standard and Guidelines should eliminate or

reduce impacts to any TE, proposed or candidate species. However, as distribution increases through implementation of recovery efforts, there is potential for human interaction and disturbance on occupied sites to increase. This would lead to an increase potential for new AIS infestations, reduction in habitat quality (i.e. reduced stream shade or increased sediment on spawning gravels) and an increased probability of disease transmission, specifically Bd.

If livestock use were authorized, current distribution of LCT, SNYLF, and, if detected, Yosemite toad could decrease due to habitat degradation. Livestock grazing reduces herbaceous and riparian vegetation, causes soil compaction, and alters stream channels due to streambank trampling. Higher water temperatures from loss of shade, increased sedimentation and reduction in plant detritus and some benthic macroivertebrates (Rinne 1988) are known impacts of livestock grazing and cause a loss in species that require clean, cold water habitats such as LCT, SNYLF, and Yosemite toad.

Status and Trend in Species Distribution (Tui chub, rams-horn, and Northern leopard frog): There is potential for decrease of habitat quality and distribution by potentially increasing access to sensitive aquatic habitats where species occur. If Northern leopard frog were detected, habitat and distribution could decrease if authorized grazing occurred near occupied habitat. Grazing can replace riparian species by upland species and invasive weeds (Kauffman et al, 1983a, Green and Kauffman 1995), reducing riparian habitat for species such as Northern leopard frog.

Climate Change

Reiman and Isaak (2010) provide management options to support adaptation of fish populations and stream communities in response to climate change. These include enhance resilience and resistance, prioritize, facilitate transition to new states, develop local information, and coordinate efforts. While all alternatives address some of these options, Alternative D does not enhance resilience and resistance, or facilitate transition to new states because this alternative focus on passive management. Alternatives B and C, both specifically address removal of barriers for migration, and aquatic invasive species. Removal of barriers to organism passage will afford an opportunity for species to take advantage of the improved connectivity, allowing them to migrate and avoid localized detrimental conditions caused by climate change.

3.4.3.4. Analytical Conclusions

The overall condition and function of streams, lakes, wetlands and meadows across the LTBMU is expected to either improve, stay at current baseline levels or adjust with the on-set of climate change. Management direction in Alternative B and C more clearly and contemporarily outlines restoration and enhancement of watershed and aquatic habitat specific to the Lake Tahoe basin. Lahontan cutthroat trout and Sierra Nevada yellow-legged frog are expected to increase in their localized range with implementation of area-specific recovery/restoration efforts. Impacts from the recreation, road and trail and permitted land use programs could potentially off-set achievement of desired conditions for aquatic habitat and species due to increased human disturbance in and around aquatic habitat. This potential situation being prevalent in all

alternatives, but buffered in Alternatives B, C and D where updated desired conditions, objectives and standard and guidelines provide project-level direction for protection, enhancement, and restoration for aquatic habitat and associated species. To the greatest extent are the benefits in Alternative B as the impacts from other resource areas a minimal and the benefits from restoration and AIS management is the greatest. Although Alternative C shares the restoration benefits and AIS management, it is off-set by the increase in recreation, roads and trails. Furthermore, the prevalence of existing AIS populations and potential for new introductions becomes highest in Alternative D where passive management would make control and eradication more challenging.

How the Alternatives Maintain or Achieve the Desired Conditions

The restoration objectives and biological resource protection measures proposed under Alternatives B and C address contemporary desired conditions tied to species life history, habitat needs, and overall community-level management in the LTBMU. The biological resources protection measures provide clear and proactive management direction for special-status species protection and habitat restoration and enhancement as well as management standards for certain hot spot areas in the LTBMU. The desired conditions are based on Lake Tahoe and Sierra Nevada specific current state of knowledge from various watershed, ecological and species-centric assessments and research. The goal of the restoration program desired conditions is to refine management intent by defining proactive elements which sustain aquatic wildlife habitat and communities of special status species. In addition, approaches to achieve such watershed and aquatic restoration, and biological resource protection desired conditions (strategies, objectives and standards and guidelines) are scientifically credible and outcomes measurable. In contrast, desired conditions under the current direction (Alternative A) are founded in a more reactive management intent with goals of preventing aquatic habitat and species degradation from land management actions. Under Alternative A the opportunity to design site-specific land management projects to restore multiple ecosystem functions becomes more of a challenge. Alternative D includes the same desired conditions as Alternatives B and C for biological resources protection and watershed and aquatic habitat condition but fails to follow the same restoration objectives to achieve these desired conditions. Therefore, Alternatives A and D may fall short of reaching desired conditions because of the lack of the proactive biological resource protection measures in Alternative A and lack of continued restoration under Alternative D. Additionally, due to the lack of active restoration, forest management, and AIS treatment, Alternative D could contribute to habitat degradation.

Overall, Alternatives A, B, and C include management options that would maintain and/or improve aquatic wildlife habitat and better enable the habitats to respond to changing climate conditions, thereby assisting species dependent on features of these habitats. Alternative D does not provide for these opportunities. Alternatives B and C also provide for maintenance and improvement of movement corridors that would improve habitat connectivity and assist species as changing climate conditions may influence species ranges or habitat needs. The increase in recreation proposed in Alternative A and C, however, limit opportunities to meet the desired conditions for aquatic habitat and species by increasing the threat of AIS and reducing critical habitat parameters. Alternative B provides the best balance in land use and management direction to attain desired conditions.

Comparison of Consequences by Alternative

Table 3-20. Comparison of Consequences by Alternative, Aquatic Wildlife

Aquatic Resource Type	Alternative A	Alternative B	Alternative C	Alternative D
Streams, Lakes, Wetlands and Meadows	Status and trend: a) improve as result of restoration and enhancement, b) stays at baseline in roadless and wilderness areas, or areas treated in forest vegetation actions, or c) decreases where impacted by land uses, especially where expansion of recreation increases potential for AIS transference.	Status and trend: a) improve as result of restoration and enhancement, b) stays at baseline in roadless and wilderness areas, or areas treated in forest vegetation actions, or c) decreases where impacted by land uses, especially recreation, roads and trails and permitted livestock grazing. Impacts on aquatic habitat are less than Alt. A.	Status and trend: a) improve as result of restoration and enhancement, b) stays at baseline in roadless and wilderness areas, or areas treated in forest vegetation actions, or c) decreases where impacted by land uses, especially recreation, roads and trails, construction of temporary roads (forest veg), permitted livestock grazing. Impacts on aquatic habitat are more than Alt. A and B.	Status and trend: a) improve as a result of currently planned restoration and enhancement b and c) decreases where restoration or enhancement (aquatic and terrestrial) is needed but not permitted, by land uses, especially recreation, roads and trails and permitted livestock grazing. Impacts on aquatic habitat more than A, B, and C (due to AIS threats and risks of catastrophic fire).
LCT	The species distribution is expected to increase as recovery/restoration strategies progress. LCT may face increased threats with expansion of recreation facilities, trails and subsequent human interaction on occupied habitat.	The species distribution is expected to increase as recovery strategies progress. LCT may face increased threats with expansion of recreation facilities, trails and subsequent human interaction on occupied habitat at levels less than Alt. A.	The species distribution is expected to increase as recovery strategies progress. LCT may face increased threats with expansion of recreation facilities, trails and subsequent human interaction on occupied habitat at levels greater than Alt. A and Alt. B.	The species distribution is expected to increase as recovery strategies progress. LCT may face greater threats than in Alt.'s A, B and C due to increased AIS, increase risk of fire, increase impacts of unmanaged recreations, and lack of active restoration

Aquatic Resource Type	Alternative A	Alternative B	Alternative C	Alternative D
SNYLF	The species distribution is expected to increase as recovery/restoration strategies progress. SNYLF may face increased threats with expansion of recreation facilities, trails and human interaction and potential for an increase in AIS as human interaction in occupied habitat increases.	The species distribution is expected to increase as recovery strategies progress. SNYLF may face increased threats with expansion of recreation facilities, trails and subsequent human interaction and potential for an increase in AIS as human interaction in occupied habitat increases. This potential threat is less when compared to Alt. A.	The species distribution is expected to increase as recovery strategies progress. SNYLF may face increased threats with expansion of recreation facilities, trails and subsequent human interaction and potential for an increase in AIS as human interaction in occupied habitat increases at levels greater than Alt. A and B.	The species distribution is expected to increase as recovery strategies progress. SNYLF may face greater threats than in Alt.'s A, B and C due to increased AIS, increase risk of fire, increase impacts of unmanaged recreations, and lack of active restoration.
Tui Chub and Great Basin rams-horn	The species distribution is expected to stay at baseline conditions or decrease with a potential increased distribution of existing and new AIS. Otherwise, the species will be susceptible to potential impacts on sensitive shore zone and lake-stream interface habitats.	The species distribution is expected to stay at baseline conditions or increase with continued emphasis on AIS prevention, control and eradication and restoration and enhancement efforts. Potential impacts to sensitive habitat are expected to be less than Alt. A.	The species distribution is expected to stay at baseline conditions or increase with continued emphasis on AIS prevention, control and eradication and restoration and enhancement efforts. Species distribution will decrease where land use, specifically recreation, roads/trails, temporary roads (forest management) increase. Potential impacts to sensitive habitat are expected to be more than Alt. A and B.	The species distribution is expected to stay at baseline conditions or increase with decreases in recreation. Species distribution expected to decrease due to increased threat of AIS, catastrophic fire, unmanaged recreation. Potential impacts to sensitive habitat comparable or greater than other alternatives.

3.4.4. Botanical Habitat and Species

3.4.4.1. Introduction

The purpose of this botanical resource analysis is to evaluate potential effects to botanical resources across four Forest Plan Revision alternatives (see Chapter 2 of the DEIS for descriptions of Alternatives A, B, C and D). The Forest Plan is a document that provides management direction for National Forest System (NFS) lands comprising the Lake Tahoe Basin Management Unit (LTBMU).

Methodology

Effects will be assessed by how forest management activities affect the botanical resource. The analysis is driven by both Forest Service and other federal policy which include various goals to conserve and/or protect species and habitat. The above listed laws, regulations, and policies provide the fundamental guidance. TES plant survey documents and data stored in NRIS/TESP national application for data management provide the source for this analysis. The scope for botanical resources, which include vascular and non-vascular plants, lichens, fungi, and plant communities, covers:

- Threatened, endangered, candidate, and proposed species under the Endangered Species Act of 1973 (as amended)
- Region 5 Forest Service Sensitive Species

The spatial extent of the analysis includes the above botanical resources across the entire LTBMU.

Meaningful botanical effects have been identified by selected management activities. These activities ("stressors") were selected from the slate of management activities because of their potential effects to the botanical resource:

- Vegetation Management
- Watershed and Aquatic Habitat Restoration
- Terrestrial Invasive Species Management
- Recreation (which includes Day Use and Developed Recreation of Ski Areas)

The effects of the different alternatives are displayed by habitat type (in Table 3-24) in order to provide a readily accessible summary.

Technical Assistance with U.S. Fish and Wildlife Service (USFWS) for species protected as Candidates under ESA will be requested. Technical Assistance will be completed prior to issuing a Decision on the revised Forest Plan.

Assumptions

Assumptions Common to all Alternatives and Resources

The following assumptions have been made:

- Actions comprising each program and sub-program area are consistent with pertinent resource federal and state law and current and proposed revised Forest Plan standards and guidelines.
- Current and future actions for threatened, endangered (T&E) and candidate species restoration and recovery are consistent with conservation strategies, interim prescriptions, and recovery plans.
- Current and proposed revised Forest Plan components (i.e. desired conditions, standard and guidelines, etc.) invoke unit-specific habitat and species conservation elements, which are meant to be consistent with the intent of federal law and state code/statue.

3.4.4.2. Overview of the Affected Environment

The LTBMU lies within the California Floristic Province (CFP), which is based on similarities of flora and climate. The California Floristic Province (CFP) is characterized by hot, dry summers and cool, wet winters (Davis et al., 1997).

Diversity in topography, climate, geology and soils are the main factors leading to the unusual diversity of habitats and plants in the CFP (Messick 1994). The distribution of plants in the Tahoe Basin today has been heavily influenced by the past climates and geologic history. Many species are rare because they require habitat conditions that are no longer prevalent (relicts). They may be relics of earlier times, once more common, or they may just have poor mechanisms for propagating and dispersing themselves. But, just as many, if not more, are rare because they occur only in highly restricted habitats that are of a more recent origin and may never become common. These plants have specific needs met by a unique combination of habitat factors not often duplicated (Cochrane 2010). Some plants occur over wide areas, have broad distribution in more common habitats, but are seldom seen or occur in such low numbers as to be considered rare. The reasons for their rarity are not clearly evident.

The vascular plant flora of the Tahoe Basin is a subset of the CFP flora, within the Sierra Nevada physiographic region. Michael Graf (1999) describes 600 species for the area in “Plants of the Tahoe Basin,” while the Tahoe Baikal Institute suggests that there are more than 1000 (“Lake Tahoe and Lake Baikal Watersheds,” 2010), and the Lake Tahoe Watershed Assessment (Murphy et al. 2000) lists about 1,800 known or potential vascular plant species. Forest Service surveys have recorded over 1,100 species of vascular plants and over 190 species of non-vascular plants, with new species identified every year (need citation). Tahoe yellow cress (*Rorippa subumbellata*), a species in the mustard family, is found only on beaches and back beaches around Lake Tahoe itself. This endemic species is rated as Critically Endangered in Nevada and Endangered in California. It is a Candidate for listing with the USFWS.

Two other rare plants found primarily in and around the Lake Tahoe Region are Tahoe draba (*Draba asterophora* var. *asterophora*) and Cup Lake draba (*Draba asterophora* var.*macrocarpa*), both of which are also in the mustard family. On-going genetic studies at Brigham-Young University in Utah indicate that there might actually be three taxa involved, which would result in each of these species being rarer than current ratings suggest.

It is difficult to reconstruct what botanical species, including those considered rare and/or endemic, were historically present prior to the discovery of Lake Tahoe in 1844 by John C. Fremont. Fremont's collections of Sierran plants included the first collections of plants from the Tahoe area. Following the influx of Europeans into the area, a steady stream of botanists visited and collected in the Tahoe Basin, starting with William H. Brewer in 1860 and continuing through the 1900's with botanical studies made by Gladys L. Smith, who published 2 works, one in 1973 and a supplement in 1984 (Smith 1984). However, many of the collections were made primarily at personal vacation locations, and were not focused collections for the Basin.

In addition, during the Comstock Era (about 1859 to 1900) which was only about 40 years in length, trees in the lake tahoe basin were harvested to support mining operations. Only the inaccessible steep slopes of original forest remained untouched. From Smith (1984): "Many of the plants found in early years were, in fact, not found during the field work of this study and are apparently now historical records." In summary, the existing condition may well be impoverished when compared with the diversity of plants a mere 150 years previous.

Changes in temperature, precipitation, and fire behavior have been occurring in the Lake Tahoe Basin and throughout the Sierra Nevada and are likely influencing plant species. Mean annual temperature has risen by about two degrees Fahrenheit and precipitation has increased during the last century in the Lake Tahoe Basin (Safford 2010). Overall there appears to be a strong upward trend in air and lake temperature, rainfall intensity, a shift from snow to rain, earlier seasonal snowmelt events, and increased inter-annual variability in the Lake Tahoe Basin (Coats 2010). The Sierra Nevada has experienced an increased frequency of fires since the 1980's (Westerling et al. 2006) and an increase in the mean and maximum fire size, total burned area, and fire severity between the early 1980's and 2007 (Miller et al. 2009); increases are attributed to the interaction between climate change and increasing forest fuels.

Changing climate conditions are likely influencing both terrestrial and aquatic plant species in the Lake Tahoe Basin but our understanding of the effects are not well understood and predictions are limited. Models of global plant distributions predict that over the next 100 years half of the world's plant species will be threatened or endangered with temperature increases of just 2-3^{0}C (Hawkins et al. 2008). Models of California plant diversity have shown that 66% of CA plant species will experience >80% reductions in range size in the next century (Loarie et al. 2008). Mountainous areas may provide future refuge to species with shrinking ranges (Loarie et al. 2008). Individual species will respond differently to changing climate (Hawkins et al. 2008), which may change community composition and lead to the formation of novel communities.

In order to survive species have two options, migrate to appropriate conditions or adapt to new environmental conditions (Hawkins et al 2008). Species with fast generation times and wide ecological tolerances are more likely to survive than species with specific habitat requirements or long generation times (Hawkins et al 2008). Climate change has been correlated with latitudinal and altitudinal range boundary shifts (Crimmins et al. 2011, Lenoir et al. 2008). Lenoir et al.

(2008) found the 2/3 of the species they investigated shifted up in elevation, while only 1/3 of the species shifted down. There were larger shifts in distribution for mountainous species and species with faster life cycles (Lenoir et al. 2008). Water availability plays a crucial role in vegetation composition in California (Dolnac et al. 2012, Crimmins et al. 2011). In California, a larger number of species shifted towards warmer conditions, while and equal number of species shifted towards wetter and drier conditions (Crimmins et al. 2011). Rare species often have small ecological tolerances, which suggest these species may be less successful in adapting to climate change.

Species that are able to respond to climate change is by adjusting their phenology have historically increased in abundance (Willis et al. 2010). Willis et al. (2010) found that non-native and invasive species are better able to adjust their phenology than native species. This suggests that changes in climate may increase non-native species naturalization and invasion (Willis et al. 2010). In addition, this can cause a disruption in synchrony between plants and pollinators, leading to further species declines across the food chain (Hawkins et al. 2008). A decline in some species may trigger a cascade effect of local extinctions among associated species (i.e. plant species and a pollinator) and could lead to large changes in ecosystems.

Threatened, Endangered, Proposed, Candidate and Sensitive Plant Species

The Threatened, Endangered, Proposed, Candidate and Sensitive Plant Species (TEPCS) found in Table 3-21 are addressed in this analysis. The following sections provide a brief summary of these plant species. The Biological Assessment/ Biological Evaluation, located in the Forest Plan project record, includes a complete description of the TEPCS and determinations by species.

Table 3-21. Federal Threatened, Endangered, Proposed, Candidate, Sensitive Plant Species (TEPCS)

Common Name	Scientific Name	Ranking[5]					Known to occur on LBTMU
		LTBMU	Global	CA	NV	CNPS	
Whitebark pine	*Pinus albicaulis*	Candidate, FSS[1]	G3G4				Y
Tahoe yellow cress	*Rorippa subumbellata*	Candidate, FSS, SI[2], SE[3], CE[4]	G1	S1.1 SE[3]	S1S2 CE[4]	1B.1	Y
Galena Creek rockcress	*Arabis rigidissima* v. *demota*	FSS, SI	G3T2Q	S1.2	S2	1B.2	Y
Tiehm's rockcress	*Arabis tiehmii*	FSS	G2				N
Upswept moonwort	*Botrychium ascendens*	FSS	G2G3	S1.3	S1	2.3	Y
Scalloped moonwort	*Botrychium crenulatum*	FSS	G3	S2.2	S1	2.2	Y
Slender moonwort	*Botrychium lineare*	FSS	G2	S1.3		1B.3	N
Common moonwort	*Botrychium lunaria*	FSS	G5	S2		2.3	N
Mingan moonwort	*Botrychium minganense*	FSS	G4	S1.2		2.2	Y
Western goblin	*Botrychium montanum*	FSS	G3	S1.1		2.1	Y
Bolander's candlemoss	*Bruchia bolanderi*	FSS	G3	S2.2		2.2	Y
Branched collybia	*Dendrocollybia racemosa*	FSS	G2G3	S1/S1.2			Known only from an herbarium specimen from Tahoe City
Tahoe draba	*Draba asterophora* v. *asterophora*	FSS, SI	G2T2	S2		1B.2	Y
Cup Lake draba	*Draba asterophora* v. *macrocarpa*	FSS, SI	G2T1	S1		1B.1	Y

Common Name	Scientific Name	Ranking[5]					Known to occur on LBTMU
		LTBMU	Global	CA	NV	CNPS	
Subalpine fireweed	*Epilobium howellii*	FSS	G4	S4		4.3	Y
Starved daisy	*Erigeron miser*	FSS	G2	S2.3		1B.3	N
Torrey's or Donner Pass buckwheat	*Eriogonum umbellatum* v. *torreyanum*	FSS	G5T2	S2.2		1B.2	N
Blandow's bog moss	*Helodium blandowii*	FSS	G5	S1		2.3	Y
Short-leaved hulsea	*Hulsea brevifolia*	FSS	G3	S3		1B.2	N
Kellogg's lewisia	*Lewisia kelloggii ssp. hutchisonii*	FSS	G4T2T3	S2.S3		3.3	N
Kellogg's lewisia	*Lewisia kelloggii ssp. kelloggii*	FSS	G3	S2.2		1B	N
Long-petaled lewisia	*Lewisia longipetala*	FSS, SI	G2	S2.2		1B.3	Y
Three-ranked humpmoss	*Meesia triquetra*	FSS	G5	S4		4.2	Y
Broad-nerved hump-moss	*Meesia uliginosa*	FSS	G4	S2		2.2	Y
Veined water lichen	*Peltigera hydrothyria*	FSS	G4	S3.2			Y

Table 3-22. Definitions of the various rankings used to describe rarity status

Range/System	Rank	Definition
Global	G1	Critically Imperiled – At very high risk of extinction due to extreme rarity.
Global	G2	Imperiled – At high risk of extinction due to few populations, restricted range, etc.
Global	G3	Vulnerable – At moderate risk of extinction.
Global	G4	Apparently Secure – Uncommon, but not rare.
Global	G5	Demonstrably Secure – Common, widespread and abundant.
State	S1	Critically Imperiled – At very high risk of extinction due to extreme rarity.
State	S2	Imperiled – At high risk of extinction due to few populations, restricted range, etc.
State	S3	Vulnerable – At moderate risk of extinction.
State	S4	Apparently Secure – Uncommon, but not rare.
State	S5	Demonstrably Secure – Common, widespread and abundant.
CNPS	1A	Plants Presumed Extinct in California
CNPS	1B	Plants Rare, Threatened, or Endangered in California and Elsewhere
CNPS	2	Plants Rare, Threatened, or Endangered in California, but More Common Elsewhere
CNPS	3	Plants About Which We Need More Information - A Review List
CNPS	4	Plants of Limited Distribution - A Watch List
CNPS Threat Rank	0.1	Seriously threatened in California (over 80% of occurrences threatened / high degree and immediacy of threat)
CNPS Threat Rank	0.2	Fairly threatened in California (20-80% occurrences threatened / moderate degree and immediacy of threat)
CNPS Threat Rank	0.3	Not very threatened in California (<20% of occurrences threatened / low degree and immediacy of threat or no current threats known)

*Subspecies receive a T-rank attached to the G-rank. With subspecies, the G-rank reflects the condition of the entire *species* whereas the T-rank reflects the global situation of just the *subspecies* or *variety.* A “Q” indicates taxonomic questions.

**Expressing the ranks as a range of values (e.g. S2S3) means the rank is somewhere between S2 and S3.

TEPC Plant Species Narratives

Currently, no plant species are considered Threatened, Endangered, or Proposed on the LTBMU. Two species are Candidates for listing: Whitebark pine and Tahoe yellow cress (TYC). These two species are also considered Region 5 Sensitive Species.

The following are brief descriptions of the two Candidate Species, including habitat type and occurrences on the LTBMU:

Whitebark pine (*Pinus albicaulis*)

The US Fish and Wildlife Service has determined (July 2011) that the threats to whitebark pine are of high magnitude and imminent across its range. Pinus albicaulis occurs in subalpine and timberline ecosystems in the mountains of western North America, including California, Nevada, Oregon, Washington, Idaho, Wyoming, and Montana in the United States, and British Columbia and Alberta in Canada. In the US, the majority of the whitebark pine occurs on land managed by the Forest Service (USFWS 2011). According to the existing vegetation map (USFS 2005), which predicts vegetation distribution from satellite imagery, P. albicaulis extent on the LTBMU comprises 1,518 acres on rocky ridges commonly above 8000 feet in places such as Genoa Peak, Mt. Rose, Freel Peak and Monument Peak (see DEIS Map #14). An additional 11,982 acres of subalpine conifer community potentially contain P. albicaulis as a component species. Historically, P. albicaulis dominated many subalpine plant communities of the western United States. Major threats include mortality and habitat loss from white pine blister rust, mountain pine beetle, fire suppression and catastrophic fire, and climate change.

White pine blister rust is a fungal pathogen that infects all P. albicaulis age classes throughout the species' range. Genetic resistance is low and infection is always eventually fatal. Ribes species (gooseberries and currants) are the primary alternate host of white pine blister rust. Currently there are no known methods of controlling blister rust; fungicide application, pruning of infected tree branches, and/or removing Ribes species have neither eliminated nor controlled white pine blister rust (Fryer 2002). The Forest Service is currently researching the propagation of rust-resistant whitebark pine seeds and seedlings (USFWS 2011).

Mountain pine beetle is the most important insect pest of mature P. albicaulis, and epidemic outbreaks cause high mortality rates. Warming associated with global climate change may further stress P. albicaulis by allowing greater reproductive success of mountain pine beetle populations in the higher elevations dominated by P. albicaulis. Research has found that blister rust-infected trees had a higher rate of mountain pine beetle attack compared to uninfected trees when beetle population density was high (Fryer 2002).

Pinus albicaulis ecosystems are maintained by a mixed-severity fire regime of widely-ranging fire frequencies and intensities. Pinus albicaulis individuals persist in fire-prone ecosystems via two strategies: survival of large refugia trees and post-fire seedling establishment facilitated by Clark's nutcrackers. Fire exclusion in the subalpine zone favors shade-tolerant, mid- to late-

successional species such as P. contorta, Tsuga mertensiana, and Abies magnifica over P. albicaulis (Fryer 2002).

Tahoe yellow cress (*Rorippa subumbellata*)

This species is endemic to the shore zone around Lake Tahoe in California and Nevada. Typically found in back beach areas between elevations of 6,233 to 6,230 ft. The Conservation Strategy for Tahoe Yellow Cress (Pavlik et al. 2002) and its implementation are considered instrumental in keeping the endemic species, TYC, from becoming listed.

Occurrences of Tahoe yellow cress fluctuate with lake water levels, which are related to dam regulation and climate. Besides high water levels, which reduce available habitat, potential threats include development, pier construction, and trampling from increasing recreational use on the beaches.

During low lake levels of drought years, this plant increases to large numbers (20,000 counted in 2002, the second year of below normal precipitation), but during high water years many of the large-numbered populations are underwater and only small populations exist above water. In 2009 only 24 occurrences of TYC were found around the Lake. A Numerical Non-degradation Standard was adopted in the Conservation Strategy (2002), setting the minimum number of population sites for Tahoe yellow cress at 26, although this number may be revised down (Stanton, Pers. Comm.).

This species does not compete well, as it is rarely found growing with other plants. However, common/woolly mullein is often found growing near Tahoe yellow cress. Whether or not common mullein has a positive or negative effect on Tahoe yellow cress is not known at this time. It may afford some protection from trampling outside of the enclosures, but its value inside of the enclosures is questionable. Additionally, the number of plants (clones) of Tahoe yellow cress varies directly with the lake level, which is controlled by the Lake Tahoe Dam (just below the headwaters of the Truckee River), built in 1913 and operated since 1915 by the Corps of Engineers.

The Tahoe Yellow Cress Conservation Strategy and Cooperating Agreement (Pavlik, 2002) was signed by the LTBMU Forest Supervisor in September 2002. The Conservation Strategy provides direction for the conservation and management of Tahoe yellow cress with the hope to preclude federal listing of the species by full implementation of the Strategy. The Strategy outlines goals to protect, improve, promote, monitor and implement an adaptive management framework for the species. The Strategy also includes instructions on when to perform annual surveys around the Lake.

Regional Forester's Species

Currently, 25 species are on the Regional Forester's Sensitive Plant Species List for the LTBMU. This includes the 2 Candidate species described above. Of those 25, 8 have not yet been found on the LTBMU. Eleven of the remaining 16 species are 'cryptogams', including 4 mosses, 1 lichen, and 6 ferns. These cryptogams are found primarily in moist to wet places, such as wet meadows, fens, and submerged in streams. The 5 remaining species include Galena Creek rockcress, a challenging species to identify, with confirmed occurrences only in the Incline Lake

area (Morefield Pers. Comm.). The remaining 4 species are the vascular plant species that the LTBMU has been primarily involved in monitoring: Tahoe draba, Cup Lake draba, long-petaled lewisia, and Tahoe yellow cress. All 4 are also TRPA species of concern and are included in the TRPA Threshold Evaluation Report that is available every 5 years. The last report was published in 2007 (TRPA 2007a). TRPA's goal for vegetation is to increase plant diversity in forests, preserve uncommon plant communities including deepwater plants, enhance late seral forests, and maintain minimum populations of sensitive plants including Tahoe Yellowcress.

The following are brief descriptions of the Regional Forester Sensitive Species, including habitat type and occurrences on the LTBMU

Galena Creek rockcress (*Arabis rigidissima* var. *demota*)

Arabis rigidissima var. *demota* is a regional endemic species that is known from the Carson Range in Douglas and southern Washoe Counties, Nevada and from the Martis Peak area in Placer and El Dorado Counties, California. There are currently seven *A. rigidissima* var. *demota* element occurences composed of 16 sub-element occurences on LTBMU lands.

Habitat includes open, rocky areas along forest edges of conifer and/or aspen stands typically on northerly aspects above 7,500 ft. The fire tolerance of ARRID is unknown. In one experiment, a related species, *Arabis holboelli*, increased in cover following a thinning and burning treatment in a ponderosa pine forest (Metlen et al. 2006). Results from a study on the Plumas National Forest of *A. constancei* suggest that the species is tolerant of low to moderate intensity underburning treatments but intolerant of high intensity fires (Coppoletta 2010). The mixed-conifer forests in which ARRID occurs historically experienced frequent, low-intensity ground fires. Thus it is likely that the species is at least somewhat tolerant of low-intensity fires and prescribed underburns may even promote species resilience.

Interim management guidelines were established for *A. rigidissima* var. *demota* on the LTBMU by Kundert (1990). The Lake Tahoe Watershed Assessment recommends that "due to limited numbers and size of occurrences, interim conservation measures would be most effective if they provide for complete protection to all occurrences." Occurrences are primarily known from private lands outside the LTBMU and are not protected. Recommendations are to maintain existing populations of this species on USFS lands.

Tiehm's Rock Cress (Arabis tiehmii)

This species is known from Mono County, CA and Washoe County, NV. There are ten occurrences in Mono County found in the Tioga Pass, Mount Dana and Dunderberg Peak areas. There are three disjunct occurrences in Washoe County in the Mount Rose area in the Northern Carson Range on the Humboldt-Toiyabe NF. The largest documented occurrence has approximately 5000 plants reported in 1988. Population estimates are available for half of the known occurrences, totaling 7,850 plants. Other occurrences are described qualitatively (e.g. "small", "the largest of the 4 surveyed", etc.). There are no occurrences on the LTBMU.

This species occurs in steep, alpine boulder and rock fields on windswept (often snow free in winter due to wind) rocky ridges and in crevices on rocky slopes at elevations of 9740-11,775 feet (2970-3590 meters). Substrate is often metamorphic/metavolcanic in origin, but also known

from limestone and is sometimes on adjacent decomposed granite. This species is associated with sparse cover of cushion plants, associated species include *Chrysothamnus parryi*, *Monocephalus* sp., *Phlox covillei*, *Arenaria kingii*, *Calamagrostis purpurascens*, *Ribes cereum*, *Leptodactylon* sp., *Draba oligosperma*, *Draba lemmonii*, *Podistera nevadensis*, *Carex rossii*, *Eriogonum* spp. Threats are minimal and include trail use and perhaps roadwork. Most populations are unthreatened in high alpine, rocky habitats.

Moonwort complex (Botrychium spp.) (*B. ascendens*, upswept moonwort; *B. crenulatum*, scalloped moonwort; *B. lineare*, slender moonwort; *B. lunaria*, common moonwort; *B. minganense*, Mingan moonwort; *B. montanum*, western goblin)**:**

Six species of moonwort have been grouped and listed as sensitive by the Regional Forester. The moonworts were listed as a group after considering the following information: 1) most species in this genus are rare in California; 2) individual species can be difficult to distinguish from each other; and 3) the species share similar habitat requirements. A draft conservation assessment has been initiated for *Botrychium* spp. (Clines 2009). The LTBMU has not yet established specific management guidelines for any of the species in this complex; however when these species have occurred in past project areas, recommendations have been for complete protection. There are currently 14 sub-element occurrences on LTBMU lands (Table 3-23).

Table 3-23. Number of LTBMU sub-element occurrences for each species of sensitive *Botrychium*.

Species	# Sub-Element Occurrences
B. ascendens	7
B. crenulatum	4
B. lineare	0
B. lunaria	0
B. minganense	2
B. montanum	1

Botrychium species share similar habitat preferences for wet or moist organic soils in marshes, meadows, and along the edges of lakes and streams at elevations between 4,700 and 9,000 ft. They often grow with mosses, grasses, sedges, rushes, and other riparian vegetation and are closely associated with mycorrhizal fungi at all life stages. *Botrychium* species depend on mycorrhizae as a significant source of carbohydrate, minerals, and water. Therefore, hot fires that consume significant soil duff and mycorrhizae have the potential to eliminate *Botrychium* from a site. However, damage or loss of aboveground structures during low-intensity fires do not affect the size and vigor of plants in the subsequent year (Clines 2009).

Threats to *Botrychium* are actions that alter existing site characteristics, including actions that would change the microclimate, canopy coverage, hydrology, or mycorrhizal associations at a site. Information on known occurrences indicate that anthropogenic threats include off-road

vehicle damage, camping and hiking, timber harvest and firewood cutting, exotic plants and herbicides, succession to closed canopy (fire suppression), and road widening and maintenance. The major threat from these activities is the actual physical disturbance of the soil that breaks root and mycorrhizae connections or otherwise uproots the plants.

Bolander's candle moss (Bruchia bolanderi)

Bruchia bolanderi is endemic to western North America from California north to Oregon and east to Nevada and Utah. There are six element occurrences with seven sub-elements on the LTBMU.

Habitat preferences are for damp, bare soils in lower and upper montane coniferous forests, meadows, or edges of fens, springs and seeps, at elevations between 5,500 and 9,200 feet. The species is opportunistic, taking advantage of moderately disturbed sites with minimal competition from other vegetation. Because it colonizes bare soil in wetter habitats, fire would typically not carry well within its habitat. Threats include trampling of stream banks and any other activity that would increase erosion or alter hydrology.

Branched collybia (Dendrocollybia racemosa)

The mushroom, *Dendrocollybia racemosa*, has been found in Washington, Oregon, and California, and there is one documented occurrence of this species in the Lake Tahoe Basin from 1982 near Tahoe City.

This species is a mycoparasite that grows on other old, decayed or blackened mushrooms, or occasionally in coniferous duff. Potential habitat is found in mixed conifer old growth stands that have a mineral soil and duff layer and a source of moisture retention (e.g. streams, down woody debris). Surveys are most effective when the fruiting body is visible, as the extent to which the species occurs on the surface and the correlation with underground abundance is unknown. When a survey does not locate the fruiting body, the species may still be present at the site. Because of this uncertainty, it is important to manage habitat to retain characteristics suitable for fungi. Mitigations that focus on protecting fungi habitat include retaining known tree and shrub host species, retaining a component of the large-diameter trees distributed throughout the treatment unit, protecting the mineral soil and forest organic layers during all project activities, and retaining standing and down coarse woody debris.

Tahoe draba & Cup Lake draba (Draba asterophora var. asterophora & var. macrocarpa)

The current distribution of *D. asterophora* var. *asterophora* is limited to the northern Sierra Nevada in the vicinity of Lake Tahoe, from Mount Rose (Washoe County, NV) in the north to the Freel Peak/Jobs Sister area (El Dorado & Alpine Counties, CA) in the south. Four element occurrences with 39 sub-elements occur on the LTBMU, and adjacent populations are located on the Humboldt-Toiyabe National Forest. The distribution of *Draba asterophora var. macrocarpa* is even more limited; it is known from one element occurrence with nine sub-elements in the Desolation Wilderness, and one adjacent occurrence at Cup Lake on the Eldorado National Forest.

Both *D. asterophora* varieties occur on north-facing, exposed talus and boulder slopes with minimal groundcover and a sparse understory, at elevations above 8,000 feet. Soils are typically

of granitic parent material but can also be volcanic in origin. Human activities that pose direct threats to *D. asterophora* include those that might trample or uproot plants, such as recreational activities (e.g. camping, hiking, equestrian use, trail construction) and grazing as well as snowmobile traffic when snow cover is thin. The fire tolerance of *D. asterophora* is unknown but fires in the alpine sites where the species occurs were likely infrequent.

subalpine fireweed (Epilobium howellii)

Epilobium howellii is a California endemic that is distributed from Yuba Pass in Sierra County south to Fresno County. Four element occurrences with eight sub-elements occur on the LTBMU. This species may often be overlooked and therefore could be more common than indicated; based on the current distribution it is assumed to be very rare. A conservation assessment was completed by Nelson (2009).

Suitable habitat includes wet meadows, mossy seeps, and riparian areas between 6,500 and 9,000 ft elevation in subalpine coniferous forest. The species is typically found growing in short vegetation and partial shade. Because it occurs in wetter environments, fire would likely not carry well within its habitat.

starved daisy (Erigeron miser)

Erigeron miser is known from sites along the Sierra Nevada crest on the Tahoe National Forest in Nevada and Placer Counties, California. This species is suspected to be present on the LTBMU but no populations have been observed to date. Plants are known from elevations above 6,000 feet on granite outcrops where small amounts of sandy soil accumulate. The habitat for this plant is limited and fragile, with a short growing season and has not demonstrated resilience to disturbance. The largest threat to *E. miser* is rock climbing on granitic rock outcrops.

Torrey's or Donner Pass buckwheat (Eriogonum umbellatum var. torreyanum)

Eriogonum umbellatum var. *torreyanum* has been observed in Nevada, Placer, and Sierra Counties, primarily in the Donner Summit area. Currently there are no populations known to occur on the LTBMU. The Tahoe NF has developed an interim management guide for this species that provides baseline information about the status, distribution, threats, and conservation recommendations (Kan 1993).

Habitat includes dry gravelly or rocky sites, often on harsh exposures such as ridge tops or steep slopes, at elevations between 6,000 and 8,000 ft. Potential threats include mining, livestock grazing, vegetation management, and recreation such as ski area development. Small populations may be threatened by extinction due to stochastic processes such as fire, avalanche, landslide, or human impacts.

Blandow's bog-moss (Helodium blandowii)

Helodium blandowii is known from Europe, Asia, and across northern United States from New Jersey and Ohio west to California and Nevada, and northwards to Canada. There are two element occurrences with three sub-elements on the LTBMU. Habitat for this moss includes bogs and fens, wet meadows, seeps, and streambanks under willows; these habitats are especially

sensitive to hydrologic changes. The two most critical factors affecting the abundance and distribution of fen species such as *Helodium blandowii* are hydrology and the nutrient concentration of incoming water. Changes in hydrology can occur through ditching, road and trail construction, or cattle trails. The fire ecology of this species is unknown, but healthy fens rarely burn.

Short-leaved hulsea (Hulsea brevifolia)

Hulsea brevifolia is known from Tulare, Fresno, Madera, Mariposa, and Tuolumne Counties in California. There is also a record from El Dorado County south of Echo Lakes that has not been verified since 1927. Currently there are no known populations on the LTBMU.

Habitat for *H. brevifolia* is gravelly soils in montane forests. This species is known primarily from red fir stands, but has also been found in mixed conifer forests. The elevation range in California is from 4,920 to 8,860 feet. Threats include off-highway vehicle traffic, timber harvest, road maintenance and construction, and possibly prescribed burning if conducted in spring or early summer, prior to seed dispersal.

Hutchison's lewisia & Kellogg's lewisia (Lewisia kelloggii ssp. hutchisonii & ssp. kelloggii)

Lewisia kelloggii ssp. *hutchisonii* is endemic to Butte, Sierra, Plumas, Nevada, El Dorado and Amador Counties in California. No occurrences have yet been found on the LTBMU.

Lewisia kelloggii ssp. *kelloggii* is is known from Plumas County southward to Madera County. No occurrences have yet been found on the LTBMU.

Habitat for *L. kelloggii* is usually on ridgetops or relatively flat open areas with widely spaced trees in partial to full sun. Most soils are sandy granitic to erosive volcanic with granitic boulders. The species is likely tolerant of wildfire due to its thick caudex and open habitat, but could be damaged during firefighting operations, when ridgelines may be used for establishing fire control lines and the plants could be impacted by bulldozing or soil compaction

Long-Petaled Lewisia (Lewisia longipetala)

Lewisia longipetala is endemic to alpine snowfield communities along the crest of the northern Sierra Nevada between elevations of 2400 and 3800 meters. It grows in moist, rocky habitats directly below persistent snowfields, typically on north-facing and leeward slopes where snow accumulations are greatest. Plants easily become water-stressed when snowmelt ceases to reach them. Populations usually occur on gentle gravelly or bouldery slopes but are also found in the crevices of large rock slabs. Soils are derived from granitic or basaltic parent materials (Halford 1992; Halford & Nowak 1996).

The distribution of *L. longipetala* is limited to the Sierra Nevada crest in El Dorado, Nevada, and Placer Counties, California. There are currently 14 extant populations (CNPS 2010). Three populations exist in the LTBMU (consisting of 8 sub-element occurrences); all occur in Desolation Wilderness, in the vicinity of Dicks Lake, Azure Lake, and Triangle Lake.

Human activities that pose direct threats to *L. longipetala* include those that might uproot plants or disrupt the soil surface, such as recreational activities (e.g. camping, hiking, equestrian use,

trail construction) and grazing. Given that the known LTBMU populations are located on relatively remote and off-trail ridges, and the activities listed above can be regulated by land management agencies, they may be of secondary concern compared to the potential threat of snowpack decline and altered hydrologic regimes related to climate change. Changes in the timing and amount of snowmelt would likely impact the viability of *L. longipetala* populations due to the species dependence on water supplied by persistent snowfields (Halford 1992; Halford & Nowak 1996). In addition, competitive exclusion of *L. longipetala* could occur if other plant species can expand into habitat where hydrologic regimes were previously more favorable for *L. longipetala* (Halford 1992).

three-ranked hump-moss (Meesia triquetra)

A conservation assessment was completed for *M. triquetra* as well as *M. uliginosa* by Dillingham (2005). The species is well distributed in the Northern Hemisphere, although a large number of central and western European populations are now extinct due to human activities. There are twelve element occurrences with 27 sub-elements of *M. triquetra* on the LTBMU.

Meesia triquetra is found in fens and bogs as well as very wet meadows. Fens are considered "Special Aquatic Features" and receive a default riparian conservation area buffer up to 300 feet (USDA FS 2004, pg 339). The two most critical factors affecting the abundance and distribution of fen species are hydrology and the nutrient concentration of incoming water. Changes in hydrology can occur through ditching, road and trail construction, or cattle trails. The fire ecology of this species is unknown, but healthy fens rarely burn. In 2007, a fen in South Lake Tahoe, CA burned during the Angora Fire. Monitoring at this site indicates that abundance of *M. triquetra* in 2011 was similar to abundance in 2006 at three of four transects (Engelhardt & Gross 2012).

Broad-nerved hump-moss (Meesia uliginosa)

A conservation assessment was completed for *M. uliginosa* and *M. triquetra* by Dillingham (2005). This species has a continuous circumboreal distribution, and is found widely across North America. Two element occurrences are known on the LTBMU; both are located near South Lake Tahoe, CA.

Meesia uliginosa is found in fens and bogs as well as very wet meadows. It tends to grow on raised hummocks, old stumps, and old logs within the bog or fen. It has also been found in rock crevices. Fens are considered "Special Aquatic Features" and receive a default riparian conservation area buffer up to 300 feet (USDA Forest Service 2004a, pg 339). The two most critical factors affecting the abundance and distribution of fen species are hydrology and the nutrient concentration of incoming water. Changes in hydrology can occur through ditching, road and trail construction, or cattle trails. The fire ecology of this species is unknown, but healthy fens rarely burn. In 2007, a fen in South Lake Tahoe, CA burned during the Angora Fire. Monitoring at this site indicates that overall abundance of *M. uliginosa* in 2011 had decreased compared to abundance in 2006 (Engelhardt & Gross 2012); however the observed decrease may be more related to the altered hydrologic regime at the site compared to the fire.

Veined water lichen (Peltigera hydrothyria)

Peltigera hydrothyria is an uncommon North American endemic found in all major mountain ranges. A Conservation Assessment was prepared by Peterson (2010). This lichen is found in cold unpolluted streams in mixed conifer forests; it typically grows on rocks that are submerged through most of the year. *Peltigera hydrothyria* is a strong indicator of water quality as it is very sensitive to pollution and only occurs in pristine mountain streams. There are two sub-element occurrences on the LTBMU; both are located in streams flowing into Echo Lakes in El Dorado County.

Threats are any activities that alter stream characteristics including water quality, water chemistry, temperature, light regime, flows, sediment load, stream bank stability, or microclimates. Climate change may result in increased stream temperatures, which would have a detrimental effect on this species, as *P. hydrothyria* requires water temperatures below 15 °C.

Threatened, Endangered, Sensitive, Proposed and Candidate (TESPC) species Plant Species by Habitat

The following describes the seven habitat groupings and then Table 3-22 lists the rare plant species assigned to each habitat.

SEZ

Stream Environment Zones are defined in the draft Forest Plan as follows: “The SEZ concept includes wetlands as defined by the Army Corps of Engineers, but is broader, encompassing some ecotypes that are drier than wetlands. Stream environment zones (SEZs) are areas that owe their biological and physical characteristics to the presence of surface or ground water. It is important to note that SEZs are ecotypes, not simply riparian buffer zones of a designated width. Stream environment zones include perennial, intermittent and ephemeral streams, meadows and marshes, other areas of near-surface water influence, and groundwater-dependent ecosystems such as springs and fens.”

Many of the forested SEZs in the Lake Tahoe basin are currently overstocked as a result of fire suppression activities in the Lake Tahoe basin since 1911 and because SEZs were frequently avoided during fuels treatments over the past several decades. SEZs were also often affected by decades of grazing activities such as the creation of water diversion and storage structures.

Shorelines

Few shorelines around the Lake Tahoe basin’s large lakes (i.e. Fallen Leaf, Cascade, Echo Lakes), including Lake Tahoe, remain undeveloped yet are valuable to native plant and animal species such as osprey and Tahoe yellow cress. The interface of large lakes and other aquatic and terrestrial ecosystems are often relatively biologically diverse, as identified in the LTWA (2000). The largest wetlands in the Lake Tahoe basin and our only barrier beaches and lagoons are located along the shorelines of large lakes.

Meadows

In the Lake Tahoe Basin, meadow vegetation occurs at elevations ranging from lake level to almost 10,000 feet. Meadow vegetation is characterized by dense graminoid (grasses, sedges, rushes) and forb cover, with or without a shrub component. While meadows account for a small percentage of the overall Lake Tahoe Basin landscape, they are of great ecological importance. Meadows in the LTB are a spatially limited resource that plays a crucial role in hydrologic processes, erosion control, nutrient cycling, and habitat for many plant and animal species.

Meadows are usually classified based on vegetation, elevation, water table, landform, hydrology, and soil characteristics. Water table level and seasonal water table patterns are the most important factors determining the distribution of meadow vegetation, but meadow size and composition is further affected by climate, fire, and herbivory. In the LTB, dry meadows are found on floodplains or drainageways and at the dry edges of stream terraces. This type is moist in the early growing season and dry as the season progresses. Moist meadows are also found on floodplains or drainageways and stream terraces, but these sites are wet to moist through the growing season in most years. Wet meadows are found on sites that have water-saturated soils within 50 cm of the surface for most of the year. Fens are wet meadows that occur in highly organic soils were the water table is at the soil surface for most of the year.

Past land use and recurrent droughts have impaired natural function and processes of many meadows in the LTB. Perhaps the most significant documented trend in many montane meadows in the Sierra Nevada is soil drying and resulting changes in meadow structure, composition, and function. Reasons for meadow drying include past overgrazing, road construction (which alters hydrology), conifer encroachment, which may be largely due to lack of fire since the beginning of fire suppression policies, and climate warming. Montane meadows have been identified as one of the most vulnerable and impacted habitat types of the Sierra Nevada, and meadow ecosystems are an important focus area for restoration efforts in the Lake Tahoe Basin.

General Forest

The General Forest habitat type consists of Jeffrey Pine, White Fir-Mixed Conifer, Red Fir and Lodgepole Pine forest. Each of these forest types is described below.

Jeffrey Pine Forest

In the Lake Tahoe Basin, Jeffrey pine forest type occurs at elevations ranging from lake level to over 8,000 feet, and is the dominant vegetation type up to about 7500 feet, especially in the Carson Range. This forest type is dominated by Jeffrey pine and often includes white fir as an important associate; other associated conifer species are red fir, lodgepole pine, western white pine and incense cedar, depending on local environment and disturbance history of the site. Important understory species are a variety of grass and forb species as well as montane chaparral shrubs (especially manzanita, ceanothus, and bush chinquapin), sagebrush, and bitterbrush. Jeffrey pine, like ponderosa pine, is extremely fire tolerant but is not highly competitive under conditions where stands are not frequently disturbed. Shade-tolerant/fire-intolerant conifer species (principally white fir and red fir) have taken advantage of over 70 years of fire exclusion to replace Jeffrey pine as the dominant species in many sites of moderate to high productivity. Stand

densities in such sites have also greatly increased. As a result, the area of Jeffrey pine-dominated forest has greatly declined. In 1935, Jeffrey pine forest covered nearly 40% of the area of the Lake Tahoe Basin, while the most recent vegetation inventory (2003) maps only 19% of the Lake Tahoe Basin as occupied by Jeffrey pine forest. Huge areas of Jeffrey pine forest were cut down in the late 19th century to feed the silver mines in Nevada. As a result, Jeffrey pine forests in the Lake Tahoe Basin are primarily comprised of more or less single-aged, mid-seral stands.

White Fir-Mixed Conifer Forest

In the Lake Tahoe Basin, the white fir-mixed conifer forest type occurs at elevations ranging from lake level to about 7500 feet. The white fir-mixed conifer type is most common on the northwest and west shores of Lake Tahoe, but is also found in moist environments on the south and east shores. This forest type is composed of a variable mixture of conifer species, with white fir being generally dominant in the overstory and highly dominant in the understory. Jeffrey pine and other pine species may share dominance with white fir in drier, warmer locations and places of otherwise low productivity. In higher productivity sites and moist environments, white fir may comprise >70% of overstory tree density. Other associated conifers include Jeffrey pine, sugar pine, red fir, incense cedar, and lodgepole pine. Shrub species associated with white fir-mixed conifer include montane chaparral shrubs (e.g., manzanita, ceanothus, huckleberry oak, bitter cherry), Scouler's willow, and a variety of shade-tolerant shrubs like gooseberry and snowberry. Understory forbs and grasses and shrubs tend to be very heterogeneously distributed due to spatial variation in overstory canopy cover. White fir is less fire-tolerant than the pines it coexists with (except lodgepole pine), and it has increased greatly in density in response to >70 years of fire suppression in the Lake Tahoe Basin. The areal extent of white-fir dominated forest has doubled in the last 70 years, from less than 10% of the Lake Tahoe Basin in 1935, to over 20% today. Like Jeffrey pine, many stands of white fir-mixed conifer were clearcut in the late 19th century, resulting in an overabundance of mid-seral stands in the Lake Tahoe Basin.

Red Fir Forest

In the Lake Tahoe Basin, the red fir forest type occurs at elevations ranging from about 7500 feet to 9000 feet. In a few places, red fir forest sometimes occurs as low as lake level in areas of cold air drainage. The red fir forest type occurs at elevations characterized by the deepest winter snowfall. This forest type is dominated by red fir, with an important component of white fir, Jeffrey pine and sometimes sugar pine at lower elevations, and western white pine, lodgepole pine, Jeffrey pine, and mountain hemlock at higher elevations. At middle elevations in higher productivity sites and moist environments, red fir may comprise >90% of overstory tree density, but similar sites at lower elevations usually support high densities of white fir as well. The pine species become more important in lower productivity sites at higher elevations, although lodgepole pine is also found in cold, wet sites. Shrub species associated with red fir forest include montane chaparral shrubs like huckleberry oak, bush chinquapin, and species of manzanita and ceanothus, and understory shrubs like gooseberry and snowberry. Understory forbs and grasses and shrubs tend to be of low cover and are very heterogeneously distributed. Due to infrequent occurrence of fire, red fir forest has been

less impacted by fire suppression than lower elevation forest types, but some areas of heavy 19th century logging have seen strong increases in the density of lodgepole pine. The areal extent of red fir-dominated forest has increased over the last 70 years, and currently comprises about 18% of the Lake Tahoe Basin.

Lodgepole Pine Forest

In the Lake Tahoe Basin, the lodgepole pine forest type occurs at variety of elevations, often on “azonal” soils, for example sites that are either too wet or too dry or rocky for more competitive species to dominate the stand. Lower elevation lodgepole pine stands are primarily found on wet soils or in areas of cold air drainage, where air and soil temperatures are unfavorable for other species. Examples are the borders of meadows, lakes, and riparian zones. Riparian lodgepole stands are often very dense and comprised of many thin-stemmed individuals and high densities of snags and down timber. Understory diversity can range from very low to very high, depending on the availability of sunlight at the ground surface. Stands at meadow and lake edges are often much more open, and may support high levels of shrub and herb cover. At higher elevations, lodgepole pine is also common in wet soils, but it becomes the dominant species on thin, rocky soils as well. In lakeside stands, a relatively open overstory may allow the development of high understory shrub cover (e.g., willow, heather, blueberry, gooseberry). In drier stands, which also form part of the subalpine forest, the tree canopy is usually open (<50% cover) and characterized by trees of large diameter. Shrubs may include sagebrush, currant and snowberry, or scattered patches of montane chaparral. Lodgepole may also grow in dense, single-aged stands where canopy openings have occurred in fir forests.

Aspen

In the Lake Tahoe Basin, the aspen forest type occurs at elevations ranging from lake level to over 9000 feet. Stand sizes range from less than a quarter acre to 130 acres, with half of the stands being 0.8 acres or smaller. 35% of the aspen stands in the Lake Tahoe Basin are within 300 elevational feet of the level of Lake Tahoe, mostly growing in the broad bottomlands of west side canyons. In total, aspen covers less than two percent of the Lake Tahoe Basin, which is probably a fraction of its area before the institution of fire suppression policies.

Aspen is intolerant of shade, needing full sunlight to successfully establish and grow. The species reproduces primarily by vegetative reproduction, and is able to quickly respond to increases in light availability caused by disturbances like fire or treefall. Aspen grows best on deep, moist soils, but it is found on a variety of soil types. The aspen forest type is a highly valued biological habitat in the Lake Tahoe Basin. Aspen is the only upland hardwood tree species in the Lake Tahoe Basin. Aspen stands support a very species rich herbaceous plant community, and a highly diverse assemblage of insects and other invertebrates as well. Intact aspen communities are valuable nesting, hiding, foraging habitat for passerine and other bird species, rodents, large native ungulates, and raptors. The aspen forest type has a beneficial hydrologic effect in trapping snow, and storing and slowly releasing subsurface water during the dry season. As a result, aspen stands often act as effective natural barriers to fire. Aspen stands

are also prized for their aesthetic qualities, especially in the fall, when their leaves turn bright yellow.

The aspen forest type exists in a dynamic seral relationship with a number of conifer species, including lodgepole pine, white and red fir, and Jeffrey pine. Aspen is a pioneer tree species that survives in conifer-dominated forest types by taking advantage of periodic small and large-scale disturbances which reduce the density of its conifer competitors. Those disturbances provide the hormonal and environmental conditions aspen needs to dominate the forest canopy. However, historic logging and grazing practices, and >70 years of fire suppression in the Lake Tahoe Basin have diminished the occurrence of conditions which favor aspen over conifers. Surveys in the LTB have identified that approximately 2/3 of aspen stands in the Basin are currently at moderate, high, or very high risk of loss, due to conifer encroachment and/or the lack of aspen regeneration.

Insects and diseases of aspen are not well documented for California and reports of historic outbreaks or even significant insect and disease activity are lacking. However, aspen is host to a large variety of leaf spots, rusts, shoot blights, stem cankers, stem decays and defoliating and wood boring insects. Many of these agents, when combined with other stress factors such as drought and conifer encroachment, can accelerate the rate of stand decline by increasing crown dieback and mortality of individual stems. Some common native insects and diseases present in and around the Lake Tahoe Basin documented as causing injury in stressed aspen stands are the poplar borer, the bronze poplar borer, cytospora canker, and sooty bark canker. High levels of defoliation by leaf feeding insects can result in a reduction in streamside shading and wildlife hiding value, but tree mortality occurs at low levels unless repeated, multi-year events take place.

Subalpine Forest

In the Lake Tahoe Basin, the subalpine forest type occurs at elevations ranging from about 8000 feet to 10000 feet. Major tree species include mountain hemlock, whitebark pine, red fir, lodgepole pine, western white pine, and sierra juniper. Subalpine forest occurs on ground that is frozen for much of the year. Mountain hemlock is an indicator of deeper, moist soils, and deep winter snowpack. Whitebark pine is commonly found on thin soils in rocky sites that are exposed to the wind and high insolation. The subalpine forest in the Lake Tahoe Basin is extreme heterogeneous in its distribution, with patches of high density trees often separated by very open stands and expanses of rock or permanent snow fields. The extent of subalpine forest has not appreciable changed in the LTB over the last century. There is some evidence of increasing stand densities in many subalpine stands, probably due to warming temperatures and increasing precipitation over the last century. Fire frequency in subalpine forest has not changed over the last century.

Bark beetles have caused significant mortality in lodgepole pine, especially in older, relatively pure stands. Some areas experience chronic mortality levels that fluctuate in response to changes in moisture availability (i.e., tree stress) and beetle populations.

Red fir mortality primarily occurs as a result of extended drought conditions and fir engraver attack. Western white and white bark pine mortality caused by mountain pine beetle has been

occuring for the past several years and white pine blister rust (non-native) has been documented on both hosts in the LTB. Levels of western white and white bark pine mortality caused by mountain pine beetle are expected to increase if warmer temperatures and drier climate patterns prevail in the future. Mountain hemlock and sierra juniper do not typically succumb to infestation by native insects and diseases, however, typically non-tree killing agents may become more prevalent given current climate change predictions.

The subalpine forest type is not a major focus of land management concern in the LTB, and the Desired Conditions statement is less detailed than for other forest types.

Rocky Habitats

Rocky habitats are intended to describe a diverse group of terrestrial land types that may provide habitat for plant species. Rocky habitats include, but are not limited to, the types of sites displayed in Table 3-24: talus and scree fields; rock outcrops and boulders; rocky, steep slopes and ridge tops; granitic, sandy soils; shallow, volcanic soils; and thin, rocky soils in conifer forests.

Table 3-24. Plant species associated with habitat types

Common and Scientific Name	SEZ	Shorelines	Meadows	General Forest	Aspen	Subalpine Forest	Rochy Habitats
Whitebark pine *(Pinus albicaulis)*				x		x	x
Tahoe yellow cress (*Rorippa subumbellata)*		x					
Galena Creek rockcress (*Arabis [Boechera] rigidissima* v. *demote)*				x	x		
Tiehm's rockcress *(Arabis [Boechera] tiehmii)*						x	x
Upswept moonwort (*Botrychium ascendens*)	x		x				
Scalloped moonwort *(Botrychium crenulatum)*	x		x				
Slender moonwort *(Botrychium lineare)*	x		x		x		

Common and Scientific Name	SEZ	Shorelines	Meadows	General Forest	Aspen	Subalpine Forest	Rochy Habitats
Common moonwort (*Botrychium lunaria)*	x		x		x		
Mingan moonwort (*Botrychium minganense)*	x		x		x		
Western goblin (*Botrychium montanum)*	x		x		x		
Bolander's candlemoss *(Bruchia bolanderi)*	x	x	x		x		
Branched collybia *(Dendrocollybia racemosa*)				x			
Tahoe draba *(Draba asterophora* v. *asterophora*)						x	x
Cup Lake draba (*Draba asterophora* v. *macrocarpa)*						x	x
Subalpine fireweed *(Epilobium howellii*)	x		x		x		
Starved daisy (*Erigeron miser*)							x
Torrey's or Donner Pass buckwheat *(Eriogonum umbellatum* v. *torreyanum*)				x		x	x
Blandow's bog moss (*Helodium blandowii*)			x				
Short-leaved Hulsea (*Hulsea brevifolia)*				x			

Common and Scientific Name	SEZ	Shorelines	Meadows	General Forest	Aspen	Subalpine Forest	Rochy Habitats
Kellogg's lewisia (*Lewisia kelloggii ssp. hutchisonii*)				x			
Kellogg's lewisia *(Lewisia kelloggii ssp. kelloggii*)				x			
Long-petaled lewisia (*Lewisia longipetala*)							x
Three-ranked hump-moss (*Meesia triquetra*)			x				
Broad-nerved hump-moss (*Meesia uliginosa*)			x				
Veined water lichen *(Peltigera hydrothyria*)	x						

3.4.4.3. Environmental Consequences

This section displays the consequences to habitats (listed in Table 3-22), and how each alternative moves the botanical resources towards the desired condition rather than site specific environmental effects. Environmental consequences are described at a programmatic level: they are not site-specific in nature.

The primary impacts to TEPCS species from all alternatives are expanded recreational opportunities, expanded special use permits, threats from invasive species and vegetation management activities. Climate change will invariably be a driving force in the changing composition of plant communities in the Sierra Nevada; however, this will not become evident over the 15-20 year life of this Forest Plan.

Recreational use of TYC habitat (shorelines) is the second most important impact next to high water occurrences. Expanding special use recreation permits for ski areas into rare plant habitat could impact species such as Tahoe draba and whitebark pine. The varying degrees of and speed at which vegetation management activities occur could impact TEPCS species.

Vegetation and Fuels Management

Forest vegetation management across all alternatives focuses on fuels reduction, early seral forest creation, type conversion (fir to Jeffrey pine and mixed conifer), and stand resiliency. Such management is focused in the Wildland Urban Interface (WUI) for the first ten years of the Forest Plan. Across all habitat types, invasive species would pose a threat to TEPCS species under all of the alternatives. Alternatives C and D would have the greatest potential for impacts from invasive species because Alternative C would allow the greatest amount of mechanized fuels reduction and Alternative D would allow natural processes to control the rate of ecological restoration and would not allow eradication. Another impact that could occur across all habitat types would be the threat of catastrophic wildfire which would obliterate plant habitat. Within the WUI, all four alternatives would have similar effects on modifying fire behavior, and thus preventing catastrophic wildfire. Outside the WUI, alternative C would provide the most acres of modified fire behavior followed by alternatives A and B and finally alternative D (see fire/fuels section). Alternative D would have the greatest potential for habitat and plant loss from catastrophic wildfire.

SEZ

Vegetation and fuels management would have little effect on SEZ habitat because standards and guidelines and standard operating procedures would be followed under all alternatives.

Shorelines

Vegetation and fuels management would not occur along the shorelines and would therefore have no effect to this habitat type.

Meadows

Vegetation and fuels management prescribed in alternatives A, B, and C would keep encroaching conifer species from meadow habitats and promote species associated with this habitat. Under alternative D conifer species would be allowed to encroach upon meadow habitats and would cause a decrease in this habitat type and those associated species.

General Forest

Vegetation and fuels management would have the most effect on the general forest habitat type because treatments are focused in these habitat types. Under alternatives A, B, and C; active management would occur in this habitat type. Conversion of mid seral stages to early seral stages would occur the fastest in alternative C, but would also occur in alternative B. Alternatives B and C promote more diverse forest structure in this habitat type and would benefit the most species. However, alternative C would accomplish vegetation and fuels treatments with the least number of entries which would minimize disturbance to plants. Under alternatives A and D, late seral forest structure would be promoted through either active management or natural processes and this would benefit those associated species.

Aspen

Implementation of the Aspen community restoration project would occur under all of the alternatives, so all of the alternatives would have the same effects. After these initial treatments are completed, the alternatives will differ in their effects. Alternatives A, B and C would continue to treat aspen communities (Alternative C would treat more overall than A or B) and would therefore benefit these plant communities. Alternative D would employ a passive approach to restoration and so would have negative effects to this plant community because natural processes would drive restoration which may not occur at rate sufficient to maintain aspen communities.

Subalpine Forest

Alternative A does not focus vegetation and fuels management in this habitat type and would have little to no effect on the associated species. Alternatives B and C would allow vegetation and fuels management in to occur in subalpine forest, including both tree removal and the use of prescribed fire as well as planting blister rust resistant whitebark pine. Alternative C would treat more acres than alternative B during the life of the Forest Plan (15-20 years). These management actions would promote fire adapted species, such as whitebark pine. Alternative D would only allow fire in this habitat type for restoration and would take longer to restore this habitat type.

Rocky Habitats

Vegetation and fuels management is not focused on this habitat type and would have little to no effect on the associated species.

Watershed and Aquatic Habitat Restoration

SEZ

Watershed and aquatic habitat restoration would have the most effect on SEZ and Meadow habitat types because most restoration occurs in these habitat types. Alternative A would continue to provide for watershed and aquatic habitat restoration, but with the emphasis on water quality. Alternatives B and C would have the most beneficial effects to SEZ and meadow habitat because active restoration would continue, with an emphasis on aquatic habitat. Alternative D would have the least beneficial effects because no further watershed or aquatic habitat restoration would occur after current projects are implemented, natural processes would drive restoration. This would push the timeline for restoration beyond the life of this Forest Plan (15-20 years).

Shorelines

Watershed and Aquatic habitat restoration is not focused in this habitat type and would therefore have no effect on the associated species.

Meadows

Affects to meadow habitat would be the same as those to SEZ habitat. See SEZ discussion above.

General Forest

Watershed and aquatic habitat restoration is not focused on this habitat type and would have little to no effect on the associated species.

Aspen

See aspen discussion above for effects.

Subalpine Forest

Watershed and Aquatic habitat restoration is not focused in this habitat type and would therefore have no effect on the associated species.

Rocky Habitats

Watershed and Aquatic habitat restoration is not focused in this habitat type and would therefore have no effect on the associated species.

Recreation Opportunities and Access

Wilderness recreation opportunities could affect each of the seven habitat types. Wilderness designation varies by alternative with alternative D having the most amount of acres designated, followed by Alternative C and then Alternatives A and B. The number of acres of designated wilderness generally corresponds to the effects. In general, wilderness designation would be

beneficial to all of the habitat types because of the limits to which activities can occur in the wilderness (i.e. no mechanized or motorized use). Effects to all of the habitat types in wilderness include the risk of invasive species from pack animals.

SEZ

Recreation opportunities that could affect SEZ habitat include bike trails and roads. In alternatives A and B the existing road and trail systems would have little change. In alternative C, roads and trails would be upgraded to allow access to the forest by the highest amount of people so would therefore have the most negative effects. Alternative D would allow for the removal of roads and trails from this habitat type and would have the greatest positive effects.

Shorelines

The shoreline habitat type would be impacted by beach going activities, for the most part trampling. There would be no difference among the alternatives for dispersed recreation. Alternative C would allow the most expansion of developed recreation and would therefore negatively impact species in this habitat type. Alternative A would not change the amount of recreation currently allowed in this habitat type. TEPCS species locations would be protected, but conflicts with developed recreation areas would still occur. While alternative B would still allow expansion of developed recreation sites but not in sensitive areas. Alternative D would not allow any further development in sensitive areas and so would have the least amount of affects to this habitat type.

Meadows

Meadow habitat would be most impacted by trails. Alternatives A, B and D would have the most mileage of hiking and equestrian trail (367 miles each) followed by alternative C (3360 miles. Alternatives A and B have the most mileage of mechanized trail (227 miles each) followed by alternative C (218 miles) and D (200 miles). Alternatives A and B, with the most amount of mechanized and hiking/equestrian trails would have the most effect to this habitat type. Alternative D would have the least amount of effect from trails because it allows the least amount of mechanized and hiking/equestrian trails. Alternative C would range between alternatives A/B and C.

General Forest

General forest habitat types would have the same type of impacts from recreation opportunities as SEZ, Meadows, and Subalpine forest.

Aspen

Effects to the aspen habitat type would not differ by alternative.

Subalpine Forest

Recreation opportunities related to alpine skiing will have the most impact on the subalpine forest habitat type. Alternatives A and B would continue to allow ski resort expansion.

Alternative C would allow the most expansion of any of the alternatives and would therefore have the most negative effects. Alternative D would not allow new development at ski resorts and would therefore have the least effect on this habitat type and associated species.

Rocky Habitats

Effects to the rocky habitat type would not differ by alternative.

3.4.4.4. Analytical Conclusions

Comparison of Environmental Consequences by Alternatives

Vegetation and Fuels Management – Overall, alternative C would provide for the most amount of acres treated, greatest diversity of habitat types and the most reduced risk of catastrophic wildfire within the life of the Forest Plan. Alternatives A and B would also provide benefits but at a reduced amount of acres, followed by alternative D.

Watershed and Aquatic Habitat Restoration – Overall, alternatives B and C would have the most beneficial effects to plants from watershed and aquatic restoration because emphasis would be put on this type of restoration. Alternative A would also benefit plants from watershed and aquatic restoration, but not as much as alternatives B and C because emphasis is on water quality and not habitat. Alternative D would have the least benefit to plants from watershed and aquatic habitat restoration because active restoration would not occur.

Recreation Opportunities and Access – Overall, alternative D would have beneficial effects from recreation opportunities and access because motorized and mechanized trails would be minimized, and sites would be removed from sensitive areas. Alternative C would have negative effects from recreation opportunities as habitat would be lost to expansion and roads would be upgraded. Alternatives A and B would have some beneficial effects to habitat as sites are moved and developed outside of sensitive areas and roads and trails are basically managed in their current condition and configuration.

How the Alternatives Maintain or Achieve the Desired Conditions

Alternatives A, B and C all provide management options for mitigation and adaptation of plant species to climate change. Alternative D does not provide active opportunities for addressing plant responses to climate change. Critical management options in A, B and C include the conservation of plant diversity and the control of non-native invasive species. The conservation of plant diversity will increase the probability that native species will persist under different climatic options (Hawkins et al 2008).

Alternative A

This alternative would maintain stability in the short-term for botanical resources, but may not sustain continued progress towards achieving the desired condition. This alternative allows for the expansion of recreation infrastructure. Future winter demand for ski areas is addressed in this alternative, where large areas for future expansion have been identified, which potentially may affect whitebark pine and Tahoe draba.

Alternative B

Progress would follow the same pace and extent as Alternative A, resulting in the long-term of achieving desired conditions.

Alternative C

This alternative may help achieve the desired condition for some botanical resources especially in areas that would lower fire and beetle risks, such as for whitebark pine. However, this alternative may not achieve the desired condition for the Candidate species, Tahoe yellow cress, as this alternative provides the most ability to respond to summer public recreational demand.

Alternative D

This alternative may help achieve desired conditions for Tahoe draba by creating a Freel Peak Wilderness and keeping ski resorts at current acreage; however, for other species, it may not achieve the desired conditions.

3.4.5. Botanical Terrestrial Invasive Species

3.4.5.1. Introduction

The USDA Forest Service Strategic Plan for Fiscal Years 2007 through 2012 identifies the introduction and spread of invasive species as one of the four primary threats to the nation's forests and grasslands (USDA 2007). One of the identified objectives under the Strategic Plan's primary goal to "restore, sustain, and enhance the nation's forests and grasslands" is to "reduce adverse impacts from invasive and native species, pests, and diseases" (USDA 2007).

Several federal laws and regulations require the Forest Service to manage and control noxious weeds on Forest Service lands. Among these are the Federal Noxious Weed Act of 1974, as amended (7 U.S.C. 2801 et seq.), and the National Environmental Policy Act (NEPA) (42 U.S.C. 4321- 4346) and implementing regulations found at 40 CFR Parts 1500-1508 (FSM 1950; FSH 1909.15). Forest Service Manual 2080 (FSM 2080), which governs the management of noxious weed on NFS lands, describes these laws and additional regulations in Section 1 (USDA 1995). In addition, the land management plan for each national forest or forest region contain policies and guidelines for the prevention and control of invasive species. A Noxious Weeds Risk Assessment has been prepared in compliance with FSM 2080 (and now FSM 2900), which 1) analyzes the risk of noxious weed introduction or spread associated with the Lake Tahoe Basin Management Unit Forest Plan Revision within the LTBMU; 2) identifies appropriate methodology, impact reduction strategies, and BMPs to reduce these risks; and 3) identifies the recommended management actions required to further reduce project induced weed related impacts below a significant level under NEPA. This assessment is available in the Specialist's Reports section of the project record (Botanical Terrestrial Invasive Species Report, Project Record PR#4). This section is a summary of that assessment.

Definition and Selection of Noxious Weeds

The term "noxious weeds" includes all plants formally designated by the Secretary of Agriculture or other responsible State official as such, and these species usually possess one or more of the following characteristics: "aggressive and difficult to manage, poisonous, toxic, parasitic, a carrier or host of serious insects or disease, and being non-native or new to or not common to the United States or parts thereof" (USDA 1995). Several noxious weeds, as defined by the California Invasive Plant Council (Cal-IPC) or the Forest Service, already exist within or near the proposed Project in well-established populations, often clearly associated with a source of disturbance. The primary objective of this assessment is to identify noxious weed threats from actions that could result from this project.

Noxious weeds present a severe threat to natural habitats. When noxious weeds become established in an area, they can cause a permanent or long-lasting change in the environment by

increasing vegetative cover, thereby creating a dense layer that prevents native vegetation from germinating, and essentially halting normal successional processes that would typically allow an area to recover from disturbance. Weed populations can also alter edaphic and hydrological conditions and structure through nitrogen fixation (as in Spanish broom, Spartium junceum) or draining of the water table (as in giant reed, Arundo donax). Monocultures of noxious weeds create such an unfavorable environment for wildlife that associate, mutualistic species necessary for native plant life cycles, such as seed dispersers, fossorial mammals, or pollinators, can be lost from the area. In addition, heavy infestations can also significantly reduce the recreational or aesthetic value of open space. This being said, weed control efforts are costly, labor intensive, often require several years to decades of follow-up monitoring and a combination of control methods to completely eradicate populations. In many cases noxious weeds pose significant risk to native plants that may occur within the weed control area. Even still, the ecological costs and risks associated with not managing noxious weed populations are so great that these exceed risks posed by most control methods (DiTomaso 1997).

Methodology

Terrestrial Non-Native Invasive Species (NNIS) include non-native plant species that are invasive or potentially invasive to LTBMU national forest system lands, and may or may not be rated by the California Department of Food and Agriculture (CDFA) as “noxious”. This weed risk analysis is driven by both Forest Service and other federal policy which include various long-range goals and objectives consistent with an integrated pest management approach. The spatial extent of the analysis includes the above resources across the entire LTBMU. The weed risk analysis should analyze the risk of introduction, establishment and spread of existing and new NNIS – not meaningful botanical effects. The risk of introduction, establishment, and spread can be compared by management activity by alternative.

Assumptions

The following assumptions have been made:

- NNIS will continue to be introduced into new areas via use of existing roads.
- LTBMU will continue to coordinate weed management activities with MOU partners and agencies.
- High priority weeds will continue to be treated by the LTBMU on all land ownerships dependent on funding.

3.4.5.2. Overview of the Affected Environment

There are approximately 154,000 acres of NFS lands within the Tahoe Basin (78% of Basin). The LTBMU Terrestrial Invasive Plant Species (TIPS) Environmental Assessment (USDA, 2010) reported a canopy cover of 8.9 acres as infested (0.00006% of the total Forest) with NNIS. The 2010 Annual Invasive Weed Report (USDA 2011) downgraded that canopy cover acreage to 4.82.

An invasive that has been increasing dramatically in number and size of occurrences is cheatgrass (Bromus tectorum). Cheatgrass is considered widespread in both Nevada and California. Treatment of cheatgrass has not been a priority due to the difficulty of finding a successful treatment option. However, the ecological effects of cheatgrass can be greater than many of the other species that currently receive priority treatment classification. Cheatgrass can promote fire on the landscape, and over time, can change the plant community to a monoculture of cheatgrass through a frequent fire regime. Cheatgrass sites had not been tracked on the LTBMU until recently, so the rate of spread of this species is unknown. Extensive infestations of weeds can permanently degrade NFS lands. The term permanently degraded means with today's economics and technology. NNIS (weeds) have already taken over or severely impaired millions of acres of western Federal lands. The biodiversity of the Sierra Nevada region is undergoing change due to alterations in human uses and fire regimes, climate change, and invasions by non-native species (Brooks et al. 2004). In general terms, LTBMU NFS lands are considered weed free, with most weed occurrences located along roads. Table 3-23 displays the list of weeds known to occur on the LTBMU.

Invasive plant species are one of the greatest threats to wildlands in the United States (Mullin et al. 2000). Weed infestation and spread is one of the greatest negative impacts to maintaining or improving the health of the NFS lands. Climate changes will result in massive geographical shifts in locations of sites that provide environments for native plants. Opportunities for replacement of native species with undesirable exotic organisms will be enhanced (Franklin 2003).

A warming climate in the western part of the United States will often lead to an upward elevational migration of plant species. Rapid changes in climate may cause a loss of native plant species from the lower elevations if they cannot migrate upward and establish fast enough. Stressed communities with fewer plant species distributed over large areas could have an increase in the quantity of unused resources. These stressed communities are then more available for the invasion and establishment of weeds (Tausch 2008).

Once weeds become established, it is hard to get rid of them. Weeds arrived in the United States without the insects and diseases that preyed on them, and the plants that evolved in competition with them in their native land. Without insects, diseases, etc. to control these weeds, they can increase at a rapid rate.

Disturbed areas generally have more non-native plants than non-disturbed areas. Alien, non-native invaders are more likely to have higher leaf area and lower tissue construction costs (advantageous under high light and nutrient conditions) and greater phenotypic plasticity than

native plants. Increased resource availability and altered disturbance regimes associated with human activities often differentially increase the performance of invaders over that of natives (Daehler 2003).

The exotic plant species that have the potential to reduce local diversity or transform ecosystems have been called "transformer species" (Brooks et al. 2004). Transformer species have the potential to form monotypic stands, and greatly alter resource availability, trophic structure, ecosystem productivity, and/or disturbance regimes (ibid). Some of the transformer species invading the Sierra Nevada include: cheatgrass (*Bromus tectorum*), medusahead (*Taniatherum caputmedusae*), yellow star thistle (*Centaurea solstitialis*), spotted, diffuse and Russian knapweed (*Centaurea maculosa*, *C. diffusa*, and *Acroptilon repens* respectively), perennial pepperweed/tall whitetop (*Lepidium latifolium*), purple loosestrife (*Lythrum salicaria*), dalmatian toadflax (*Linaria genistifolia var. dalmatica*), leafy spurge (*Euphorbia esula*), gorse (*Ulex europaea*), French broom (*Genista monspessulana*), Scotch broom (*Cytisus scoparius*), Spanish broom (*Spartium junceum*), Himalayan blackberry (*Rubus discolor*), Russian olive (*Eleagnus angustifolia*) and Saltcedar (*Tamarix parviflora and T. ramosissima*) (ibid). A few of these weeds are widespread, but many are still relatively restricted within the Sierra Nevada (SNFPA 2001 in Brooks et al. 2004). There are numerous factors used to assess weed risk. Weed risk is higher if any seed source is close to or within the area to be disturbed. Areas that have been recently disturbed are more vulnerable. Developing/implementing mitigation measures can reduce the risk of weed seed/plant parts being introduced into new areas in some cases. Some weeds are more aggressive than others and would have a different response to a variety of on the ground disturbances. Areas that have not been surveyed also have a high risk of weed presence and increased rate of spread because there is a higher likelihood that weeds that are introduced will go undetected and continue to spread.

The LTBMU works closely with the Lake Tahoe Basin Weed Coordinating Group (LTBWCG) a group of 20 agencies and partners. The LTBWCG list is categorized into two classes and list the same NNIS as the LTBMU, with a few species having different priorities. Both lists are reviewed annually at a minimum or sooner should new information become available.

Thirty-two NNIS are on the LTBMU list (Table 3-23). Only 21 of the 32 have been found on NFS lands in the Basin. The other species are included on the list because they have been found elsewhere in the Basin, or in close proximity to the Basin. The three species with the largest infestations are bull thistle (*Cirsium vulgare*), Saint Johnswort (*Hypericum perfoliatum*), and oxeye daisy (*Leucanthemum vulgare*). In 2010, a Decision was signed by the LTBMU that permitted the use of chemicals to treat NNIS on National Forest System (NFS) lands.

Bull thistle (*Cirsium vulgare*) is the most common infestation identified with 184 sites totaling ~363 gross acres. In 2011, nine of those sites had no bull thistle present and will be dropped if no NNIS are found for three years. In 2010, both the number of locations and the acreage infested with bull thistle decreased from 2008. In 2008 gross acreage of bull thistle in the Angora fire area was estimated at 2,500 acres. Overall gross acreage dropped from 2008 to 2009 due to better mapping of the weeds in the Angora burn. From 2009 to 2010, gross acreage in the Angora burn increased by 78.73 acres. This is due to more accurate documentation of gross acreage surveyed; even when weeds were not found. The 2009 data was missing a good portion of gross acreage survey data for sites that did not have weeds. In 2009 zero gross acreage was recorded when

weeds were not found even though a given area was surveyed and known to have weeds in thepast. In 2010 this surveyed area was captured in the gross acreage number. Canopy cover decreased by 0.18 acres between 2009 and 2010.

Saint Johnswort (*Hypericum perfoliatum*) infests 26 sites with nine new infestations discovered since 2008. Half of the sites are located within 11 feet of creeks or drainages. The largest infestation is ~49 acres along Blackwood Creek. The other half of sites are along roads and trails.

The largest infestation on LTBMU NFS lands is oxeye daisy (*Leucanthemum vulgare*) in Slaughterhouse Meadow; estimated to be about 39 gross acres. The very invasive plant was possibly introduced from nearby residences, as it is sold as an ornamental. What makes it especially difficult to control is that it is spread by both seed and root fragments.

1.4 acres of NNIS were located within 50 ft. of perennial rivers, streams, lakes and other water bodies in 2008. The average infestation within this 50 ft. range was found to be 0.06 acre of NNIS per site.

The NNIS ranked as high priority invasives by the LTBMU (Gross et. al., 2011), see Table 3-25:

Musk thistle (*Carduus nutans*) Rush skeletonweed (*Chondrilla juncea*) Bull thistle (*Cirsium vulgare*) Dalmatian toadflax (*Linaria genistifolia spp. Dalmatica*) Scotch thistle (*Onorpordum acanthium ssp. acanthium*) Medusahead (*Taeniatherum caput-medusae*) Tamarisk/saltcedar (*Tamarix chinensis, T. ramosissima, & T. parvifolia*)

Table 3-25 – Lake Tahoe Basin Management Unit Non-Native Invasive Species (NNIS) list

Common Name	Scientific Name	Weed Code	SNFPA	NDA	CDFA	Cal-IPC	LTBWCG	LTBMU
Russian knapweed	*Acroptilon repens*	ACRE3	NW	B	B	Moderate	Group 1	Medium
Tree of heaven	*Ailanthus altissima*	AIAL	NW		C	Moderate	Group 1	N/A
Cheat grass	*Bromus tectorum*	BRTE	NW			High		Low
Heart-podded hoarycress/whitetop	*Cardaria draba*	CADR	NW	C	B	Moderate	Group 1	Medium
Globe-podded hoarycress/hairy whitetop	*Cardaria pubescens*	CAPU6	NW		B	Limited	Group 1	Medium
Musk thistle	*Carduus nutans*	CANU4	NW	B	A	Moderate	Group 1	High
Purple starthistle/red starthistle	*Centaurea calcitrapa*	CECA2	NW	A	B	Moderate	Group 1	N/A
Diffuse knapweed	*Centaurea diffusa*	CEDI3	NW	B	A	Moderate	Group 1	Medium
Spotted knapweed	*Centaurea maculosa*	CEMA4	NW	A	A	High	Group 2	Medium
Yellow starthistle	*Centaurea solstitialis*	CESO3	NW	A	C	High	Group 1	Medium*
Squarrose knapweed	*Centaurea*	CESQ	NW	A	A	Moderate		Medium

Common Name	Scientific Name	Weed Code	SNFPA	NDA	CDFA	Cal-IPC	LTBWCG	LTBMU
	virgata ssp. squarrosa							
Rush skeletonweed	*Chondrilla juncea*	CHJU	NW	A	A	Moderate	Group 1	High
Canada thistle	*Cirsium arvense*	CIAR4	NW	C	B	Moderate	Group 1	Medium
Bull thistle	*Cirsium vulgare*	CIVU	NW		C	Moderate	Group 2	High
Poison hemlock	*Conium maculatum*	COMA2		C		Moderate		Medium
Scotchbroom	*Cytisus scoparius*	CYSC4	NW		C	High	Group 2	Medium
Teasel/Fuller's teasel	*Dipsacus fullonum*	DIFU2				Moderate	Group 1	N/A
Stinkwort	*Dittrichia graveolens*	DIGR3				Moderate	Group 1	N/A
Quackgrass	*Elytrigia repense*	ELRE3	NW		B			N/A
Hydrilla/Waterthyme	*Hydrilla verticillata*	HYVE3	NW	A	A	High Alert		N/A
St. John's wort / Klamath weed	*Hypericum perforatum*	HYPE	NW	A	C	Moderate	Group 2	Medium
Dyer's woad	*Isatis tinctoria*	ISTI	NW	A	B	Moderate	Group 1	Medium
Tall whitetop / Perennial pepperweed/ broadleaved pepperweed	*Lepidium latifolium*	LELA2	NW	C	B	High	Group 2	Medium
Oxeye daisy	*Leucanthemum vulgare*	LEVU	NW			Moderate	Group 2	Medium
Dalmatian toadflax	*Linaria genistifolia spp. dalmatica*	LIDAD	NW	A	A	Moderate	Group 2	High
Yellow toadflax/butter & eggs	*Linaria vulgaris*	LIVU2		A		Moderate	Group 2	Medium
Purple loosestrife	*Lythrum salicaria*	LYSA2	NW	A	B	High	Group 1	Medium*
Eurasian watermilfoil	*Myriophyllum spicatum*	MYSP2	NW	A		High		N/A
Scotch thistle	*Onorpordum acanthium ssp. acanthium*	ONAC	NW	B	A	High	Group 1	High
Curlyleaf pondweed/curly pondweed	*Potamogeton crispus*	POCR3				Moderate		N/A
Sulfur cinquefoil	*Potentilla recta*	PORE5		A	A		Group 1	Low
Himalaya blackberry	*Rubus armeniacus (*formerly *R. discolor)*	RUAR9	NW			High		Low
Medusahead	*Taeniatherum caput-medusae*	TACA8	NW	B	C	High	Group 1	High*
Tamarisk/saltcedar	*Tamarix chinensis, T. ramosissima,*	TACH2 TARA TAPA4	NW	C	B	High	Group 1	High*

Common Name	Scientific Name	Weed Code	SNFPA	NDA	CDFA	Cal-IPC	LTBWCG	LTBMU
	& T. parvifolia							
Woolly mullein/common mullein	*Verbascum thapsus*	VETH	NW			Limited		N/A

Notes:

NOT ALL LISTED CA/NV NOXIOUS WEEDS ARE LISTED. AS CONDITIONS CHANGE, NEW OCCURRENCE OF SPECIES MAY BE FOUND. THIS LIST WILL BE UPDATED CONTINUOUSLY AS NEW SPECIES ARE FOUND.

IF ADDITIONAL NOXIOUS WEEDS ARE FOUND, THEY SHOULD BE REPORTED IMMEDIATELY TO THE LTBMU NOXIOUS WEED COORDINATOR AT (530) 543-2600.

Sierra Nevada Forest Plan Amendment (SNFPA) part 3.6 defines noxious weeds as: those plant species designated as noxious weeds by Federal or State law. Noxious weeds generally possess one or more of the following characteristics: aggressive and difficult to manage, poisonous, toxic, parasitic, a carrier or host of serious insects or disease, and generally non-native.

Nevada Department of Agriculture (NDA) noxious weed list (http://agri.nv.gov/nwac/PLANT_NoxWeedList.htm divides) divides noxious weeds into categories A, B, and C. Category A: Weeds not found or limited in distribution throughout the state; actively excluded from the state and actively eradicated wherever found; actively eradicated from nursery stock dealer premises; control required by the state in all infestations. Category B: Weeds established in scattered populations in some counties of the state; actively excluded where possible, actively eradicated from nursery stock dealer premises; control required by the state in areas where populations are not well established or previously unknown to occur. Category C: Weeds currently established and generally widespread in many counties of the state; actively eradicated from nursery stock dealer premises; abatement at the discretion of the state quarantine officer.

The California Department of Food and Agriculture's (CDFA) noxious weed list (http://www.cdfa.ca.gov/phpps/ipc/) divides noxious weeds into categories A, B, and C. A-listed weeds are those for which eradication or containment is required at the state or county level. With B-listed weeds, eradication or containment is at the discretion of the County Agricultural Commissioner. C-listed weeds require eradication or containment only when found in a nursery or at the discretion of the County Agricultural Commissioner. Q-listed weeds require temporary "A" action pending determination of a permanent rating.

California Invasive Plant Council (Cal-IPC) invasive plant inventory (http://www.cal-ipc.org/ip/inventory/weedlist.php) categorizes non-native invasive plants by the ecological impacts of each plant on wildlands into three categories high, moderate, & limited as well as an alert. An "alert" is assigned for species with significant potential for invading new ecosystems. High: these species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Moderate: these species have substantial and apparent—but generally not severe—ecological impacts on physical processes, plant and animal communities, and vegetation structure. Limited: these species are invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score.

Lake Tahoe Basin Weed Coordinating Group (LTBWCG) prioritizes invasive weeds of concern by management group. Group 1: watch for, report, and eradicate immediately. Group 2: manage infestations with the goal of eradication (2010).

The Lake Tahoe Basin Management Unit (LTBMU) prioritizes noxious weeds based on their ecological impact and invasive potential and on the potential for effective management and control given the tools available to the LTBMU. A noxious weed can fall in to one of three categories: high, medium, or low. High: species that have a large ecological impact and/or invasive potential and that are easily controlled. Medium: species that have a medium ecological impact and/or invasive potential and medium ability to be controlled. Low: species that have a low ecological impact and/or invasive potential and are not easily controlled. The weighted ranking was used in this table except on those species where a weighted ranking was not given due to no current known occurrences on the LTBMU; those species are indicated with an asterisk (*). Species with an N/A were not evaluated. Evaluation of species can be done using the Development of Management Ranking System for Terrestrial Noxious Weeds/Invasive Plant Species, USDA

Common Name	Scientific Name	Weed Code	SNFPA	NDA	CDFA	Cal-IPC	LTBWCG	LTBMU
Forest Service, Lake Tahoe Basin Management Unit, 2011, Gross & Olin.								

NNIS suspected or known to occur on LTBMU NFS lands

Russian knapweed (Acroptilon repens)

Russian knapweed is a long-lived perennial herb that can spread vegetatively or by seed. Roots can grow 6 to 8 feet deep during the first growing season, and 16 to 23 feet deep in the second growing season. The primary method of reproduction is vegetative from the creeping root system. In addition to these traits, it exhibits allelopathic effects, suppressing other plant species (North Dakota Department of Agriculture, unknown date). There is currently one population less than 0.1 acres directly off highway 50 near a drainage pit above a creek. Hand pulling of this species reportedly has limited effectiveness and repeated pulling may not eradicate the infestation (Beck 2001; CDFA online; Carpenter and Murray 1998).

Cheatgrass (Bromus tectorum)

Cheatgrass is a weedy annual grass that is widespread across the Great Basin, and is invading the LTBMU. It is unlikely that control of all populations is possible with today's technologies. Higher priority populations, such as those that are smaller and manageable, will be targeted for control. The primary focus for this species is to prevent further spread where possible through management practices. Management will likely require a combination of chemical control, cultural control, and seeding perennial grasses.

Plant surveys for the Upper Truckee River Sunset Stables Restoration Project (2008) found an additional 32 populations and significant expansions of the 15 existing populations since the 2004 survey (Entrix 2009). The occurrences will be treated under the project actions, including a mitigation plan that specifies revegetation. A 2010 inventory of cheatgrass in Lam Wahtah (Rabe) Meadow on the Nevada/California border showed widespread distribution, with 19% of the 207 acres surveyed showing some level of cheatgrass cover including extensive, well-established populations (Bibbo 2010).

Cheatgrass is most common on the lower slopes of the mountains, but can occur as high as 9,000 feet. Cheatgrass is becoming a common and widespread weed on the Forest and has a high impact rating from the California Invasive Plant Council (CalIPC, online). It is found in disturbed roadside habitats such as cutbanks and road medians along the entire length of US 50 through the Basin (Bibbo 2010). Seed of this brome is spread by attaching to fur, clothing, or equipment, by wind, or by livestock/wildlife. Cheatgrass may displace native vegetation, alter microhabitat characteristics, and compete for nutrients and light. The presence of these weeds may change the frequency, extent, and timing of wildfires (Bossard et al., 2000). Young and Clements (2009) found that cheatgrass was competitive with native vegetation primarily during the seedling stage. Hoary cress – two species – Cardaria draba and Cardaria pubescens

Heart-podded hoary cress and globe-podded hoary cress are perennial herbs that reproduce by seed and thick, creeping rhizomes, and are highly competitive with other species once established (CDFA et.al. 1999). Some control can be attained through repeated manual treatments throughout the growing season but eradication is difficult if not impossible without herbicides, due to the creeping rhizomes (North Dakota Department of Agriculture, date unknown). This weed tends to establish large monospecific mats that crowd out native vegetation. There are two known populations on the Forest. One is located in front of the FS fire station at Spooner Summit. The second population did not have any plants found in 2011. The population will be monitored for three years before being dropped as a population. All known infestations on the Forest are currently less than 0.03 acre in size.

Musk thistle (Carduus nutans)

Musk thistle is a biennial or sometimes a winter, or summer annual, that can grow up to six feet tall and that prefers moist, bottomland soil, but can be found on drier uplands. The taproot is long, thick and fleshy, occasionally branched, and is capable of penetrating the soil to depths of a foot and a half or more. The plant reproduces by seed, each flower head capable of producing 1,500 or more seeds.

The largest known location of musk thistle in California, 600 acres, is found on Boca Hill, Tahoe National Forest, just north of the LTBMU near Boca Reservoir (Moonshineink. 2009). On the LTBMU one occurrence occupies less than one acre at Lam Watah (Rabe Meadows). The site continually gets treated by manual pulling and digging of the plant. Two additional manually treated sites, in Meyers and Mt. Watson, were dropped in 2010 after no new plants had been observed after 3 years. The eradicated populations were a part of early detection, rapid response, and eradication.

Diffuse knapweed (Centaurea diffusa)

Diffuse knapweed is a diffusely branched annual, biennial, or short-lived perennial that can resemble spotted knapweed with the black-tipped bracts, and is known to hybridize with it. It reproduces and spreads by seed. However, reports suggest it may resprout from the root crown as well.

A single plant can produce up to 18,000 seeds. The seeds germinate spring or fall or anytime during the growing season following disturbance (such as manual control), if adequate soil moisture is present. The plants break off at the soil surface, and become tumble weeds that disperse their seeds. Like other knapweeds, is it readily established in disturbed soil, and can produce allelopathic chemicals, excluding native plant species in disturbed areas. Management must be continuous; otherwise, reinfestation is inevitable (CDFA et.al. 1999). There are twooccurrences of diffuse knapweed reported in the project files. The oldest is under 0.03 acres and is responding well to manual treatment. It is located on FS land north of Kings Beach. The newest occurrence is located near Nevada Beach and doubled in size to 0.1 acres in 2011. The Nevada Beach first visit in 2010 had ~100 plants and ~800 plants in 2011. This may be due to the highly wet year in 2011. Both locations are being treated manually and are recommended for chemical treatment in the future.

Spotted knapweed (Centaurea stoebe ssp. micranthos [aka Centaurea maculosa]

Spotted knapweed is a biennial or short-lived perennial with a stout taproot. Like other knapweeds, is it readily established in disturbed soil, and can produce allelopathic chemicals, excluding native plant species (CDFA et.al. 1999). There are two known sites located at the LTBMU Supervisor's office and Nevada Beach Campground. One plant was removed in 2009 from the parking lot of the LTBMU Supervisor's Office but has not been found since. The Nevada Beach site had one plant pulled in 2011. CDFA (Online) reports that hand pulling spotted knapweed has limited effectiveness, since vegetative reproduction from short lateral roots can occur for several years.

Rush skeletonweed (Chondrilla juncea)

Rush skeletonweed has recently been found within the Tahoe Basin near Echo Summit, located on the edge of the road and directly next to the Forest. It is being treated by both the LTBMU and El Dorado County with one plant removed in 2011. This herbaceous, relatively long-lived perennial can flourish in very dry to very wet environments. It has the ability to form dense monocultures, displacing native species. Diligent hand-pulling or grubbing can provide effective control of very small infestations. As with oxeye daisy, this plant is difficult to control, even with herbicides.

Canada thistle (Cirsium arvense)

Fourteen locations of Canada thistle are currently known on the LTBMU, covering less than one half infested acres. Although the overall acreage of this species has increased over time, some sites found along the shoreline of Lake Tahoe appear to have been eradicated due to high lake levels in 2008. Although the large infestation found in 2005 along the Lam Watah (Rabe Meadow) Trail actually decreased in infested area by about half, the gross area continues to rise (Reed, 2008). This indicates that some of the stems have been suppressed by treatment, but the underground rhizomes are healthy and spreading out to encompass a larger area. In 2011 there was less than 2 acres recorded, but an additional 3 acres found after the end of the season reported by Douglas County in the Rabe Meadows area.

Canada thistle is a perennial with a rhizomatous root system. Although a single plant can produce thousands of seeds, and the seeds can remain viable for 20 years, Canada thistle primarily spreads by horizontal creeping roots. It is difficult to treat through manual methodsbecause the plant regenerates unless all root fragments are removed. 2011 marked the first year of chemical treatment of Canada thistle and showed promising results as a high number of dead plants were shown by second visits to the sites.

Bull thistle (Cirsium vulgare)

Bull thistle is the most common NNIS on the LTBMU, and currently is known from 175 dispersed locations on the Forest. It was the most common NNIS treated in the Angora Fire area. It can colonize relatively undisturbed grasslands and meadows, as well as disturbed areas.

Bull thistle is a coarse biennial, reproducing only by seed, and dying following seed set (Bossard 2000), making manual eradication feasible for smaller populations. Site expansions or new sites are proposed for all treatment types except chemical. As of 2011, there are ~284 gross acres on LTBMU NFS lands.

Poison hemlock (Conium maculatum)

This species was introduced from Europe as an ornamental, and has since spread to become naturalized in nearly every state in the US. It is toxic to wildlife, livestock, and humans and was commonly used to kill political prisoners in ancient Greece. All parts of the plant are considered poisonous.

This plant usually behaves like a biennial reproducing only by seed, which is dispersed by water, mud, wind, animal fur, human clothing, boots, and machinery. It has no means of vegetative reproduction. Although hand pulling is effective, care must be taken to wash the hands before eating any food! This species has been found recently on the LTBMU off the Truckee River about 250 meters inside the LTBMU boundary. The population is less than 1.5 gross acres and roughly 250 plants.

Scotchbroom (Cytisus scoparius)

There are currently three infestations located on LTBMU NFS lands: Fallen Leaf Lake Campground, at an old mill foundation off Cathedral Road, and in an Urban Lot off Kingsbury Grade, occupying less than half an acre.

Scotchbroom is a large perennial shrub with extensive roots that spreads aggressively by seed, and is an effective stem sprouter, even when cuts are made close to the ground. To minimize resprouting, larger plants should be cut when under drought stress. It is considered a fire hazard, and poor forage for native wildlife. The seeds can remain viable for years, making eradication difficult. Manual removal is typically effective only when plants are young, and can be removed in entirety (Bossard 2000; LeBlanc 2001).

Quackgrass (Elytrigia repens)

This rhizomatous perennial grass is a common weed of agricultural lands, turf grass, nurseries, and landscaped areas. It can be found abundantly in mountains meadows in California, thriving on different soil types, in gravel and peat, and also under saline and alkaline conditions. Chemical applications often need to be repeated. Although known on the LTBMU, no locations are in the database.

St. Johnswort/Klamathweed (*Hypericum perforatum)*

St. Johnswort was introduced from Europe in the 1700s, and by the 1900s it was invading rangelands in California. By 1940, more than one million hectares of California were infested by

St. Johnswort, but biological control agents have eliminated most populations below 4900 ft elevation.

On the LTBMU, this species is spreading along the stream corridors in Ward and Blackwood Canyons on the west shore, occurring at 49 sites on the Forest (Reed 2009). It is a perennial, with stout taproots and many branched, lateral roots up to five feet deep. Rhizomes develop just below the soil surface from the crown and can extend outwards to about two feet. New shoots grow from the crown and rhizomes in early spring. It reproduces from both seed and rhizomes. Fragmented rhizomes can develop new plants (CDFA, 2009).

Dyer's woad (Isatis tinctoria)

This aggressive NNIS is a member of the mustard family native to southeastern Russia. It was first discovered in the US in Siskiyou County, believed to have come over in contaminated alfalfa seed. It invades both disturbed and undisturbed areas, but is most common in dry, rocky areas. Modoc County is especially infested with this plant. A small infestation was found in 2009 along Highway 267 on the south side of Brockway Summit.

Perennial pepperweed/Tall whitetop (*Lepidium latifolium)*

Eighteen locations of perennial pepperweed/tall whitetop are currently known on the LTBMU, including a large occurrence at the Meyers Landfill. Many of the sites occur near the chairlifts at the Heavenly Ski Resort, and were likely brought in on equipment used in construction of the lifts. Most populations are currently small, covering a total of less than two acres. There are some very large and dense stands along the Truckee River in Nevada that are being treated by other agencies.

Perennial pepperweed forms dense colonies by adventitious shoots from roots and deep-seated rhizomes and spreads vigorously. It also produces abundant highly germinable seeds that can survive in the soil for at least 1 year. Fluctuating temperature regimes produce optimum germination. It can grow at altitudes of 4,000 to 8,000 feet. Perennial pepperweed is an aggressive invader of moist to wet ecosystems, even invading ecologically healthy areas, and is currently rapidly invading the Lake Tahoe Basin from the east, where it is a serious weed. Perennial pepperweed spreads aggressively by both seeds and root sprouts. Mechanical removal has been shown to be ineffective because plants form clonal stands and continue to sprout from extremely deep roots, and from root fragments (Ryan 1998, Renz 2005, Young 1995; USDI BLM 1994). It is difficult to control manually, and the LTBMU has been unsuccessful in eradicating even small populations.

Oxeye daisy (Leucanthemum vulgare)

Oxeye daisy is leading in invasiveness on the LTBMU. It has shown significant increases in acreage, primarily due to one site, Slaughterhouse Canyon. It is taking over this meadow at a rapid rate and has expanded in gross area from five gross acres in 2003-2007 to 76 gross acres in 2009 (Reed 2009).

Oxeye daisy impacts forage for wildlife in infested meadows, and wildlife avoids grazing and walking in infested areas because it irritates their noses, mouths, and legs. This perennial herb produces 2,000 to 4,000 seeds per plant and up to 26,000 seeds per plant, and can germinate within 10 days. Seeds can remain viable for several years.

A total of 45 locations of oxeye daisy were known on the LTBMU in 2011. Native to Europe, it was introduced in the U.S. as an ornamental in the 1800s. It has a lovely flower similar to Shasta daisy, to which it is related. It is also closely related to another NNIS, common tansy (Tanecetum vulgare). It is widely planted and easily escapes cultivation; the creeping rhizomes enable it to outcompete and displace native vegetation (Jacobs 2009).

Dalmatian toadflax (*Linaria dalmatica)*

Dalmatian toadflax is an escaped ornamental perennial, introduced in North America in the mid-1800s, and reproducing aggressively both by seeds and by vegetative propagation. The extensive deep root system and waxy leaves make it very difficult to control (CDFA et.al. 1999). Fourteen populations, consisting of a few individuals each are known on the LTBMU. Thirteen of these populations are on Urban Lots. Repeated annual pulling of small infestations of this species can reportedly be successful (Carpenter and Murray 1998).

Yellow toadflax (*Linaria vulgaris)*

Yellow toadflax is native to Europe, and was introduced in North America as an ornamental. Aboveground parts of yellow toadflax plants are winter-killed, but protected buds at the soil surface and buds on creeping roots produce actively growing shoots the following spring.

While most new infestations are probably started by seeds, spread of established infestations is mostly vegetative from shoots sprouting from the large network of creeping roots. Severely damaged plants, such as those killed by wildfire, can quickly regenerate from the stout, soil-protected roots. This enables yellow toadflax to become a dominant member of post-fire plant communities. Among other places on the Forest, Yellow toadflax is found at the Valhalla and 64 Acres (near Tahoe City). It is a significant problem around the Tahoe City area and along the Truckee River. Clipping and hand-pulling have not proven to be effective methods as the plants quickly resprout and set seed at short heights. It has also been found in the Angora burned area, where post-fire inspections show an expansion of this species (Reed 2008).

Scotch thistle (Onopordum acanthium)

Scotch thistle, an annual, biennial, or short-lived perennial, was introduced into the U.S. in the late 1800s as an ornamental. Although it occurs widely in California, major infestations are in northeastern California. In the Tahoe Basin it is known from only a few occasional sites, with one site on the LTBMU near Taylor Creek and Highway 89. Only a few plants were found there in 2008.

Scotch thistle has the ability to invade most habitats, and can germinate year-round, often growing to 8 feet or more in height. A single plant is imposing, but an entire colony can ruin a site. Scotch thistle is a prolific seed producer – 20,000 to 40,000 seeds per plant - and seeds can remain viable for up to 20 years or more.

Sulfur cinquefoil (*Potentilla recta)*

This perennial herb in the rose family has a single, woody taproot that can grow one to two feet in height. Key features include pointed hairs that protrude outward at right angles from the stem and leafstalk. The leaves have green coloring rather than silver on the underside.

Of particular concern is the impact on native cinquefoil (Potentilla). A single plant can produce thousands of seeds annually that allows for its rapid spread. The infestation of sulfur cinquefoil off Kahle Drive was treated in 2004 by digging up the entire infestation, but when monitored in 2005, the treatment had not reduced the size of the infestation, and in 2007 it was found to have expanded 20 times the size in 2005. Selective herbicides applied at recommended label rates are likely the only method of effective control (Reed 2008).

Himalayan blackberry (*Rubus armeniacus)*

This plant is a robust, sprawling, evergreen shrub with hooked prickles, in the rose family. Rooting can occur at the cane tips to form daughter plants. Canes can grow up to about 9 feet tall, and form impenetrable mounds in the forest, often near streams, seeps, and high groundwater tables. In 2009, a plant was found growing next to the Supervisor's Office. It is not known if it was planted or transplanted by avians. The NNIS crew manually pulled a total of 24 bolts in 2011. Woolly mullein/Common mullein – Verbascum thapsus

Mullein is common across the Forest. The known populations on the Forest typically consist of scattered individuals vs. dense stands at varying locations. It is the most common NNIS growing near the rare plant, Tahoe yellow cress (TYC), and is treated in the fenced TYC areas dependent on funding. It has been suggested that outside the fenced area, common mullein may protect TYC from being trampled in recreational areas.

Mullein is an annual or biennial plant that can invade not only disturbed sites but also pristine meadows. It reproduces only by seed, and field studies of buried seeds showed low germination rates; however, the seeds can be very long-lived, viable for up to 100 years under the right conditions (Bossard 2000). The most effective method of controlling mullein is to cut plants with a weed hoe. Pulling is also effective. Treatments will be prioritized where resource values are at greatest risk, such as on beaches around Tahoe yellow cress, and where the feasibility of control is highest. Only manual control is being proposed at this time for mullein.

NNIS not known to occur on LTBMU NFS lands

The following discussions of species are not known to occur on LTBMU lands as of the 2011 season, but are suspected to be within 50 miles of the boundary. This increases the likelihood of possible new occurrences on LTBMU in the future.

Tree of Heaven (Ailanthus altissima)

Tree of Heaven is a fast growing tree, currently documented in the Lake Tahoe Basin, but not on LTBMU NFS lands. It is deep rooted and aggressive, crowding out native plants and degrading wildlife habitat, particularly in riparian areas. The known infestation in the Basin consists of a few individuals. These trees are prolific resprouters if cut stems are left untreated (Bossard 2000).

Purple starthistle (Centaurea calcitrapa)

Purple starthistle is a close relative of yellow starthistle and an aggressive annual to short-lived perennial that is a major problem in the San Francisco Bay Area. Many of the visitors to the LTBMU are from the Bay Area. Flowers are surrounded by long, stout, pointed spines, which persist even on dead plants and create barriers to movement of animals and humans. Reproduction is by seed. Currently, there are no known occurrences within the Basin, although it is found close by.

Yellow starthistle (Centaurea solstitialis)

Yellow starthistle has not been found on NFS lands, but small occurrences have been known within the Tahoe Basin. However, all previous infestations have been eradicated. Extensive infestations of this NNIS exist in California, with its range expanding into the mountains. ElDorado County has a “Save the Sierras” program with a ‘knock back zone’ at the 3,500 foot level (El Dorado 2008). The State of California has a program targeting this NNIS also. Yellow starthistle, an annual, or sometimes a biennial, is highly competitive, and can develop dense, impenetrable stands. Taproots grow vigorously early in the season to depths of 3 feet or more, giving plants access to deep soil moisture. One plant can produce 100,000 seeds, and nearly all seeds are able to germinate within one week of dispersal.

Squarrose knapweed (Centaurea virgata ssp. Squarrosa)

Squarrose knapweed is a long-lived perennial with a stout taproot. It is a highly competitive plant that can displace native species. It has a habit of breaking off at the base and tumbling across the landscape, dispersing seeds along the way. Like other knapweeds, is it readily established in disturbed soil, and can produce allelopathic chemicals, excluding native plant species (utahweed.org. 2009). It has not been reported in the Tahoe Basin. CDFA (Online) reports that hand pulling spotted knapweed has limited effectiveness, since vegetative reproduction from short lateral roots can occur for several years.

Teasel (Dipsacus fullonum)

Teasel is native to Europe and was intentionally brought to North America in the 1700s because of its role in wool fleecing. The firm, elastic, spiny flower head was attached to a cylinder and turned against cloth to raise the nap of woolen cloth. Teasel readily escapes from gardens to meadows, displaces native Sierran plants, is not a food source for wildlife, and dense stands of the prickly plant limit trail access for hikers. Teasel has been found close to the LTBMU near the Angora burn area.

Stinkwort (Dittrichia graveolens)

Stinkwort is a poisonous, strongly aromatic annual native to the Mediterranean region. It reproduces large amounts of seed that are dispersed by wind, water, machinery, vehicles, and animals. The wind can carry seeds great distances. It can be difficult to control with herbicides due to its oily leaves, which reduce penetration by most chemicals. Isolated plants can be controlled by hand (wear gloves!) Stinkwort has recently been found near the Tahoe Basin.

Purple loosestrife – *Lythrum salicaria*

Purple loosestrife is a beautiful but aggressive invader, brought to North America by settlers for their flower gardens. It grows an impressive four- to seven feet tall and prolifically invades wetlands and other moist areas.

Pulling purple loosestrife by hand is easiest when plants are young (up to two years) or when in sand. Older plants have larger roots that can be eased out with a garden fork. Remove as much of the root system as possible, because broken roots may sprout new plants. Bio-control works best in areas of severe infestation. This species is known along Highway 50 west of theTahoe Basin. It has been planted as an ornamental in a road work project on the South Shore of Lake Tahoe.

Medusahead (Taeniatherum caput-medusae)

This annual grass forms monocultures in some areas of the west, including just to the north in Lassen and Modoc Counties. There are limited chemical options for this species, similar to the limited options for cheatgrass, both monocots. The best strategy is prevention, early detection, and rapid response. For larger infestations, Glyphosate followed by planting of native species is recommended, in the absence of an herbicide that is selective on annual grasses (rimsulfuron).

Tamarisk/Salt Cedar (*Tamarix sp.)*

Salt cedar is not found in the Tahoe Basin, but is in adjacent communities in wet and riparian areas. Salt cedar, originally brought to the U.S. as an ornamental and soil stabilizer, has taken over many of Nevada’s stream banks and lake margins (Conrad and Paris 2004). Salt cedar uses large amounts of ground water that causes water tables to fall and springs and small streams to dry up (DeLoach 2009). Large populations of salt cedar are found in the Humboldt and Walker areas of Nevada.

Salt cedar exudes excess salt from glands in its leaves, which fall during drought to form a salty crust on the soil surface, producing an allelopathic effect (DeLoach 1997). The transpiration rate of salt cedar is generally higher than that of native riparian species, depleting water supplies of the areas it inhabits (USDA APHIS 1999; Neill, 1985). Wiesenborn (1996) discusses four common physical changes caused by salt cedar: increased soil salinity inhibiting native plant germination and growth, increased water consumption and loss, increased wildfire frequency, and increased frequency and intensity of flooding.

Reproduction by seed can begin by the end of the first year of growth and a single large salt cedar can produce a half million seeds per year, primarily from late May to October. Seeds are short-lived (a few weeks) and will germinate on saturated soils or while afloat. Because of the long flowering season salt cedar has an advantage over native riparian species by exploiting suitable germinating conditions over a longer time interval. Salt cedar spreads by windblown seeds and aggressively invades flood prone washes and disturbed areas downwind of a parent plant.

When cut or disturbed, salt cedar sprouts aggressively from the root crown. If the plants have grown beyond small shrub size salt cedar is difficult to eradicate without the use of an herbicide (Bossard 2000; Muzika 2006; Tesky 1992).

3.4.5.3. Environmental Consequences

This section compares the risk of NNIS introduction, establishment, and spread of existing. Environmental consequences are based on the key management activities proposed by alternative and how they differ by alternative (see Table 2-3 Summary Comparison of Environmental Consequences by Resource in the DEIS) and the NNIS and their habitat requirements.

Vegetation and Fuels Management

Across all alternatives, ground-disturbing activities, including burning, has the potential to create habitat where invasive species can invade or expand.

Watershed and Aquatic Habitat Restoration

In Alternative D natural processes would be used to control the rate of ecological restoration which could result in expansion of terrestrial invasives.

Terrestrial Invasive Species Management

Management is expected to be similar among the alternatives, except Alternative D where passive management will occur. Funding can play a role in invasives management. Each alternative has an option to continue treatment of NNIS and is supported by executive orders and

the FSM. The alternative that disturbs the most acres (vegetation treatments, recreation, trail/road expansion etc.) will create acres to inventory for introduction and establishment making the rapid detection and treatment focus more difficult to do. Alternative D only allows for treatment of high priority NNIS due to the passive management style.

Recreation

It is expected that increased recreation generally will increase in opportunity for new terrestrial invasive species to be introduced into the Basin and known species to spread. Outfitter Guides (non-winter), such as equestrian outfitters, can potentially bring in noxious weeds in feed. Also, horses can create areas of disturbance where noxious weeds can take hold.

Grazing is primarily an incidental use on the LTBMU. There are no active grazing allotments and none are projected to become active in the future under any alternative. Fredrick's Meadow is currently under special use permit, and the permittee may be allowed to "rest, confine, or graze" stock there. Thus grazing is primarily associated with outfitter-guide activities and other equestrian recreation. Grazing may introduce or spread terrestrial invasive plants. Non-native plant species have been introduced purposefully into Fredrick's Meadow. These species may increase with grazing pressure. This situation would not vary by alternative.

Access to NFS Lands

The alternative that proposes the greatest amount of disturbance has the greatest risk of NNIS introduction/establishment and may spread NNIS from existing sites. None of the alternatives propose a programmatic expansion of the road system. Changes to roads and trails by alternative reflect changes in the maintenance level, which can affect the use type. Access to NFS would mainly affect terrestrial invasive plant species. Roads and trails are conduits for weeds. A change in the maintenance level could affect the acres of invasive species present, especially if roads are upgraded. However, the overall mileage is low in all alternatives, and the difference among alternatives would be slight.

3.4.5.4. Analytical Conclusions

Comparison of Environmental Consequences by Alternatives

Although NNIS standards and guidelines would be implemented under all alternatives to minimize, prevent, and detect new infestations, it is assumed that there would be greater risk of infestation with increased mechanical treatment and expansion of recreation and access & travel management. All other factors being equal, Alternatives A, B, and C may have a higher potential for introduction and spread of NNIS because of their greater reliance on mechanical treatments. Alternatives B, C, and D may have a higher introduction and spread of NNIS due to the expansion of access & travel management and recreation. Alternatives A appears to have lower potential for introduction and spread of NNIS populations because of a greater reliance on

prescribed fire. With appropriate control measures in future projects; all alternatives would be within acceptable levels of risk.

3.4.6. Built Environment

3.4.6.1. Introduction

This section evaluates and discloses the potential environmental consequences on the built environment that may result from the four alternatives. The built environment includes administrative buildings, developed recreation facilities, dams, water systems, and other facilities.

Methodology

The built environment was analyzed by reviewing existing facilities, needs, and funding and comparing those facilities to the desired conditions per the four alternatives. Data was collected from Infra databases, the existing forest plan, the Facility Master Plan and from the Transition Plan.

Performance Measures:

- Number of facilities maintained to standard
- Dollar amount of deferred maintenance

Assumptions

In the analysis for this resource, the following assumptions have been made:

Opportunities for BMPs will be identified and prioritized for funding, analysis and implementation.

Facilities will be managed to achieve recreation management goals.

Facilities will be managed to achieve resource management goals.

3.4.6.2. Overview of the Affected Environment

The 1988 Forest Plan defined the following goals:

1. Facilities Goal: To provide administrative facilities such as offices, shops, storage, housing, and communication to support the work force.
2. Energy Goal: Improve energy efficiency related to national forest activities in support of national policy.

The overarching theme is to provide for a sustainable built environment that supports the forest's mission. Sustainability refers to the ability to operate and maintain the facility through changing

needs and funding levels. Adaptability and purpose of the built environment are extremely important considerations for design, construction, and operation.

Current Conditions and Trends

There are 12 administrative sites containing 32 buildings and 13 trailer pads. Many structures need replacement or reconstruction, and sites need treatment to comply with BMP standards.

There are 15 dams on the LTBMU. Fallen Leaf dam has been owned and operated by the Forest Service since 1951. Nine small dams were built by the California Department of Fish and Game in the 1940's to enlarge existing lakes in order to maintain stream flows and improve fish habitat. Management responsibility for these nine dams has recently been transferred to the Forest Service. Heavenly Valley Creek dam is under Forest Service jurisdiction although managed by the ski area for domestic, dust control, irrigation, and snowmaking uses.

The Echo Lake Dam was built in the 1890s and is operated by the El Dorado Irrigation District. It diverts water into the American River system to generate electricity and supply water for irrigation.

There are three other privately owned dams on national forest land but they do not affect management activities. Although physical conditions are suitable, new hydroelectric development is unlikely because of environmental protection requirements.

The current trend of declining budgets for facility maintenance makes it difficult for the LTBMU to maintain its aging facilities according to current standards, and funding for new construction is very limited making it difficult to replace facilities. The LTBMU facilities master plan identifies buildings for decommission, reconstruction or replacement.

Several facilities are in need of rehabilitation or decommissioning, including the Honeymoon Cabin (Old Mill site) at Fallen Leaf Lake, Meeks Fire Station, Round Hill Pines Resort, Camp Richardson Cabins and several other buildings throughout the basin.

The LTBMU is in the process of exploring partnerships with local organizations to co-locate facilities, such as fire stations, barracks, and office space. In addition, partnerships are being explored to facilitate redevelopment and beneficial use of recreation facilities.

The Tahoe Regional Planning Agency requires that Best Management Practices (BMPs) be installed on developed parcels in South Lake Tahoe by October 15, 2006. While the Supervisor’s Office is in compliance, other administrative facilities may not be.

In 1998, the LTBMU completed the first of two plans needed to bring the unit into compliance with universal accessibility standards. The Transition Plan identifies and prioritizes sites where there are obstacles to accessibility associated with activities, programs or services offered at certain facilities. This is of particular relevance to special use permitting because private businesses permitted to operate on Forest Service Lands are required to comply with the “higher level of the two accessibility standards” (Americans with Disabilities Act Accessibility

Guidelines and Uniform Federal Accessibility Standards). The ADA of 1990, which applies to private businesses, requires that not only facilities are accessible but also the programs and services that take place there are also accessible. Projects in the Transition Plan are identified to be completed before those projects identified in the Accessibility Action Plan. Universal access defines those programs and facilities in which barriers to participation or access (for persons with disabilities) are not present.

Programs and facilities in the Transition Plan include:

- Zephyr Cove Resort—Lodging, restaurant, marina, boat tours, boat rentals, camping, equestrian, and beach use.
- Camp Richardson – Cross-country skiing
- Glen Alpine trail head – Hiking
- Secret Harbor Parking Lot/trail head – Scenic driving
- Taylor Creek Visitor Center and Stream Profile Chamber – Information Services
- 64 Acres River Access – River boating
- Eagle Falls Trailhead—Hiking, camping and fishing (wilderness)

In 1999, the second required report was completed, the Accessibility Action Plan, which focused on identifying and prioritizing renovation project to facilities, which is based on the inventory and assessment of the LTBMU's facilities and update needs, as well as projected cost, in order to devise a reinvestment plan for the basin's facilities to bring them up to ABA standards. Forty upgrades projects were identified in the plan including campgrounds, administrative sites, trail heads, parking and bathroom facilities, lookout areas, beaches, picnic areas, visitor centers and special use permit areas.

Major Changes Since 1988

The new Supervisor's Office was completed in May 2004. It was built to save money on high lease costs, improve employee efficiency, and to provide more parking. This facility was built using the best available energy conservation, landscaping, security, and building resources. It is located in central South Lake Tahoe, next to the Lake Tahoe Community College, and is accessible to public transportation. Most LTBMU employees' work stations are now in this facility, although some remain at the Meyers Work Center and other facilities such as fire stations.

Spooner Fire Station was completed in 2011, Meyers work center buildings A, B and C are undergoing remodel, and the William Kent House and garage have been decommissioned. The Nevada Beach campground and day use areas have been upgraded with current BMPs. Upgrades at the Fallen Leaf Campground have been systematically completed and include restroom replacements and relocation of camp sites out of sensitive areas. Currently 21 out of 53 restrooms (with sewer connections) have been replaced. The remaining 32 restrooms are not to standard.

National, regional and local codes and regulations continue to be established and upgraded for buildings, dams, and utility systems (e.g., water, sewage, solid waste, electrical, and plumbing facilities and systems). Many of the Forest Service's facilities are developed for outdoor

recreational use, such as campgrounds, picnic areas, and hiking trails. ADA and ABA guidelines pertaining to the built environment do not provide adequate guidelines and design criteria for outdoor recreational facilities. For this reason the Forest Service Outdoor Recreation Accessibility Guidelines and the Forest Service Trail Accessibility Guidelines were developed to establish design criteria specific to outdoor recreation environments and accessibility guidelines, which identify the need for preservation of the outdoor setting while maximizing accessibility where possible.

3.4.6.3. Environmental Consequences

Alternative A – No Action

Alternative A would continue the current direction for the built environment. Reduction or elimination of deferred maintenance of the built environment is the economic engine that drives decisions to construct, refurbish, or decommission the built environment and need is the primary consideration.

Other considerations include the ability to meet heritage goals, ecosystem goals, recreation goals, and administrative goals. Conflicts sometimes exist between ecosystem and recreation goals, however, through collaborative approaches, solutions may be found that provide benefit to or maintain the status of both resources.

Alternative B

Alternative B would continue the current direction for the built environment similar to Alternative A

Alternative C

Alternative C would continue to encourage more management, however because the primary driver of built environment expansion is funding, the result would be very similar to Alternative A.

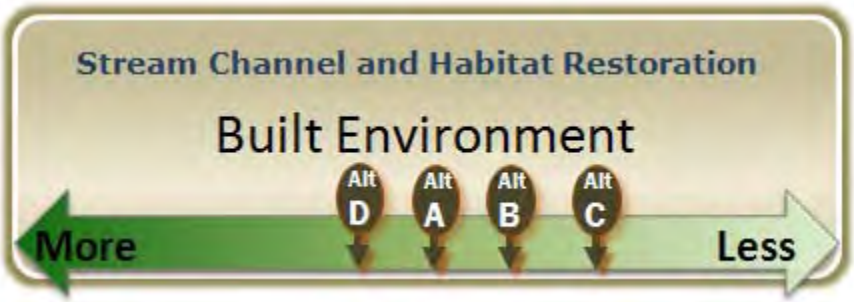
Alternative D

Alternative D would lead to a reduction of the built environment compared to the other alternatives.

Effects Common to All Action Alternatives

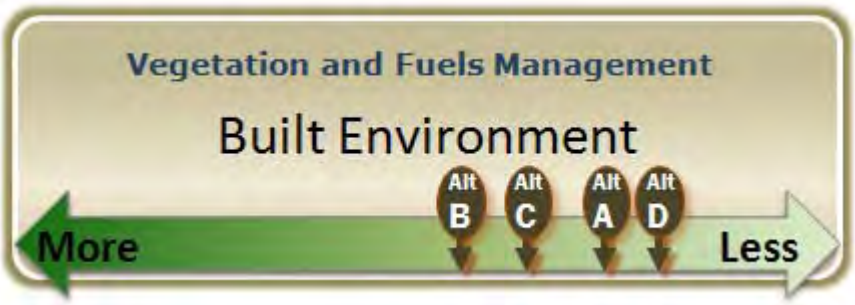
Impacts to the Built Environment from Other Resources

Stream Channel and Habitat Restoration



The effects upon the built environment from stream channel and habitat restoration would result in removal of facilities in areas identified for restoration. Removal of facilities would likely need to occur in concert with removal of access and primarily parking. Effects from unmanaged public use resulting from facility removal could lead to resource degradation. Alternative D would result in the most facility removal for ecological restoration, primarily because facilities that were removed would not be replaced. Alternative A, B and C would result less facility removal and very similar effect.

Vegetation and Fuels Management



Effects from vegetation and fuels management would likely have a long term beneficial impact upon the build environment due to the creation of defensible space. Alternative D would have the most overall entries for fuel reduction followed by Alternatives B and A, with Alternative C having the least amount of entries. More entries for vegetation and fuels management would require shorter durations and shorter duration temporary impacts to the built environment and associated operations, which in turn would have less impacts for economics that are directly and indirectly linked to the built environment.

Terrestrial Invasive Species

Management of terrestrial invasive species would likely result in long term beneficial effects for the built environment. In some cases restoration could result in the removal of the built environment for the accomplishment of multiple resource goals including preventing the spread and potentially the decline of terrestrial invasive species. Restoration projects, including removal of the built environment could occur under all alternatives and are most likely under Alternative D. Facilities that are removed for restoration under alternative D, would not be replaced.

Aquatic Invasive Species Management

Management of aquatic invasive species would likely result in long term beneficial effects for the built environment. In some cases restoration could result in the removal of the built environment for the accomplishment of multiple resource goals including preventing the spread and potentially even the decline of aquatic invasive species. Dredged stream outlets to Lake Tahoe are known to provide refuge for aquatic invasive species and boat launches provide the conduit for introduction of new or additional aquatic invasive species. Restoration projects, including removal of the built environment could occur under all alternatives and are most likely under Alternative D. Facilities that are removed for restoration under alternative D, would not be replaced.

Developed Recreation Sites

Economic trends could result in less sites being maintained to standards and an increase in deferred maintenance. As a result more facilities could be identified for decommissioning. Alternatively, additional partnership/permittee opportunities could provide maintenance, restoration or replacement of existing facilities that have deferred maintenance. Alternative D would result in less developed recreation sites and consequently less built environment, primarily because sites that are removed for ecological restoration would not be replaced. Alternative C would potentially increase developed recreation infrastructure to meet demand and Alternative A and B would maintain existing or replace existing developed recreation infrastructure.

Road and Trail Management

Changes to road or trail maintenance could change built environment needs. Transit services have been evaluated, tested and tried and additional bicycle facilities are being developed. In the future additional facilities are anticipated to support alternative transportation to the private automobile. In addition, unmanaged parking may be eliminated and managed parking created, which will create a greater dependence upon other transportation facilities. As a result use patterns would change and the location of facilities in need of replacement (such as bathrooms) could change, in order to best meet public needs. Alternative D would potentially reduce road access needs as a result of facility removal. Alternative C and to a lesser degree A and B would relocate sites and require changes to the existing road and trail system. In addition, new transit facilities would result from Alternatives A, B and C.

Land Allocation Changes

Land allocation changes would likely have little effect upon the built environment with the exception of Alternative D which would propose new wilderness areas and which will affect the Meiss Historic Cabin If a wilderness were established the cabin may be kept, moved, exempted from wilderness requirements, or removed. If the cabin were kept, upkeep activities would have to meet wilderness requirements.

3.4.6.4. Analytical Conclusions

Effects upon the built environment between alternatives are for the most part minor. Alternative D would have the greatest impacts to the built environment by reducing the built environment the most.

Comparison of Consequences by Alternative

Alternative A

This alternative would continue the existing trends of restroom replacement, installation of site BMPs and addressing deferred maintenance through decommissioning or capital improvements.

Alternative B

Similar to Alternative A this alternative would continue along existing trends. This alternative balances built environment needs with economic impacts.

Alternative C

Alternative C would allow for a potential increase in the built environment over all of the other alternatives, however, costs may not remain aligned with funding levels.

Alternative D

This alternative would result in the greatest decrease in the built environment over other alternatives. While this alternative would most effectively reduce deferred maintenance, unmanaged conditions may result in resource impacts and not meeting public expectations.

How the Alternatives Maintain or Achieve the Desired Conditions

All alternatives would meet the desired conditions, however, there are differences in timing, economics, and the extent to which the desired conditions would be met.

Alterative A is trending towards meeting desired conditions.

Alternative B would best meet the desired conditions in the shortest time frames of all the alternatives. This alternative balances the economic impacts with public needs.

Alternative C would meet the desired conditions for additional facilities to meet the current needs quickly.

Alternative D would meet desired conditions but would result in the least amount of built environment.

3.4.7. Climate Change

3.4.7.1. Introduction

The topic of climate change has emerged, in part, as an issue raised during public scoping and collaboration. This section evaluates the environmental consequences from climate change on Alternatives A, B, C, and D.

Methodology

Qualitatively evaluating alternatives from climate change using headers linked to four issues

The current climate trends were compared to future predicted trends. This provided information on future implications for the LTB in regards to climate change. The effects of the alternatives were synthesized based on the following six adaptation and/or mitigation strategies: (1) building adaptive capacity of ecosystems through ecological restoration, (2) enhancing watershed function, (3) sequestering forest carbon, (4) reducing existing stresses, (5) sustainable operations, and (6) fostering science-management partnerships and public education. The four issue areas are found in all of these adaptation and mitigation strategies. Watershed Health and Aquatic Ecosystems are primarily discussed under 2 and 4. Terrestrial ecosystems are primarily discussed under 1, 3, and 4. Recreation and Access and Travel Management are primarily discussed under 5.

Assumptions

The affected environment discusses climate trends expected in the LTBMU. These general trends were used to analyze the environmental consequences.

3.4.7.2. Affected Environment

For the Lake Tahoe Basin Management Unit and the surrounding Sierra Nevada, climate variability and weather events such as rain and snow storms, droughts, heat waves, floods, and lightning storms are an integral part of the natural environment. The Sierra Nevada is the highest mountain range in North America's only area of Mediterranean-type climate. As such, the range receives large amounts of winter snowfall, followed by a 3-5 month summer drought. The temporal misalignment of precipitation and growing season is a characteristic of Mediterranean-type climates, and leads to ecosystem patterns that are driven principally by water availability but also to a great extent by dry-season fire. Increasing changes in climate and disturbances projected for the future are expected to lead to substantial alterations in California forests and the

ecosystem services they provide (Field et al. 1999, Moser et al. 2009). The International Panel on Climate Change (IPCC 2007) has identified future impacts of temperature warming, changes in precipitation, extreme weather events, severe droughts, earlier snowmelt, increasing wildfire activity, and other changes that could significantly affect forest ecosystems.

Although science has been investigating various aspects of climate change on forests for decades, our knowledge of how plants and ecosystems will respond to a changing climate and how to react appropriately at local or regional levels where management actions are effected is still very limited (Wiener 2006, Solomon 2008). Uncertainties about outcomes will require flexibility, and land management strategies based on current or historical conditions may need to be adjusted or replaced with approaches that support adaptation to changing conditions (USFS 2008; Wiens et al., in press).

Forests can play an important role in both mitigating and adapting to climate change. Mitigation measures focus on strategies such as carbon sequestration by natural systems, increasing carbon storage in wood products, providing renewable energy from woody biomass to reduce fossil fuel consumption, and reducing environmental footprints. Adaptation measures address ways to maintain forest health, diversity, productivity, and resilience under uncertain future conditions. Adaptation and mitigation activities must also complement each other and balance with other ecosystem services (USFS 2008).

Specifics regarding many mitigation measures, such as the appropriate calculations for carbon offsets and how to consider carbon sequestration rates, are still being developed, so most focus at the Forest level at this time is on the use of management options to improve resilience and adaptability of native ecosystems under changing conditions. Over the 15-year life of the Forest Plan, as issues are better understood and appropriate measures are identified, climate change strategies can be adjusted through the adaptive management process.

Summary of current climate and climate-related trends in the Lake Tahoe Basin

(From Safford 2010, contained in Appendix D)

Mean annual temperatures in the LTBMU planning area have risen by about 2 degrees Fahrenheit over the last century, with most of the change occurring in nighttime temperatures. The occurrence of nighttime freezing temperatures has decreased over the last century, and for the first time on record, the annual mean minimum temperature at lake level is now above freezing. The average number of days in a year on which the average air temperature remains below freezing has dropped by 27 days since 1910. The Lake Tahoe Basin (LTB) rise in nighttime temperatures is higher than in most California locations and may be linked to the thermal mass of Lake Tahoe, whose surface waters have increased in temperature by one degree F in only the last 25 years. Over the last century, mean annual precipitation has risen by almost 7 inches per year, but there is very high (and increasing) interannual variability. At lake level, the balance of snow to rain has been shifting toward the latter: at the beginning of the last century, more than 50% of precipitation fell as snow, today the average is about 34%. Snowpack measurements show a strong downward trend across northern California over the last ½ century.

Although some years continue to bring significant snowfall, the average springtime snow water equivalent at measured locations near Lake Tahoe has dropped by >70% in many cases.

Changes in temperatures and amounts and timing of precipitation have led to earlier peak streamflows in most Sierra Nevada streams, with higher spring flows and lower summer flows. Streamflow data show that peak snowmelt in the LTB is occurring 2½ weeks earlier today than at the beginning of the 1960's. Forest fire frequency, size, total area burned, and – in some forest types – severity have all been increasing in the Sierra Nevada over the last two to three decades. Non-fire driven mortality of adult trees also appears to be increasing in lower and middle elevation forests in the Sierra Nevada, but not at higher elevations (>7500 feet), where warming temperatures have lengthened the short summer growing season. Studies of terrestrial vertebrate animals, birds, and butterflies show that many species have been shifting their ranges toward higher elevations, probably in response to warming temperatures and changing precipitation patterns.

Summary of projected future trends in and around the Lake Tahoe Basin

(From Safford 2010, Appendix D)

Although climate change models vary in their projections for the latter half of the 21st century, all predict significant warming (about 4 to 9° F in mean annual temperatures by 2100) in the northern Sierra Nevada, most expect precipitation to remain similar or slightly reduced compared to today. Raising the LTB's mean annual temperature by 9° is the equivalent of dropping the elevation by over 2500 feet. Most models also agree that summers will be drier on average than they are currently, regardless of levels of annual precipitation. Models project a continuously increasing rain:snow ratio and earlier runoff dates for the next century, with decreased snowpack and growing-season stream flow. The most extreme future emissions scenarios project stream inflows into Lake Tahoe may drop 20-40% by 2100. Hydrological modeling projects lower spring and summer runoff in most Sierra Nevada river basins, but winter and early spring runoff is projected to be higher under most climate scenarios, as higher temperatures cause snow to melt earlier. Flood potential in Sierra Nevada rivers that are fed principally by snowmelt (i.e., higher elevation streams) is projected by most models to rise, principally due to earlier dates of peak daily flows and the increase in the proportion of precipitation falling as rain. If overall precipitation increases over time, streamflow volumes during peak runoff will increase even more, leading to notably higher flood risk in downstream locations.

Vegetation and fire modeling linked to future climate scenarios suggests that the area of conifer-dominated forest in the Sierra Nevada will decrease, as hardwood species respond positively to warmer nighttime temperatures and changing disturbance regimes (and especially if precipitation increases). Many scenarios also expect grassland area to increase at lower and middle elevations, as woody vegetation retracts in the face of increased fire frequency. Current trends of increasing fire activity and burned area are expected to continue under almost all future climate scenarios, and some models project increases in fire intensity as well.

Potential implications of climate trends for Lake Tahoe Basin ecosystems

To this point, a climate change vulnerability assessment has not been carried out for the Lake Tahoe Basin, however a number of climate change adaptation assessments have been completed for areas including or neighboring the LTB. As a case study within a broader national assessment, Joyce et al. (2008) carried out a preliminary climate change adaptation evaluation for the Tahoe National Forest on the Sierra Nevada west slope; the Tahoe National Forest borders the LTBMU on the northwest. In May, 2011, The Nature Conservancy completed an adaptation assessment for the Northern Sierra Partnership (NSP) (Low et al. 2011), an alliance of non-governmental organizations focused on conservation in the northern Sierra Nevada. Although the Lake Tahoe Basin falls within the NSP area of interest, it is itself not a focus area for NSP conservation efforts.

The Low et al. (2011) report integrates climate projections, forecasts of the response of major habitat types, and management simulations to determine where northern Sierra Nevada ecosystems may be at greatest risk from projected future climate changes, and what conservation strategies might be most cost-effective for reducing or adapting to climate risks for selected at-risk ecosystems. Based on literature review and expert input, the authors expect the following ecological impacts to result from climate change:

- More frequent, larger fires
- Higher tree mortality during longer growing season droughts
- Longer periods of low stream flows
- Longer periods of groundwater recharge during colder months
- Increased dispersal of non-native species
- Greater conifer and deciduous tree species recruitment and growth in meadows/wetlands/riparian areas due to drought and CO_2 fertilization
- Impaired recruitment of willow and cottonwood due to modified hydrology
- Faster growth of fast-growing native tree species
- Increased recruitment of high-elevation trees
- Increased dispersal of pinyon pine and juniper in shrublands

In their analysis, Low et al. (2011) used a comparison of current vegetation distribution vs. areas of probable future persistence to develop an index of direct “climate stress”. The authors found that red fir and lodgepole pine forests, area of montane sagebrush, and aspen were more likely than other major vegetation types to lose habitat under future climates (excluding disturbances and other non-climate factors). Those least likely to suffer *direct* climatic stress were mixed conifer and pine-dominated forest types, blue oak, and subalpine forests.

Low et al. (2011) also modeled distributions of vegetation successional (seral) stages within different vegetation types, and compared baseline models (which they assumed represented the natural range of variability [NRV]) against current conditions and future projections. They found that the vegetation types that are currently most departed from NRV are riparian and wet meadow types, followed by aspen, big sagebrush, and yellow (ponderosa and Jeffrey) pine-dominated conifer forests. Vegetation types under the greatest risk of loss, invasion, and/or conversion under future climate warming were, in this order: (1) wet meadows; (2) riparian systems; (3) big sagebrush; (4) yellow pine-dominated conifer forests; (5) other sagebrush ecosystems.

As a case study within a broader national assessment, Joyce et al. (2008) carried out a preliminary climate change adaptation evaluation for the Tahoe National Forest on the Sierra Nevada west slope; the Tahoe National Forest borders the LTBMU on the northwest. Joyce et al. (2008) identified the following key climate change impacts to the northern Sierra Nevada:

- Combined effects of continued warming, declining snowpack, and earlier stream runoff threaten longer summer droughts and greater soil moisture deficits during the growing season. This will increase stress that an already long, dry Mediterranean summer imposes on vegetation and wildlife
- Increased fuel build-up and risk of uncharacteristically severe and widespread forest fire
- Longer fire seasons; year-round fires in some areas
- Higher-elevation insect and disease and wildfire events
- Increased interannual variability in precipitation, leading to fuel build-up and causing additional forest stress. This situation promotes fire vulnerabilities and sensitivities
- Increased water temperatures in rivers and lakes and lower water levels in late summer
- Increased stress to forests during periodic multi-year droughts; heightened forest mortality
- Decreased water quality as a result of increased watershed erosion and sediment flow
- Increased likelihood of severe floods
- Loss of seed and other germplasm sources as a result of population extirpation events

Safford (2010; see Appendix D), identifies other potential impacts of ongoing and future climate change, including changing geographic distributions of animal and plant species, and changing patterns of dominant vegetation composition and structure.

3.4.7.3. Environmental Consequences

Climate change is one of the greatest challenges to sustainable management of forests and human well-being because rates of change will likely exceed many ecosystems' capabilities to naturally adapt. Rapidly changing climate and associated agents of change, such as amplified fire regimes, insects and diseases, atmospheric contaminants, and invasive species, have resulted in recent impacts to forest ecosystems and resources in the LTB and surrounding Sierra Nevada. Anticipating future effects of changing climate to these ecosystems will be challenging, since climate projections are inherently uncertain and climate-related stressors are variable and complex. An adaptive management approach that incorporates the best available science information, monitors ecological conditions, and adjusts management approaches based on these conditions is crucial in an era of rapidly changing climate.

The first step in addressing climate change is to carefully assess the associated risks and vulnerabilities for the natural and human communities. Vulnerability assessments are one management strategy that may be utilized to guide management for climate change. In order to build resilience we must understand the vulnerabilities, including projected environmental changes, key values at risk, and the sensitivity of those values at risk to projected change. A vulnerability assessment spans the range of ecosystems and values at risk to identify the relative vulnerability of ecosystem components and their ability to adapt to increased stress. In turn, this helps prioritize where management actions may focus in order to maintain healthy, resilient ecosystems and protect human communities. A collaborative approach to vulnerability assessment (including management, research, and the public) can help to avoid fragmented, piecemeal approaches that lack public support.

An effective management strategy to changing climate must be flexible, responsive, incremental, and reversible (Millar et al. 2007). This will be especially challenging in forest ecosystems of the LTB and surrounding Sierra Nevada that are typified by homogeneous canopy structure and heavy fuel loads, resulting from decades of fire exclusion and intensive logging (McKelvey and Johnston 1992, Murphy and Knopp 2000, North et al. 2007). Both adaptation strategies and mitigation strategies will be necessary to manage forest ecosystems in the context of changing climates and amplified fire regimes (Millar et al. 2007, Stephens et al. 2010). Adaptation strategies increase the resilience of ecosystems and resources to climate change impacts (IPCC 2007). Promotion of key ecological processes, heterogeneity in forest structure, biodiversity, and reduced surface and ladder fuels conducive to restoring wildland fire are examples of effective adaptive strategies for Sierra Nevada ecosystems in the face of changing climate (Stephens et al. 2010). Mitigation strategies seek to reduce the long-term severity of climate change by lowering the concentration of greenhouse gases in the atmosphere. Examples of mitigation strategies include carbon sequestration in ecosystems, renewable energy to reduce fossil fuel consumption, and reduction in carbon footprint through sustainable practices and operations. If we actively manage ecosystems before climate-related effects induce change, long term management goals may be attained more effectively with less resources. Short term adaptations build resistance and resilience so that ecosystems are better able to withstand change, while long term adaptations are needed to avoid thresholds being crossed where one ecosystem abruptly transitions into another (Blate et al. 2009).

Below, the alternatives are compared with respect to their predicted relative abilities to support six adaptation or mitigation strategies that are current focus areas for Forest Service response to climate change (USFS 2008, 2011). These strategies are: (1) building adaptive capacity of ecosystems through ecological restoration, (2) enhancing watershed health, (3) sequestering forest carbon, (4) reducing existing stresses, (5) sustainable operations, and (6) fostering science-management partnerships and public education.

Building adaptive capacity of ecosystems through ecological restoration

Ecological restoration is a major focus area for forest managers throughout the Sierra Nevada. A prerequisite for restoration is the identification of current condition and trend in the focus forest type, and the identification of historical reference conditions that can provide guidance as to the nature of "proper function" in ecosystem processes and the capacity of certain forest structures and functions to be "resilient" to environmental change. Climate change is projected to become one of the main drivers of extinction and habitat loss (Dawson et al. 2011). It is widely thought that restoration practices based on a thorough understanding of past, pre-EuroAmerican settlement conditions are more likely to be sustainable over time. Adaptive capacity of biological and landscape level diversity to climate change depends on both intrinsic factors (e.g. species, ecosystem type, genetics) and extrinsic factors (e.g. rate of change, additional stressors) (Dawson et al. 2011). Restoration and protection of habitats may be critical for increasing species and ecosystem adaptive capacity to climate change, depending on the individual species and/or ecosystem specific; both positive and negative effects on species have been identified due to a changing climate (Dawson et al. 2011). Litell et al. (2012) and Blate et al. (2009) recommend several adaptation strategies that can be linked to building adaptive capacity of ecosystems through ecological restoration:

- Increase landscape diversity
- Implement treatments that restore resilience at large spatial scales
- Reduce fuel loads in forests
- Develop silvicultural treatments to reduce drought stress
- Treat large-scale disturbance as a management opportunity and integrate it in planning
- Increase use of wildland fire use
- Maintain biological diversity
- Develop corridors/habitat connectivity for species migration and habitat protection
- Review genetic guidelines for reforestation

All alternatives increase landscape diversity to some extent. A desired condition of the forest plan is that stand and landscape conditions provide a diversity in vegetation types, stand structures, and species compositions that resembles patterns resulting from the interaction of natural disturbance regimes (e.g., wildland fire, insect and disease outbreaks, landslide and avalanche, windthrow, flooding, pre-Comstock aboriginal manipulations), variations in the physical landscape (e.g., elevation, soils, site productivity, aspect, slope), and the reigning climate. Alternatives B and C focus on managing for forest structural heterogeneity and landscape diversity, which will increase resilience to stressors. As new data become available, updated reference conditions may be applied when and where appropriate. Alternatives B and C provide flexibility in order to meet heterogeneity within the natural range of variability. Alternative A has the potential to increase landscape diversity in early and late seral forests; however this alternative has absolute canopy closure limits so lacks some flexibility. Alternative D depends on natural events, such as wildfire, to increase landscape diversity. Alternatives A and D restrict vegetation treatments in old forest ecosystems under the old forest emphasis area. Alternatives B and C do not use the old forest emphasis designation, but instead old growth is preserved wherever it occurs and mid-seral forests are promoted for future late-seral conditions.

All alternatives reduce fuel loads in the Wildland Urban Intermix (WUI) where community safety is the first fuels priority. Alternatives B and C emphasize active ecological restoration to restore resilience and protect natural resources in both the WUI and across the landscape. These alternatives provide the greatest flexibility for ecological restoration. Silvicultural treatments in alternatives B and C would be designed within the natural range of variability to provide greater resilience to insect outbreaks and drought. Alternative C would reduce the number of treatments compared to alternative B by reducing stand densities towards the lower end of the natural range of variation. Alternative D vegetation management outside WUI does not include cutting trees to manipulate stand structure for forest health, the focus would be to let natural processes operate to restore and promote resilience. Trees greater than 30 inches DBH may be removed in alternatives B and C to achieve forest health, restoration, and safety goals. Alternative A only allows removal of trees greater than 30 inches DBH for hazard tree removal or to enable equipment operation. After existing projects are implemented, alternative D only allows trees less than 12 inches DBH to be removed outside of the defense zone in order to allow safe use of prescribed fire and natural ignitions. Hand thinning limitations in alternative D may not result in sufficient openings as trees get larger, especially if large scale disturbances are absent on the landscape.

A desired condition of the forest plan is that disturbance processes occur in the ecosystem within the natural range of variability, and, where this is not feasible due to inherent risks, surrogates (e.g. prescribed fire, thinning) are used carefully to effectively mimic natural disturbance. Disturbance processes and/or their surrogates create and maintain forest conditions that are well-adapted to current and future climates. Alternatives B, C and D have more flexibility to use large scale disturbance, including wildland fire, as management opportunities than alternative A, which has aggressive fire suppression guidance. Alternative B provides the greatest flexibility, allowing planned and unplanned ignitions to be utilized for forest health restoration purposes in all fire management zones except the WUI Defense zone. Alternative C allows planned and unplanned ignitions to be utilized for forest health restoration purposes in all fire management zones except the WUI Defense and Threat zones. Alternative A only allows unplanned ignitions to be used for resource objectives in the Desolation Wilderness. Alternative D uses management

of natural ignitions and under burning as the preferred tool for vegetation and fuels management; planned and unplanned ignitions would be utilized for forest health restoration purposes in all fire management zones except the WUI Defense and Threat zones. However, managed wildfire alone is challenging and may not be an effective tool. Forests in the Lake Tahoe Basin and other public and private lands in the eastern Sierra Nevada have been greatly altered by human management over the past 150 years. EuroAmerican settlement has led to more homogenous forest structure and a shift to higher stand densities and more fire intolerant species (Beaty and Taylor 2008). High fuel loads combined with the homogenous forest structure can lead to uncharacteristically severe wildfire.

Biological diversity will be maintained and improved in alternatives A, B and C. Alternatives B and C would promote active mitigation and restoration strategies to ensure sufficient quality habitat is available for target species. Habitat connectivity would be provided for unobstructed movement sufficient for survival, migration, reproduction, and dispersal given the potential effects of climate change on habitat and species and trophic level biodiversity will be considered during project planning and design. In addition, alternatives B and C include management direction to protect and restore habitat for target species and to allow restoration activities in PACs. There are not specific measures for active restoration to improve biological species and habitats in alternative A; however active management would still occur in some instances. Alternative A and D do not allow restoration activities in PACs. Alternative D does not use active restoration to maintain or improve biological diversity, natural processes would control ecosystem diversity. Alternatives A and D do not specifically consider habitat connectivity, however alternative D may provide habitat connectivity due to decreased recreational opportunities or could also decrease biological diversity due to passive management, and therefore a potential increase in stressors.

Alternatives B and C provide specific strategies for incorporating species mix, stocking density, or use of genetically superior or pest resistant planting stock, to restore landscapes and improve adaptability under climate change. Alternatives B and C also recommend that restoration activities use species and populations that are adapted to current and likely future conditions to successfully reestablish resilient ecosystems after disturbances. Alternative A does not specifically mention reviewing genetic guidelines for reforestation, however other Forest Service direction may still provide guidance on this (e.g. FSM 2600). Alternative D would not use reforestation, because this alternative would focus on natural reforestation.

Enhancing watershed health

Climate change is projected to become one of the main drivers of extinction and habitat loss (Dawson et al. 2011). Adaptive capacity of biological and landscape level diversity to climate change depends on both intrinsic factors (e.g. species, ecosystem type, genetics) and extrinsic factors (e.g. rate of change, additional stressors) (Dawson et al. 2011). Restoration and protection of habitats may be critical for increasing species and ecosystem adaptive capacity to climate change, depending on the individual species and/or ecosystem specific; both positive and negative effects on species have been identified due to a changing climate (Dawson et al. 2011).

Litell et al. (2012) and Blate et al. (2009) recommend several adaptation strategies for building adaptive capacity that can be linked to enhancing watershed function:

- Increase landscape diversity
- Implement treatments that restore resilience at large spatial scales
- Maintain biological diversity
- Develop corridors/ habitat connectivity for species migration and habitat protection

Landscape diversity will be maintained and improved in alternatives A, B and C. Alternative A focuses primarily on restoration of streams and watershed processes, while alternatives B and C increases emphasis on aquatic habitat improvement with equal emphasis on stream process, water quality, and aquatic habitat components. These alternatives recognize the need for restoring resilience into watershed systems and their associated habitats specifically to better enable them to adapt to changing climate conditions. Alternative D does not use active restoration to build adaptive capacity. Restoration would only occur where existing projects are planned or where infrastructure has accelerated degradation. The assumption behind this alternative is that the natural processes would be responsible for setting the pace to achieve equilibrium with existing and future stressors. In addition, alternative D has the least protection for water quality due to the increased potential for wildfires burning at increased frequency and severity.

Biological diversity and development of corridors/habitat connectivity for species migration and habitat protection is discussed under building adaptive capacity of ecosystems through ecological restoration.

Sequestering forest carbon

Forests are recognized as a carbon sink; however management techniques vary for managing forests with frequent fire regimes to maximize carbon storage while minimizing carbon emissions during planned and unplanned fires. The risk of losing stored carbon to disturbance is important to consider when developing management prescriptions (Hurteau et al. 2009). In the short term, overgrown fire-suppressed stands may contain more carbon than a treated forest until a large disturbance event occurs. Hurteau and North (2009) found that while untreated forested stands had the greatest carbon storage in the presence of wildfire these stands had the largest total carbon emissions. They found that maximizing carbon in the presence of fire was best achieved with treatments designed for a lower stand density with large fire resistant trees. North and Hurteau (2009) found that in seven years ‘burn only’ and ‘understory thin’ treatments had net positive carbon stocks, while the ‘overstory thin’, and ‘overstory thin and burn’ treatments had net negative carbon stocks. The ’understory thin and burn’ treatment had a net negative carbon balance after 7 years; however tree growth rates suggested that this treatment would become a net positive balance after an additional several years.

Fuel treatments are important in forests where fire suppression has caused a deviation from historic fire regimes, causing hazardous fire conditions. Forests in the Lake Tahoe Basin and other public and private lands in the eastern Sierra Nevada have been greatly altered by human management over the past 150 years. EuroAmerican settlement has led to more homogenous forest structure and a shift to higher stand densities and more fire intolerant species (Beaty and Taylor 2008). High fuel loads combined with the homogenous forest structure can lead to uncharacteristically severe wildfire. In the montane zone of the Lake Tahoe Basin the average pre-settlement fire return interval ranged from 8 to 17 years (Beaty and Taylor 2009, Taylor 2004). Current fire frequency is at one of its lowest points in the last 14,000 years. The paleo-record suggests that climate warming will increase fire episode frequency as regional drought intensifies (Beaty and Taylor 2009, Taylor 2004). Various authors have recommended different mitigation strategies for sequestering carbon in areas with a frequent fire regime:

- Develop vegetation treatments to achieve a lower overall stand density with large fire resistant trees (Hurteau and North 2009)
- Reduce surface and ladder fuels (Hurteau and North 2010, North et al. 2009)
- Store carbon in wood products or use it as a biomass fuel (Millar et al. 2007)
- Avoid uniform high density forest conditions vulnerable to severe disturbance (Millar et al. 2007)

Alternatives B and C will retain the highest level of forest carbon over the coming century. Treatments under these alternatives focus on restoration across the landscape to achieve forest structural heterogeneity and landscape diversity and lower stand densities dominated by fire resistant trees. Alternative C will have fewer entries than alternative B, which will reduce emissions during project implementation. Alternative A focuses on treatments in the WUI, which will also retain high levels of forest carbon. Alternative D will retain the greatest amount of carbon over the short term, however in the presence of a large wildfire this alternative is likely to retain the least amount of carbon because treatments will only occur in the WUI and these stands will have greater densities than in other treatments.

The use of wood products for biofuels is not discussed under any alternative; however it may be an option for alternatives A, B, and C, which allow post disturbance timber harvest. Alternative A allows post disturbance timber harvest for commercial value. Alternative B and C consider post disturbance timber harvest after concerns for safety, habitat, soils, and water resources are met to meet restoration objectives. Post fire timber harvest is not allowed in alternative D, which in addition to not using the wood products for biomass or alternative products, may slow overall recovery of the forest and thus slow carbon accumulation from regenerating forest species.

Reducing existing stresses

Natural climatic variability is one of the greatest drivers of ecological change. Restoration and protection of habitats and removal of stressors unrelated to climate is one of the most important adaptation options for building ecosystem resilience in response to climate change (Blate et al. 2009, Dawson et al. 2011). Litell et al. (2012) and Blate et al. (2009) recommend several adaptation strategies that can be linked to reducing existing stresses:

- Implement early detection/rapid response for non-native invasive species and undesirable resource conditions
- Implement treatments that restore resilience at large spatial scales

Early detection/rapid response will be utilized in alternative B and C for aquatic and terrestrial non-native invasive species. Alternative A provides direction for early detection/rapid response of terrestrial species only. Alternative D focuses on allowing natural processes to control the rate of recovery. This alternative does not utilize early detection/ rapid response as an adaptation strategy. Restoration actions would only occur to remove stressors, focusing only on the removal of high priority species or where directed by law.

Alternatives B and C include language specifically intended to promote resilience to stressors including resilience to fire, changing climate, disease, and insect outbreaks. Alternatives A and D do not include specific language to promote resilience to stressors.

Sustainable operations

Healthy forests are directly linked to sustainable consumption. The Forest Service is committed to reducing our environmental footprint, and including these principles into our programs, practices, and policies. Litell et al. (2012) and Blate et al. (2009) recommend several adaptation strategies that can be linked to sustainable operations:

- Implement treatments that restore resilience at large spatial scales
- Expand recreational opportunities across all four seasons
- Match engineering of infrastructure to expected future conditions
- Redesign roads and trails to withstand increases in rainfall intensity

All alternatives consider recreational opportunities across all four seasons. However, recreational capacity is greatest in alternative C meeting the greatest visitor demand and lowest in alternative D which has the most unmet demand for recreation. Alternative B has the greatest sustainable benefit, because it links recreational demand to improvements in ecological sustainability, which will restore resilience. Alternative A includes expansion of recreation infrastructure and development of new sites to meet predicted future demands after safety and resource impacts are

assessed. Alternative B focuses on deferred maintenance and modification of existing facilities to achieve ecological, social and economic sustainability. Expansion could occur in general forest or within existing facility footprints when facilities are modified or displaced. This alternative would also increase overnight accommodation sites. Alternative C would provide the greatest number of overnight accommodation units, the greatest number of day use parking spaces, and greatest number of developed acres. Alternative D would not replace recreation lost to ecological restoration, financial constraints or conflicts with other resources. Recreational infrastructure would not increase or expand to accommodate increased demand. While alternative D improves ecological conditions, this alternative does not consider increased recreational demand which could lead to an increase in unmanaged recreation which could lead to additional ecological problems due to the lack of infrastructure in a place where approximately 5.7 million visitors visit annually.

All alternatives continue developed ski area recreation. Climate models project a continuously increasing rain:snow ratio and earlier runoff dates for the next century, with decreased snowpack and growing-season stream flow. Alternative A would allow expansion within the ski area operational boundary, while alternative B would allow less expansion, alternative C more expansion and alternative D allowing the least amount of expansion. Expanding recreational opportunities to other seasons in ski areas will become increasingly important.

While alternative D does increase recommended wilderness acres, it decreases overall recreational capacity. Alternatives A and B continue management of existing wilderness and inventoried roadless in accordance with current plans and policies. Alternatives C and D would recommend Dardanelles Roadless Area for addition to the National Wilderness Preservation System. Additionally, alternative D would recommend Freel Roadless Area for addition to the National Wilderness Preservation System and would shift 12,000 acres from General Conservation to Backcountry Management Emphasis Area.

All of the alternatives use Access and Travel Management (ATM) to identify routes, crossing upgrade and BMP needs, and restoration and reroute opportunities that will protect and enhance natural resources. This process will assist engineering with matching infrastructure to expected future conditions. Alternative A would expand the non-motorized trail system and construction of trailhead parking. Alternatives B and C would formalize the ATM planning process and would revisit ATMs after implementation to adaptively manage and determine the effectiveness of their implementation and to address new and remaining issues. Alternative C would increase vehicle access to the forest on passenger vehicle routes, decrease percentage of challenging vehicle routs, and would increase developed parking. Alternative D would reduce the maintenance level of roads and trails compared to current maintenance level, which would increase the percentage of primitive and challenging trails. Non-motorized access to the forest would increase under alternatives C and D.

The Forest Service has concurrent Executive Orders and statutory requirements to reduce the environmental footprint for all federal agencies. Under all alternatives, the LTBMU will reduce its environmental footprint and decrease greenhouse gases emitted through implementation of sustainable practices in its day-to-day operations. All alternatives promote the use of public transport through the development of multi-modal transit stops, which will reduce greenhouse

gases emitted. Alternatives B, C, and D would increase informational signage and increase fee parking. Alternative C would provide the greatest amount of managed parking, while alternatives B and C would reduce roadside parking, with alternative D containing the least amount of managed parking.

Fostering science-management partnerships and public education

Many of our climate change activities will require assistance from technical climate experts. Long term science-management partnerships are key to facilitating adaptive management of public lands (Vogel et al. 2007). Science based adaptation is critical because if management actions are monitored then we can increase certainty about climate impacts (Litell et al. 2012). Litell et al. (2012) and Blate et al. (2009) recommend several adaptation strategies that can be linked to fostering science-management partnerships and public education:

- Promote education and awareness about climate change among resource staff and local publics
- Collaborate with a variety of partners on adaptation strategies and to promote ecoregional management
- Enhance research partnerships
- Expand conservation education programs to include climate change
- Seek opportunities to educate national forest visitors on climate change

The Forest Service provides guidance on educating resource staff about climate change. The LTBMU will continue to educate resource staff under all alternatives in regards to climate change.

In 2010 the LTBMU participated in a climate change working group that partnered with: California Tahoe Conservancy, Nevada Division of Environmental Protection, Tahoe Metropolitan Planning Organization, Tahoe Regional Planning Agency, Tahoe Science Consortium, Tahoe Transportation District, US Environmental Protection Agency, USFS – Lake Tahoe Basin Management Unit, Lahontan Regional Water Quality Control Board, US Army Corps of Engineers (USACE), and two Consultants who led the group. The LTBMU will continue to collaborate with partners on adaptation strategies under all alternatives.

Primary researcher institutions that the LTBMU currently collaborates with include the Tahoe Science Consortium, UC Davis, University of Nevada Reno, Pacific Southwest Research Station, Tahoe Regional Planning Agency, Desert Research Institute and Humboldt State University. The LTBMU will continue to enhance research partnerships under all alternatives.

While the alternatives do not contain a specific strategy for educating national forest visitors on climate change, these programs may still be developed depending on funding.

3.4.7.4. Analytical Conclusions

Comparison of Consequences by Alternative

The four alternatives are ranked by their overall ability to address the adaptation and mitigation strategies presented above:

- Building adaptive capacity of ecosystems through ecological restoration: B/C, A, D
- Enhancing watershed function: B/C, A, D
- Sequestering forest carbon: C, B, A, D
- Reducing existing stresses: B/C, A, D
- Sustainable operations: B, C, D, A
- Fostering science-management partnerships and public education: B, C/A/D

Overall alternative B is best prepared, followed by alternative C, then A, and finally D in regards to address adaptation and mitigation strategies in response to climate change. Alternative D may not be able to implement adaptation and mitigation strategies, because this alternative primarily relies on natural processes and does not provide flexibility for managers to implement strategies.

How the Alternatives Maintain or Achieve the Desired Conditions

The Forest Plan has four desired conditions that specifically mention climate. Additional climate language can be found in the Forest Plan strategies. Alternatives A, B, and C will be able to meet the desired conditions, with alternatives B and C having the greatest ability to do so. Alternative D may not be able to meet the desired conditions during the life of the plan, because this alternative depends on passive management. The four desired conditions are:

1. Stand and landscape conditions provide a diversity in vegetation types, stand structures, and species compositions that resembles patterns resulting from the interaction of natural disturbance regimes (e.g., wildland fire, insect and disease outbreaks, landslide and avalanche, windthrow, flooding, pre-Comstock aboriginal manipulations), variations in the physical landscape (e.g., elevation, soils, site productivity, aspect, slope), and the reigning climate.

2. Disturbance processes occur in the ecosystem within the natural range of variability, and, where this is not feasible due to inherent risks, surrogates (e.g. prescribed fire, thinning) are used carefully to effectively mimic natural disturbance. Disturbance processes and/or their surrogates create and maintain forest conditions that are well-adapted to current and future climates.

3. Watersheds provide important ecosystem services such as high quality water, recharge of streams and aquifers, the maintenance of riparian communities, and moderation of climate variability and change.

Terrestrial and aquatic habitat connectivity continues to provide unobstructed movement sufficient for survival, migration, reproduction, and dispersal given the potential effects of climate change on habitat and species.

3.4.8. Cultural Resources

3.4.8.1. Introduction

This section evaluates and discloses the potential environmental consequences on Cultural Resources that may result with the adoption of a revised land management plan. It examines the four alternatives for revising the 1988 LTBMU Forest Plan.

Methodology

No modeling was used for this analysis. It is a qualitative analysis.

Assumptions

In the analysis for this resource, the following assumptions have been made:

All specific projects that result from selection of any alternative will undergo separate National Environmental Policy Act and National Historic Preservation Act review before implementation.

3.4.8.2. Overview of the Affected Environment

As of December, 2011, approximately 68,982 acres have been surveyed (representing 44% of the LTBMU land), and 899 cultural sites have been recorded. Cultural evaluations of 254 sites determined 126 are eligible to be listed on the National Register of Historic Places and 128 are not eligible.

Most inventory and site recording has resulted from large forest health projects. Numerous small project-related inventories, including urban lots and grazing allotments, account for the rest of the survey. This pattern of inventory and site recording has resulted in concentrations of information with large gaps in the more remote portions of the forest that may bias the sample of archaeological resources. Essentially, the project area inventory opportunities have mostly been exhausted and future information will probably need to be a result of Section 110 (Historic Preservation Act of 1966) efforts.

Additionally, more recent inventories beginning with the East Shore project have included the intensive recording of transportation systems that were ignored during earlier inventories. This has left an uneven impression of the presence of these systems across the forest.

The East Shore project identified a pristine Historic Logging Landscape associated with the Comstock mining boom in Virginia City. Many of the sites within the area have been determined to be contributors to a National Register of Historic Places eligible Comstock Logging District. These sites range from an extensive array of Chinese associated woodcutter cabins, lumber milling sites, flumes, ditches and complex transportation systems. This east shore complex is unique because of the single logging event that took place in the 1870’s to 1900 and then the area was not re-entered, leaving the historic landscape unaltered from more recent logging entries.

Managing this large landscape presents challenges during fuels reduction and forest health projects.

Significant Native American milling complexes have been identified in the Meiss Lake, Freel Peak, and Mount Rose areas. Additional Section 110 inventory in similar remote high altitude could expand or further define these complexes.

The Cave Rock Traditional Cultural Property is an important traditional resource that has been identified and evaluated and will present management challenges due to the 2005 Forest Order restricting access to the area. Development of Subpart C regulations in the Code of Federal Regulations could help with these challenges. This area may need to be designated a Special Interest Area.

Groves of aspen trees carved by Basque sheepherders have been identified throughout the LTBMU and pose management challenges. These resources consist of carved information and art on living trees, many of which are reaching the end or have exhausted their life expectancy. How to treat these fragile resources can be complex. These resources could be served by a management plan that provides guidance for recording the information, protecting the trees and carvings, preserving selected examples of the carvings and possibly sustaining them through traditional use.

A Memorandum of Agreement has been developed to restore and rehabilitate nine dilapidated historic cabins at Camp Richardson Resort. These contributors to the National Register of Historic Places Camp Richardson Resort Historic District have been neglected for over 20 years and are in danger of becoming unsalvageable. A focus of future management at Camp Richardson and other Historic resorts should be balancing historic preservation of contributing structures with the resorts economic viability.

The structures at National Register eligible Glen Alpine Springs Resort are used under a life estate to Robert Fritchee and under a Memorandum of Understanding (MOU) to Historic Preservation of Glen Alpine Springs Inc. Oversight of the resort has been uneven over the duration of the current Land and Resource Management Plan. Some periodic activities may not be appropriately authorized under the MOU and some discussion has taken place regarding putting the resort under Special Use Permit. A Special Use Permit should continue to be pursued for appropriate authorization, management consistency, and ease of transition in the future when the life estate terminates.

3.4.8.3. Environmental Consequences

None of the alternatives will have direct effects to Cultural Resources provided that the assumption noted above is valid. Indirect impacts could accrue from several provisions in some alternatives.

3.4.8.4. Analytical Conclusions

No direct effects will result from the adoption of any of the alternatives.

Comparison of Consequences by Alternative

An indirect effect could accrue if the recommendation of the Dardanelles Inventoried Roadless Area for Wilderness designation in Alternatives C or D is acted upon by Congress. Recent court precedence suggests that historic structures in Wilderness areas cannot be maintained and must be allowed to decay. The Meiss Cabin and Barn are important historic properties within the Dardanelles Inventoried Roadless Area that have been determined to be eligible to the National Register of Historic Places. Unless provisions for maintaining these structures were included in the desigination legislation, desigination would result in an adverse impact from lack of maintenance. Additionally, historic dams are located at Showers, Dardanelles and Round lakes in the Dardanelles Inventoried Roadless Area. These structures have not been evaluated for their eligibility to the National Register of Historic Places, but similar adverse impacts could result from designation if they are determined eligible.

The same indirect effect would accrue under Alternative D with the addition of the dam at Star Lake within the Freel Inventoried Roadless Area could also be adversely impacted.

Fuels treatments in Alternative B could have the long term indirect effect of reducing or eliminating impacts to cultural sites with organic components from wildfires. In the short term, impacts to cultural sites from treatment activities could occur.

Under Alternative C, the reduced number of entries needed would indirectly reduce the possibility of impacts to Cultural sites from project activity while providing the same protection from wildfire as in Alternative B. Wildland fire management for resource objectives could indirectly result in short term increased risk to Cultural sites when fire is allowed to burn in areas where cultural inventories have not occurred.

The management of natural ignitions and under burning in Alternative D would have the most risk for indirect impacts to Cultural sites while providing the same long term indirect benefits as Alternatives B and C.

How the Alternatives Maintain or Achieve the Desired Conditions

All alternatives equally maintain the Desired Conditions.

3.4.9. Tribal Relations

3.4.9.1. Introduction

This discussion evaluates and discloses the potential environmental consequences on Tribal Relations that may result with the adoption of a revised land management plan. It examines four different alternatives for revising the 1988 Lake Tahoe Basin Management Unit Land and Resource Management Plan as amended (1988 forest plan).

Methodology

No modeling was used for this analysis. It is a qualitative analysis.

Assumptions

It is assumed that the LTBMU will continue its mandated Government to Government relationship with the Tribe.

3.4.9.2. Overview of the Affected Environment

The Washoe people are the original occupants of the land encompassed by the LTBMU and the lands administered by the LTBMU were managed by the Washoe for millennia before their displacement in the late 18th and early 19th centuries. Lake Tahoe is considered by the Washoe to be the center of their aboriginal territory and of great importance to their culture, livelihood and traditions. For many years Washoe tribal members had little presence at the lake and often felt unwelcome.

The Tribe has stated reestablishing a Washoe presence at Lake Tahoe, maintaining cultural traditions and language, reintroducing traditional environmental management practices, and increasing trade and commerce as primary goals at Lake Tahoe. Progress toward accomplishing these goals have been made during the life of the LRMP.

The LTBMU has a well established long term relationship with the Washoe Tribe of Nevada and California (Tribe) that has sustained over the life of the LRMP through several tribal administrations and Forest Service Line Officers. During the life of the previous plan the LTBMU and Tribe have developed a Government to Government protocol agreement and three additional use agreements. The protocol agreement needs to be updated to include other forests with relationships with the Tribe.

The Agreement for Meeks Meadow traditional plant tending and uses and the agreement for collaborative wetlands conservation planning in the Baldwin/Taylor and Meeks Meadow areas have helped maintain and reintroduce traditional practices into the management of land and resources and Lake Tahoe.

Congressional legislation has conveyed approximately 24 acres of land to the Tribe at Skunk Harbor. Additionally, the LTBMU has produced the Environmental Analysis to issue the tribe a Special Use Permit for a Cultural Center at Taylor Creek. At Baldwin Beach day use area, the concessionaire reserves parking spaces for Washoe use and does not charge fees for tribal

members. These endeavors have furthered the goal of reestablishing a Washoe presence at Lake Tahoe.

The Tribe successfully bid on the economic opportunity to manage Meeks Bay Resort, a Forest Service facility on the west shore of Lake Tahoe. This opportunity furthers the goal of increasing trade and commerce at Lake Tahoe.

3.4.9.3. Environmental Consequences

None of the alternatives will have direct effects to Tribal Relations provided that the assumption noted above is valid. Indirect impacts could accrue from provisions in the action alternatives.

3.4.9.4. Analytical Conclusions

No direct effects will result from the adoption of any of the alternatives.

Comparison of Consequences by Alternative

Each of the Alternatives have fuels treatment components that would indirectly be beneficial to the Tribes management of their adjacent land in the Skunk Harbor area. Alternative D accomplishes treatments throughout the basin in the most traditional manner utilizing managed prescribed fire as a tool.

How the Alternatives Maintain or Achieve the Desired Conditions

All alternatives equally maintain the Desired Conditions

3.4.10. Fire and Fuels

3.4.10.1. Introduction

Changing fire patterns and fuel management are primary issues driving forest plan revision. Past management practices including fire exclusion have lead to increasing forest density and fuel loads, and an overall decrease in structural and compositional heterogeneity. This over-crowding combined with three periods of drought since 1975 has lead to beetle-caused mortality further increasing the hazardous nature of fuel conditions.

Wildfire frequency, size, total annual burned area, and – in some forest types – fire severity, are all trending upward across the western U.S. It is believed that climate warming in conjunction with the increasing fuel loads are contributing to these trends (Miller et al. 2008, Flannigan et al. 2000). In recognition of this, federal wildland fire management policies have changed to allow more flexibility in fire management. In addition, our improved understanding of forest dynamics has provided more ecologically sound vegetation treatment practices. While some of these practices are not prohibited under our current direction, revising the forest plan will enable us to incorporate these policies and practices directly into our guiding documents providing goals, strategies, objectives, and standards and guidelines based on new science not available when the current plan was developed.

Here we summarize the results of the fire and fuels program environmental consequences analysis. The analysis evaluates and discloses the potential environmental consequences on fire and fuels that may result with the adoption of a revised land management plan. The analysis examines, in detail, the four different alternatives for revising the 1988 Lake Tahoe Basin Management Unit Land and Resource Management Plan as amended (1988 forest plan). There is considerable overlap between fire and fuels programs and vegetation management programs. This analysis focuses on the effects fuels treatments have on fire behavior in the wildland-urban interface, the ability of the alternatives to return fire to the ecosystems, and wildland fire management throughout the LTBMU.

Methodology

Wildfire Risk Analysis

Analysis questions:

1. Where have ignitions occurred historically?
2. Where are the potential problem areas for fire behavior?
3. Where are the fire return interval departures the greatest?
4. What has been the recent fire activity?

Analysis methods:

Ignition Risk--Ignition risk was assessed in two ways:

1. Recorded ignition point data (1973-2010) were used to produce a density surface partitioned into five risk classes ranging from very low to very high ignition risk.
2. The ignition point data were then separated by fire management unit (FMU) to produce an ignition risk by FMU map. The ignition risk by FMU data were displayed in charts by general cause (human vs. natural), and by frequency and proportion (see Fire and Fuels Specialist Report).

Current Wildfire Potential --FLAMMAP (Version 3) was used to predict fire behavior characteristics such as flame length and fire type (e.g. crown fire, surface fire). FLAMMAP uses GIS-based raster inputs for terrain and fuel characteristics and computes fire behavior outputs of a given landscape using standard fire behavior prediction models. For this analysis, the 2011 update California Fuels Landscape was used(http://wfdss.usgs.gov/wfdss_help/index.htm?page=WFDSSHelp_Non-LANDFIRE_CAv082710.html). Raster maps are produced showing potential fire behavior characteristics (flame length, crown fire potential, etc.) over the entire landscape. Fire behavior modeled with FLAMMAP provides a point in time (assumes fuel moisture, wind speed and wind direction are constant) fire behavior calculation for each 30 meter cell across the landscape. It does not simulate fire growth or changes in fire behavior characteristics over time (see Fire and Fuels Specialist Report).

Actual weather conditions are variable and dynamic throughout the Basin. No set of weather parameters can fully account for all possible conditions that may be encountered. Therefore, a generalized set of weather conditions are used in this analysis.

As with all models, FLAMMAP provides estimates of possible real-world processes. The model will never perfectly replicate actual events.

No site-specific treatments are proposed. Therefore no post-treatment FLAMMAP runs have been created.

Fire Return Interval Departure (FRID)—This polygon layer consists of information compiled about fire return intervals for major vegetation types on the 18 National Forests in California and adjacent land jurisdictions. Comparisons are made between pre-Euroamerican settlement and contemporary fire return intervals (FRIs). Current departures from the pre-Euroamerican settlement FRIs are calculated based on mean, median, minimum, and maximum FRI values.

Recent Fire History—Historical fire report data were analyzed in a variety of ways to answer the analysis questions related to recent fire activity. Data from FAMWEB (http://famtest.nwcg.gov/fam-web/) data warehouse: queries and reports—Fire Causes and Acres Burned by Year.

Potential to Meet Fire and Fuels Program Objectives

Analysis questions:

1. What are the environmental and regulatory constraints that might affect the ability to meet program objectives?
2. Where and when has lightning historically occurred?
3. Based on a regression of the historical record, how often does a lightning strike cause an ignition?
4. What is the potential for meeting objectives with managed wildfire by alternative? *Note: any modeled potential acres of managed wildfire accomplishments for any of the alternatives are not TARGETs. Rather they are modeled maximum acres burned under favorable conditions in which every lightning ignition from the historical record was modeled as a wildfire managed to meet resource objectives. With the amount of WUI, infrastructure, current fuel conditions, smoke management issues, and prevailing weather typical at or near periods where lightning ignitions are expected to occur, accomplishments will more likely be near the lowest end of the projections.*

Analysis methods:

Historical Burn Day Analysis--To assess prescribed burning opportunities on the California side of the Lake Tahoe Basin (LTB), we analyzed data from California Air Resources Board (CARB) and the Meyers remote automated weather station (RAWS). All CARB and weather data were combined into a single database and a day-by-day comparison over the past 13 year period was analyzed to assess patterns and trends when prescribed fire prescriptive criteria coincide with days designated as permissible burn days by CARB. Note: Smoke management in Nevada is regulated by Nevada Division of Environmental Protection (NDEP). NDEP does not designate days as burn days or non burn days. This analysis, as designed, was not conducted for the Nevada portion of the LTBMU (see Fire and Fuels Specialist Report).

Lightning Strikes and Ignitions Analyses--Lightning strike data for 1990 through 2010 were obtained from the Bureau of Land Management (BLM) (The lightning data is

provided to BLM under contract by WSI Corporation, Inc.). Lightning ignition data were derived from FAMWEB. Linear regression to assess relationship between annual strikes and ignitions was conducted to provide the ability to use lightning strike frequency as a predictor for ignition frequency. Lightning strikes by month and by FMU were assessed to examine potential opportunities to manage wildfire to meet resource desired conditions and objectives.

Ability to Use Managed Wildfire to Meet Resource Desired Conditions and Objectives (Managed Wildfire)—The Fire spread probability (FSPro) model in the wildland fire decision support system (WFDSS) was used to model potential to meet management objectives. FSPro provides the ability to estimate the probability of wildfire spread into an area or to a point of interest from a specific location. The advantage of using FSPro over other fire behavior models is that multiple wind-weather scenarios for historical climatology records are used to simulate hundreds of possible patterns. The proportion of the total each cell is impacted by fire is then partitioned into probability categories which are used to predict potential managed wildfire opportunities. Historically, the majority of lightning caused ignitions occur in August. Therefore simulations were run using August 1 start dates. In order to cover a range of moisture conditions, two sets of simulations were run using historical climatological records from a low precipitation year (2007) and a high precipitation year (2011). Each simulation ran 500 different fires scenarios for seven days.

Indicators

1. Modification of fire behavior.
2. Reductions in fire return interval departure (FRID).

Indicator descriptions

1. **Modification of wildland fire behavior** is a primary objective of fuels treatments. During the planning and design phase of a site specific fuels treatment project, each treatment unit has desired outcomes and objectives to which the unit is designed, i.e. desired post-treatment fire type (surface fire) or flame length. These objectives are specific to each unit based on location, fuel type, terrain features, etc. For instance, in order to achieve a surface fire type under a given set of weather conditions, a different thinning prescription would be needed for flat ground than for a steep slope in order to meet the surface fire objective. For this analysis, when any alternative proposes fuels reduction on one of the treatments listed below, the proposed acres of treatment are all assumed to meet the minimum criteria (modification of fire behavior) for which it was designed (see assumptions below). Some treatments may not be designed with fire behavior modification as a primary objective but those included here are expected to have similar effects to a fuels treatment. Forest vegetation treatments that modify fire behavior are:

- Thinning and fuels reduction in the WUI
- Forest structure restoration--establishing new age classes in the form of small openings.
- Forest type conversion—converting fir to Jeffrey pine or mixed conifer
- Forest stand resilience—thinning outside the WUI

2. **Reducing fire return interval departure (FRID)** is a critical piece of the forest restoration and fuels reduction strategy of the forest plan revision alternatives. The reference fire regimes of the major forest types in the LTB include attributes such as burn patterns, severity, rotation, and fire return interval. The observed departures of current conditions from these reference conditions provide a guide to direct management objectives. Although we can attempt to predict what the severity or burn pattern might be should a particular portion of the landscape burn in a wildfire, we cannot predict with any certainty what the outcome will be. Prior to an actual fire, the only departure from an historic fire regime attribute in which we can place a reasonable degree of confidence is in FRID. Although a single wildfire event or prescribed fire may not contribute greatly to reducing this indicator in areas that have missed multiple fire cycles, it does set the stage for implementation of a regular program of using fire for fuels treatment maintenance and ecological restoration. For this analysis we use reduction in FRID as an indicator by which we can measure success in restoring fire's role back into the ecosystem. The tools we will use to reduce FRID are prescribed fire and managed wildfire. Both of these tools depend upon many conditions outside of our control (see assumptions below). Each alternative's proposed amount of prescribed fire acres are derived from past accomplishments and adjusted to be consistent with an alternative's strategy for meeting desired conditions. Average acres burned using managed wildfire is estimated using FSPro to produce probability analysis for each alternative. Although the estimates are based on a high degree of uncertainty, the acres are included as potential reductions in FRID to measure the relative effectiveness of the alternative's potential for affecting this indicator.

   Regardless of the effects or ignition source; all wildfires and prescribed fires contribute to reducing FRID. Annual acres burned by wildfires in the LTB are highly variable, ranging from less than ten to greater than 3,000 acres. Recent studies on climate change and the potential to affect wildfire suggest larger and more intense wildfire in the future (Flannigan et al. 2000, Lenihan et al 2003, McKenzie et al. 2004, Stephens et al. 2007, National Research Council 2011, also see the Climate Report in Appendix C). However, when considering wildfire contributions to reducing FRID, we project annual acres burned at the current 10 year moving average of 455 acres per year. Although the alternatives' different strategies are expected to affect vegetation and fuels in different ways and to varying degrees, we project this number of acres and the associated effects equally for all alternatives, and therefore do not include it in the analysis of this indicator.

Assumptions

In the analysis for fire and fuels, the following assumptions have been made:

Modeling assumptions

- Actual weather conditions are variable and dynamic throughout the Basin. No set of weather parameters can fully account for all possible conditions that may be encountered. Therefore, a generalized set of weather conditions are used in this analysis.
- As with all models, FLAMMAP provides estimates of possible real-world processes. The model will never perfectly replicate actual events.
- No treatments will occur on the ground therefore no post-treatment FLAMMAP runs have been created, treatments are assumed to be effective at the prescriptive criteria used in treatment prescription design.
- Estimated acres of managed wildfire assume every lightning ignition in approved FMUs is managed to meet resource objectives.
- FSPro simulations assume no suppression actions taken.
- When multiple fires are simulated in FSPro, some fire sizes may be limited as fires grow together. These limits to fire size are assumed to mimic conditions of an active managed wildfire program where fire scars of previous wildfires limit growth of subsequent fires.
- For the Environmental Consequences section, FSPro estimated maximum acres of managed wildfire are based on 2011 climatology. The assumption is that managed wildfire decisions in dry years such as 2007 will be No-Go decision (decision is instead to suppress the fire).
- When calculating estimated acres of managed wildfire by alternative, FSPro spreads are cut off at approved FMU boundary. This is assuming that fires spreading from approved FMUs into unapproved FMUs will be suppressed.

Fire and Fuels specific assumptions

- In all four alternatives, the majority of fuels reduction treatment efforts are concentrated in the WUIs until initial WUI treatments are completed (see the Lake Tahoe Basin Multi-Jurisdictional Fuel Reduction and Wildfire Prevention Strategy – September 20, 2007—hereafter the “10 year strategy”). WUI treatments that maintain the treatment unit’s effectiveness occur as needed. Note that scheduling in the 10 year strategy has outpaced accomplishments on the ground. However, the pace of WUI mechanical and hand treatments will not vary by alternative.
- Fuels treatments are assumed to be effective at conditions for which they were designed.
- Prescribed fires and managed wildfires burn at intensities within or close to those expected under natural fire regime. The assumption is that if conditions or prescriptive criteria are outside of an acceptable range (conditions conducive to high or extreme fire behavior) decisions will be to suppress wildfires or not to ignite prescribed fires.

- Weather, resource availability, smoke dispersion, and other conditions necessary for implementation of a prescribed fire or managed wildfire are extremely difficult to predict beyond the very short-term. Any projected acres of prescribed fire or managed wildfire are based on the assumption that conditions are sufficient for safe and effective implementation.
- Pile burning is included as reducing FRID. Although it can be argued that pile burning does not provide the same level of ecological benefits as understory burning, pile burning does put fire back into the system. More importantly, pile burning is often a necessary precursor to follow-up understory burns.
- Currently, as an alternative to prescribed pile burning, biomass utilization accounts for approximately 100 acres per year. If future opportunities for biomass utilization increase, then the proposed pile burning will decrease proportionally.

3.4.10.2. Overview of the Affected Environment

The LTBMU Comprehensive Evaluation Report 2006 (CER) assessed the current state of management direction for fire and fuels management and identified the need to address the following:

- Direction in the 1988 Forest Plan called for suppression of all wildfires and did not provide the opportunity to manage wildfire to meet resource objectives (Note: The Sierra Nevada Forest Plan Amendment (SNFPA 2004) allows wildfires in wilderness areas to be managed to meet resource objectives). The Desolation Wilderness Forest Plan Amendment (November 1998) approved wildfire management to meet resource objectives in the Desolation Wilderness.
- Fire and fuels management needs to have more integration with vegetation and habitat management, and fire ecology.
- Focus should be on historic fire regimes, and forest vegetation composition and structure.
- New science and modeling data need to be included in forest plan revision, especially concerning the importance of restoration of natural disturbance regimes and their effects on forest structure, composition, and function.
- The number of human caused ignitions needs to be decreased, especially since these usually occur in close proximity to human communities. With projected warming and increasing fuels loads associated with climate change, potential for catastrophic wildfire affecting communities and natural resource will continue to increase.
- Updating guidance for smoke management. Although the current plan provides guidelines and mitigations for reducing smoke emissions and impacts, some of the options for slash disposal now conflict with scientific knowledge and current management practices. The revised Forest Plan needs to consider potential smoke emissions from these sources (CER p32)
- The public expressed a variety of opinions regarding the management of the amount of smoke in the basin resulting from prescribed burns used to improve forest health and safety. In most cases, those who understood the goals of prescribed burning generally supported the need to continue these burns, however there was overwhelming support to use alternatives to burning where possible (especially pile burns).

Summary of past actions

Prior to European settlement, fires were ignited by lightning or members of the Washoe Tribe. It is estimated that between 2,000 and 8,000 acres on average burned each year, although there was very high interannual variability. Fifty percent or more of the acres burned were at the lower elevations in the montane zone (Manley et al. 2000). Because frequent fires in the montane zones reduced surface and ladder fuels, fire intensities were low and there was relatively little mortality of mature trees (Manley et.al. 2000, Skinner and Chang 1996).

Over the last century LTB ecosystems have been altered through a combination of drought, fire suppression and past timber harvesting (Stephens et al. 2004, Taylor 2004, Nagel and Taylor 2005). This has resulted in heavy accumulations of dead and down woody fuels, altered fuel arrangements and changes in vegetative structure and composition. As a result, the fire regime attributes have departed substantially from historic patterns.

As Europeans settled in the LTB, several factors contributed to changes in the fire regime and fuel hazards. The seasonal fires set by the Washoe Tribe were eliminated as Native Americans left the basin. During the Comstock Era (1875- 1895) large scale clear cutting removed most of the old growth forests in the Basin (Lindstrom et al. 2000). By 1900, most of the Basin's forests were dominated by seedlings and saplings (trees with a DBH of less than 12"). In addition to current fuel conditions and the effects of past actions, increasing temperatures and changing precipitation patterns exacerbate the problem. Western fire seasons are beginning earlier and lasting longer than in the past (Westerling et al. 2006, Miller et al. 2008, North et al. 2009 GTR 220). Extreme fire weather has become more frequent and forest fires are predicted to continue to grow larger and more severe making them more difficult to suppress (Flannigan et al. 2000, McKenzie et al. 2004, Stephens et al. 2007, National Research Council 2011).

Recognition of the role natural disturbance regimes play in shaping ecosystem condition leads to the need to provide a fire and fuels program strategy that re-establishes natural disturbance processes while providing for community safety. In many cases, existing heavy fuel loads preclude the use of fire until other management techniques are first used to reduce heavy fuel loading in order to facilitate safe use of fire.

Where have ignitions occurred historically?

Figures 3-31 and 3-32 show the distribution of ignitions skewed towards the WUI. More natural ignitions than human ignitions occur in the General Forest FMU. The opposite is true in the other FMUs. To summarize: 12% of all types of ignitions occur in the General Forest, 9% in Wilderness, 56% in the WUI Defense Zone, and 23% in the WUI Threat Zone (Figure 3-32).

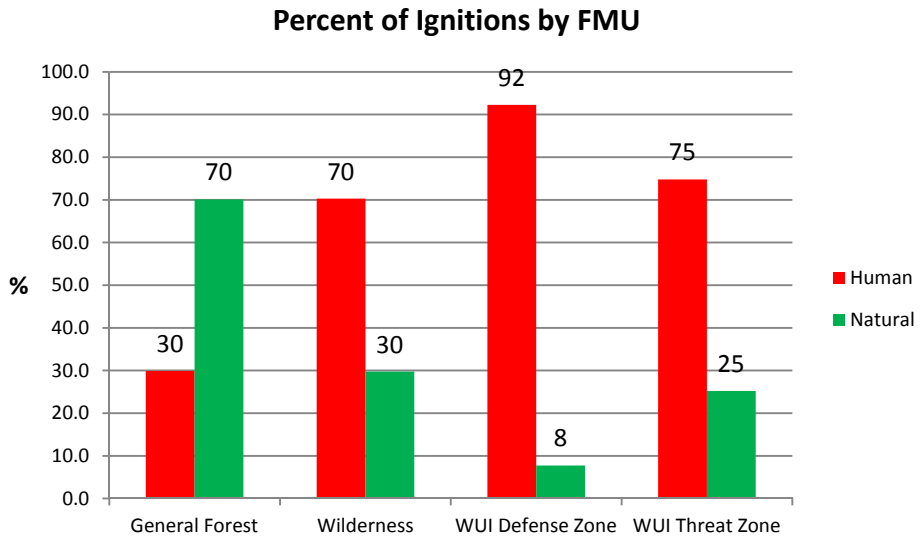


Figure 3-31. Percent of ignitions throughout the Lake Tahoe Basin by fire management unit (FMU) and cause (Human vs. Natural) 1976-2010.
Note: the WUI FMU is broken down into its components; threat and defense zones.

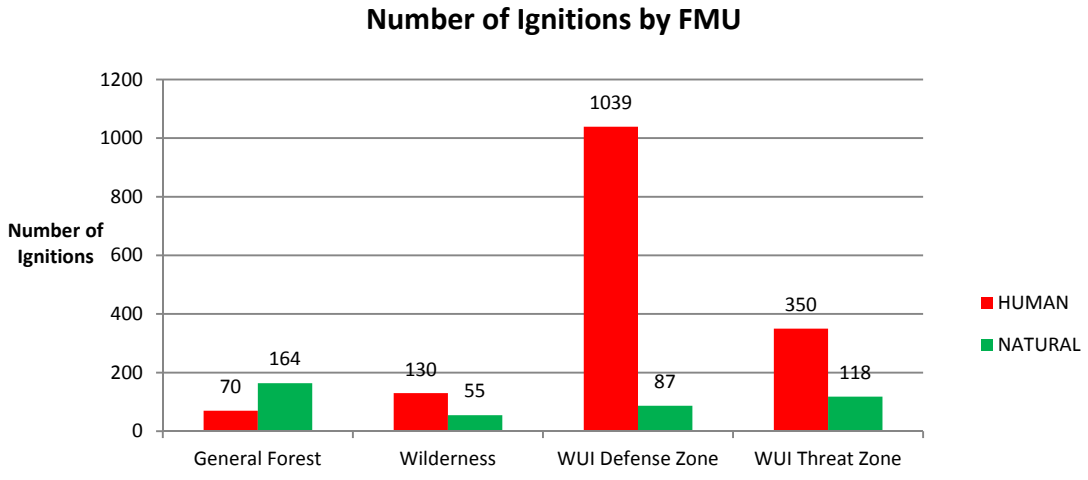


Figure 3-32. Number of ignitions throughout the Lake Tahoe Basin by fire management unit (FMU) and cause (Human vs. Natural) 1976-2010.
Note: the WUI FMU is broken down into its components; threat and defense zones.

Where are the potential problem areas for fire behavior?

Flammap was used to display areas where fire behavior under high fire danger conditions (90th percentile weather) is expected to vary across the landscape (Figure3-33). Areas in red are a major concern since these areas may experience extreme fire behavior (active crown fire) threatening values at risk.

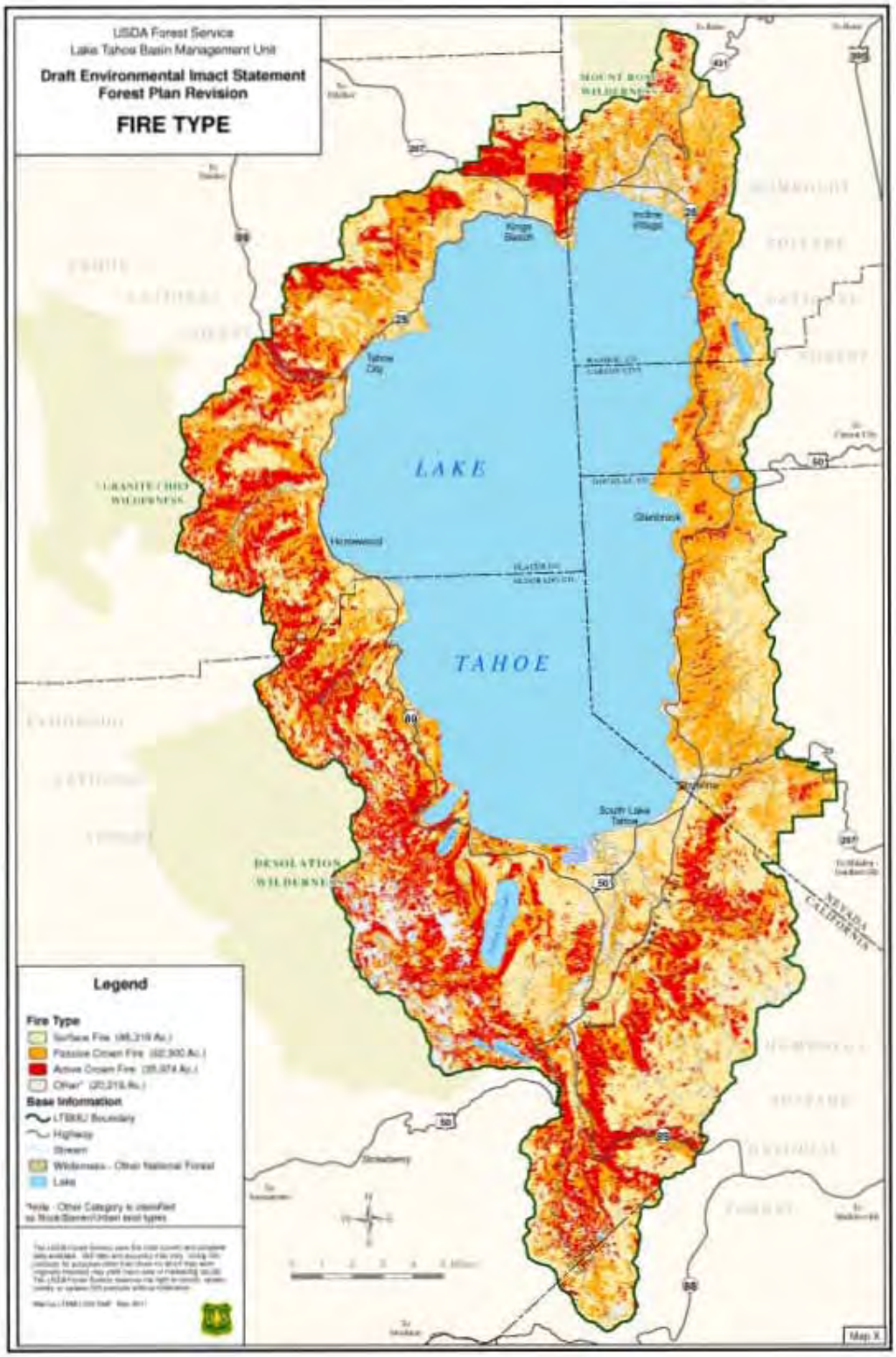


Figure 3-33. Fire type map based on FLAMMAP outputs (see "Current wildfire potential" above)

Where are the fire return interval departures the greatest?

Historic mean fire return intervals (FRI) in the LTB ranged from over 400 years in the subalpine zone to about 10 years in the lower montane zone (Elliott-Fisk et.al 1996, Manley et.al. 2000, Barbour et.al. 2002, Taylor 2004, Nagel and Taylor, 2005, Beaty and Taylor 2009, Safford and Schmidt 2007). About 50% of the landscape supported vegetation with FRIs less than 22 years.

Today large wildfires (greater than 100 acres) are uncommon in the Basin and current (1910-2005) FRIs are extremely long (Figure 3-33). Ninety eight percent of the land area in the LTB has not had a fire since 1910, and greater than 90% of the land is characterized as moderately or severely departed (FRI condition classes II and III) from pre-Euro-American settlement FRIs (Safford and Schmidt 2007, cite FRID). Additionally, wildfire severity proportions during recent wildfires have not been consistent with natural fire regimes. For example, greater than 50% of the Angora fire burned at high severity compared to 5-15% expected in the forest types burned (Safford et al. 2009, Carlson 2009).

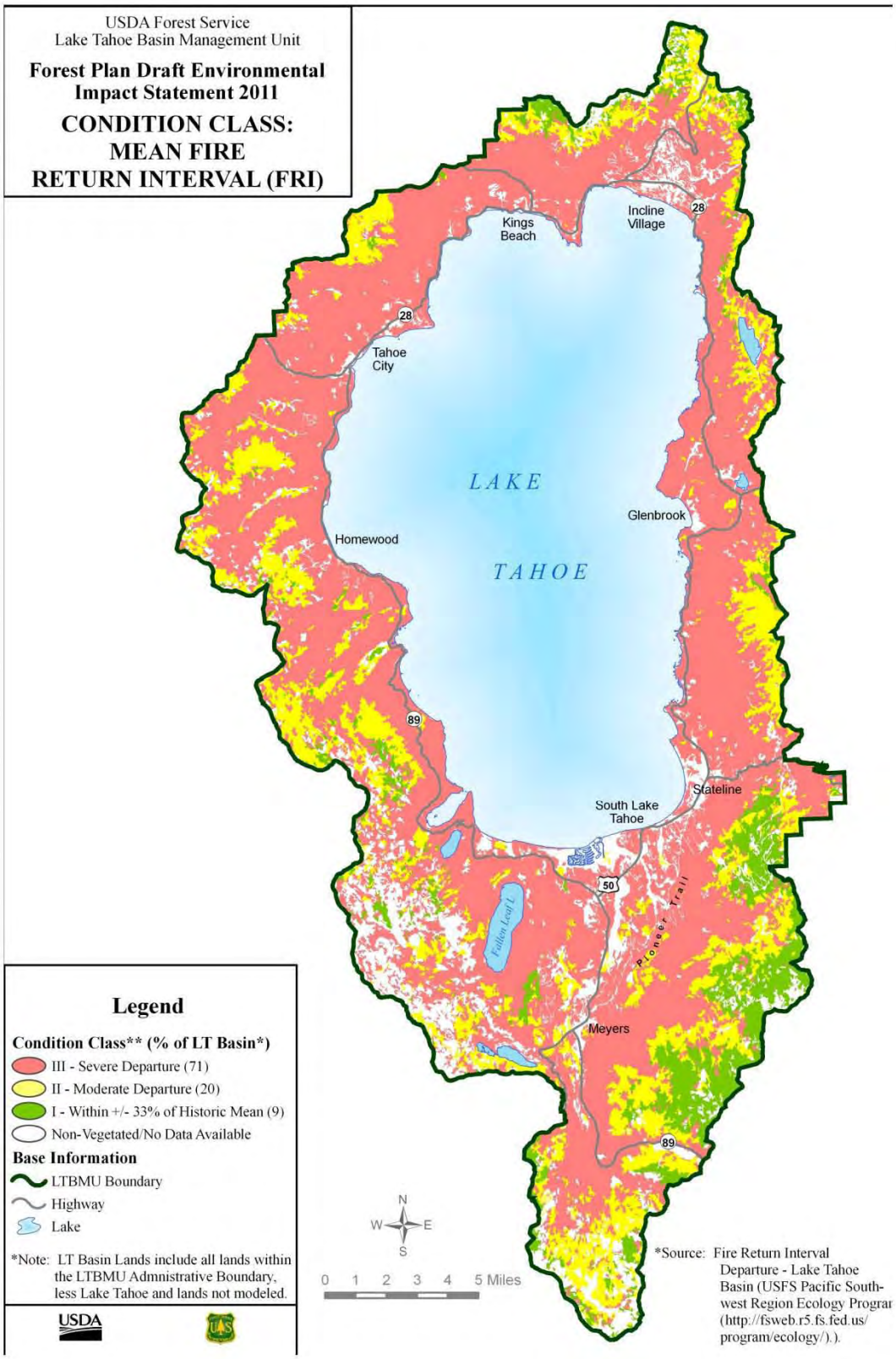


Figure 3-34. Condition Class based on mean FRID (CC(FRI)).
This condition class (CC) measure is derived using the departures from mean point fire return interval (FRI) data. *To summarize: CC-I = within +/- 33% of historic mean. CC-II = moderately departed—between 33% and 67% departure. CC-III = >67% departure.* cite FRID.

What has been the recent fire activity?

The number of acres burned by wildfires in the LTB has increased in each decade since 1973 including a ten-fold increase during the last decade (Figure 3-34). Although the majority of fires are small, three recent fires during the last decade grew larger than fires of the past few decades —the Gondola and Showers Fires (673 and 294 acres, respectively) in 2002 and the Angora fire (3,100 acres) in 2007. The Angora Fire, which destroyed or damaged more than 240 buildings, was the largest fire ever recorded in the LTB. Weather conditions on the initial burning period of each of these fires recorded from Lake Tahoe Airport are listed in the table below (Table 3-26). It should be noted that these recorded weather conditions in Table 3-26 are below the 90th percentile conditions to which the Basin designs its fuel treatments. Even with highly effective suppression resources, the crown fire activity and sizes of these fires provide additional evidence that fuel hazards in the Basin have increased substantially and will continue to increase in the years ahead (Lake Tahoe Basin Multi-Jurisdictional Fuel Reduction and Wildfire Prevention Strategy –10 year strategy, September 20, 2007).

Table 3-26. Weather recorded on days when large fire occurred in Lake Tahoe Basin. Data from National Weather Service; Lake Tahoe Airport (LTVL). Ninetieth percentile calculated from Meyers RAWS' historical dataset May through October.

	Date	Max Temp (^{o}F)	Min RH (%)	Avg. Afternoon 20ft Wind (mph)
Gondola	3 July, 2002	77	18	9-13 with gust to 22
Showers	19 August, 2002	76	11	10-16 with gusts to 26
Angora	24 June, 2007	68	11	9-13 with gusts to 28
90th percentile		85	5	25 (10 minute average)

Human caused ignitions are the predominant source of wildfire ignitions in recent decades (Table 3-25, Figures 3-35 and 3-36). On average, human caused ignitions occur nearly four times as often as natural ignitions since 1980 (Figure 4). Over the same time period human caused ignitions accounted over 99% of acres burned (Figure 5). Further, lightning ignitions have greatly declined since 2003; with 2006 having the most with 9 lightning ignitions (Table 3-25, Figures 3-34 and 3-35). Lastly, the number of acres burned is related more to climatic factors such as drought, and to weather conditions near the time of ignition, than to the number of ignitions.

Table 3-27 Number of ignitions and acres burned by cause (human versus natural) over the last three decades. Data from FAMWEB (http://famtest.nwcg.gov/fam-web/) data warehouse: queries and reports—Fire Causes and Acres Burned by Year. These data pertain to National Forest System Lands in the Lake Tahoe Basin

Wildfire Activity 1980-2010						
	Human Cause		Natural Cause		Grand Total	
Year	Number	Acres	Number	Acres	Number	Acres
1980	45	9	15	2	60	12
1981	84	17	3	0	87	17
1982	32	7	10	1	42	8
1983	22	3	1	2	23	5
1984	71	139	12	2	83	140
1985	73	19	10	5	83	24
1986	72	12	5	1	77	13
1987	67	10	18	27	85	38
1988	88	14	36	8	124	22
1989	52	8	17	2	69	9
1990	61	8	41	6	102	14
1991	37	6	12	2	49	7
1992	33	5	40	5	73	11
1993	4	0	0	0	4	0
1994	101	53	11	1	112	54
1995	54	152	2	0	56	153
1996	34	168	16	3	50	171
1997	3	0	2	0	5	1
1998	24	8	10	2	34	11
1999	41	10	13	2	54	12
2000	43	7	13	2	56	8
2001	63	31	7	2	70	34
2002	35	1041	18	2	53	1043
2003	34	278	39	6	73	283
2004	52	6	3	1	55	6
2005	17	2	2	0	19	2
2006	34	36	9	2	43	38
2007	50	3127	5	1	55	3128
2008	44	5	0	0	44	5
2009	58	8	0	0	58	8
2010	43	5	6	3	49	8
Total	1471	5194	376	89	1847	5283
Average	47	168	13	3	60	170

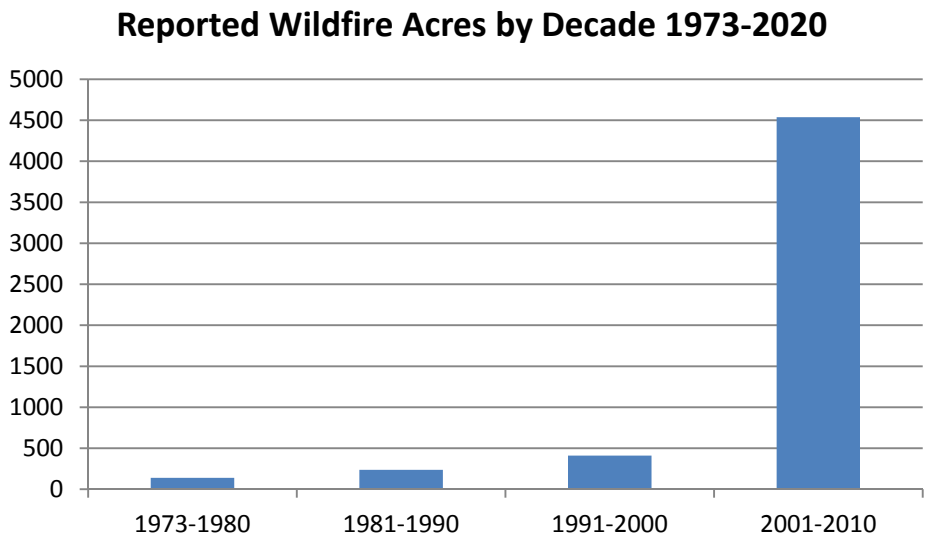


Figure 3-35. Wildfire acres burned in the Lake Tahoe Basin by decade (1973-2010).
Data from FAMWEB (http://famtest.nwcg.gov/fam-web/) data warehouse: queries and reports—Fire Causes and Acres Burned by Year.

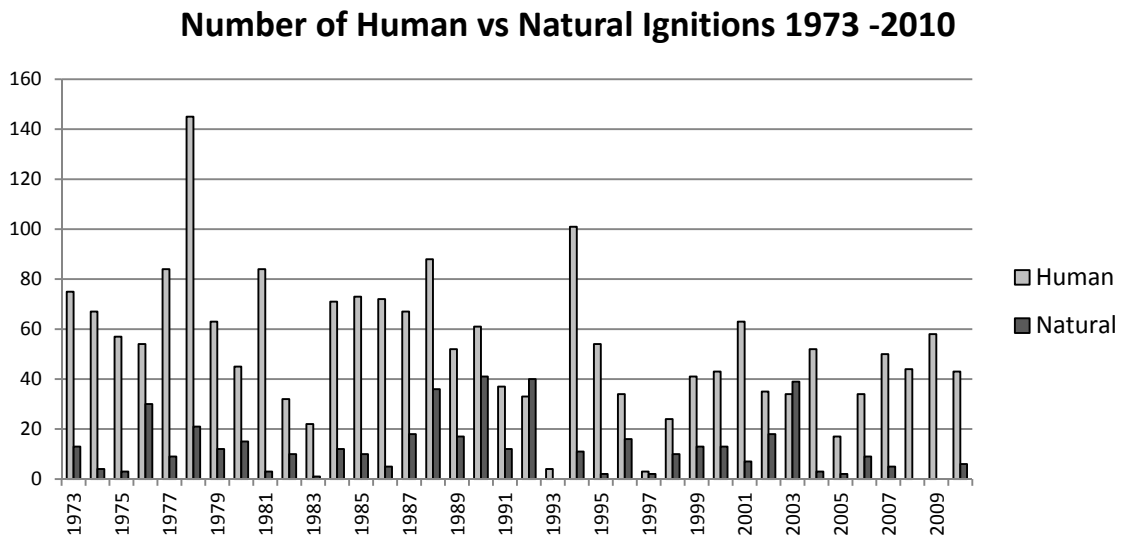


Figure 3-36. Number of human and natural ignitions1973-2010.
Data from FAMWEB (http://famtest.nwcg.gov/fam-web/) data warehouse: queries and reports.

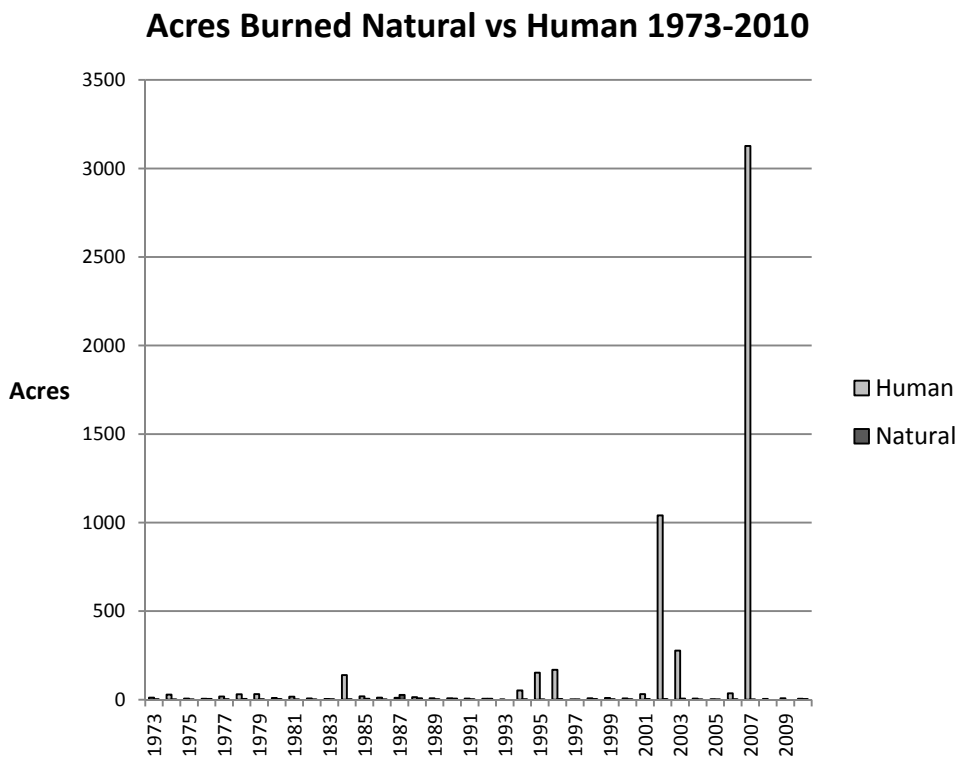


Figure 3-35. Fire Causes and Acres Burned by Year.
Data from FAMWEB (http://famtest.nwcg.gov/fam-web/) data warehouse: queries and reports.

What are the environmental and regulatory constraints that might affect the ability to meet program objectives?

The LTBMU conducted an historical analysis combining days that met burn plan prescriptive criteria coincident with days designated by the California Air Resources Board (CARB) as permissible burn days (atmospheric conditions meeting smoke dispersion criteria). These data are very important for assessing the Unit's ability to implement prescribed fires (Figure 3-36). They can also be used to predict periods where conditions conducive to using managed wildfire are expected. Seasonality of available burn days is an obvious pattern when looking at the monthly means, with the summer months having the lowest number. Note the inverse relationship between average burn days (Figure 3-36) and average monthly lightning strikes (Figure 3-37).

Historical Burn Day Analysis

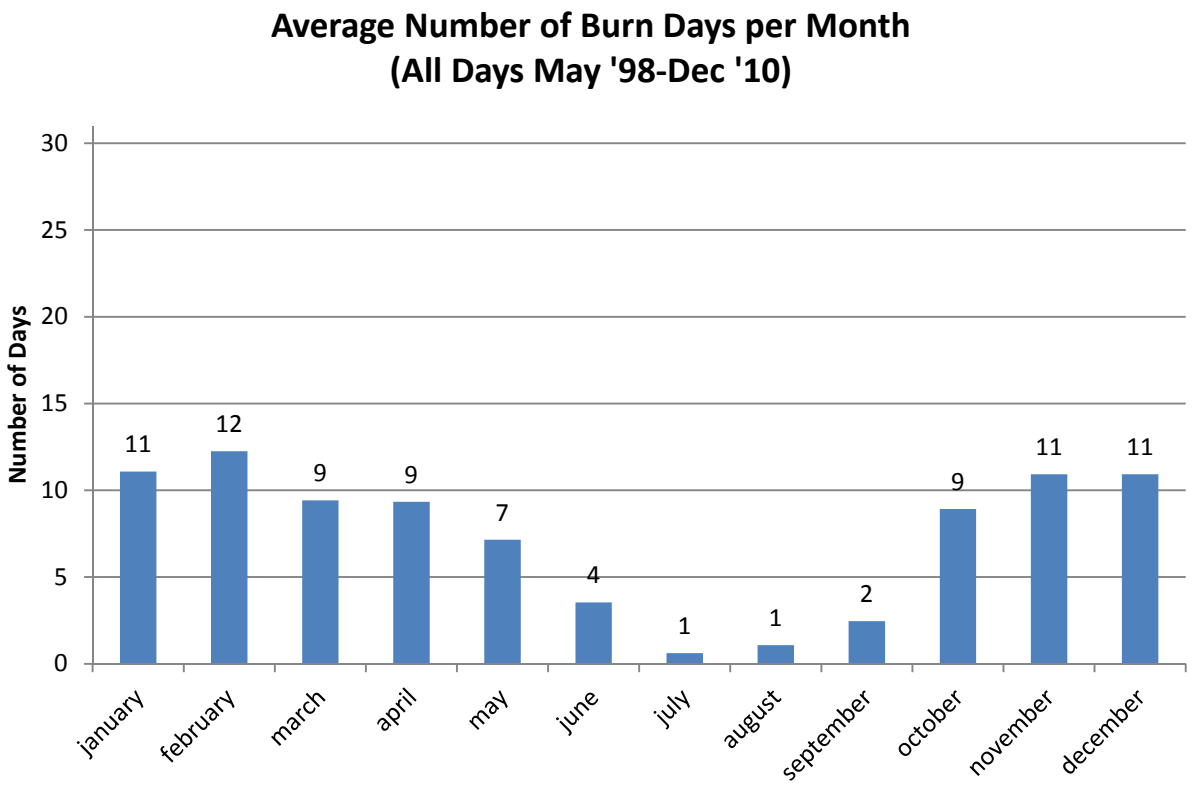


Figure 3-36. **Monthly average number of days that meet permissible burn day and burn plan prescription criteria.** Data from CARB and Meyers RAWS, May 1, 1998 though Dec 31, 2010.

Where and when does lightning occur?

Historic Lightning Occurrence – Over the past couple decades, lightning strikes in the LTB have been mostly concentrated between June and September, and have been extremely rare between November and March (Figure 3-37). Areas approved for managed wildfire in Alternative A averaged 54 lightning strikes per year. Alternative C averaged 249 annually and Alternatives B and D averaged 375 strikes annually (Figure 3-38) (Lightning strike data for 1990 through 2010 were obtained from the Bureau of Land Management (BLM) (The lightning data is provided to BLM under contract by WSI Corporation, Inc.).

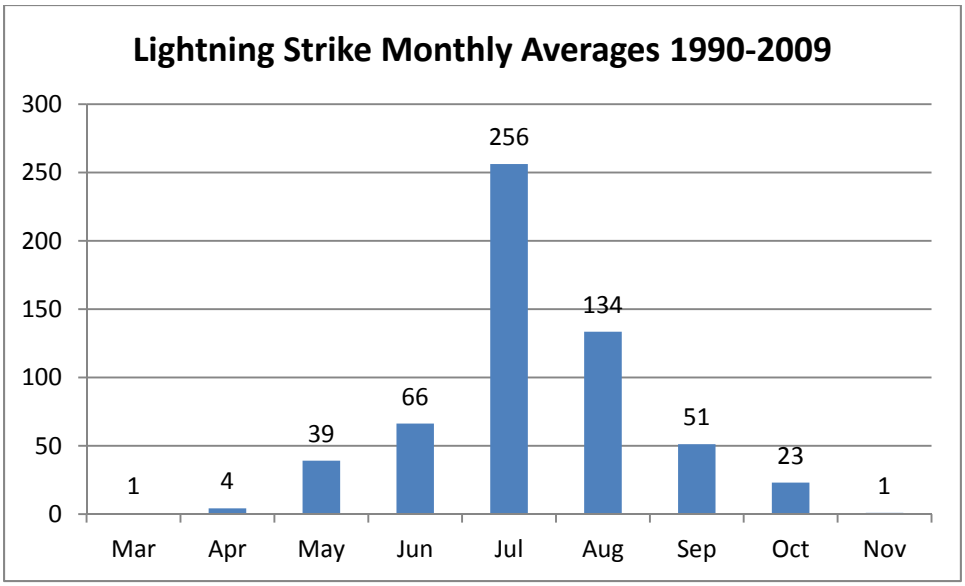


Figure 3-37. Average lightning strike occurrence in the Lake Tahoe Basin recorded by month from 1990 through 2009. Proprietary lightning data acquired from Bureau of Land Management (Lightning strike data for 1990 through 2010 were obtained from the Bureau of Land Management (BLM) (The lightning data is provided to BLM under contract by WSI Corporation, Inc.).

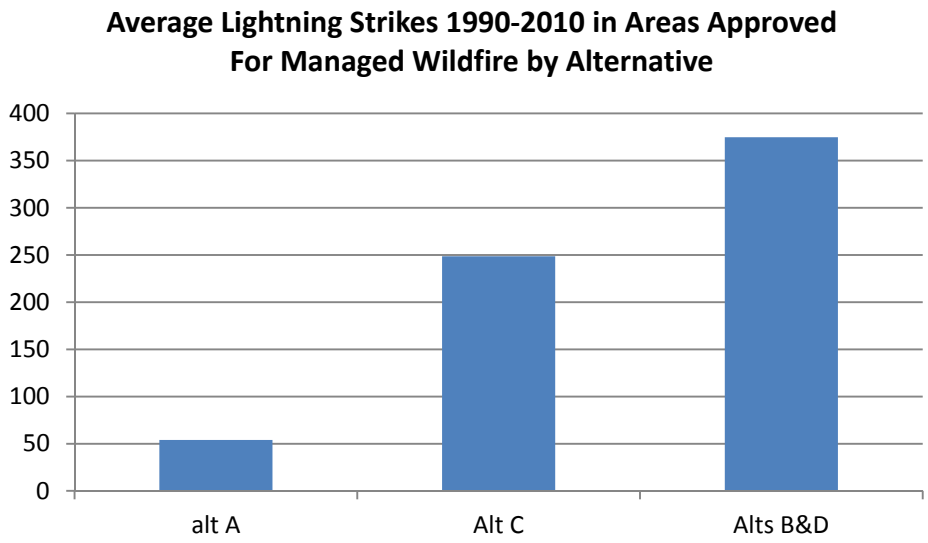


Figure 3-38. Average number of lightning strikes occurring from 1990 through 2010 in areas approved for managed wildfire by alternative (Lightning strike data for 1990 through 2010 were obtained from the Bureau of Land Management (BLM) (The lightning data is provided to BLM under contract by WSI Corporation, Inc.).

How often does lightning cause ignitions?

Based on the regression (Figure 3-39), the lightning frequencies stated above predict an average of three ignitions annually in approved fire management units (FMUs) for Alternative A, ten for Alternative C, and 15 for Alternatives B and D (Table 3-26).

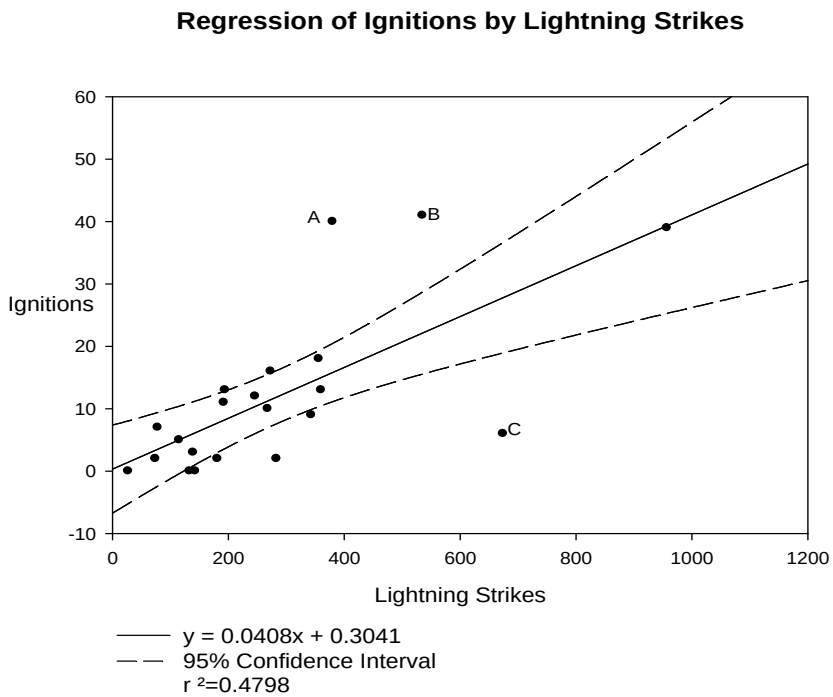


Figure 3-39. Linear regression of lightning ignitions by lightning strikes from 1990 through 2010. Ignition data from FAMWEB (http://famtest.nwcg.gov/fam-web/) data warehouse: queries and reports—Fire Causes and Acres Burned by Year. Proprietary lightning data acquired from Bureau of Land Management. Note the 3 outliers labeled A, B and C. Points A and B correspond to 1990 and 1992, years with annual precipitation recorded at 49% and 56% of average respectively. Point C is data from 2010, a year with 168% of average annual precipitation (precipitation data from NOAA (http://www.cnrfc.noaa.gov/rainfall_data.php) and California Dept. of Water Resources (http://cdec.water.ca.gov)). R-squared value increases to 0.8092 when outliers excluded.

Average numbers of reported lightning caused ignitions in the approved FMUs for each alternative are also shown in table 3-28.

Table 3-28. Average annual lightning strike occurrence by area approved for managed wildfire by alternative, and estimated ignitions calculated from regression equation (see figure 3-39). Average reported ignitions from FAMWEB (http://famtest.nwcg.gov/fam-web/) data warehouse: queries and reports—Fire Causes and Acres Burned by Year

	Average Annual	Estimated Ignitions	Reported Ignitions (avg.)
Alternative A	54	3	1
Alternative C	249	10	6
Alternatives B&D	375	15	8

What is the potential for meeting objectives with managed wildfire by alternative?

The ability to restore fire to a degree necessary to achieve desired conditions will depend on many things, including patterns and trends in lightning strike occurrence, weather and atmospheric conditions, as well as management constraints such as resource availability and suppression preparedness level. In order to assess each alternative's potential to utilize fire, we analyzed historic lightning occurrence from 1990-2009 (Figures 3-37 and 3-38), reported lightning caused ignitions (Tables 3-25 and 3-26), and California Air Resources Board (CARB) permissible burn days that coincided with day in burn plan prescription from 1998-2010 (Figure 3-36).

Utilizing historic lightning ignition point data, the LTBMU conducted an analysis to project potential for managed wildfire to restore fire as an ecosystem process. These data were used as ignition points from which to grow simulated wildfire spread probability maps using the Fire Spread Probability (FSPro) model. FSPro is a spatial-probabilistic model that produces fire spread partitioned into polygons based on the proportion of times each cell in the polygon was burned by the numerous fires in the simulation. The analysis was based on hundreds of fires grown from each historical ignition point modeled under hundreds of possible weather scenarios.

In order to produce a range of climatological conditions under which managed wildfire growth was estimated, a dry year (2007) and a wet year (2011) were used as model inputs.

The analysis assumes every lightning ignition from the past 30 years of fire report data occurring in approved FMUs by alternative is managed to meet resource objectives.

Figure 6 shows the number of days that historically are expected to meet air quality and prescribed fire weather criteria. Although these may not be directly linked to future managed wildfire decisions, they do show relative trends of when conditions can be expected to be most favorable. Note the inverse relationship between average lightning strikes by month (Figure 3-36) and available burn days (Figure 3-37).

Note that modeled fires allowed to grow into the defense zone and urban core spread into greater that 90% more acres when using 2007 weather. FSPro spread probabilities of greater than 60% were used.

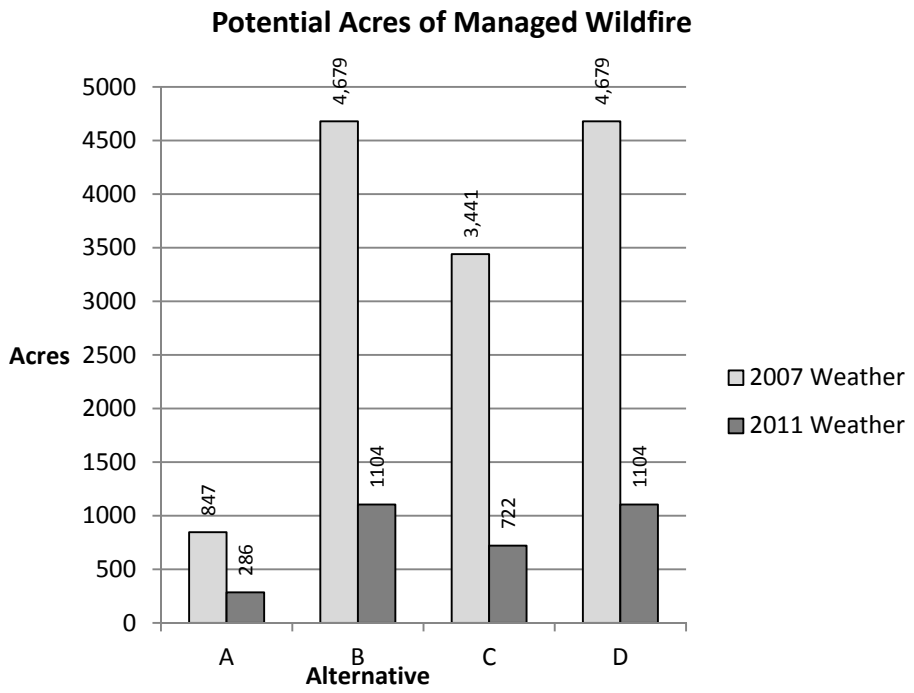


Figure 3-40. Potential acres of managed wildfire produced using the Fire Spread Probability (FSPro) model. Based on lightning ignitions over a 30 year period (1981-2010) and expected acres summed across 60 through 100 percent FSPro spread probabilities. Analysis covered two disparate years in terms of rainfall: a dry year (2007) and a wet year (2011).

Summary of the Affected Environment

- The Comprehensive Evaluation Report (USDA Forest Service LTBMU 2006) determined the need for the fire and fuels resource to:
    - Reconsider more opportunities to implement managed wildfire
    - More thoroughly integrate fire and fuels management with other resource programs
    - Focus more on historic fire regimes as well as vegetation structural diversity and ecological function
    - Utilize science and modeling products available since the last plan update
    - Reduce the number of human ignitions
    - Consider alternatives to pile burning

- Risk to human communities and ecological resources
    - Ignition risk by FMU—nearly 80% of all ignitions occur in the WUI, 56% in the Defense Zone and 23% in the Threat Zone.

- Greater than 90% of the Basin is moderately or severely departed from reference fire return interval (FRI).
- Under 90th percentile weather conditions, fire behavior modeling produced fire type outputs in the following proportions—46% surface, 34% passive crown, 19% active crown
- Additionally, wildfire severity proportions during recent wildfires have not been consistent with natural fire regimes, specifically, low severity has been under-represented and high severity over-represented.
- Gondola Fire—July 3, 2002, 673 acres
- Showers Fire—2002, 294 acres
- Angora Fire—2007, 3,100 acres, over 250 home destroyed, the largest fire ever recorded in the LTB.
- Of all acres burned since 1980, 85% burned in the last decade (2002-2011)

- Fire and fuels management programs:
  - Burn plan prescription criteria and air quality restriction limit the number of days available to meet prescribed burning objectives.
  - In recent years lightning caused ignitions have declined. If the trend continues, opportunities for managed wildfire will be minimal. Lightning frequency is probably cyclical.
  - Wet years such as 2011 may provide opportunities to utilize managed wildfire to meet various resource desired conditions and objectives
  - Dry years, such as 2007 may be much more difficult to manage wildfires and thus suppression of most or all wildfires will be the likely decision.
  - There has been a slight negative trend in human caused ignitions over the past three decades.

Current trends in climate change are expected to increase fuel production as well as increase fire activity that may affect LTBMU's fire and fuels programs to known degrees.

3.4.10.3. Environmental Consequences

All four alternatives are consistent with Federal wildland fire management policy. LTBMU wildland fire management promotes the goal of managing fire to meet safety, protection, and natural resource management goals. Initial action on human-caused wildfire will continue to suppress the fire at the lowest cost with the fewest negative consequences with respect to firefighter and public safety.

One of the main issues identified in the CER (USDA Forest Service LTBMU 2006) and during collaborative efforts with stakeholders that are now driving forest plan revision is broad concern about the high levels of hazardous fuels present throughout many parts of the LTB and the severely altered natural fire regimes in many areas. This issue also identifies the need to apply

strategies that bring the mix of vegetation species and seral stages back into balance with reference conditions.

The CER also identified a need for change allowing managed wildfire over more of the landscape. Many stakeholders realize that natural processes such as wildland fire are a necessary component of a healthy functioning ecosystem. The relative contributions of the various alternatives towards meeting these needs are described below in terms of the two indicators: Modification of fire behavior, and reduction of fire return interval departure (FRID).

The following activities are expected to affect the indicators:

- Indicator 1—modification of fire behavior will be affected primarily by WUI thinning and fuels reduction, but also by activities that restore forest structure, forest type conversion, and resilience.
- Indicator 2—Reducion in FRID is affected only by prescribed fire and managed wildfire activities.

WUI thinning and fuels reduction

Indicator 1--Modification of fire behavior—All four alternatives are very similar with respect to modification of fire behavior in the WUI zones until initial WUI treatments are complete (~10 years). Alternative D relies slightly more on hand treatments over mechanical treatments in the WUI, but total acres remains the same between all alternatives. Greater differences will emerge once the initial WUI treatments are complete and the Threat Zone converts to General Conservation Emphasis in Alternative D.

Forest structure restoration

Indicator 1--Modification of fire behavior— Alternatives A, B, and D propose the same number of acres. Alternative C proposes twice the number of acres of this activity. Alternative D relies completely on hand thinning and prescribed fire to meet forest structure restoration objectives.

Forest type conversion

Indicator 1-- Modification of fire behavior— Alternatives A, B, and D propose 50 acres per year, while Alternative C proposes 100 acres per year. Alternative D relies on hand treatment and prescribed fire.

Forest stand resilience

Indicator 1— Modification of fire behavior—Alternatives A and B propose 500 acres per year (7,500 ac over the life of the plan). Alternative C doubles the number of acres (15,000 ac over the life of the plan). Alternative D proposes only 300 acres per year (4,500 ac over the life of the plan) of stand resiliency treatments, and relies on hand treatments and fire.

Table 3-29. Acre contributions to effects on indicator by the various vegetation and fuels treatments. These are estimates of average annual accomplishments and those expected over the life of the Plan (15 years).

Indicator 1 – Modification of Fire Behavior (acres)								
Activity	**Alternative A**		**Alternative B**		**Alternative C**		**Alternative D**	
	Annual	Plan Life	Annual	Plan Life	Annual	Plan Life	Annual	Plan Life
WUI thinning & fuel reduction	2,000	30,000	2,000	30,000	2,000	30,000	2,000	30,000
Structure restoration	100	1,500	100	1,500	200	3,000	100	1,500
Type conversion	50	750	50	750	100	1,500	50	750
Forest stand resiliency	500	7,500	500	7,500	1,000	15,000	300	4,500
Total	2,650	39,750	2,650	39,750	3,300	49,500	2,450	36,750

Prescribed burning

Indicator 2— Reduction in FRID— All four alternatives use prescribed fire as the primary tool for reducing FRID. Alternatives A and B propose reductions on 1,900 acres per year or 28,500 acres over the life of the plan. Alternatives C and D propose 2,300 and 2,550 acres per year respectively, or 34,500 and 38,250 acres respectively over the life of the plan.

Managed wildfire

Indicator 2— Reduction in FRID— Current direction provides for this only in the LTBMU portion of the Desolation Wilderness (21,998 acres). Alternative C provides the option in all areas except the WUI (83,534 acres) and Alternatives B and C propose the highest number of acres available (130,740). This includes all areas except the WUI Defense Zone. Figure 3-40 shows modeled upper estimates for managed wildfire acres under 2007 and 2011 weather scenarios. Modeled FSPro wildfire spread into defense zone and urban core areas occurred greater than 90% more frequently when using 2007 weather. Since a year such as 2007 is less likely to receive an affirmative decision to manage a wildfire to meet resource objectives, estimated acres using the 2011 weather only are reported in Table 3-30 below *(Note: any*

modeled potential acres of managed wildfire accomplishments for any of the alternatives are not TARGETs. Rather they are modeled maximum acres burned under favorable conditions in which every lightning ignition from the historical record was modeled as a wildfire managed to meet resource objectives. With the amount of WUI, infrastructure, current fuel conditions, smoke management issues, and prevailing weather typical at or near periods where lightning ignitions are expected to occur, accomplishments will more likely be near the lowest end of the projections.).

Table 3-30. Acre contributions to effects on indicator 2 by prescribed fire and managed wildfire. These are estimates of average annual accomplishments and those expected over the life of the Plan (15 years). Managed wildfire acres here reflect only those acres modeled using 2011 weather. *These are considered maximum acres with minimums estimated annual acres equal to zero.*

Indicator 2 – Reduction in Fire Return Interval Departure (acres)								
Activity	**Alternative A**		**Alternative B**		**Alternative C**		**Alternative D**	
	Annual	Plan Life	Annual	Plan Life	Annual	Plan Life	Annual	Plan Life
Prescribed Fire	1,900	28,500	1,900	28,500	2,300	34,500	2,550	38,250
Managed Wildfire	286	4,287	1,104	16,561	722	10,825	1,104	16,561
Total	2,186	32,787	3,004	45,061	3,022	45,325	3,654	54,811

Climate Change

Over the last 100 years, mean annual temperature in the Lake Tahoe Basin has increased by 2oF. Days with temperatures below freezing are decreasing. Average annual precipitation during the last 100 years is increasing, but inter-annual variability is also increasing. While average annual precipitation is increasing, the amount falling as snow is decreasing, as well as average winter snow pack. Further, spring thaw is occurring 5-30 days earlier than several decades ago (see Appendix C-the Climate Report). These observed trends are expected to affect fire and fuels in a variety of ways. Increasing the growing season for fuels may affect the rate at which fuels accumulate under current conditions. Excess water during wet years can support higher rates of fuel production, while dry years are more conducive to large fire growth. Extended summer drought may increase tree mortality and contribute to more of these accumulating fuels providing more available fuels that contribute to increasing fire size and severity. This can be seen in recent trends in wildfire characteristics throughout the Sierra Nevada region over the past 2-3 decades, where wildfire frequency, size, total area burned and severity have all been observed to increase.

Climatic changes discussed above are considered primary causal factors for these increases (Westerling et al. 2006; Miller et al. 2009).

If these projected changes occur the fire and fuels program may be affected in a variety of ways. It might make prescribed fire and managed wildfire implementation more difficult if the fire season is extended. Alternatively, if more of the winter months experience rain rather than snow, burn opportunities could expand. Most likely, the projected high inter-annual variability will create years with abundant burn opportunities alternating with years with very few burn windows. Climate change impacts to the program will be very similar across all the alternatives.

3.4.10.4. Analytical Conclusions

Modification of fire behavior

This indicator is affected by numerous activities (see previous section). Here we analyze and summarize the effects of WUI fuels treatments and various forest restoration treatments on wildland fire behavior in the treated areas. All four alternatives are equal in the number of acres of WUI thinning and fuels reduction, although Alternative D relies more on hand thinning and less on mechanical thinning than the other alternatives

Reduction of fuel loading and modification of fuel arrangement are effective in modifying fire behavior thereby reducing risk to communities, infrastructure and natural resources (North et al. 2009, Safford et al 2009, Stephens et al 2009, Ager et al 2010, Moghaddas et al 2010). Each fuels reduction project in the WUI will have fire behavior modification as the primary objective. Each WUI treatment will be designed to meet a minimum fire behavior threshold under prescribed weather and fuel moisture conditions (90th percentile). Even though all alternatives' fuels treatments will meet minimum criteria, those alternatives with fewer constraints may exceed those criteria. WUI treatments will have similar effects for all the alternatives. All the alternatives propose 2,000 acres per year of WUI fuels treatments. Alternatives A and D include more stringent thinning and diameter limit constraints. Alternative D relies more heavily on hand thinning than the other alternatives. Fuels treatments in Alternative C are designed to meet objectives with fewer entries and provide for longevity of treatment effectiveness.

Forest restoration activities outside of the WUI also contribute to modification of fire behavior even though that might not be the primary objective. Alternatives A and B propose equal numbers of acres, but more stringent diameter limits and thinning constraints provide less flexibility and decrease the ability of Alternative A to meet or exceed fire behavior objectives. Alternative C proposes treating twice the acres over Alternatives A and B, and has fewer constraints than Alternative A. Alternative D imposes the most stringent diameter limit of 12 inches outside the WUI. This becomes even more important after initial WUI fuel treatments are completed. At that time (approximately 10 years) the WUI Threat Zone converts to General Conservation Management Emphasis in Alternative D. In addition to the 12 inch diameter limit in Alternative D, mechanical treatments are minimized and the alternative relies heavily on hand thinning and prescribed fire to meet objectives. The uncertainty of having conditions suitable for using fire to meet objectives does not provide the flexibility to meet objectives when fire is not available to managers.

Overall, Alternative C will provide the most acres of modified fire behavior with 3,300 acres per year or 49,500 acres over the life of the plan. That is 35% greater than Alternative D and 25% greater than Alternatives B and C. This alternative also has the most flexibility to meet or exceed fire behavior criteria and to provide the greatest treatment longevity.

Reducing fire return interval departure (FRID)

All four alternatives use prescribed fire as the primary tool for reducing FRID (Table 3-27). Managed wildfire may also contribute. Therefore we include estimated maximum annual acres of managed wildfire (Table 3-28). Alternative D is estimated to reduce FRID on the most acres at 54,811 acres over the next 15 years. That is about 10,000 acre more than Alternatives B and C, and about 20,000 acres more than Alternative A.

Wildland fire is a natural process that, among other things, reduces fuel loads, supports a superior forest gene pool, promotes development of all structural stages, and increases resilience to disturbances and to climate change. According to FRID (2007) over 90% of the Basin is characterized as moderately or severely departed from historic fire return interval. It is estimated that wildfires burned an average annual acreage of between 2,000 and 8,000 acres in pre-settlement times (Manley et al. 2000); 1,600 to 6,400 of those estimated acres occurred in the montane and upper montane zones. These are the vegetation zones in which most of the LTBMU's management activities are located, much of which occurs in the WUI.

Alternatives A and B each propose 1,800 acre of prescribed burning per year in the WUI. If this is accomplished, 27,000 acres will be treated over the life of the plan. This equates to 45% of the WUI that will have some fire on the ground.

Alternatives C and D each propose 2,100 acre of prescribed burning per year in the WUI. If this is accomplished, 31,500 acres will be treated over the life of the plan. This equates to 52% of the WUI that will have fire on the ground.

Prescribed burning outside of the WUI is proposed to begin once initial WUI treatments are complete. Alternatives A and B propose 100 acres per year. Alternative C proposes 200 acres per year, and Alternative D 450 acres per year.

Alternative D does less pre-treating and relies much more on hand treatment to prepare units for prescribed fire. Those units outside the WUI are further subject to the 12 inch diameter limit. Denser post-treatment stands may narrow the prescription window. But, there may be trade-offs as a denser stand will have lower insolation, reduced wind speeds and decreased undergrowth regeneration than more open stands (cite). Stands thinned to a lower minimum density provide greater treatment longevity over stands with higher residual densities (cite). Alternative C provides the greatest treatment longevity. Alternative D will rely on fire to meet treatment objectives. More high intensity fire and tree mortality should occur during prescribed burning with Alternative D. This is consistent with this strategy and expected to help restore structure and composition. Proximity to communities may limit use of higher intensity prescribed fires as public acceptance of intense fire activity and torching trees is limited.

Assuming that these proposed acres are accomplished, substantial FRID reductions in the WUI will be realized over the life of the plan. Getting these initial burns accomplished is critical to restoration efforts since second entry prescribed burning are more likely to resemble natural fire regimes.

Projecting any amount of prescribed burning or managed wildfire acres requires assuming that conditions will be suitable, objectives can be met, resources are available to complete the projects, smoke impacts can be mitigated, and the burn can be implemented with acceptable risk. These are huge assumptions based on a high degree of uncertainty. The LTBMU conducted an historical analysis of burn opportunities over a 13 year period (see figure 6), and based on the analysis, conditions suitable for underburning are not abundant. During the late summer months, when most presettlement burning occurred (cite), smoke dispersion and weather conditions coincide only about one third of the time. Further, two to four consecutive day periods meeting these criteria occur very infrequently (average less than twice per year in each of these three months) and longer consecutive day periods are even rarer. Based on these constraints and all the inherent uncertainties, projecting acres using prescribed fire to reduce FRID is a difficult exercise. In order to keep up with fuel accumulation, restore fire to the ecosystems, and meet the goals and objectives of any of the alternatives will require us to be prepared to take advantage of burn opportunities as they arise. Alternatives that provide conditions most favorable for safe implementation of prescribed fire will have the most potential for success. Alternatives A and B propose the least number of acres of prescribed fire. Alternative D proposes the most, but imposes constraints on activities needed to prepare treatment units for prescribed fire. This reduces the probability of success for this alternative. Because Alternative C imposes fewer constraints on preparatory treatments, it provides the most flexibility and probability of success.

Utilizing natural ignitions for meeting resource desired conditions and objectives is essential for restoration (Collins and Stephens 2007, Collins et al. 2008, North et al. 2009) but also effective for fuels reductions (Miller 2003). The importance of fire in restoring forest structure and composition as well as reestablishing a dynamic equilibrium with changing climate and ignition conditions should not be underemphasized (North et al. 2009). The LTBMU realizes the value of using fire to meet these objectives. As with any application of fire, making decisions to allow naturally ignited fires to meet resource objectives is subject to a variety of constraints based on weather criteria, fuel conditions, resource availability, smoke dispersal conditions, and safety concerns. Projecting desired acres into the future based on these assumptions and inherent uncertainty is extremely difficult.

For the LTBMU, decisions for utilizing this tool are even more difficult for fire managers and line officers because of the proximity to communities and the high-value resources throughout the unit. Conditions under which a decision to go ahead with a naturally ignited wildfire and manage it to meet resource objectives will undoubtedly be those conditions that will have low fire activity and thus result in small fires (conditions such as those in 2011 rather than 2007). While Alternatives B and D propose more acres available than C, the extra acres consist of WUI Threat Zone acres. FSPro simulations using 2007 climatology burned greater than ten times more acres in the defense zone and urban areas than those simulations using 2011 climatology. These are areas that are least likely to provide decision makers with the level of comfort to make the decision to allow a fire to be managed for resource objectives. Likelihood of affirmative

managed wildfire decisions decrease with proximity to values at risk, but may increase when in proximity to treated areas.

In order to make a decision to manage a wildfire to meet resource objectives, the ignition must be natural (lightning) caused. Since 2004 there have been a total of 25 lightning caused ignitions reported in the Basin (see lightning occurrence and natural ignitions in Affected Environment section of this report). If this frequency trend continues, our ability to meet resources objectives using managed wildfire will be very limited. If lightning ignitions continue at the current frequency or trend downward, the importance of utilizing this tool to meet resource objectives will be virtually non-existent. Should this reduced frequency of lightning caused ignition over the last few years be part of a cyclic pattern, or perhaps due to stochastic processes, opportunities to manage natural ignitions to meet resource objectives may increase. Given all the uncertainties and assumptions listed above:

While Alternatives C and D estimate more acres in FRID reduction, Alternative B will provide the greatest probability of success in reducing FRID. Alternative D estimates more potential acres of FRID reduction, but is much more dependent on conditions outside the unit's control.

Alternative C proposes more pretreated acres, which is an advantage for meeting resource objectives, but includes less area allowable for manage wildfire. Alternative A by far provides the least opportunities for reducing FRID.

Climate Change

The effect the fire and fuels program on mitigating the effect of climate change may vary by alternative and will be mostly dependent on the amount of area treated, post-treatment stand density and the amount of prescribed burning proposed and managed wildfire allowed by alternative. For the amount of area treated and post-treatment stand density, Alternative C creates the most resilience to climate change, followed equally by alternatives A and B. Alternative D creates the least resilience to climate change. When considering use of prescribed fire and managed wildfire, the differences between alternatives depend greatly on where the amount of burning falls in the range of proposed prescribed fire and acres of estimated managed wildfire. The alternatives differ at the upper range of burning, but all have the same lower range of zero. So if climatic conditions are such that prescribed fire or managed wildfire accomplishments trend towards the lower range, differences between alternatives will be minimal. If optimal burning conditions are realized, Alternative D will have the most beneficial effect followed by Alternative C, then B, and finally A.

Other activities that may affect fire fuels indicators

- Acres of PACs restored by 2025—A=0, B=3,900, C=same as B, D=0. PACs are human constructs delineated to include spotted owl or goshawk nest stands and encompass the best available 300 acres of habitat consisting of two or more tree canopy layers, large trees (> 24“ dbh) and high canopy cover (> 60%). These conditions are very susceptible to stand replacing fire, and therefore would not contribute to any of these indicators if restored, except where prescribed fire is used as a restoration tool and will contribute to reductions in FRID. However, activities used to meet these restoration targets are not described by alternative and therefore, effects on FRID reduction cannot be evaluated.
- Developed recreation expansion (overnight units, parking, permit expansion, ski run expansion)—A=0-10% increase, B=0-5% increase, C=0-15% increase, D=0-15% decrease. Were activities associated with recreation expansion to occur, some alteration of vegetative cover would likely be required. However, most these activities would be much localized and are not expected to have significant impacts on the any of these indicators or on fire and fuels management in general. Significant exceptions would be new or widened ski runs which would be effective as fuels breaks. However, without project specific details this is difficult to evaluate except to say that this activity is most likely to occur in Alternative C and descends in likelihood according to the percentages above.
- Miles of Roads—A=232, B=239, C=254, D=234. Alternative C may provide an advantage over the other alternatives since it proposes between 15 and 22 miles of more road access. Depending on where future fuels treatments are located, these roads may provide important access to vehicle and equipment needed for implementation. However, without site specific treatment location information, it is not possible to precisely quantify the effects additional roads will have on the fire and fuels indicators.
- Acres of Inventoried Roadless Areas and Wilderness—the alternatives propose varying amounts of roadless and wilderness areas. This is based on recommending current IRA as Wilderness. Therefore any increase in Wilderness is accompanied by an equal decrease in IRA. Alternatives A and B keep current acreages. Alternative C recommends the Dardanelles Roadless Area as recommended Wilderness area. Alternative D recommends the Dardanelles and the Freel Roadless Areas. Impacts of these recommendations on fuels indicators or programs will be minimal since we do not conduct much fuels management in roadless or wilderness areas. Wildland fire management might be affected if more Wilderness areas are added since there are constraints to what suppression tactics can be employed inside Wilderness areas. However, none of the alternatives are expected to have significant impacts on fire and fuels management due to changes in Wilderness or roadless areas.

How the Alternatives Maintain or Achieve the Desired Conditions

- **Modification of fire behavior and reducing risk to communities**

  Throughout implementation of the 10 year strategy for the WUI, all four alternatives would progress towards community risk and fire behavior modification desired conditions in similar fashion and at a similar rate. The exceptions would be those alternatives with more thinning constraints (diameter and canopy cover retention limits) or those relying more on hand treatments than mechanical. These would reduce fire behavior less and provide less treatment longevity than alternatives with fewer constraints. Alternatives A and B will be similar in effects because they both treat the same number of acres. However, since Alternative B has fewer constraints, its effects on fire behavior and treatment longevity will be greater than Alternative A. Alternative C treats the most acres with the fewest constraints and therefore, provides the most longevity and modification of fire behavior. Alternative D's heavy reliance on fire to achieve desired conditions and to meet objectives includes a great deal of uncertainty. If conditions are mostly suitable for using fire, then Alternative D may meet desired conditions and objectives as well or better than the other alternatives. Should conditions be unfavorable for application of fire, then Alternative D will reduce fire behavior the least and have the least treatment longevity due to the heavier reliance on hand versus mechanical treatments.

  Once initial treatments of the 10 year strategy are complete, some changes will occur in the alternatives. The most significant changes will be vegetation management increased emphasis on ecological restoration outside the WUI and Alternative D's Threat Zone converting to General Conservation Emphasis management. The restoration treatments outside the WUI will be less important in terms of community risk than WUI treatments, but are still important in reducing fire behavior because wildland fires originating outside the WUI can still threaten WUI and natural resources. Alternative B is slightly better than Alternative A in its ability to meet fire behavior and community risk reduction desired conditions outside the WUI. Alternative C is the most effective at meeting these desired conditions. The reasons are the same as those stated in the paragraph above. The most significant difference outside the WUI occurs in Alternative D, because Threat Zone is converted to General Conservation Emphasis along with associated thinning constraints and heavy reliance on hand treatments and prescribed burning to meet restoration objectives. So evaluating the effectiveness of Alternative D at meeting fire behavior modification desired conditions outside of the WUI Defense Zone depend on successful use of fire. If conditions do not permit enough use of fire, then thinning constraints would make this Alternative the least effective. If conditions permit sufficient use of fire to thin forest to appropriate levels, Alternative D can be as effective as any other alternative. However, any alternative that limits choices and reduces flexibility for meeting desired conditions should be viewed with caution.

- **Restoring and maintaining ecological processes and disturbance regimes, restoration of historic forest structure, composition.**

  Alternatives A and B treat the same number of acres for meeting these ecological restoration desired conditions. Alternative B provides fewer constraints and more flexibility and would make better progress towards these desired conditions. Alternative C doubles acreage and would progress towards the desired conditions much faster than Alternatives A or B. Alternative D relies primarily on hand treatment and use of fire to meet ecological restoration desired conditions. Restoration of natural processes such as fire is the preferred method of meeting desired conditions. Such a strategy, theoretically, would reestablish dynamic equilibrium with reigning climates and provide the most resilient and sustainable conditions. Alternatives B and D project the greatest number of managed wildfire acres, followed by Alternatives C, and then A. If conditions are optimal for using fire, then Alternative D will have as high a probability of success as Alternative B. However, excluding other available tools and technologies that can be used as surrogates to natural disturbance processes will reduce this alternative's ability to meet desired conditions when conditions safe for implementation of fire use are not available.

- **Resilience**

  Several desired conditions discuss increasing the forest's resilience to fire, drought, insects, and pathogens. Additionally, most predictions suggest a warmer and potentially drier future for the Lake Tahoe Basin (see the Climate Report in Appendix C) Creating resilience to these stressors is an important part of each of the action alternatives. The desired conditions for forest vegetation are based both on contemporary reference conditions (unlogged forest with minimal fire suppression) and historical pre-settlement conditions (since these conditions evolved over centuries under prevailing disturbance regimes). Strategies with the best chance for success seek to reestablish fundamental ecosystem processes (fire, hydrology, propagule dispersal, etc.) wherever possible, so that LTB ecosystems can more readily achieve dynamic equilibrium with changing climates. All alternatives seek to utilize natural processes, such as wildfire, or surrogates, such as prescribed fire and thinning, to create more resilient conditions. Alternatives A and B propose equal efforts in terms of acres treated. Once again, Alternative B has fewer constraints and more flexibility and would have better ability to create resilience. Alternative C doubles the acreage of Alternatives A and B and includes fewer constraints than Alternative A, providing more resilience than Alternatives A or B. The common theme with Alternative D is that relying too heavily on one set of tools, however appropriate those tool may be, could end up tying the hands of managers should the appropriate conditions for using those tools not materialize.

Overall, Alternative C provides the best strategy for achieving desired conditions. Although alternative D would achieve desired conditions if all conditions are optimal, the restrictions from using all tools when conditions are not optimal may tie the hands of managers during times when conditions are not suitable for the safe use of fire.

3.4.11. Forest Vegetation

The goal for forest vegetation in this plan is to restore forest structure and composition to conditions that are more resilient to future changes in climate and disturbance regimes. The first step will be to target historic, pre-Euroamerican settlement conditions where possible, with eventual modifications as more is learned about the influences of a changing climate. Goals include Jeffrey pine and white fir forests that have fewer and (on average) larger trees, more structural variability, and a more clumped (or random) spatial distribution than current forests (Taylor, 2006).

As defined here, forest restoration includes:

1) Creating early seral openings within the mid-seral stage to restore temporal and physical distribution of structure by major forest type;
2) Converting overabundant white fir types to more resilient pine or mixed conifer types to restore relative abundance of major forest types; and
3) Reducing stand densities and understory fuels periodically over the life of the stand to resilient levels that allow for continued stand development following drought, fire and bark beetle attacks.

The forest in the Lake Tahoe Basin is subdivided into smaller, relatively homogenous units, called stands. This makes management of the larger landscape much easier because it can be approached one stand (one group of trees) at a time (Hunter, 1990). An important point to remember is that these units of area (e.g, stand, forest, landscape) are not static and change a great deal through time. Disturbance, whether a stochastic event or something that occurs slowly over time, will influence the competitive advantages of trees and other associated species within – and across – each major forest type.

3.4.11.1. Introduction

Analysis of how well each alternative achieves or maintains the forest vegetation desired conditions is based primarily on the scale and intensity of forest restoration treatments. A suite of currently used prescriptions are used with varying degrees of intensity (i.e., higher or lower numbers of acres of treatment per year) in the SPECTRUM model to accomplish forest restoration. Since the timeframe to achieve the desire condition extends beyond the life of this plan, this analysis is focused on which alternative makes the most progress towards achieving the restoration goals.

Methodology

The Spectrum model was the primary model used by analysts to predict future outcomes of planned treatments identified to achieve forest restoration goals. Based on the spatial information contained in the GIS, and application of prescriptions, a variety of outputs was generated by alternative.

Established data sets were used for analysis within the model. There were three sources of established data sets used including: 1) current forest vegetation from the Forest Inventory & Analysis program of the US Forest Service-PNW along with corresponding IKONOS satellite imagery, 2) historic forest structure and composition information from modern studies of historic or reference conditions and fire frequency by multiple researchers as well as the Wieslander inventory for the US Forest Service in the 1930s, and 3) locally and Regionally defined prescriptions for treatment using professional judgement as related to the objectives.

Geographic Information System is the primary tool for spatially quantifying various types of information, e.g., slope percent, soil types, suitable road access, etc. that influence treatment methods and constraints (e.g., cultural sites, riparian areas) that require special treatment measures. Major forest types were highlighted in the GIS generated map with stratification made on the basis of structural class, density, and location within the land suitability framework.

Outputs of the modeling are approximations of future outcomes to aid in evaluating consequences of actions. Although the timeframe for implementation of the revised forest plan is 15 years; to understand the implications of restoration outcomes a half century or more is needed to determine whether the actions taken today will have the desired effect beyond the life of the plan.

Limitations inherent in the information, analytical tools, and modeling include:

- Currently used prescriptions are generalized for practical modeling purposes. These general prescriptions satisfy the majority of cases in which a silviculturist would prescribe treatment to meet the desired conditions.
- Model strength or accuracy is generally greater the shorter the modeled duration or period. The predictive growth model is thought to be reliable up to 50 years out. After that it drops in reliability.
- There are slight differences in classification of forest types between current inventory (CWHR) and representations of modeled historic forest types in the historic reference condition mapping. Historic forest types are classed as percentages of the landscape within a structural seral stage while the current inventory of forest types represent the actual seral stage acreage within each (HUC 6) watershed.
- The model includes periodic disturbance from wildfire and bark beetles based on historic occurences. Disturbance frequencies and severities may not be the same in the future, but is all we have to go by. Drought was not specifically modeled.

Indicators

The key indicators selected for evaluating progress and accomplishment of forest restoration goals resulted from a collaborative approach comprising technical experts from agencies, universities, and private sector consulting. These indicators best represent conditions at each stage of stand development as well as overall conditions at the landscape scale (also see Table 3-31).

1. **Forest Structure –** This indicator is both a physical and temporal distribution of stand development stages (hereafter called "seral stages") that have been classified as Early, Mid Open, Mid Closed, Late Open, and Late Closed seral stages.
2. **Forest Type –** This indicator is related to composition of the dominant tree species that make up a stand, sometimes represented by a single species or as a mixture. Conversion of a forest type from one to another relates to abundance desired at the basin-wide scale that was present pre-settlement.
3. **Forest Stand Resiliency –** This indicator refers to the ability of a forest stand to withstand disturbance at each seral stage. Resiliency comes from the trees within a stand being capable of capturing sufficient resources (water, sunlight) to resist drought, fire and bark beetles. This indicator can be measured directly as a result of actual mortality or predicted through the use of modeling. In addition to being an indicator, density levels for each forest type over a range of site conditions can be used to predict mortality.

Table 3-31. Status and Trend of Indicators towards meeting forest restoration goals in the Lake Tahoe Basin

Indicator	Existing Condition	Trend	Goal
Forest Structure	Predominance of Mid-Seral stages	Mid trending to Late without enough Early to grow into Mid	Seral Stage distributions more similar to pre-settlement, leading to higher stand heterogeneity.
Forest Type	Overabundant White Fir & under represented Jeffrey Pine. Lodgepole pine encroaching into riparian vegetation.	Riparian converting to lodgepole. White fir continues to dominate where pine once did.	Relative abundance of dominant species more similar to pre-settlement abundances.
Forest Stand Resiliency	High stand densities resulting in high risk of bark beetle and fire mortality.	Continued increase in density and susceptibility to bark beetles and fire	Forest stands are thinned to levels that can sustain disturbance without a high amount of mortality.

Forest Types include Jeffrey pine, white fir-mixed conifer, and red fir (see Figure 3-41). These are derived from California Wildlife Habitat Relationships (CWHR) vegetation types.

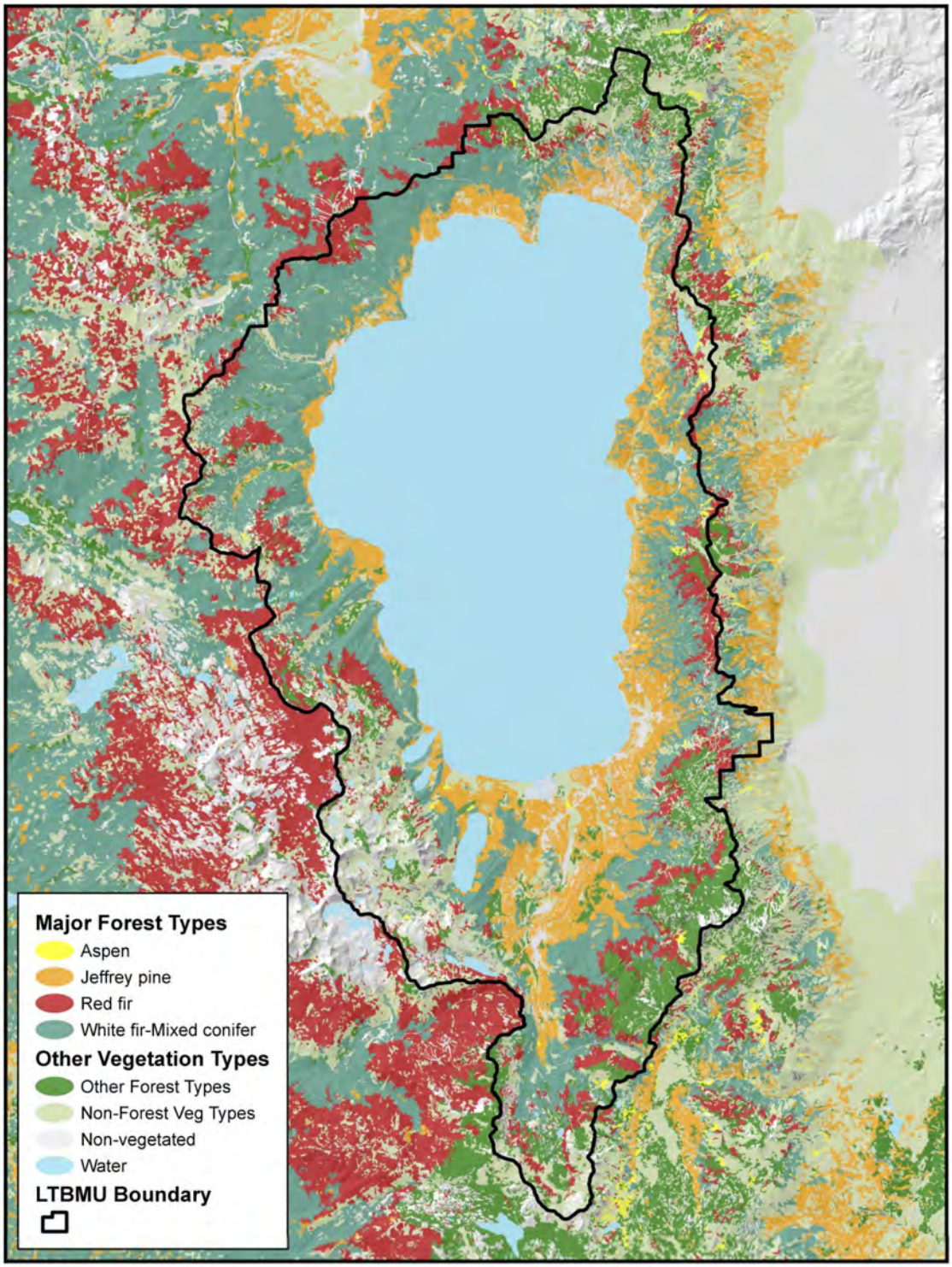


Figure 3-41. Major Forest California Wildlife Habitat Relationships (CWHR) vegetation types

Assumptions

In the analysis for this resource, the following assumptions have been made:

- The SPECTRUM model is correct.
- After treatments, forest stands regenerate back to original forest type unless purposefully converted.

The SPECTRUM model is correct with the following considerations:

- The aim is to restore forest structure and forest composition beyond the life of the Forest Plan.
- Prescriptions in the Wildland Urban Interface (WUI) generally follow the Lake Tahoe Basin Multi-Jursidictional fuels reduction & wildfire prevention strategy.
- Stochastic wildfire events are predicted using 90th percentile weather.
- We allow the SPECTRUM model to create small openings (<5 acres) in the Defense Zone (1/4 mile from communities) of the WUI , because they are good for fire behavior modification as well as structural modification.
- Forest type conversion and group selection is avoided in both Late Seral Stages.
- Subalpine vegetation is considered to be within the desired condition and not analyzed as a separate forest type in the model.
- Meadow and aspen restoration are not analyzed in the model, because SPECTRUM models conifer growth, and conifers would be removed completely or nearly completely in these systems.

3.4.11.2. Overview of the Affected Environment

The forest types surrounding Lake Tahoe range along elevational gradients, beginning with those found in the montane zone at lake level (6,250 feet), continuing through an upper montane zone (7,200-8,500 feet) and up to the sub-alpine zone along the mountain peaks and ridges (above 8,500 feet). The major forest types that comprise the greater extent of the lower elevations include the Jeffrey pine and white fir-mixed conifer while the upper montane includes red fir. Together, these three forest types comprise the majority of forested lands around Lake Tahoe.

Montane and upper montane forests were dramatically changed in the late 1800s by logging to support silver mining in Nevada, and since the early 1900s from exclusion of fire to protect people and property at the Lake. Prior to the changes wrought on the forest in the 1800s, the Washoe Tribe was a regular visitor to the Basin and made use of fire as a tool for maintaining open forest and abundant forage for game. Fire plays a pivotal role in shaping and maintaining the structure, composition, and function of mixed-conifer and yellow pine ecosystems and was once very common in most of the Sierra Nevada (North et al. 2009). Heavy logging and long-term fire suppression have severely altered Lake Tahoe Basin forests from their “natural” state.

Today there are few examples that can be used as proxys for ecosystem-based management that approximate a forested ecosystem with its inherent disturbance regimes. The coniferous forest of the Peninsular Ranges of northern Baja California are close analogues to the Lake Tahoe Basin, having similar climate, geology, and dominant species. Because large areas of these northern Mexican forests were not logged, and because fire suppression has only been in effect for the last few decades, their composition and structure provide an important reference for the very altered forests of the Lake Tahoe Basin.

Multilayered and very dense canopies, often associated with Pacific Northwest old-growth forests, are not the best model for Sierran mixed-conifer forests because when adjacent trees are multilayered, the continuity of vertical fuels can provide a ladder for surface fire into the overstory canopy. Almost all historical sources suggest that, on average, yellow pine and mixed conifer forests were much more open and heterogeneous in structure than current forests. Horizontal heterogeneity, however, used to be relatively common in Sierran mixed-conifer forests (North et al. 2009). All of the Sierran reconstruction studies suggest mixed-conifer forests, under an active fire regime, had a naturally clumped distribution containing a variety of size and age classes (North et al. 2009).

There has been no deliberate restoration of early seral stages or structural heterogeneity across vegetation types in the Basin through management activities over the life of the current forest plan. The primary factors affecting the forest conditions remain the Comstock era logging that removed most of the Jeffrey pine forest in the late 19th century and the exclusion of fire for more than 100 years. Over the past decade two wildfires occurred in 2002, the Gondola Fire (700 acres) and the Showers Fire (300 acres) and two in 2007, the Angora Fire (3,000 acres) and the Washoe Fire (20 acres). Although these fires resulted in some early seral vegetation, they do not represent restoration. Except for the sub alpine zone, the historic fire regime or fire return interval has not occurred in these areas.

Forest vegetation treatments have occurred for fuel reduction, including understory removal with minimum thinning of the canopy. The recent climate has been favorable for growth and has created an increased potential for large-scale and intense levels of mortality due to bark beetles. The dominant mid-seral stage condition present today that resulted from Comstock era logging persist in the montane and upper montane areas around the Lake, and it is progressing toward old forest. However, this trend is not sustainable as there are few acres of early seral stages to progress into the mid seral stages.

Table 3-32. Seral stages and tree sizes modeled

Seral Stage	Canopy	Tree Size
Early	Open	0-4.9”
Mid	Closed	5-23.9”
Mid	Open	5-23.9”
Late	Open	≥24”
Late	Closed	≥24”
Note: “Open” and “closed” are relative measures for the canopy layer of a stand. For this analysis, a stand is considered open if the canopy closure is less than 40 percent.		

Table 3-33. Annual Aerial Tree Mortality Survey for the Years 2000 to 2011. (USFS State & Private Forestry, Forest Health Protection).

Acres with mortality and damage by causal agent and year													
Causal Agent	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Totals**
Unspecified or mixed bark beetles*	15	1	0	171	6,030	73	6,090	774	78	3,373	116	214	16,935
Jeffrey pine beetle	99	5	217	2	418	104	170	655	159	212	180	142	2,363
Mountain pine beetle	345	280	0	30	22	69	1,724	2,286	1,985	961	694	776	9,172
Red turpentine beetle	0	0	0	0	0	0	0	0	0	40	0	0	40
Ips engraver beetles	0	0	0	0	0	0	0	5	1	0	4	0	10
Fir engraver	19	61	570	210	4,642	4,145	1,889	109	163	1,416	5,607	2,517	21,348
Unknown**	80	0	0	0	0	0	56	0	24	73	39	39	311
Totals	558	347	787	413	11,112	4,391	9,929	3,829	2,410	6,075	6,640	3,688	50,179
Number of estimated dead trees by causal agent and year													
Causal Agent	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Totals**
Unspecified or mixed bark beetles*	29	1	0	1,149	6,814	78	18,025	566	103	13,717	110	506	41,098
Jeffrey pine beetle	311	7	730	4	674	954	359	972	413	247	353	150	5,174
Mountain pine beetle	1,355	461	0	124	45	120	3,368	12,563	7,848	2,931	2,510	868	32,193
Red turpentine beetle	0	0	0	0	0	0	0	0	0	1,750	0	0	1,750
Ips engraver beetles	0	0	0	0	0	0	0	10	19	0	20	0	49
Fir engraver	32	703	1,182	414	6,756	5,034	3,735	58	125	3,852	12,098	3,864	37,853
Unknown**	0	0	0	0	0	0	15	0	10	0	0	230	255
Totals	1,727	1,172	1,912	1,691	14,289	6,186	25,502	14,169	8,518	22,497	15,091	5,618	118,372

*Unspecified or mixed bark beetles typically denotes mortality affecting true fir and one or more species of pine.

**Unknown agents in the Tahoe Basin were attributed as either "aspen decline, aspen mortality or aspen defoliation," with the exception of 57 acres of fir defoliation in 2000

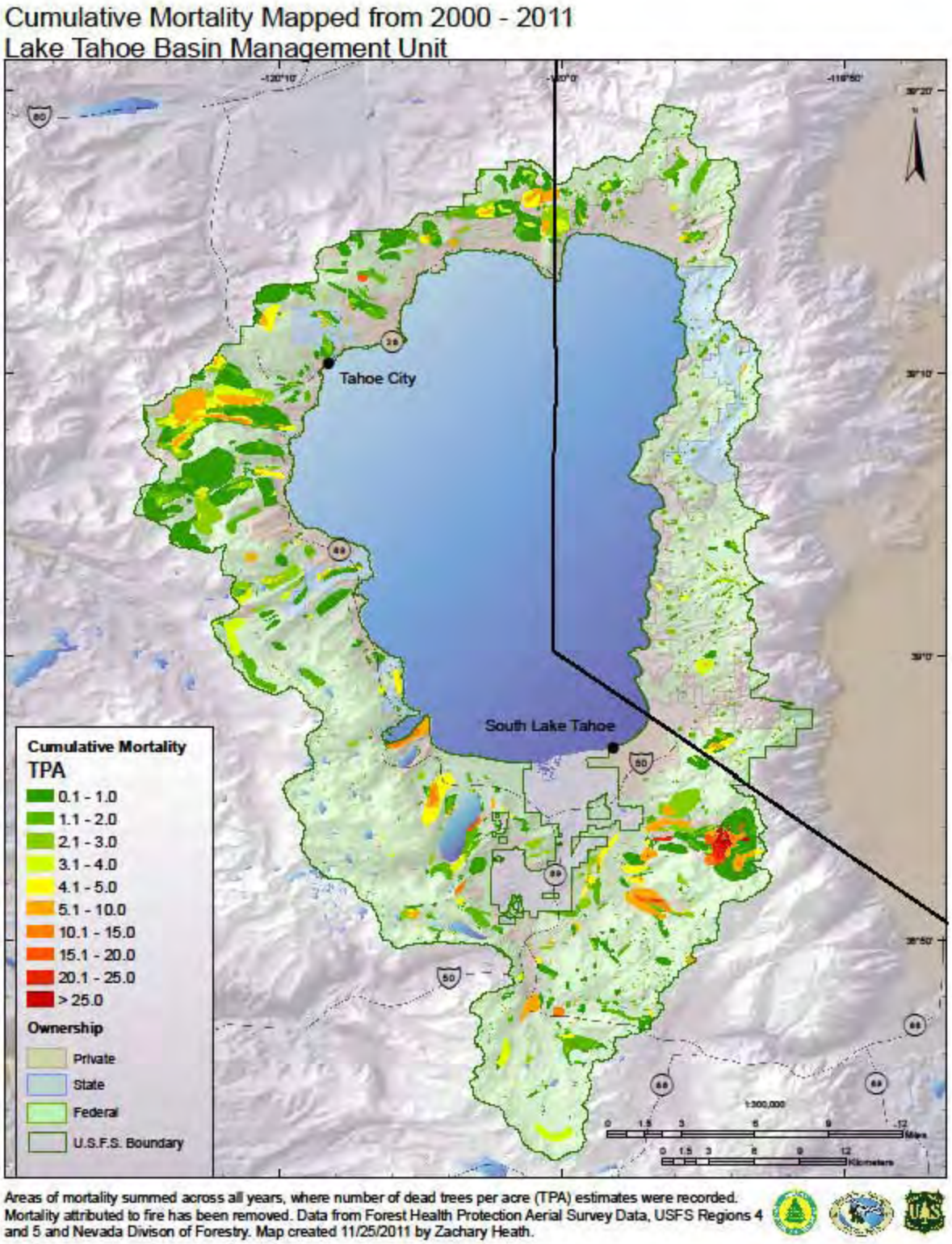


Figure 3-42. Cumulative Mortality, trees per acre (TPA) across the LTBMU, 2000-2011

Periodic disturbances, such as fire, drought, bark beetle outbreaks, flooding, wind, and other human caused disturbances, have occurred historically and more recently have been suppressed or mitigated or to the extent possible. Stephens et al (2009) found when fires were preceded by drought that spatial heterogeneity was a key feature in forest resiliency. In a warming climate, disturbance events could become more dramatic and prolonged, resulting in management actions that might need to be taken after an event. Moving current forest conditions towards the pre-settlement conditions is part of an overall approach that will also include adaptive strategies based on what can be learned from climate change to refine the prescriptions needed to achieve desired conditions.

Table 3-34. Comparison of average percent of disturbance of Vegetaion by Type and Stage

Vegetation Description *	Approx. Percent of Area 1935	Approx. Percent of Area 2003	*	Condition	Average Percent of Vegetation Type				
					Early-Seral	Mid-Seral, Closed Canopy	Mid-Seral, Open Canopy	Late-Seral, Open Canopy	Late-Seral, Closed Canopy
White fir mixed conifer	10	21		Reference (modeled)	10-20	5-15	10-15	30-40	20-30
				Current	3	16	11	40	30
Jeffrey pine	37	19		Reference (modeled)	5-15	5-10	25-30	45-50	5-10
				Current	4	42	49	4	1
Red fir	15	18	**Red fir-white fir phase**	Reference (modeled)	10-20	20-30	5-15	15-25	25-35
				Current	1	13	49	30	8
			Red fir-western white pine phase	Reference (modeled)	5-15	10-20	20-25	35-40	10-15
				Current	1	5	48	41	5

Notes:

Historic Reference Condition modeling for major Lake TahoeBasin forest types, developed from non-linear forest stand dynamics (state and transition) modeling, using disturbance regimes from pre-Euro-American settlement period. Climate inputs from 20th century. Values cannot be reliably applied to landscape units less than about 10,000 acres in area (Safford and Schmidt 2007).

1935 percent of area from from Forest Service 1935 Vegetation Type Map (Wieslander);

2003 percent of area from Lake Tahoe Basin Existing Vegetation Map, Version 4.1, updated for the 2007 Angora Fire.

Early, mid, and late seral stages represent stand quadratic mean diameters of 0-5”, 5-25”, and >25” dbh respectively.

For white fir, and the red fir types, an “open” canopy has less than 50 percent closure while a closed canopy has closure greater than 50 percent; for Jeffrey pine, the open-closed cutoff is 40%. For detailed seral stage definitions, see Historic Reference Condition Mapping, Safford and Schmidt 2007, in the Plan Set of Documents.

Vegetation data to be updated as new information becomes available.

The ability of the forest to self-maintain all seral stages only exists within the potential for periodic mortality-inducing disturbance events, e.g. bark beetle outbreaks and fire. To the extent that these can be controlled, management treatments will be necessary to restore forest conditions that are more resilient to disturbance, drought and other climate-related changes. This is an objective in the current plan and will be even more important to achieve if the forests of Lake Tahoe are to become healthy (see the Glossary for a specific definition of Forest Health) and sustained for future generations.

Table 3-35. Desired Range of Stocking (density) and basal area of live trees and Number of Snags and Coarse Woody Debris on the Forest Floor

Forest Type	Stocking (stems				Basal area (feet^2/acre)				Snags (>20" dbh/acre)				CWD (tons/acre)			
	Low	Median	Mean	High	Low	Median	Mean	High	Low	Median	Mean	High	Low	Median	Mean	High
White fir-mixed conifer	25	80	100	300	40	150	200	350	0	3	6	25	0	2	10	150
Jeffrey pine	15	60	70	200	30	80	100	250	0	1	3	15	0	1	6	100
Red fir-white fir	25	80	100	300	50	250	350	700	2	4	7	25	0	10	20	150
Red fir-western white pine	10	70	80	250	5	200	250	600	2	3	5	20	0	5	10	120

Table References: Collins, B.M., and S. L. Stephens. 2010; Fites, J. 1993; Harrod, R.J., W.L. Gaines, W.E. Hartl, and A. Camp. 1998; Minnich, R.A., Barbour, M.G., Burk, J.H., and Sosa-Ramirez, J. 2000; Potter, D.A. 1998; Safford, H. D., D. A. Schmidt, and C. Carlson. 2009; Stephens, S.L. 2004; Stephens, S.L., Fry, D.L., and Franco-Vizcaíno, E. 2008; Stephens, S.L., Fry, D.L., Franco-Vizcaíno, E., Collins, B.M., and Moghaddas, J.M. 2007; Stephens, S.L., and Gill, S.J. 2005; Taylor, A.H., 2004; USDA Forest Service. 2001; Waddell, K.L. 2002.

3.4.11.3. Environmental Consequences

Sustainability of the forest vegetation surrounding Lake Tahoe can be affected to differing levels by each alternative. Restoring and managing for forest health, increasing wildlife and plant habitat heterogeneity, and resiliency to drought, bark beetle outbreaks and wildfire are the primary objectives that can be achieved with treatments. Much of the forest structure falls within the mid-seral stage and is trending towards late-seral or old growth. In the coming decade, most of this will move towards the late seral stages, leaving very little early-seral stage in the mix to replace it over time. Reductions in stand densities and moving some of the mid-seral stage stands to the early seral stage will be imperative to the sustainability of the forest overall

Associated with the goal of managing for the inherent sustainability of the forest are the fire and fuels, wildlife, botany, recreation, scenic, and watershed goals. These associated values can be viewed along with those of forest vegetation from an ecological or social point of view. Many social values have direct effects on whether the goals for ecological functions can be restored, maintained, or enhanced through management actions. Likewise, laws, regulation, policy and public input into project-specific planning play a vital role in determining the level of flexibility to manage for forest sustainability, ecological functions, or restoration.

The following graphs illustrate the modeled output of changes to the forest structure of the three major forest types over 5 decades. In none of the forest types are the desired condition achieved over the 50 year time frame though white fir does make some progress towards it in Alternative C. There is an increase in the amount of Late Seral stages overall, but very little Early Seral

created. Although some progress is made towards reducing departures from historic conditions, the constraints in policy and regulation do not permit sufficient amount of treatment to restore forest structure.

The effects of each alternative in achieving forest vegetation

Alternative A

In this alternative, forest vegetation treatments continue to be implemented following the direction of the current plan. There are diameter and canopy closure limits imposed with the goal to perpetuate a greater abundance of large trees and dense-canopy stands over the Sierra Nevada Range. There is allowance for the creation of openings up to 7 acres in size to establish early seral habitat. Although integrated pest management is an objective, this is mostly attained through thinning under the timber management objectives.

Forest Vegetation – The current Forest Plan would retain tree diameter and stand canopy cover limits that would conflict with forest structure and forest resiliency conditions. Although more large trees would emerge from the ranks of smaller diameter trees, the density at which they would grow would put them in a higher degree of vulnerability from fire, bark beetles, drought, and other effects of a changing climate. The unit would continue to conduct treatments within the WUI to reduce hazardous fuels over the first decade of the plan. Towards the end of the first decade and into the second decade of the plan, approximately 50 acres per year of group selection harvests with reserves (scattering of trees or groups of trees) would occur in openings from 2 to 5 acres with some as large as 7 acres.

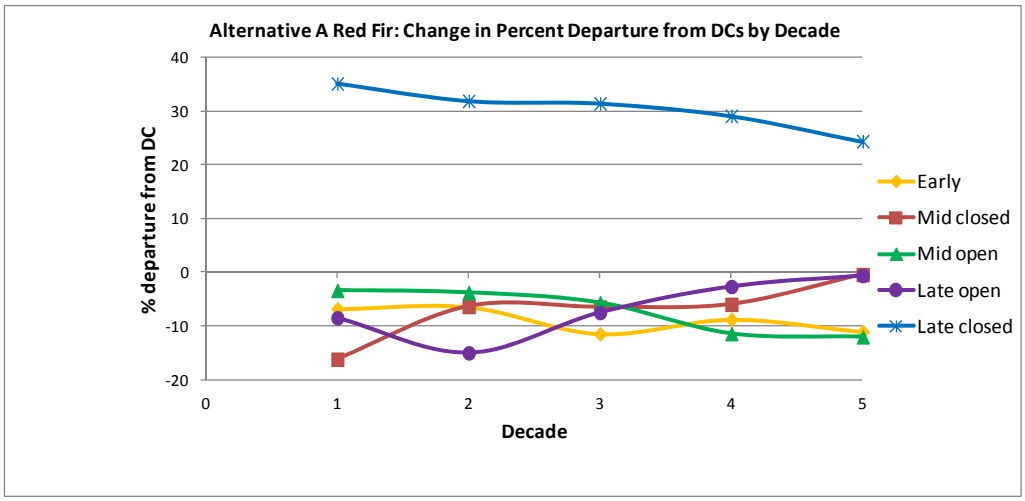


Figure 3-43. Alternative A, Red Fir: Change in Percent Departure from DCs by Decade

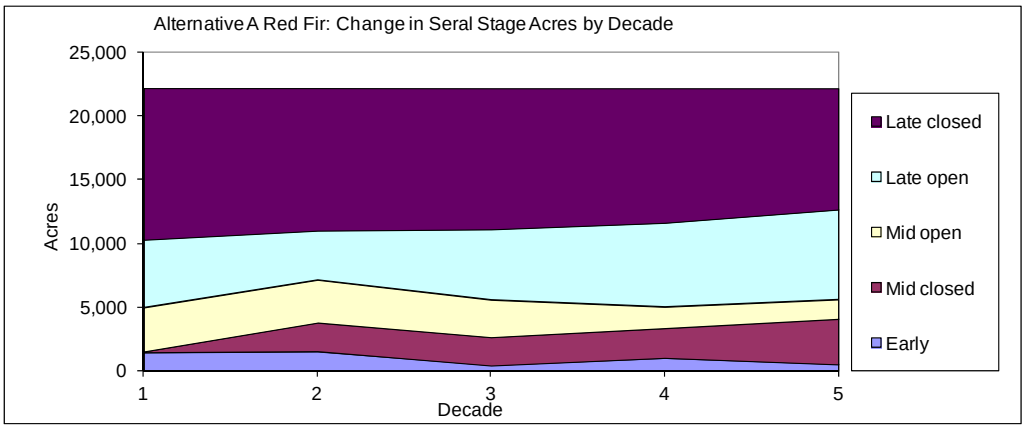


Figure 3-44. Alternative A, Red Fir: Change in Seral Stage Acres by Decade

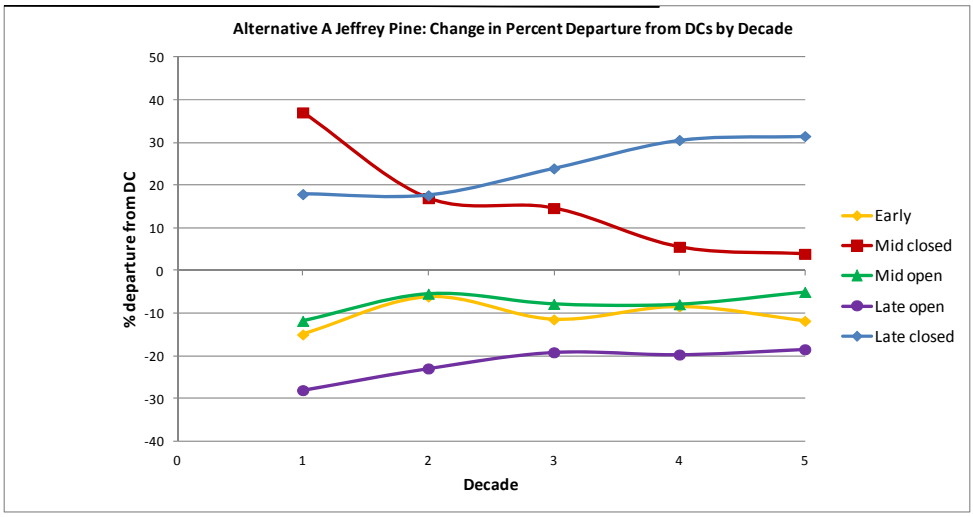


Figure 3-45. Alternative A, Jeffrey pine: Change in Percent Departure from DCs by Decade

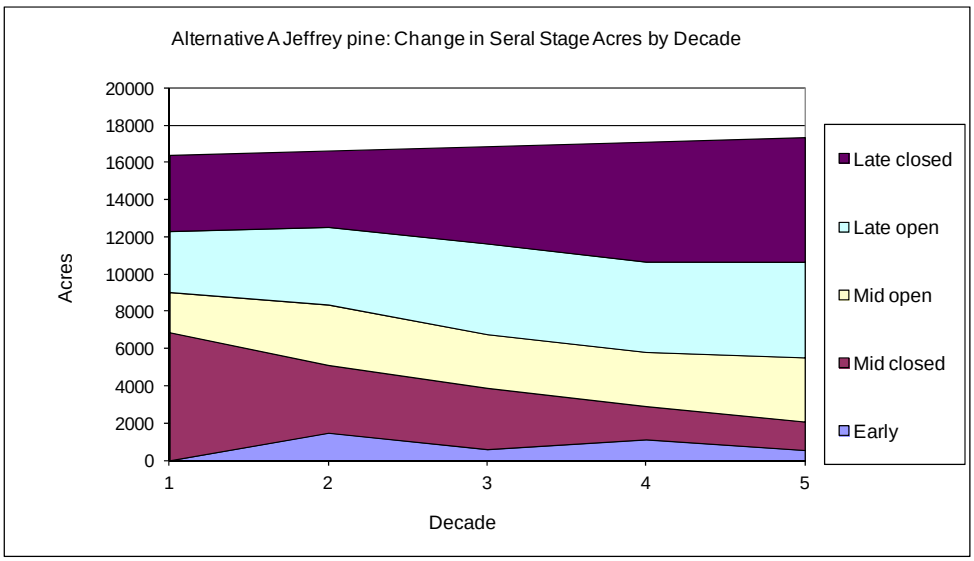


Figure 3-46. Alternative A, Jeffrey pine: Change in Seral Stage Acres by Decade

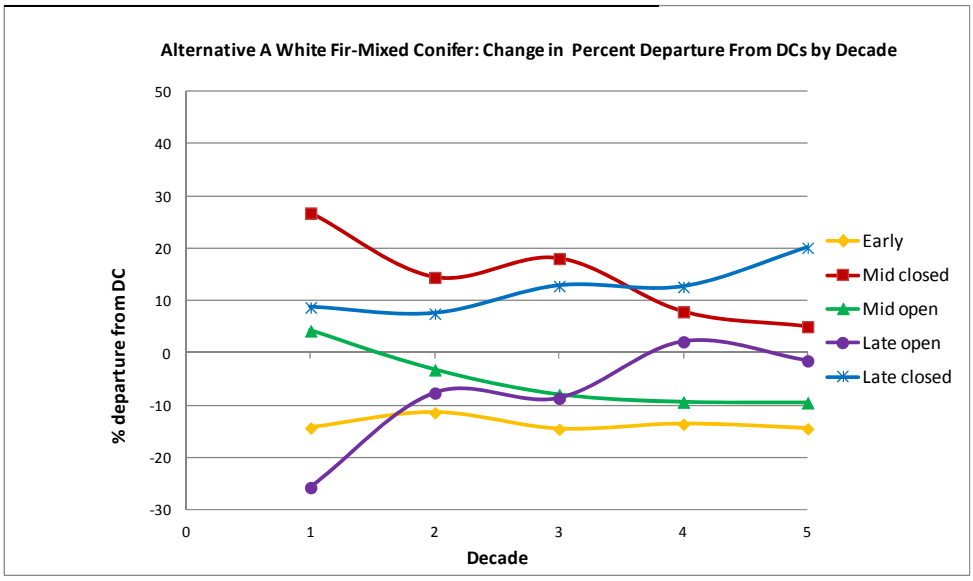


Figure 3-47. Alternative A, White Fir-Mixed Conifer: Change in Percent Departure from DCs by Decade

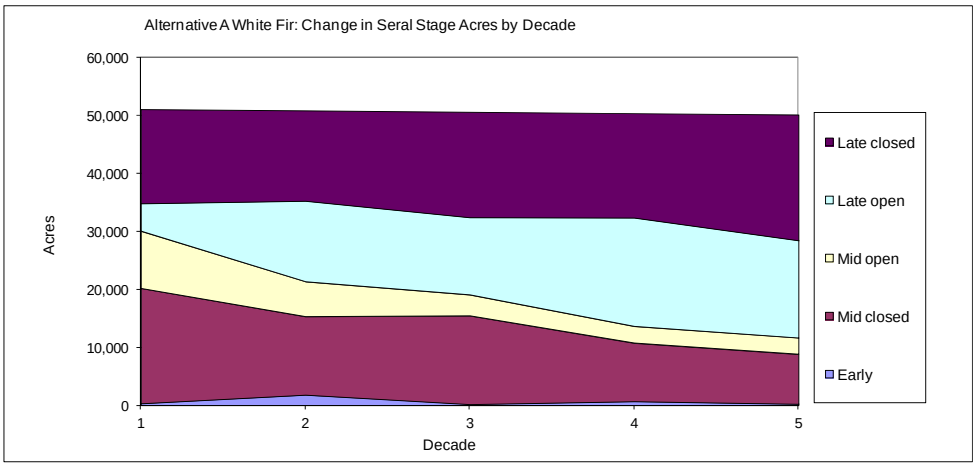


Figure 3-48. Alternative A, White Fir: Change in Seral Stage Acres by Decade

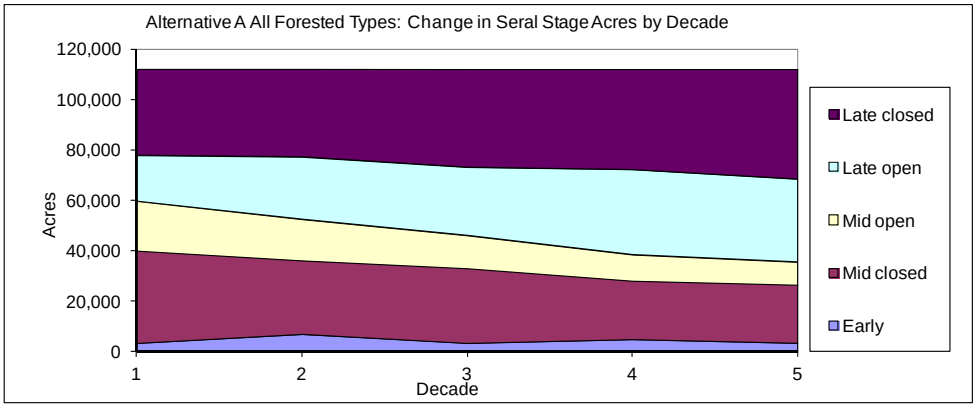


Figure 3-49. Alternative A, All Forest Types: Change in Seral Stage Acres by Decade

In light of historical recurrences of periodic droughts, proliferation of invasive species, and the uncertain effects of climate change, the continued dominance of "closed" (dense) stands will have drastic consequences. First, drought when combined with high densities predictably results in bark beetle outbreaks as well as the potential for stand replacing wildfire. Second, exotic invasive plant species inhibit regeneration of native forest species by quickly occupying growing space following such stand replacing disturbances. Lastly, the effect of climate change could lead to an exascerbation of droughty conditions during the latter stages of the typical growing season, which could increase the level of inter-tree competition for water.

Associated Resources - Related to achieving forest vegetation goals in this plan are the following associated resource effects:

Wildlife – Forest vegetation management would primarily be conducted in conjunction with wildlife habitat objectives. However, this alternative limits the diameter to which trees can be cut to 30 inches and canopy closure in a stand to no less than 40 percent closure. As a result, vegetation management results primarily in a continued densification in forest stands, although aging of the stands means that more stands will be dominated by large trees. As trees continue to grow in size and density, these limits will inhibit managers to enhance older stands of trees and would likely result in a more rapid decline in late seral or old growth stands. This effect would be most profound in habitat for species dependent on late seral or old growth conditions, e.g., spotted owls and goshawks. Thus, the following graphs that depict an increase in the number of large and very large trees is somewhat misleading as these numbers increase without any disturbance.

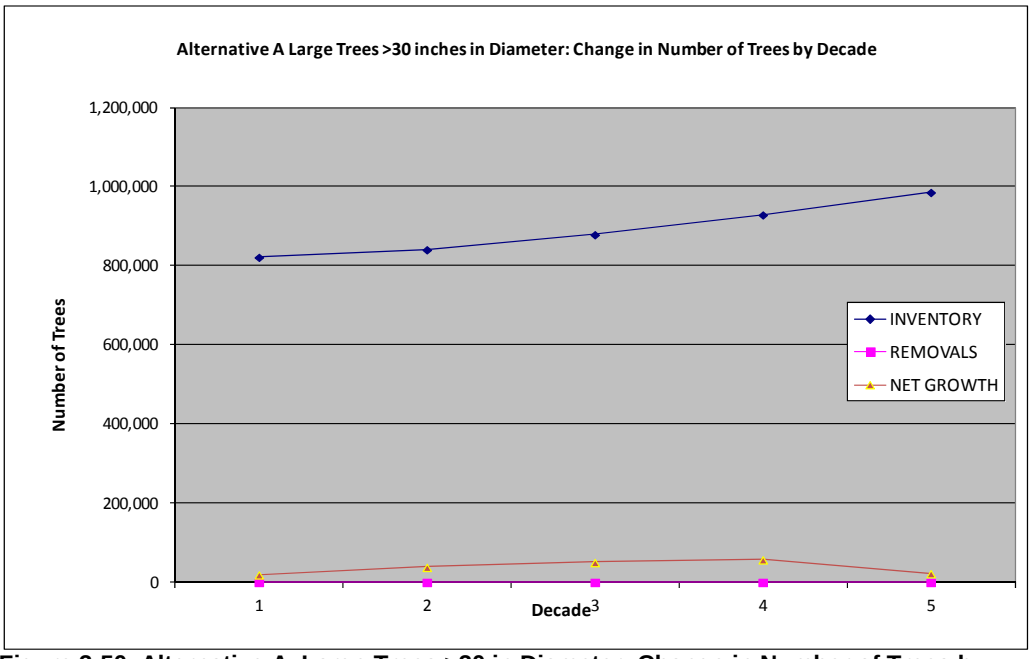


Figure 3-50. Alternative A, Large Trees >30 in Diameter: Change in Number of Trees by Decade

Botany – This alternative would have mostly negative consequences for botanical diversity. Many of the disturbance effects of fire that are integral to the sustainability of the forest are likewise essential for the regeneration of a diverse array of plants and plant communities. The associations of these resources link them to the ability of forest managers to restore a diverse forest structure on the landscape. In many areas, the dynamics of the understory plants is hampered by restrictions on the extent to which a forest stand can be thinned or group selections made to create openings that favor early seral vegetation.

Scenic – The general aspect of Tahoe Basin forests would not change much under this alternative, with dense forests covering most slopes. Over time, vegetation would become denser and more homogeneous, with less area occupied by shrubs, aspen, and open areas. Whether one views the forest from the Lake, a road or a mountain top, the mortality resulting from the limitations on cut diameter and canopy closure would be clearly visible. If wildfires occur, they will likely have severe effects under this alternative, possibly creating large areas of dead trees. The extent and intensity of bark beetle outbreak caused mortality would depend on the severity and duration of a drought. Although the current level of treatment is providing enhanced views into the forest or opening views to Lake Tahoe, the integrity in the long term of these treatments will decline.

Recreation – Many of the developed recreation sites along Lake Tahoe have a high proportion of large old trees that were protected from historic logging around home sites and resort areas. Today none of these trees could be thinned to enhance the overall health and longevity of the larger trees due to limitations on cutting diameter, even where they are clearly affecting the health or survival of older, larger legacy trees. Currently, bark beetles have caused large tree mortality in developed recreation sites annually (see table above and map above). As some trees die the result is more growing space for the survivors, however, the overall density continues to increase, which would likely trigger greater numbers of trees killed in the event of drought. This would increase the number of large and possibly more complicated (proximity to buildings, trails, and other use areas) hazard trees that would have to be mitigated. Without some selective thinning on these sites, not only would the longevity of these trees be at high risk from bark beetle caused mortality, but there would be no advanced regeneration of trees that eventually could take the place of these legacy trees. The result would be large areas within and around these sites with only seedling and sapling sized trees for decades.

Alternative B

In this alternative, forest vegetation treatments would be implemented without diameter and canopy closure limits. However, cutting large trees or thinning to lower densities would be implemented where the objective is to enhance the promotion of mid seral, longevity of late seral stands, or the resiliency of any stand. There is allowance for the creation of openings within the mid seral stage of up to 10 acres in size to establish early seral habitat.

Forest Vegetation – In this alternative there is a greater positive response towards the desired conditions by the third decade. In particular, there is near achievement in the desired condition for white fir and in Jeffrey pine a noticeable increase in late seral open. Early seral increases in both white fir and Jeffrey pine, which represent the Montane zone. Much of the change in late

seral results from greater amount of thinning to enhance this stage, which is the likely explanation for the near identical decrease in late seral closed as the increase in late seral open. According to the literature related to historic conditions of forest structure, the late seral stage in the Lake Tahoe Basin would have been mostly comprised of open canopy stands.

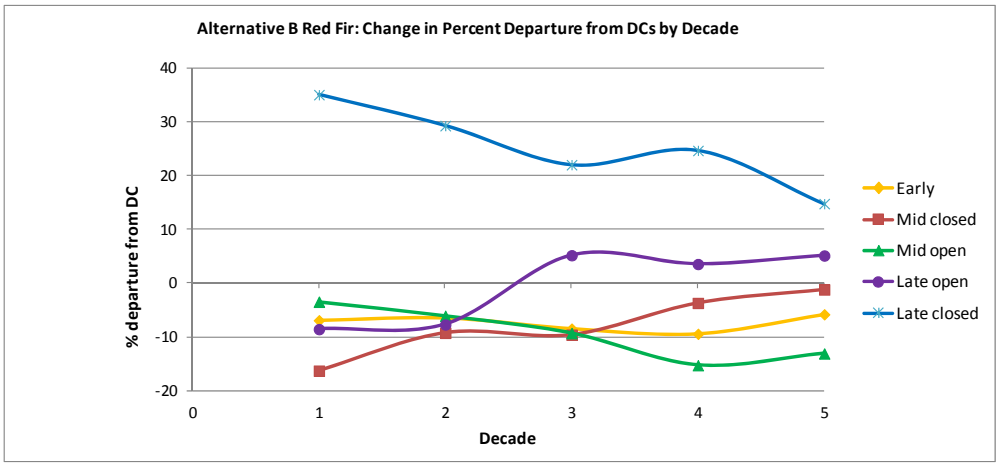


Figure 3-51. Alternative B, Red Fir: Change in Percent Departure from DCs by Decade

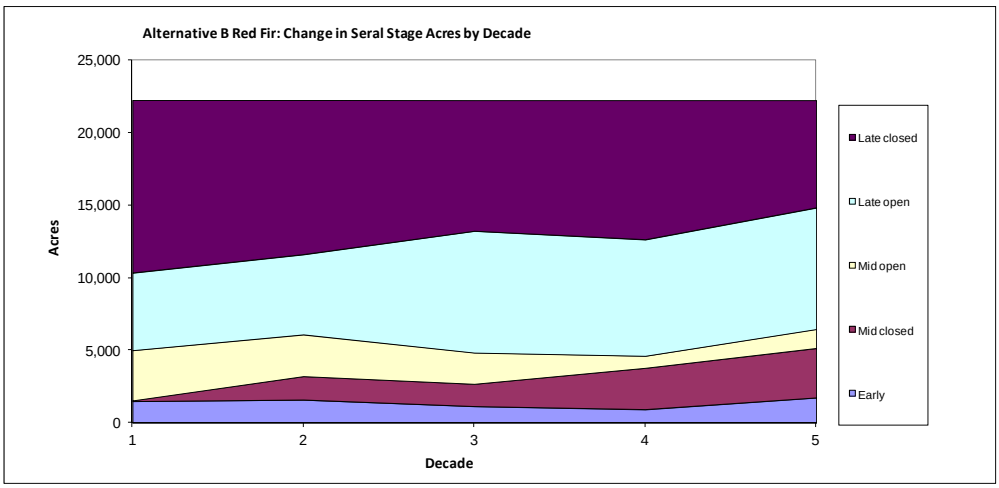


Figure 3-52. Alternative B, Red Fir: Change in Seral Stage Acres by Decade

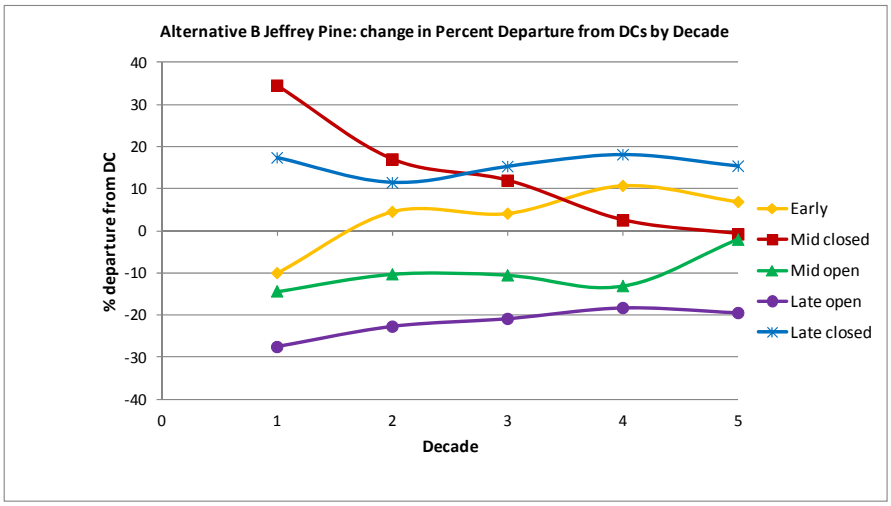


Figure 3-53. Alternative B, Jeffrey pine: Change in Percent Departure from DCs by Decade

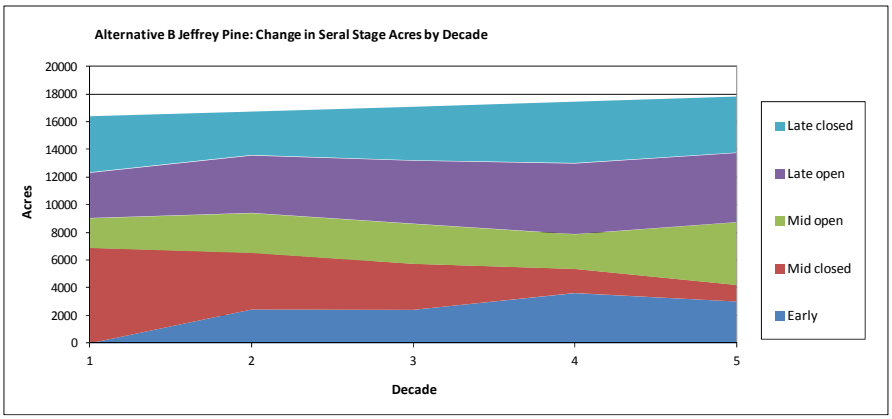


Figure 3-54. Alternative B, Jeffrey pine: Change in Seral Stage Acres by Decade

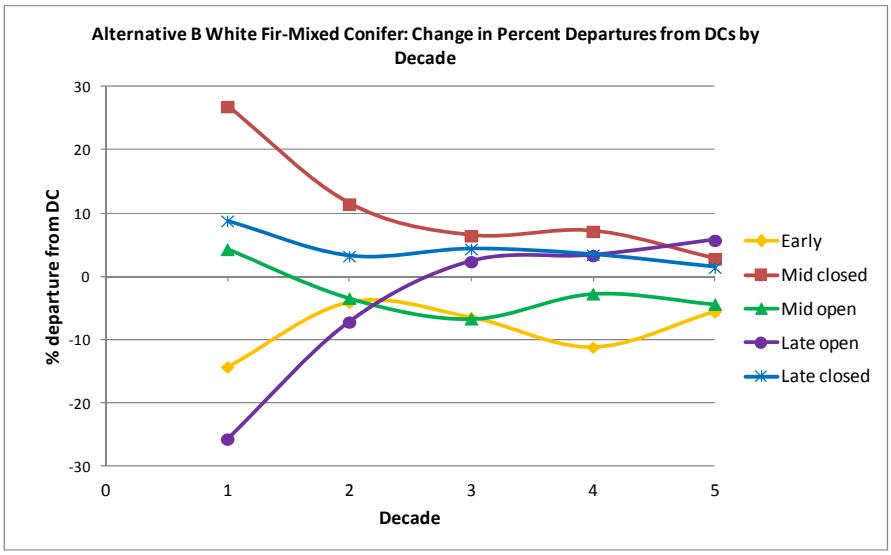


Figure 3-55. Alternative B, White Fir-Mixed Conifer: Change in Percent Departure from DCs by Decade

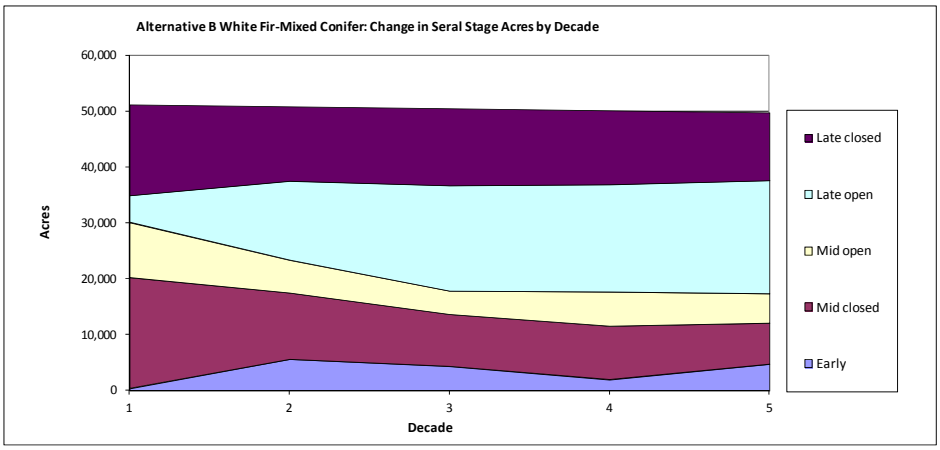


Figure 3-56. Alternative B, White Fir: Change in Seral Stage Acres by Decade

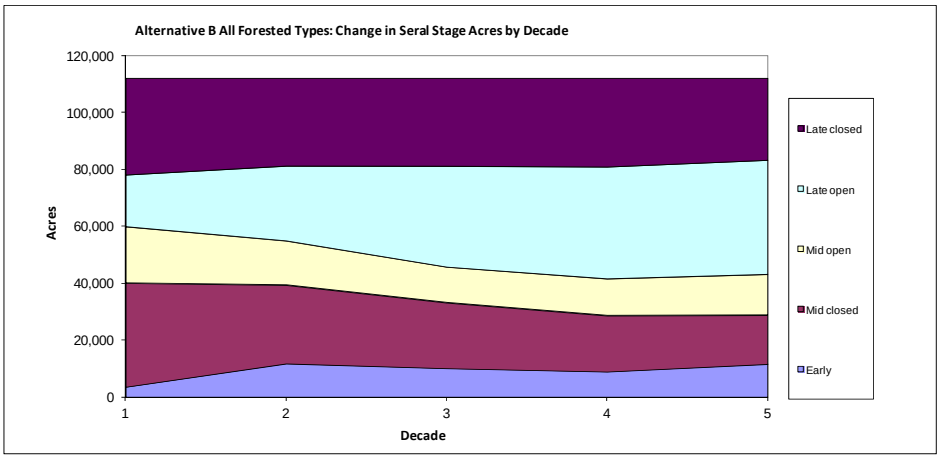


Figure 3-57. Alternative B, All Forest Types: Change in Seral Stage Acres by Decade

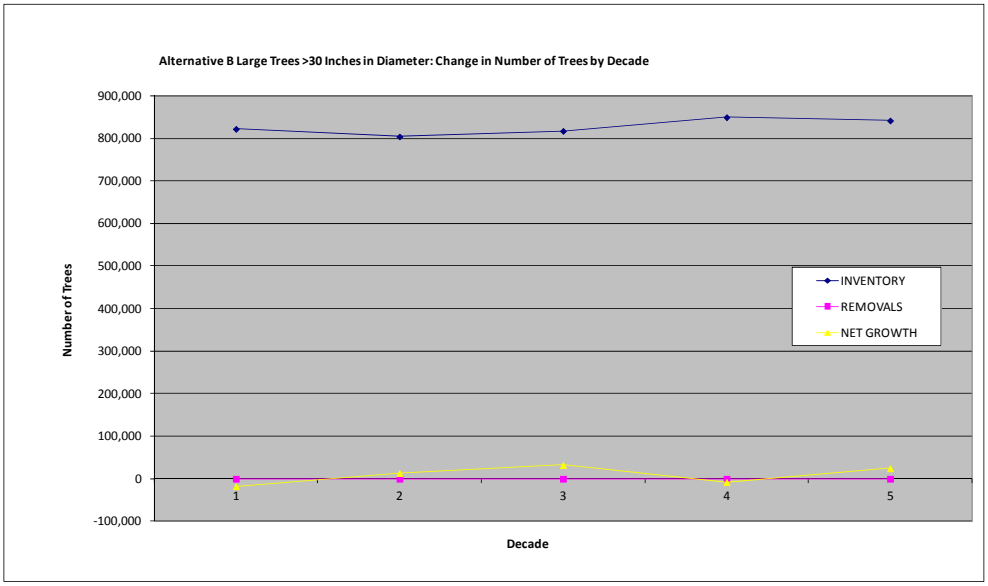


Figure 3-58. Alternative B, Large Trees >30 in Diameter: Change in Number of Trees by Decade

Associated Resources - Related to achieving forest vegetation goals in this plan are the following associated resource effects:

Wildlife – Summed across the three forest types, there is a moderate reduction in the amount of late seral closed and a large increase in late seral open . This will bring Tahoe Basin forests closer to desired conditions and increase the amount of stand heterogeneity, which should benefit most wildlife species.

Botany – More open canopies, larger forest gaps, and heavier thinning could provide greater benefits to early seral species of plants.

Scenic – Some of the openings may be visible to the public, but emphasis on the location of opening will be more than ¼ mile beyond the community. Heavier thinning will result in larger diameter growth that is likely to be more desireable. Thinning will also provide for greater viewing opportunities to landscape features (mountains, lake, etc.).

Recreation – If applied to developed recreation sites, this alternative could have a positive effect by thinning to reduce the number of hazard trees that are killed by bark beetles.

Alternative C

This alternative is similar to alternative B with a greater number of treatment acres implemented per year. More acres would be treated using mechanized equipment if possible. All other factors are the same.

Forest Vegetation – Of all of the alternatives, Alternative C makes the most progress toward desired conditions, in all three major forest types. Except for the mid-open stage in Jeffrey pine, at the end of 50 years all seral stages (including early) are much closer to their desired proportional representation on the landscape than they are today.

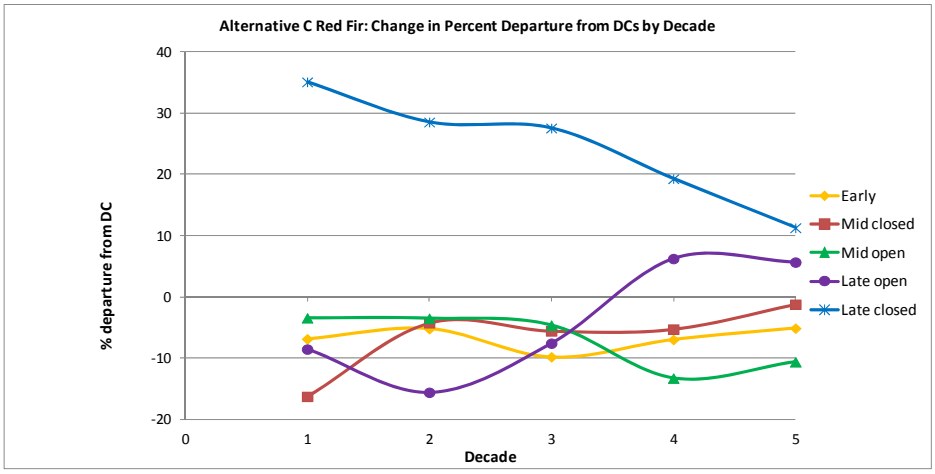


Figure 3-59. Alternative C, Red Fir: Change in Percent Departure from DCs by Decade

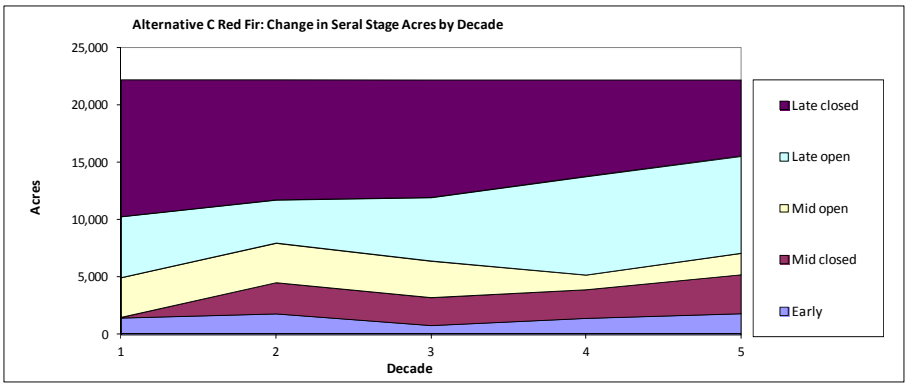


Figure 3-60. Alternative C, Red Fir: Change in Seral Stage Acres by Decade

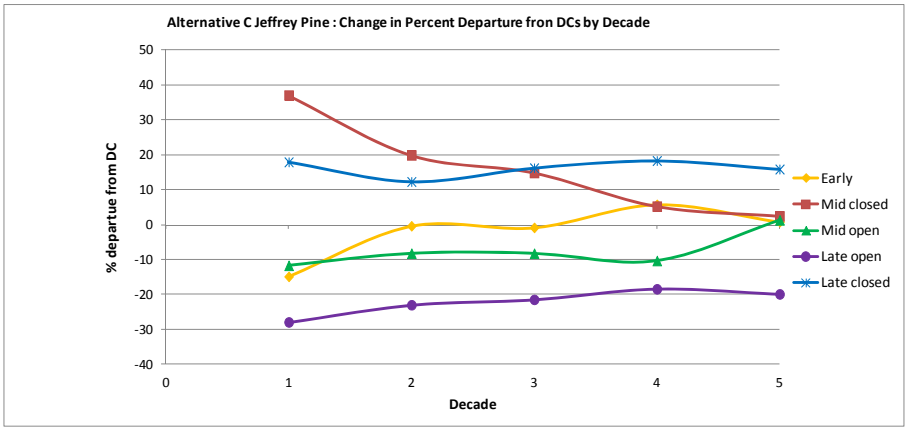


Figure 3-61. Alternative C, Jeffrey pine: Change in Percent Departure from DCs by Decade

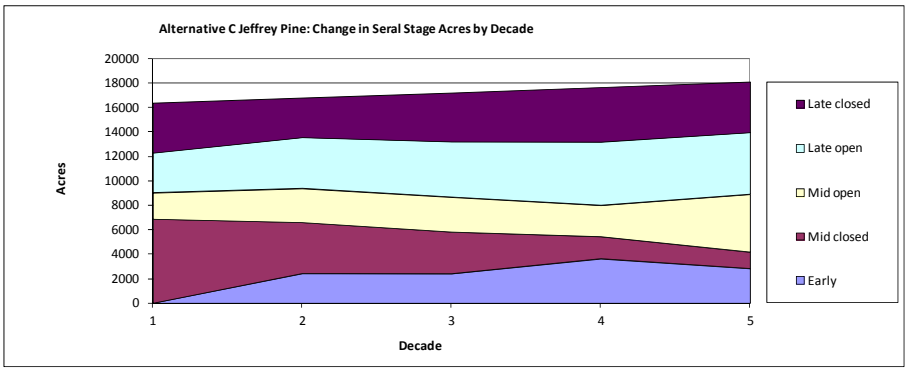


Figure 3-62. Alternative C, Jeffrey pine: Change in Seral Stage Acres by Decade

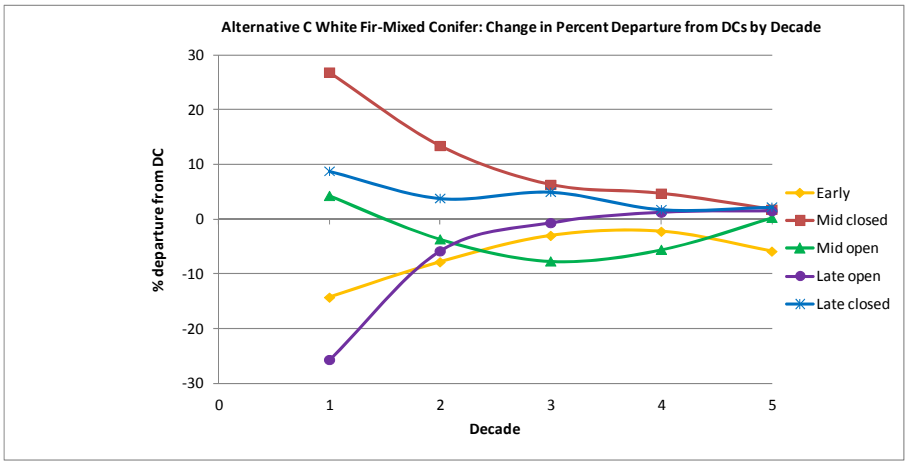


Figure 3-63. Alternative C, White Fir-Mixed Conifer: Change in Percent Departure from DCs by Decade

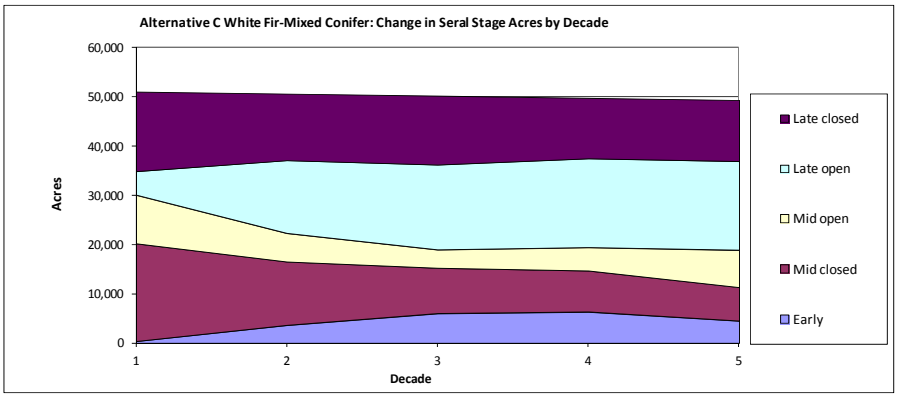


Figure 3-64. Alternative C, White Fir: Change in Seral Stage Acres by Decade

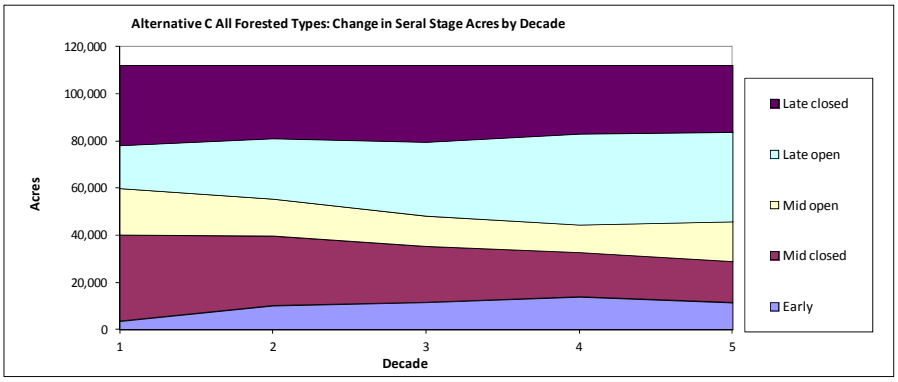


Figure 3-65. Alternative C, All Forest Types: Change in Seral Stage Acres by Decade

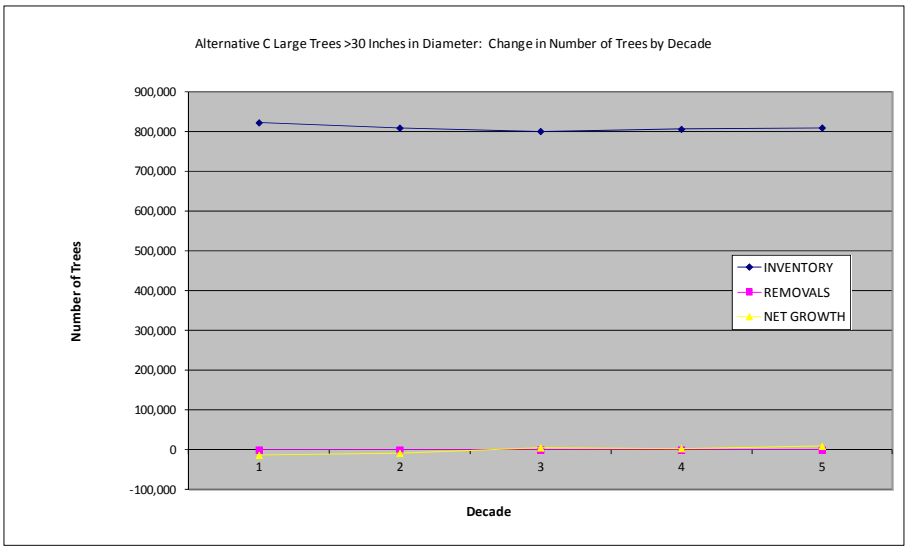


Figure 3-66. Alternative C, Large Trees >30 in Diameter: Change in Number of Trees by Decade

Associated Resources - Related to achieving forest vegetation goals in this plan are the following associated resource effects:

The effects to associated resources in this alternative are similar to alternative B, except that the rate of implementation is greater in this alternative. Alternative C was developed in part to demonstrate a quicker achievement of desired conditions, and the outcomes portrayed in the graphics above demonstrate its effectiveness. The total number of large trees remains similar across the 50 year simulations in this alternative, but their proportional representation goes up, since stands are thinning, and the mean diameter of large trees also rises, such that greater basal area is contained in large trees at the end of the scenarios.

Alternative D

In this alternative, the treatments are under similar limitations as in alternative A, including a lower tree cutting diameter limit of 12 inches DBH. However, there is more of an emphasis on using hand treatments and prescribed fire with less emphasis on the use of mechanized equipment to accomplish treatments. In addition, treatments in this alternative would focus primarily in the WUI defense zone.

Forest Vegetation – In this alternative restoration of forest structure, resiliency or abundance would not be likely. Given that the majority of smaller trees have already been removed from the understory throughout the WUI defense zone, there would be very little left under this alternative to accomplish. The current densities in the mid and late seral stages would continue to increase, posing greater risk of mortality from fire, drought, and bark beetles. Without the ability to continue thinning stands of trees where the diameters exceed 12 inches DBH, the health of the forest stands would steadily decline. The majority of forested acres appears to move towards late seral, however this is in the absence of disturbance and future trends are predicted to include steadily greater inertia for fire due to increasing fuels, drier summers, and lower snowpack.From the annual aerial mortality surveys from 2000 to 2011, many of the bark beetle related mortality

comes from larger trees in overstocked stands at high densities. This condition would pervade most if not all of the stands that develop under this alternative.

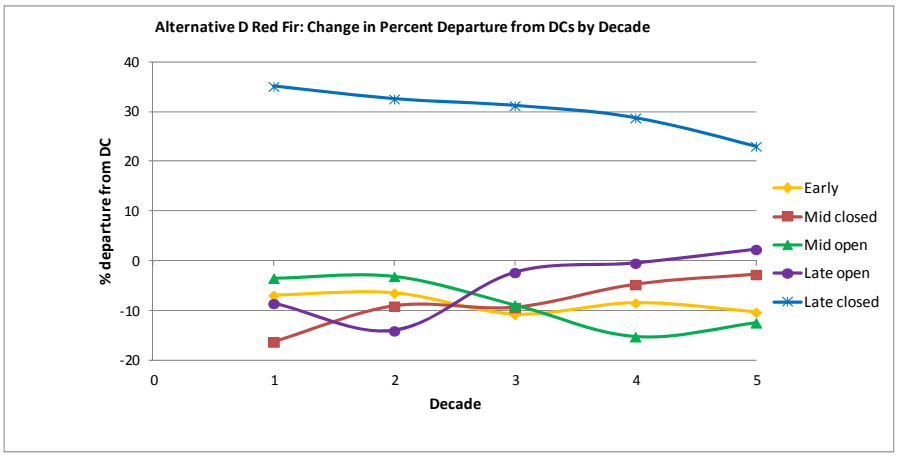


Figure 3-67. Alternative D, Red Fir: Change in Percent Departure from DCs by Decade

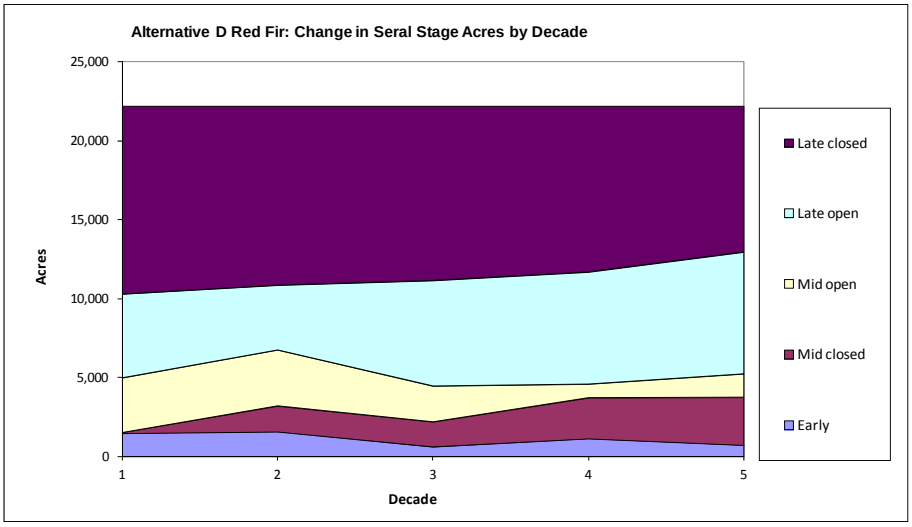


Figure 3-68. Alternative D, Red Fir: Change in Seral Stage Acres by Decade

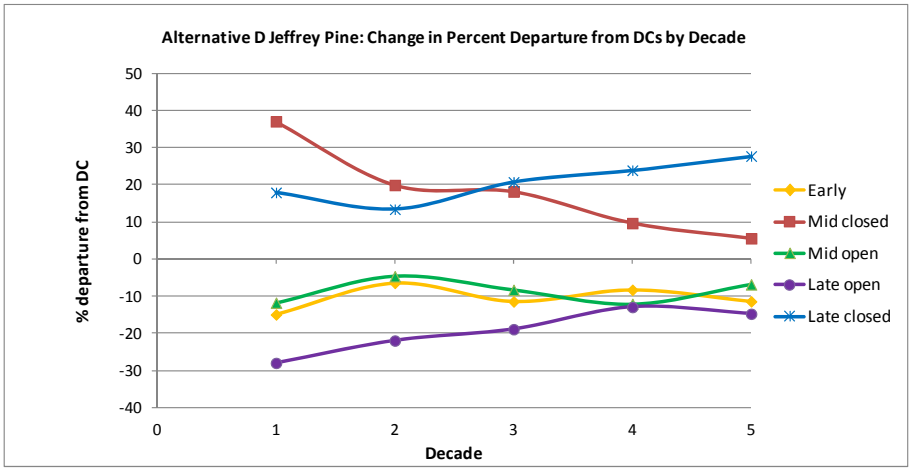


Figure 3-69. Alternative D, Jeffrey pine: Change in Percent Departure from DCs by Decade

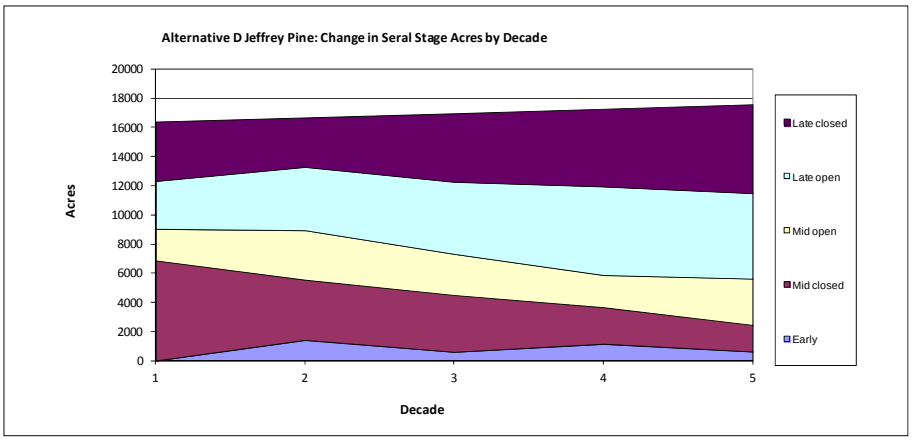


Figure 3-70. Alternative D, Jeffrey pine: Change in Seral Stage Acres by Decade

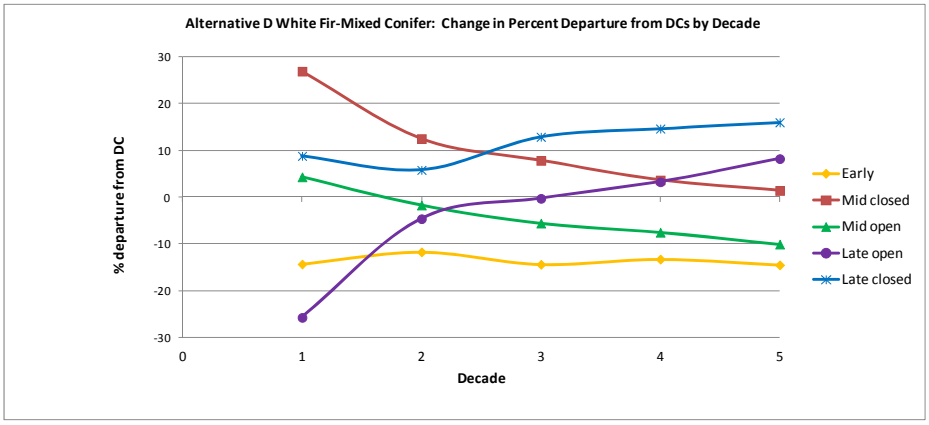


Figure 3-71. Alternative D, White Fir-Mixed Conifer: Change in Percent Departure from DCs by Decade

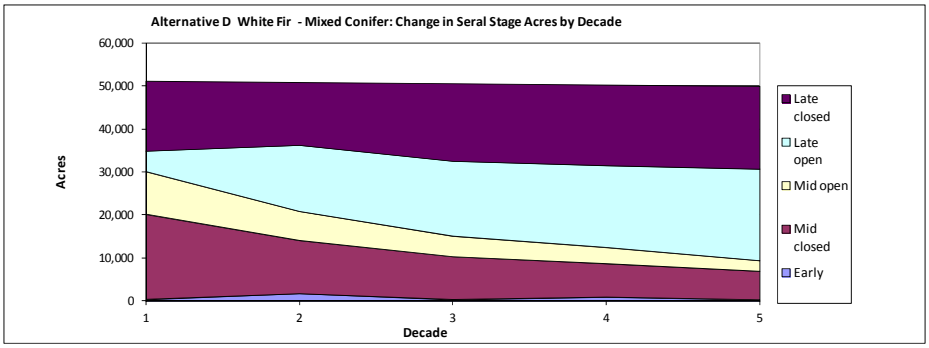


Figure 3-72. Alternative D, White Fir: Change in Seral Stage Acres by Decade

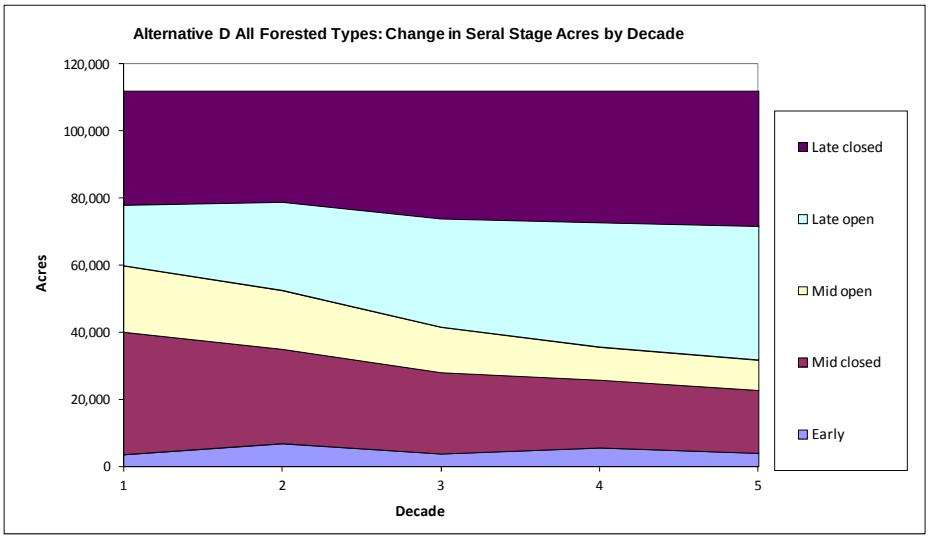


Figure 3-73. Alternative D, All Forest Types: Change in Seral Stage Acres by Decade

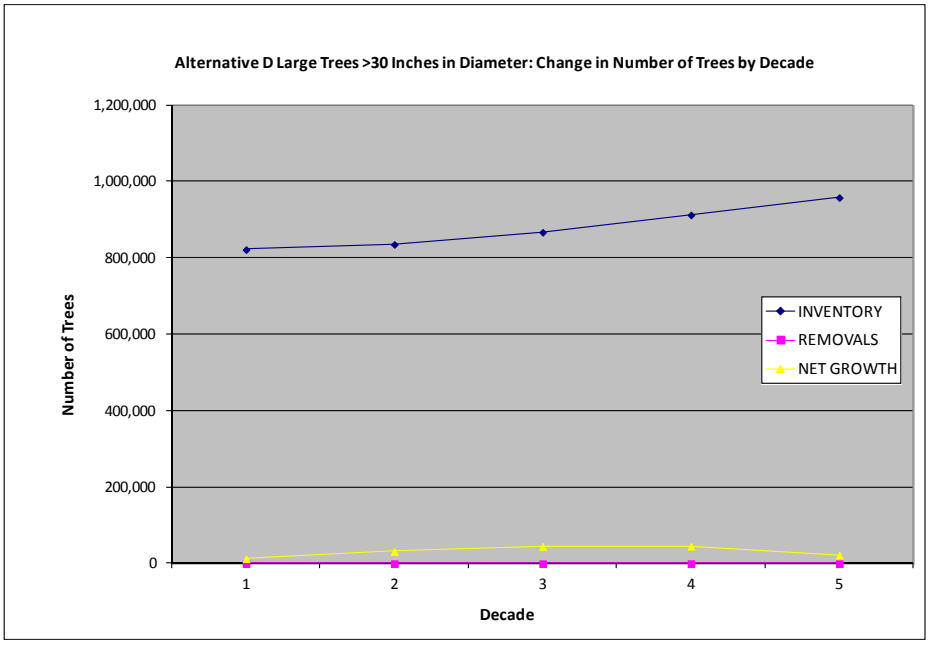


Figure 3-74. Alternative D, Large Trees >30 in Diameter: Change in Number of Trees by Decade

Associated Resources

Wildlife – There is a large increase in the number of large trees in this scenario, to a great extent in closed canopy, denser forest stands. These are the types of stands thought to be most vulnerable to future climates and related disturbances, which could notably reduce the projected numbers.The model does not qualify the other characteristics of quality habitat nor does it include risk from catastrophic disturbances. There is very little progress toward desired conditions in this alternative.

Botany – To an extent, this alternative would benefit fire dependent understory plant species through the use of prescribed fire, but very little canopy opening would be accomlished, so overall effects on understory diversity would be minimal. There could be difficulty in meeting prescribed fire prescriptions if there is insufficient thinning within a stand to be burned. This could have the opposite effect than what it should be theoretically. In addition, the higher density of trees would permit less light to the forest floor thereby limiting understory growth.

Scenic – Like Alternative A, this alternative would result in steady increases in stand density over time for most of the landscape. This could lead to either higher or lower levels of scenic integrity, depending on the viewer, due to the higher prevailing stand densities that would result from limitations on thinning. Many stands are currently at high risk levels for bark beetle outbreak. Over the life of this plan, these risk levels would increase and given the possibility of a drought (1-3 years or more) could trigger a outbreak scale mortality. The probability of severe fire would also increase under this alternative.

Recreation – This alternative is similar to alternative A in terms of the risk of mortality and subsequent hazard trees in developed recreation sites.

3.4.11.4. Analytical Conclusions

The relationships between people and the environment are highly complex. The forest, as long as it is green and abundant, is assumed to be healthy and beautiful. As well, it is considered safe. However, most people view their relationship with the forest over a very short time-span (their lifetime) rather than in the centuries over which a forest grows. Current conditions in the forests at Lake Tahoe were largely brought about by human interventions,through large-scale logging, urban growth, and fire exclusion. Although many forest management activities create some adverse human effects, including smoke, a greater management intervention is needed to better assure that the forest within the Lake Tahoe Basin continues to provide both ecosystem and human benefits for generations to come.

Sustaining a resilient forest at Lake Tahoe is principally a function of restoring and maintaining variation in forest structure of the major forest types. The current status and projected trends in the departure of forest structure from pre-settlement conditions indicate resilience to future climate warming and increasing propensity to fire and insect outbreak is likely to be low. Forest restoration is desperately needed, but such work will require significant effort. These efforts will not be without uncertainty: uncertainty about the effects of climate change on the forest and forest-modifying disturbances (drought, bark beetles, fire); uncertainty about the ability of different forest management techniques to increase forest resilience; and uncertainty about the social demands on the forest and social perspectives of forest health und resilience.

Comparison of Consequences by Alternative

Alternative C would allow for the greatest progress towards restoring forest structure and composition over the life of the plan. Tree removal would be greatest in this alternative through

group selections with reserves, which could furnish a greater amount of early-seral habitat while enhancing or prolonging the existing and future late seral habitat.

Alternatives A and B would make slower progress toward meeting desired conditions, but Alternative D would make the least progress.

Table 3-36. Relative Comparison of the Positive Effects of Each Alternative to Achieving Desired Conditions.

Indicator	Alt A	Alt B	Alt C	Alt D
Forest Structure	Low-Moderate	Moderate	Moderate-High	Low
Forest Composition	Moderate	Moderate	High	Low
Forest Resilience	Low-Moderate	Moderate	High	Negative

How the Alternatives Maintain or Achieve the Desired Conditions

Alternative A

This alternative would maintain treatment effectiveness within the WUI in the short-term, but eventually, increasing diameters and canopy closures would limit successive thinnings as the forest stands progress towards late seral. In the long-term, this limitation would hinder continued progress towards achieving and maintaining the desired condition throughout the Montane and Upper Montane zones.

Alternative B

This alternative would not be restricted by the same standards described in Alternative A. Progress would follow the same pace and extent as Alternative A, resulting in only achieving the long-term desired conditions of restoring forest structure and composition with the short-term consequences of fire and beetle risks.

Alternative C

This alternative would not be restricted by the same standards described in Alternative A. Twice the rate of progress as Alternative B would result in achieving the desired condition and maintaining existing treatment areas that would lower fire and beetle risks.

Alternative D

This alternative would not achieve the desired conditions. Maintenance of WUI treatments in the defense zone would be achieved, but falls short of restoring forest structure.

In summary, Alternative C puts in motion the treatments necessary for achieving the desired conditions more fully and in less time than Alternative A, B or D. Although no alternative meets the desired conditions within the life of the plan, alternative C establishes a pathway towards meeting the historic ranges of forest structure, abundance and resilience. Based on indications of the direction climate change is taking, these historic ranges will likely be a milestone on the way to conditions with lower densities and larger portions of pine versus fir.

3.4.12. Interpretive Services, Conservation Education , and Visitor Services

3.4.12.3. Introduction

Interpretive Services

Interpretive Services primarily serves visitors to National Forest sites. The Taylor Creek Visitor Center and the Tallac Historic Site are the major public points of contact, providing guided and self-guided activities, educational programs, and living history throughout the summer months. Two interagency partnership facilities are located at Meyers Interagency Visitor Center and Explore Tahoe Visitor Center. Minor self-guided interpretive sites include Inspiration Point Overlook, Stateline Lookout Overlook, Logan Shoals Vista, and Lam Watah interpretive trail.

Interpretive Services staff strive to “light a spark” within visitors so that they can continue to learn about their natural and cultural resources and how to take care of them. Interpretive products include wayside exhibits, interpretive signage, self-guided trails, brochures, and programs.

Assumptions

Taylor Creek Visitor Center continues to be managed as the major visitor information, conservation education, and interpretive facility for the Forest Service at Lake Tahoe. Future plans include replacement of the existing Visitor Center with a new structure designed to meet program needs as described in the 2010 Decision Notice and Environmental Assessment.

The Tallac Historic Site will continue to be managed as a Special Interest Area as described in the 1988 LTBMU Forest Plan.

Continue partnerships to leverage support and funding with Tahoe Heritage Foundation, Great Basin Institute, California Tahoe Conservancy, and others for interpretive and educational programs, facility maintenance/renovation/upgrades, etc.

Partner with Nevada Department of Transportation on an East Shore Drive National Scenic Byway interpretive signage program.

Form partnerships to nominate CA State Route 89 - West Shore Drive - as a National Scenic Byway.

Conservation Education

Conservation Education serves students, K-12, in formal education programs. Students are primarily served in the classroom, and when bus funding is available, at forest sites. Education programs utilize nationally recognized curriculum and activity guides such as Project Learning Tree, Project WET, Project WILD and Project Wild Aquatic. Classroom education is tied to state content standards and builds student environmental literacy from awareness to understanding to informed action on environmental issues. Conservation Education works with numerous state, federal and local agencies, non-government organizations and community volunteers to deliver programs. For high-school age students, students become actively engaged in community and forest projects through the Generation Green club and/or through a youth employment program in the summer.

Assumptions

The expansion of conservation education programs to meet current conditions and trends will continue in the future. Funding for these educational programs is budgeted into future SNPLMA projects as a measure to increase project effectiveness. The addition of a Conservation Education Assistant will assist this effort.

Forest Service employee Jose Gomez recognizes youth for successfully completing the Jr. Forest Ranger program.
By offering interpretive programs to visitors, the LTBMU strives to better connect people to their public lands.

Visitor Services

Visitor Services staff are often the first Forest Service contact for the visiting public at forest offices and visitor centers. Visitor Services staff provide information on recreation opportunities, appropriate behavior, special events and attractions. Visitor service products include maps, and recreation opportunity guides. Sales of interpretive publications and maps are

provided by the Tahoe Heritage Foundation.

3.4.12.4. Overview of the Affected Environment

Interpretive Services

The strategy for implementation of this program includes the continued use of partnerships, volunteers, grants, and community support. Delivery of this program fluctuates with annual Forest Service base program budgets where reduced budgets may lead to reduction in facility operating hours and/or overall program delivery. Increased budgets may result in expansion of program facility operations and increased program delivery. Partnerships including the Tahoe Heritage Foundation, Great Basin Institute, Lake Tahoe Unified School District, Nevada Air National Guard, RV and local volunteers, college interns, and numerous others.

Conservation Education

The strategy for implementation of the Conservation Education program includes the continued use of partnerships, volunteers, grants, and community support. Delivery of this program is budgeted into future SNPLMA projects as a measure to increase project effectiveness. Partnerships including the Tahoe Heritage Foundation, Great Basin Institute, Lake Tahoe Unified School District, volunteers, college interns, and numerous others.

Ranger Joy Barney is assisted demonstrating to a 5th grade class how trees absorb nutrients. Forest Service Conservation Education programs utilize nationally recognized curriculum and activity guides to educate local students outdoors and inside Lake Tahoe community classrooms.

Visitor Services

The strategy for implementation of the Visitor Services program includes the continued use of partnerships, volunteers, grants, and community support. Delivery of this program fluctuates with annual Forest Service base program budgets where reduced budgets may lead to reduction in facility operating hours and overall program delivery. Increased budgets may result in expansion of program facility operations and increased program delivery. Partnerships including the Tahoe Heritage Foundation, Great Basin Institute, Lake Tahoe Unified School District, Nevada Air National Guard, RV and local volunteers, college interns, and numerous others.

3.4.12.5. Environmental Consequences

Interpretive Services

The overall program capacity and delivery fluctuates with annual budgets. The program will interpret direction and emphasis reflected in the final Forest Plan, regardless of alternative selection.

Conservation Education

The overall program capacity and delivery fluctuates with annual budgets. The program will interpret direction and emphasis reflected in the final Forest Plan, regardless of alternative selection.

Visitor Services

The overall program capacity and delivery fluctuates with annual budgets. The program will interpret direction and emphasis reflected in the final Forest Plan, regardless of alternative selection.

3.4.12.6. Analytical Conclusions

Comparison of Consequences by Alternative

Interpretive Services

Same for all alternatives. There are no programmatic differences between the alternatives.

Conservation Education

Same for all alternatives. There are no programmatic differences between the alternatives.

Visitor Services

Same for all alternatives. There are no programmatic differences between the alternatives.

How the Alternatives Maintain or Achieve the Desired Conditions

Interpretive Services

There would be no difference between the alternatives in how desired conditions are maintained or achieved.

Conservation Education

There would be no difference between the alternatives in how desired conditions are maintained or achieved.

Visitor Services

There would be no difference between the alternatives in how desired conditions are maintained or achieved.

3.4.13. Lands Program

3.4.13.1. Introduction

There are four program areas within the lands program. The three primary program areas are the Land Acquisition and Adjustment Program, the Land Boundary and Title Program, and the Lands Special Uses Program. The fourth program area is the Land Withdrawal Program. This section evaluates and discloses the potential environmental consequences on the four lands program areas that may result from the adoption of Alternatives A, B, C or D.

Methodology

No statistical or analytical models were utilized. Acreage estimates are from current GIS data. Projections for lands activities are based on the historic trends since the 1988 plan and current needs and demands.

Assumptions

In the analysis for this resource, the following assumptions have been made:

The current urban areas within the Lake Tahoe Basin will not undergo any large scale expansion. New private residential and commercial development will be within the existing urban and developed areas.

Major transportation and utility corridors will not be designated in the Lake Tahoe Basin.

The Lake Tahoe Basin is not suitable for large scale energy development projects.

Most of the land suitable for acquisition by the Forest Service has already been acquired.

Acquisitions of environmentally sensitive lands will continue under the analysis and recommendations of the Land Acquisition Plan for the Lake Tahoe Basin Final EIS, January 1982, as amended, but the purchase program for small urban subdivision lots is basically completed.

3.4.13.2. Overview of the Affected Environment

Land Acquisition and Adjustment Program

The primary focus of the land adjustment program in the Lake Tahoe Basin has been the acquisition of private lands to increase public ownership, protect important resource values, make the lands available for public use and recreation, and to prevent the development of environmentally sensitive lands. The overall goal is to protect the water quality and public use at Lake Tahoe.

Land acquisitions by the Forest Service and state and local governments has been a predominant factor in arriving at the current management status in the Lake Tahoe Basin. Around the turn of the 19th century when the three National Forests that included the Lake Tahoe Basin were created, parts of which now comprise the LTBMU, there was only about 30,000 acres remaining in federal ownership. Nearly all the rest of the Lake Tahoe Basin had been transferred to private ownership by the public land laws and railroad grants. Today there are approximately 154,000 acres under National Forest ownership within the LTBMU. Within the Lake Tahoe hydrologic basin, about 78% of the land is under National Forest ownership. Total public ownership, including state and local government ownership within the Lake Tahoe Basin is near 88%. This exceeds the goals for National Forest and public ownership in the 1988 plan of 75%, and 85%, respectively.

In general, land acquisition by the Forest Service may occur by purchase, exchange, or donation. Purchases are primarily funded by the Land and Water Conservation Fund as appropriated by Congress. Land exchanges require an equal exchange of values, in land or cash, and must result in a net public benefit. Donation must meet acceptable public land management purposes.

On the LTBMU there are three other funding sources for land purchases. The Santini/Burton Act passed in 1980 authorizes the purchase of environmentally sensitive lands anywhere in the Basin to protect them from development and preserve water quality. The emphasis is on acquiring small urban subdivision lots, although there is no restriction on the size of parcels that could be purchased. The Act was funded by the sale of BLM public lands in a designated area near Las Vegas, with annual appropriations from Congress to the LTBMU for purchases under the Act. In addition, the Southern Nevada Public Land Management Act (SNPLMA), passed in 1988, authorized the sale of public land in a much broader area around Las Vegas, with some of the proceeds to be used for land purchases in Nevada. Land purchases were funded on a competitive basis. SNPLMA also directed that land sales under the Act in the original Santini/Burton disposal area were to be set aside in a separate account for land acquisitions under the Santini/Burton Act at Lake Tahoe. These funds, referred to as SNPLMA-S/B, funds could be used in both states.

Prior to 1965, the primary means of federal land acquisition in the Lake Tahoe Basin was by land exchange. After 1965, the emphasis changed to purchases using the Land and Water Conservation Fund. After 1981, Santini/Burton funding became the primary means of purchasing land and the type of land to acquire switched to small urban lots, although larger parcels were still acquired. By 2000, about 3,500 urban lots had been acquired. In addition, both California and Nevada passed public bond acts to fund the purchase of additional small lots by each state. Between the two states, another 5,000 lots (approx.) were acquired. After 2000, the LTBMU started shifting the priority for land purchases to larger lots that blocked up ownership or had high resource values or improved public access. During the last 15 years, major land acquisitions by the LTBMU have included the Zephyr Cove/Dreyfus and Thunderbird Lodge lake front properties (BLM land exchanges), High Meadows, the headwaters of Cold Creek at 1,790 acres, Madden Creek north of Homewood Ski area at 284 acres, Quail Lake south of the Homewood Ski Area at 205 acres (all with SNPLMA/S-B funding) and Incline Lake at 753 acres (SNPLMA funding).

The LTBMU currently has an active land acquisition program, but at a much lower level of activity than at the height of the Santini/Burton small lot purchase program, when hundreds of purchases were completed in a single year. The LTBMU receives about 12 to 18 inquiries each year from potential sellers. The LTBMU does not actively seek out properties for purchase, but is still very successful in adding many of the key remaining parcels to the purchase program. This is a result of landowners being motivated to protect their properties from development. LTBMU staff screen potential purchases and conduct early negotiations. Suitable purchases are submitted to the Regional Land Adjustment Team for processing, as the LTBMU no longer has the authority from the Regional Office to process their own purchases. Primary funding is from the Santini/Burton SNPLMA fund, which also pays for case processing. At present, there is adequate funding for all properties in the current land purchase program.

The outlook for the land acquisition program on the LTBMU is that the number of suitable land purchase opportunities will steadily diminish. There are still properties that are suitable for National Forest acquisition, but most of the suitable properties have already been acquired by the LTBMU and state and local governments. The emphasis will be to acquire larger parcels, two acres or larger, that have important resource values such as recreational opportunities, watershed protection or wildlife values or improved public access, and to protect environmentally sensitive lands from development in accordance with the Santini/Burton Act. Another emphasis will be to acquire lands that improve management efficiency, such as inholdings or parcels that block up ownership or provide better access opportunities for management and project activities.

The purchase of large numbers of small urban lots under the Santini/Burton Act as directed under the 1982 Land Acquisition Plan for the Lake Tahoe Basin Final EIS and the 1988 Forest Plan is essentially completed and is no longer a program emphasis. With the exception of Placer County, the LTBMU will no longer purchase small lots that do not meet the criteria stated above. Essentially, the TRPA environmental thresholds for the acquisition of environmentally sensitive lands that are now protected from development have been met in El Dorado, Douglas and Washoe Counties. As a result, all lots with a TRPA Individual Parcel Evaluation Score (IPES) of 1 or higher can be considered as buildable in these three counties. A score of 0 is a lot in a Stream Environmental Zone and is not considered buildable. The LTBMU policy as set out in an amendment to the 1982 EIS was to not purchase small lots with a buildable IPES score. Therefore, the only small lots in these 3 counties that qualify for purchase by the Forest Service are already protected from development. In Placer County, the buildable IPES score is still set at the original level of 725, so all lots with a lower IPES score still qualify for purchase by the LTBMU under the Santini/Burton Act. In Washoe County there is another factor that eliminates most small lots from consideration for purchase. In the late 1990s, the Office of General Counsel, which approves the title for all FS land acquisition, determined that the LTBMU could no longer purchase lots in Incline Village that were subject to the Covenants, Conditions, and Restrictions of the Incline Village General Improvement District, as they created conditions of title unacceptable to the U.S.

Therefore, emphasis on the purchase of small lots is greatly reduced. The LTBMU will consider the purchase or donation of O IPES lots in El Dorado and Douglas Counties that improve management by improving overall land ownership patterns. In addition, the LTBMU will

continue to purchase qualifying small lots from willing sellers in Placer County, as long as Santini/Burton funding is available, although there have been very few interested land owners in the last ten years.

In addition to the acquisition of lands, the land adjustment program includes the disposal of NFS lands in limited circumstances for specific purposes. The primary method for disposing of NFS lands is through land exchanges. In order to dispose of these lands in a land exchange, specific findings that the lands are suitable and have been identified for disposal are required, usually at the Forest Plan decision level. Reasons for disposal may include that the lands are no longer suitable for National Forest management. In addition there must be an overall improvement in public benefits from the exchange. Several small land exchanges were completed on the LTBMU in the 1990s.

In general, NFS lands within the Lake Tahoe Basin have important natural resource and public recreation values, and most lands were acquired for specific public purposes and benefits. Other than small urban lots, NFS lands on the LTBMU should be retained in public ownership; no NFS lands are identified as suitable for disposal.

Another way NFS lands can be transferred to local, state or private ownership is through federal legislation. One nine-acre parcel on the LTBMU was transferred to Washoe County for the Incline Village Elementary School. More recently, another 22-acre parcel at Skunk Harbor was transferred to the Dept. of Interior to be held in trust for use by the Washoe Tribe.

In addition, on the LTBMU, the Forest Service has a special authority in the Santini/Burton Act for the transfer of lands acquired under the Santini/Burton Act to state or local governments as set forth in Sec. 3(a)(4)(b):

Lands acquired under the Burton Santini Act shall be administered as a part of the United States National Forest System; except that the Secretary of Agriculture, acting through the chief of the Forest Service, may , in the case of lands which are unsuitable for Forest Service Administration, transfer such lands or interests therein to an appropriate unit of State or local government with appropriate deed restriction to protect the environmental quality and public recreational uses of the lands concerned.

This authority was used to transfer urban lots to Washoe, Douglas and El Dorado Counties and the City of South Lake Tahoe as part of the Erosion Control Grants Program. Under the Santini/Burton Act, the use of urban lots for erosion control projects was suitable and the construction of erosion control structures was authorized on more than 300 lots. The following criteria were developed to determine when lots under permit for erosion control project should be transferred to the responsible party:

The criteria used by the LTBMU to determine whether lands were currently unsuitable for Forest Service administration in these situations were:

1) A permanent urban storm water treatment structure or improvement was installed that requires long term maintenance, and,
2) The area of encumbrance was 25% or greater than the total size of the parcel, and
3) The parcel did not have resource or management values that required retention.

During the late 1990s, 115 parcels were transferred under this program. Each deed for these transfers included extensive and specific deed restrictions to protect the parcels from other forms of development and to preserve public access and recreation values. There have been no additional transfers since that time period. There is not a specific monitoring program to ensure the deed restrictions are being complied with.

On Dec. 15, 2000, the USDA Office of Inspector General issued an audit report on the LTBMU Land Acquisition and Urban Lot Management Programs under the Santini/Burton Act (Report No: 08003-5-SF). The report directed the LTBMU to work with the State Governments to find opportunities to consolidate ownership of urban lots between the agencies to improve ownership and management efficiencies. The LTBMU has had discussions with both Nevada State Lands and the California Tahoe Conservancy to identify opportunities for land adjustments to meet this recommendation. The LTBMU is currently in active discussions with CTC to develop broad scale land adjustments to improve each agency's land ownership and management. Since both of these state agencies are land management agencies with similar management objectives for their land in the Lake Tahoe Basin, land adjustments with them offer the best opportunity to improve overall management and present the least concern for future monitoring of the deed restrictions on parcels transferred to them.

Land ownership adjustments with CTC and Nevada State Lands are the preferred means of improving overall ownership and management efficiency at Lake Tahoe. The primary constraint is the need for adequate funding and staffing to process the land adjustments.

Lands Special Uses Program

Lands (or non-recreation) special use authorizations allow occupancy, use, or rights and privileges on NFS lands for federal, state and local agencies, private industry, and private individuals. Special use authorizations may include permits, leases, or easements. Uses that can be authorized include public or private roads, utilities including electric, gas, cable TV, fiber optic, water and sewer facilities, communication sites and facilities, water quality and erosion control structures, research projects, monitoring facilities, filming, photography, and commercial education activities. The program screens proposals for use of NFS lands to determine if the proposed use needs to be located on NFS lands and is a suitable use, and issues permits or leases authorizing the occupancy of NFS lands including terms and conditions to protect resource values and other Forest users. Once a use is authorized, the program monitors the use for compliance with the terms and conditions of the permit, collects fair market rental, unless rental is waived, and ensures that the use is terminated and the land restored when the use is no longer needed.

The LTBMU has an active and growing Lands special uses program. As of December, 2011, the LTBMU administered 170 permits and leases as shown in table 3-37.

Table 3-37. Special Use Permits issued by the LTBMU, as of 12/9/2011

Issued Permits		**170**
Utilities	Gas	1
	Electric	2
	Water	36
	Sewer	10
	Telephone	3
	TV	1
Roads		46
Communication Sites	Broadcast	3
	Non-broadcast	5
	Other	1
Erosion Control		30
Research Study		7
Other		26
Expired Permits		**41***
* Older (long-term) permits with no expiration date: 31 (Mostly roads and utilities.)		

There is a backlog of expired permits. Most are still in use, and in accordance with the special uses handbook and policy, are still considered as active authorizations with annual rental collected when appropriate. The total area of NFS lands under permit for Lands uses is 841 acres.

Once a use is authorized, it is monitored on a regular basis to ensure compliance with the terms of the permit and to ensure that no resource damage is occurring. In addition, there is an increasing emphasis on monitoring the use of Forest Service system roads and other roads for maintenance and repair activities to ensure that permittees are not damaging the roads and are performing their share of road maintenance. The many miles of powerlines crossing NFS lands require regular maintenance to remove hazard trees and maintain required line vegetation clearances. The work planned for each year is submitted in annual maintenance operating plans and reviewed and approved by the LTBMU. Hazard tree removal must be approved in a timely manner to ensure the integrity of electrical service and minimize fire potential.

In addition to the Lands uses under permit, there are numerous pre-existing third party rights located on NFS lands on the LTBMU. These are primarily in the form of easements for roads and utilities. Since most of the NFS lands in the LTBMU have been acquired (as opposed to established as public domain lands), there were often pre-existing utility and road easements in place when the lands were acquired by the Forest Service, and title was acquired subject to these easements. These easements are essentially private property rights across NFS lands, and do add to the complexity of managing NFS lands in the Lake Tahoe Basin.

Although the Forest Service cannot interfere with these private rights, the Forest Service is still the underlying land owner. Repairs, construction and tree removal activities on these easements need to be coordinated with the LTBMU. In addition, where existing facilities and roads are causing resource damage or erosion to adjacent NFS lands, the Forest Service can require corrective actions, including the installation of BMPs. Also, a good number of these easements do not have adequate access for the vehicles needed to maintain and repair the facilities, and the owners need to utilize Forest Service System roads to manage their easement.

In the past, these third party easements often were not addressed, and third party rights to FS System roads were often not known by the FS. Currently, whenever a permit for utilities across NFS lands is amended or re-issued, a primary objective is to also identify all related facilities of the applicant that are located on NFS lands, and to identify all roads that need to be used to maintain the facilities. Although no authorization is needed for the easements, this effort allows the LTBMU to monitor use of the easements, manage use of system roads and prevent unnecessary resource damage. These easements also present a large additional workload for the Lands special uses program.

The demand for lands use authorizations on the LTBMU appears to be increasing. Ten to fifteen proposals are submitted each year. The proposals are primarily for utility system upgrades, new cellular, wireless and other communication sites, erosion control structures funded by the erosion control grant program, new bicycle and recreation trails, and new permits to replace expired permits. This trend is likely to continue, especially for upgraded water systems to improve fire protection and for new and updated wireless communication facilities.

Allowing the use of NFS lands for renewable energy development is a high priority for the Forest Service. However, the Lake Tahoe Basin is a specially designated management area where water quality, scenic and recreational resource are the highest priority. Therefore, the Lake Tahoe Basin is not suitable for large scale energy development. On the other hand,

opportunities for small scale, site specific solar, wind, and geothermal projects that are compatible with visual resource and water quality objectives should still be encouraged.

There are no major utility transmission corridors designated through the Lake Tahoe Basin. Additionally, major efforts to identify new utility corridors throughout the western states to facilitate renewable energy development over the last 10 years have not identified the need for a corridor through the Lake Tahoe Basin. To preserve the scenic and recreational values at Lake Tahoe, and in consideration of the topographical constraints in the Basin, no major utility corridors should be identified or designated through the Lake Tahoe Basin.

Future requests for Lands authorizations on the LTBMU will continue to be evaluated on a case by case basis. The primary criteria will continue to be that the use of NFS land is necessary, the proposed use is a suitable and appropriate use of NFS lands, and the proposed use can be compatible with other existing uses and resource management objectives.

Land Boundary and Title Program

The boundary and title program involves the survey, retracement and signing of the property boundaries between NFS lands and adjacent private, state, local government and other federal lands, the maintenance of land ownership, status and title records, and the identification and resolution of unauthorized uses of NFS lands (encroachments) and title claims on NFS lands.

Timely location and signing of NFS boundaries is necessary for a variety of reasons. Boundaries need to be located and clearly signed before the design and implementation of forest projects such as fuels reduction and forest health projects, ecosystem restorations projects, and special use authorizations to ensure that Forest Service activities do not intrude onto nonfederal land. Locating boundaries is necessary to identify encroachments and clearly signed boundaries are necessary to prevent additional encroachments. In addition, marking and signing boundaries identifies and locates NFS lands for public use and enjoyment.

The demand for timely location and signing of NFS land boundaries on the LTBMU in support of forest project work and encroachment identification is greatly increased by the large areas of urban interface, especially the 3,500 urban subdivision lots. Also, boundary signs and even survey monuments tend to be lost at a higher than normal rate in these areas.

There are approximately 400 miles of NFS boundary that need to be maintained on the LTBMU. There is about another 100 miles of boundary that does not need to be maintained between adjacent National Forests and water bodies. The boundary program has been very active over the last ten years due to the large number of forest projects that have been designed and implemented, especially the fuels treatments of the urban lots. Over the last ten years, 376.5 miles of boundary have been located and signed. This includes boundaries that have been retraced more than once due to delays in project implementation. The boundary program is funded almost entirely by the forest management programs needing boundary work for their projects.

The priorities for boundary management are 1) support the LTBMU's project needs, 2) identify, resolve and prevent encroachments, and 3) identify NFS lands for public recreational use.

The title program is also very active on the LTBMU. This is driven by the same factors as the boundary program, the ownership of numerous small subdivision lots and the many miles of general forest boundary adjacent to residential development. Encroachments on NFS lands range from wood piles and vehicle parking to landscaping, volleyball courts, horseshoe pits, bicycle obstacle courses, driveways, decks, and portions of garages and houses. These unauthorized uses can cause serious resource damage and must be removed before FS project work can proceed to eliminate liability and safety concerns.

Since 2007, 260 encroachments have been resolved with 88 cases resolved just in 2010 and 2011. There is a known backlog of 68 cases, with the potential for a much larger backlog that has been reported but not confirmed. Most of the encroachments are located on urban lots and identification and resolution are funded by the urban lots program. Encroachments on general forest lands are funded by Lands appropriated funding.

The priorities for resolving encroachments are 1) clearing lands of encroachments for forest project work, 2) stopping encroachments that are causing resource damage, especially soil disturbance and water quality and erosion problems and restoring the damage, and 3) encroachments involving major improvements such as driveways, deck and buildings.

In addition to encroachments, there is a backlog of between 20 and 40 title cases on the LTBMU. These involve unauthorized improvements on NFS lands where the owner of the improvements can make a title claim against the FS for the improvements. These claims on the LTBMU nearly all result from the improvements having been in place when the land was acquired by the Forest Service and the improvements were not identified and properly removed before the Forest Service accepted title to the land. With Regional Office approval, these title cases are resolved through boundary line adjustments that give the owners clear title to their improvements.

In the future, the level of activity in the boundary and title programs will be determined by the level of forest management project work on the LTBMU, since that is the primary funding source.

Land Withdrawals

A withdrawal closes public lands or NFS lands to entry under the general land laws, including the mining laws. The general land laws included entry and appropriation of public lands for homesteading, stock raising homesteads, desert land entries and the filing of mining claims under the mining laws. Most forms of entry have been repealed, but the general mining laws are still in effect. National Forest System lands within the LTBMU that are not withdrawn are open to entry under the general mining laws.

Withdrawals are made to protect wilderness areas, areas with special resource or cultural values, lands for water and hydroelectric projects, and developed recreation and administrative facilities. On the LTBMU a total of 31, 816 acres are in withdrawals. Of these lands, 23,886 acres are

under statutory withdrawal for designated wilderness areas. Most of these acres are for the Desolation Wilderness, but portions of the Granite Chief and Mt. Rose wildernesses are included. The remaining 7, 930 acres of withdrawals are administrative withdrawals for developed recreation sites, administrative sites and water project withdrawals. The statutory withdrawals for wilderness areas are part of wilderness designation and can only be changed by legislation. The administrative withdrawals can be continued as long as the purpose for the withdrawal continues or they can be terminated, opening the areas to entry under the mining laws.

As long as the lands under administrative withdrawals are still being used for the purpose of the withdrawals, the withdrawals should be continued to protect the lands from the filing of mining claims.

Since there is only very limited potential for locatable minerals in the LTBMU and very few active mining claims, there is no specific need currently identified to pursue additional withdrawals on the LTBMU. If additional areas needed for administrative sites, developed public recreation areas, special interest areas, wetlands or preservation of cultural resources are identified that need additional protection from entry under the General Mining Laws, the Forest Service may pursue withdrawal of those areas.

3.4.13.3. Environmental Consequences

Land Acquisition and Land Adjustment Program

The objective of acquiring the remaining qualified properties for FS management within the Lake Tahoe Basin depends on willing sellers with suitable properties and the availability of funding for the purchases. The objective and results will not be affected or changed by any of the four alternatives.

The objective of pursuing opportunities to consolidate ownership of urban lots with Nevada State Lands and California Tahoe Conservancy will be determined by available funding and staffing in the FS and the two state agencies. The objective and completion of land adjustments will not be affected or change under any of the four alternatives.

Land Special Uses Program

The demand for additional Lands special use authorizations will be driven by the need for NFS lands by private and local and state governments for additional utilities, roads, communication facilities, erosion control projects and other uses requiring formal authorizations. This will not change or be affected by any of the alternatives. The goal of not authorizing additional infrastructure in roadless areas and environmentally sensitive or incompatible areas remains the same in all alternatives.

Land Boundary and Title Program

The desired condition of this program is to have all boundaries marked and maintained to standard and to remove and prevent all encroachments on NFS lands. The reality is that the funding and accomplishments in the boundary and title program are determined by the level of forest management projects which does vary in the alternatives. However, whichever alternative is adopted, the actual level of project work will be determined by available funding. In general, the more forest project work that is planned and implemented, the more boundary and title support will be needed, and more miles of boundary will be maintained and more title cases resolved.

Land Withdrawals

The goal of retaining existing administrative withdrawal as long as the use or resource value for which the withdrawal was implemented remains, will not change or be affected by any of the alternatives. The acres of statutory withdrawals for designated wilderness will only change if additional wilderness designations are made. Alternatives C and D would both recommend additional wilderness designations and could result in additional acres of land being withdrawn if the designations are actually approved by Congress. That would be a consequence, not a preferred or desired condition from a program standpoint.

3.4.13.4. Analytical Conclusions

Comparison of Consequences by Alternative

Land Acquisition and Land Adjustment Program. The objectives and accomplishments of the land acquisition and land adjustment program will remain the same under all four alternatives and will not be affected by the alternatives.

Land Special Uses Program. The objectives and accomplishments of the lands special uses program will remain the same under all four alternatives and will not be affected by the alternatives. The number and type of lands uses authorized will not change under any alternative.

Land Boundary and Title Program. Assuming an equal level of funding for all alternatives, Alternatives A and B would result in a similar level of accomplishments in maintaining land boundaries and preventing and resolving encroachments. Alternative C with a more active forest management approach would result in an increase in accomplishments with the most proactive boundary and title program. Alternative D with a lower level of active forest management would result in a lower level of boundary and title accomplishments.

Land Withdrawals. None of the alternatives would affect the goal of retaining existing administrative withdrawals as long as they are needed. Alternative C could result in additional acres under statutory withdrawal if the recommendation for wilderness designation for the Dardanelles Roadless Area is implemented. Alternative D could result in the most acres under

statutory withdrawal if the recommendation for wilderness designation for both the Dardanelles and Freel Roadless Areas is implemented. Again, this is just a result and has no management implications from a Lands program standpoint.

How the Alternatives Maintain or Achieve the Desired Conditions

There would be no difference between the alternatives in how desired conditions are maintained or achieved.

3.4.14. Management Indicator Species (MIS)

3.4.14.1. Introduction

The 1982 National Forest System Land and Resource Management Planning Rule (1982 Planning Rule) requires the selection of management indicator species (MIS) during development of forest plans (1982: 36 CFR 219.19(a)(1)). This section summarizes the MIS selected for the revised Land and Resource Management Plan (LRMP) and the conditions they are to represent. Details regarding the identification and selection of these MIS, including the reasons for their selection, as required under the Planning Rule ((1982: 36 CFR 219.19(a)(1)), can be found in the 2007 Sierra Nevada Forests Management Indicator Species (SNFMIS) Amendment Final Environmental Impact Statement (FEIS) (USDA Forest Service 2007a) and SNFMIS Amendment Record of Decision (ROD) (USDA Forest Service 2007b), which are hereby incorporated by reference.

The Forest Service selects species as Management Indicator Species (MIS), one of a variety of elements to address National Forest Management Act (NFMA) requirements related to diversity of plant and animal communities. Species are selected as MIS "because their population changes are believed to indicate the effects of management activities" (1982: 36 CFR 219 (a)(1)). They are to be used during planning to help compare effects of alternatives (1982: 36 CFR 219.19(a)(2)), and as a focus for monitoring (1982: 36 CFR 219.19(a)(6)). Where appropriate, MIS shall represent the following groups of species (36 CFR 219 (a)(1)):

- Threatened and endangered species on State and Federal lists;
- Species with special habitat needs that may be influenced significantly by planned management programs;
- Species commonly hunted, fished, or trapped;
- Non-game species of special interest; and
- Species selected to indicate effects on other species of selected major biological communities or on water quality.

Although species from all 5 categories are to be considered, there is no requirement or compelling need to choose one or more species from each category. Instead, the categories provide a universe from which the appropriate MIS may be selected (USDA Forest Service 2007b, p.12).

In 2007, the USDA Forest Service, Pacific Southwest Region Deputy Regional Forester amended the MIS lists and associated monitoring for 10 National Forests in the Sierra Nevada, including the LTBMU, to improve the effectiveness of those lists to meet their intended purpose, and to improve economic efficiency to make MIS monitoring affordable, and hence, more implementable (USDA Forest Service 2007b). Suitability and Feasibility criteria were used to identify the MIS. The suitability criteria used were: (a) The species is linked to a habitat or ecosystem component that is affected by Forest Service management activities, and (b) The population changes of the species are thought to primarily indicate the effects of Forest Service land management activities versus indicating the effects of other factors. The feasibility criteria used were: (a) There is an available, tested methodology (either currently being implemented or

readily available to implement) to monitor the population or habitat of the species); (b) the methodology, including data analysis, can be implemented within budget constraints; and (c) the methodology gives information regarding population or habitat status and change of the species that is useful to informing management decisions. Additional details on these criteria and how they were applied can be found in USDA Forest Service 2007a, Appendix B.

MIS for the LTBMU include seven (7) terrestrial habitats and ecosystem components with nine (9) associated Management Indicator Species, as well as aquatic macroinvertebrates as the MIS for lacustrine and riverine habitat. These MIS and their associated habitats or ecosystem components are listed in Table 3-38.

The LTBMU Revised Forest Plan proposes to adopt the same MIS that were adopted in the 2007 SNFMIS Amendment ROD for the LTBMU (USDA Forest Service 2007b): 9 MIS for the 7 terrestrial habitats and ecosystem components occurring for the LTBMU and aquatic macroinvertebrates as the MIS for lacustrine and riverine habitat (Table 3-36). These major habitats and ecosystem components were selected because they can be affected by Forest Service management on the LTBMU, as well as on other national forests in the Sierra Nevada (USDA Forest Service 2007a, pages 17-20). These species were selected as MIS because they are associated with the indicated major habitat or ecosystem component and their population changes are believed to indicate the effects of land management activities (1982: 36 CFR 219.19(a)(1)), and were selected via a process that considered all known plant and animal species present on the 10 National Forests within the Sierra Nevada, including 692 terrestrial vertebrate species; the consideration process is documented in detail in the SNFMIS Amendment FEIS, Appendix B (USDA Forest Service 2007a).

The LTBMU Revised Forest Plan also proposes to adopt the monitoring strategies identified in the 2007 SNFMIS Amendment ROD (USDA Forest Service 2007b). For the terrestrial MIS, the monitoring strategy is habitat monitoring and distribution population monitoring at the Sierra Nevada scale, including sampling on the LTBMU. Bioregional (Sierra Nevada scale) monitoring was selected because many management issues transcend individual forest boundaries and monitoring of MIS across neighboring forests enables a clearer examination and understanding of the effects of management activities (USDA Forest Service 2007b). In addition, in many cases, forest scale information does not provide the most meaningful biological data and maintaining a separate, uncoordinated monitoring effort on each individual forest is not strategic and is an inefficient use of money and resources (USDA Forest Service 2007a). Distribution population monitoring tracks the changes in the presence at the Sierra Nevada scale of the species across a number of sample locations. Habitat monitoring tracks the status and trends at the Sierra Nevada scale of each of the CWHR habitat types. For the aquatic macroinvertebrates, the monitoring strategy is bioregional habitat and bioregional Index of Biological Integrity. This bioregional monitoring has been conducted since 2008 or 2009 at the Sierra Nevada scale, including on the LTBMU (USDA Forest Service 2010a).

Table 3-38. Management Indicator Species (MIS) components for the Lake Tahoe Basin Management Unit

Habitat or Ecosystem Component	CWHR Type(s) defining the habitat or ecosystem component[1]	Management Indicator Species *Common Name* *Scientific Name*	Category (s)
Riverine & Lacustrine	**Habitats:** Lacustrine (LAC) and riverine (RIV)	aquatic macroinvertebrates	Species selected to indicate effects on other species of selected major biological communities or on water quality.
Riparian	**Habitats:** Montane riparian (MRI), valley foothill riparian (VRI)	**yellow warbler** *Dendroica petechia*	Non-game species of special interest
Wet Meadow	**Habitats:** Wet meadow (WTM), freshwater emergent wetland (FEW)	**Pacific tree frog** *Pseudacris regilla*	Non-game species of special interest
Early and Mid Seral Coniferous Forest	**Habitats:** Ponderosa pine (PPN), Sierran mixed conifer (SMC), white fir (WFR), red fir (RFR), eastside pine (EPN), tree sizes 1, 2, 3, and 4 all canopy closures	**Mountain quail** *Oreortyx pictus*	Species commonly hunted, fished, or trapped
Late Seral Open Canopy Coniferous Forest	**Habitats:** Ponderosa pine (PPN), Sierran mixed conifer (SMC), white fir (WFR), red fir (RFR), eastside pine (EPN), tree size 5, canopy closures S and P	**Sooty (blue) grouse** *Dendragapus obscurus*	Species commonly hunted, fished, or trapped
Late Seral Closed Canopy Coniferous Forest	**Habitats:** Ponderosa pine (PPN), Sierran mixed conifer (SMC), white fir (WFR), red fir (RFR), tree size 5 (canopy closures M and D), and tree size 6.	**California spotted owl** *Strix occidentalis occidentalis*	Non-game species of special interest; Forest Service Sensitive Species
		American marten *Martes americana*	Non-game species of special interest; Forest Service Sensitive Species
		northern flying squirrel *Glaucomys sabrinus*	Non-game species of special interest

Habitat or Ecosystem Component	CWHR Type(s) defining the habitat or ecosystem component[1]	Management Indicator Species *Common Name* *Scientific Name*	Category (s)
Snags in Green Forest	**Ecosystem Components:** Medium and large snags in green forest	**hairy woodpecker** *Picoides villosus*	Species with special habitat needs that may be influenced significantly by planned management programs.
Snags in Burned Forest	**Ecosystem Components:** Medium and large snags in burned forest (stand-replacing fire)	**black-backed woodpecker** *Picoides arcticus*	Species with special habitat needs that may be influenced significantly by planned management programs.

[1] All CWHR size classes and canopy closures are included unless otherwise specified; **dbh** = diameter at breast height; **Canopy Closure classifications:** S=Sparse Cover (10-24% canopy closure); P= Open cover (25-39% canopy closure); M= Moderate cover (40-59% canopy closure); D= Dense cover (60-100% canopy closure); **Tree size classes:** 1 (Seedling)(<1" dbh); 2 (Sapling)(1"-5.9" dbh); 3 (Pole)(6"-10.9" dbh); 4 (Small tree)(11"-23.9" dbh); 5 (Medium/Large tree)(≥24" dbh); 6 (Multi-layered Tree) [In PPN and SMC] (Mayer and Laudenslayer 1988).

Since adoption of these regulations, the management indicator species concept has been reviewed and critiqued by the scientific community (Caro and O'Doherty 1999, Simberloff 1998, Noss 1990, Landres et al. 1988, and Weaver 1995). These reviews identify proper uses and limitations of the indicator species concept. They generally caution against overreaching in use of indicator species, especially when making inferences about ecological conditions or status of other species within a community. Caution is needed because many different factors may affect populations of each species within a community, and each species' ecological niche within a community is unique. Additional information regarding scientific criticisms of the MIS concept is discussed in the 2007 Sierra Nevada Forests Management Indicator Species (SNFMIS) Amendment Final Environmental Impact Statement (EIS) (USDA Forest Service 2007a, p.4).

The 2007 SNFMIS Amendment EIS and Record of Decision focused on identifying MIS which can be used to test the assumption that if habitat is managed a certain way, MIS populations will respond in a certain way (USDA Forest Service 2007a, p.4). This use of MIS has not been negated by the recent scientific criticisms summarized above. Thus, the selected MIS and associated monitoring identified in the 2007 SNFMIS Amendment and the LTMBU Plan Revision are designed to meet the NFMA requirement for MIS in light of this current scientific understanding of the MIS concept. The MIS process is but one tool used to develop management strategies and monitoring programs designed to meet NFMA requirements related to diversity of plant and animal communities.

Some of the other elements used in comprehensive planning for plant and animal diversity include: objectives and standards in forest plans for maintenance and restoration of desired

ecological conditions; and management of important ecosystems and ecosystem components, such as aspen, snags and down logs, and plants that are culturally important to Native Americans; and biological evaluations and assessments at both the forest plan and site-specific project levels.

Other elements important to monitoring the effects of forest plan implementation on plant and animal diversity include, where appropriate: monitoring key ecological conditions; monitoring management activity levels; monitoring species of interest, including watchlist species; change detection of vegetation structure and species composition; monitoring water quality; monitoring plants that are traditionally important to Native Americans; and monitoring of threatened, endangered, and sensitive species.

The MIS categories (1982: species (36 CFR 219 (a)(1))) applicable to the LTBMU MIS are identified in Table 3-37. Further information regarding these categories is in the SNFMIS Amendment ROD (USDA Forest Service 2007b, pp.4-5). The comparison of the effects of alternatives related to MIS (1982: 36 CFR 219.19(a)(2)) is found in the Environmental Consequences section below. Monitoring related to the MIS (1982: 36 CFR 219.19(a)(6)) is discussed in the Monitoring Plan.

3.4.14.2. Affected Environment

The species present in the area selected as MIS for the LTMBU are identified and the reasons for their selection is summarized in this section, as required by (219.19(a)(1)); more detailed information is found in the SNFMIS Amendment FEIS (USDA Forest Service 2007a, pp.37-40) and ROD (USDA Forest Service 2007b).

In addition, the status and trend of each MIS habitat and associated MIS are summarized in this section. The current bioregional status and trend of populations and/or habitat for each of the MIS is discussed in detail in the Sierra Nevada Forests Bioregional Management Indicator Species (SNF Bioregional MIS) Report (USDA Forest Service 2010a). The map of the Sierra Nevada bioregion in context to the ten national forests is displayed in Figure 3-77, at the end of this resource section.

Lacustrine/Riverine Habitat (Aquatic Macroinvertebrates)

Reason for selection as an MIS

Aquatic macroinvertebrates were selected as the MIS for lacustrine and riverine habitats because they represent a diverse group of relatively sedentary species that react strongly and predictably to management activities (Hawkins et al. 2000, Knapp et al. 2005, Fore 2007, Herbst et al. 2012). Variation in their relative abundance may be interpreted to determine whether water quality and aquatic habitats have been impaired relative to reference condition (EPA 2006) the standard for compliance with the Clean Water Act. Reference condition is defined as the relative absence of impacts from land management activities such as timber harvest, grazing, road building, and mining (Ode and Schiff 2009). Since it may be virtually impossible to find an undisturbed reference site with no road building or other land use history, a relaxed standard for reference condition, allowing for some disturbance (e.g. no more than 1 km/km^2 rather than no roads in the

reference watershed) has sometimes been adopted. Sensitivity to alteration of habitat for such features as water temperature, riparian vegetation, sedimentation, nutrients and water chemistry vary within the macroinvertebrate community, allowing interpretation of what factors may be compromising water quality and aquatic habitats (Hawkins et al. 2000, Hodkinson and Jackson 2005, Knapp et al. 2005, Herbst et al. 2006, EPA 2006, Ode 2007a, Fore 2007, Rehn 2009, Herbst and Silldorff 2009, Larsen and Ormerod 2010, Herbst and Cooper 2010, Reylea et al. 2012, Herbst et al. 2012).

Objectives for the maintenance and improvement of habitat for this MIS by Alternative (219.19(a)): Under Alternative A, objectives for the maintenance and improvement of lacustrine and riverine habitat in the LTBMU will follow guidance described in the current Forest Plan, as amended by the 2004 Sierra Nevada Forest Plan Amendment. Management direction for Alternatives B,C, and D is primarily described in the Draft Forest Plan and in Appendix I. This direction includes: achieving load reduction targets for Stream Environment Zones (SEZs) in the Lake Tahoe total maximum daily load (TMDL); implementing BMPs; restoring geomorphic and habitat function of targeted stream and floodplain/SEZ habitat; achieving a target maximum mean daily temperature of 20 degrees C or less in cold water conditions during June through September; restoring targeted streams, and maintaining and restoring connectivity among aquatic habitats (Alternatives B and C only); screening and decontaminating hand carried/non-motorized and motorized watercrafts for the presence of invasive species; and controlling or eradicating various aquatic invasive species.

Sierra Nevada Bioregional Status and Trend

Aquatic macroinvertebrates were designated as aquatic Management Indicator Species in the 2007 SNFMIS ROD and sampling has occurred annually since 2009, which has not provided enough time to track trends in Sierra Nevada bioregional condition. However, it is possible to reach some conclusions about the trend of native aquatic fauna, including aquatic invertebrates, based upon the SNEP (1996) evaluations. A major conclusion of that evaluation was that “the aquatic/riparian systems are the most altered and impaired habitats of the Sierra.”

In the summary volume, SNEP (1996) concluded that amphibian species at all elevations have severely declined throughout the Sierra Nevada. Dams and impoundments, which block fish access to streams, together with degraded conditions above dams, have led to loss of about 90% of the historic anadromous fish habitat in the Sierra. Local degradation of habitats has led to significant impacts on aquatic invertebrates, which make up the vast majority of aquatic species in the Sierra Nevada.

This downward trend reflects a legacy of extensive past use of the Sierra Nevada Province resources for timber harvest, road building, mining, grazing and water diversions (Kattelmann 1996). For the SNEP assessment, Moyle et al. (1996) summarized the status of forty fishes native to the Sierra Nevada: Six (15%) are formally listed by the federal and/or state government as threatened or endangered species, twelve (30%) are considered to be species of special concern because they are in trouble statewide and are potential candidates for listing or because they have limited distributions, four (10%) are in decline in the Sierra Nevada but are probably in less trouble than elsewhere, and eighteen (45%) seem to have stable or expanding populations for native fish species of the Sierra Nevada Province. Introduced, alien fish species were identified

as a major reason for the declines of native fishes. The 2001 FSEIS for the Sierra Nevada Province (USDA Forest Service 2001c) concluded that "fishes of the Sierra Nevada can be characterized as having declined in population size. Most of these declines have occurred over the last 50 years."

Bioregional monitoring for Sierra Nevada MIS to date was summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010). For aquatic macroinvertebrates, condition and trend was determined by analyzing macroinvertebrate data using the predictive, multivariate River Invertebrate Prediction And Classification System (RIVPACS) (Hawkins et al. 2000) to determine whether the macroinvertebrate community has been impaired relative to reference condition (Ode and Schiff 2009) within perennial water bodies. This monitoring consists of collecting aquatic macroinvertebrates according to a rotating panel design (Stevens and Olsen 2004) to assess all perennial waters and measuring stream habitat features according to the Stream Condition Inventory (SCI) manual (Frasier et al. 2005). Evaluation of the condition of the biological community is based upon the "observed to expected" (O/E) ratio, which is a reflection of the number of species observed at a site versus the number expected to occur there in the absence of impairment (Hawkins et al. 2000, SWAMP 2006, Ode and Schiff 2009). Sites with a low O/E scores have lost many species predicted to occur there in the absence of anthropogenic disturbance, which is an indication that the site has a lower than expected richness of species sensitive to disturbance and is therefore impaired.

Sierra Nevada MIS monitoring for aquatic (benthic) macroinvertebrates was conducted in 2009 and 2010. Benthic macroinvertebrates were collected from stream sites during both the 2009 and 2010 field seasons according to the Reachwide Benthos (Multihabitat) Procedure (Ode 2007b). The initial BMI data from 2009 and 2010 found 46% (6 of 13) of the surveyed streams indicate an impaired condition and 54% (7 of 13) indicate a reference or non-impaired condition (see USDA Forest Service 2010a, Table BMI-1).

Forest (LTBMU)-Specific Data: There are currently 127,055 acres of lacustrine (LAC) and riverine (RIV) habitat in the LTBMU. Of this area, 122, 278 acres or about 96% include Lake Tahoe. In general, lacustrine and riverine habitat conditions in the LTBMU are influenced by alteration of native riparian vegetation, urban development and bank instability (Herbst 2005, 2009, HydroScience 2005), as well as the threat of aquatic invasive species becoming established within the ecosystem. In addition, water uses throughout the LTBMU and land uses adjacent to various lacustrine and riverine habitats influence the amount of water that is available in these habitats. The major focus of the Lake Tahoe TMDL restoration work is controlling the influx of fine sediments that enter Lake Tahoe from two main tributary sources: bank erosion from the Upper Truckee River and Blackwood Creek together provide 20% of all fine sediment delivered to Lake Tahoe. Ward Creek is also a major contributor of sediment to Lake Tahoe (HydroScience 2005).

The Lake Tahoe Basin has a rich data set for aquatic macroinvertebrates. Four main sources of data were included in this analysis. The Tahoe Regional Planning Agency (TRPA) collected 169 samples during 2003, with systematic sampling along major stream longitudinal profiles. Data with calculated RIVPACS O/E scores were also available for 1998-2007 from legacy U.S. Forest Service monitoring, the Tahoe Regional Planning Agency (TRPA), the State's Surface Water Ambient Monitoring Program (SWAMP) and Lake Tahoe TMDL sampling. Together, these four

data sets provided site-condition information for 231 samples with intensive sampling along 10 major tributaries to Lake Tahoe (Figure 3-75 and Figure 3-76).

In general, the aquatic MIS communities of streams tributary to Lake Tahoe are in good condition with about 150 sites sampled (almost 65%) in reference condition according to the Observed to Expected ratios (i.e. 0.7 < O/E < 1.3, Figure 3-75). Sites with low O/E scores show a loss of sensitive-species richness. Sites with high O/E scores are degraded because they are out of balance with normal community composition and enhanced elevated richness may indicate nutrient enriched conditions. There is some indication that for samples closer to the lake margin, a higher proportion of sites are degraded (Herbst 2005, Fore 2007). Even though Blackwood and Ward creeks have experienced more impacts and have higher levels of bank erosion than other tributaries, it is noteworthy that the distribution of scores for these two creeks was quite similar to the relatively un-developed sites along Meeks and General creeks (Herbst 2005, Figure 3-75). Erosion rates are relatively high for both Blackwood and Ward creeks, but the influence of fine sediments is attenuated where stream gradients are high enough to prevent fine sediment deposition. Trout Creek site scores also reveal that site conditions deteriorate nearest to Lake Tahoe, again reflecting a high degree of development there (Herbst 2009). In contrast, the Trout Creek headwaters are generally in good to excellent condition.

Among the ten tributaries for which substantial data were available in the Lake Tahoe Basin, three showed degraded conditions, with median O/E scores less than reference condition: the Upper Truckee River, Edgewood Creek and Taylor Creek. The relatively low scores, were concentrated in the lower sections of the river near Lake Tahoe. Higher in the watershed (e.g. above the confluence with Angora Creek), all but one score were in reference condition.

Edgewood Creek scores were depressed as would be expected since there is a high level of development (i.e. golf course, ski resort and roads) in close proximity. Taylor Creek had the lowest scores overall which is an indication of the low gradient, slack water conditions there and manipulations of flow by a dam operation below Fallen Leaf Lake. Taylor Creek also receives a kokanee salmon run each year and as a result the decomposing spawned-out salmon elevate the nutrient levels significantly.

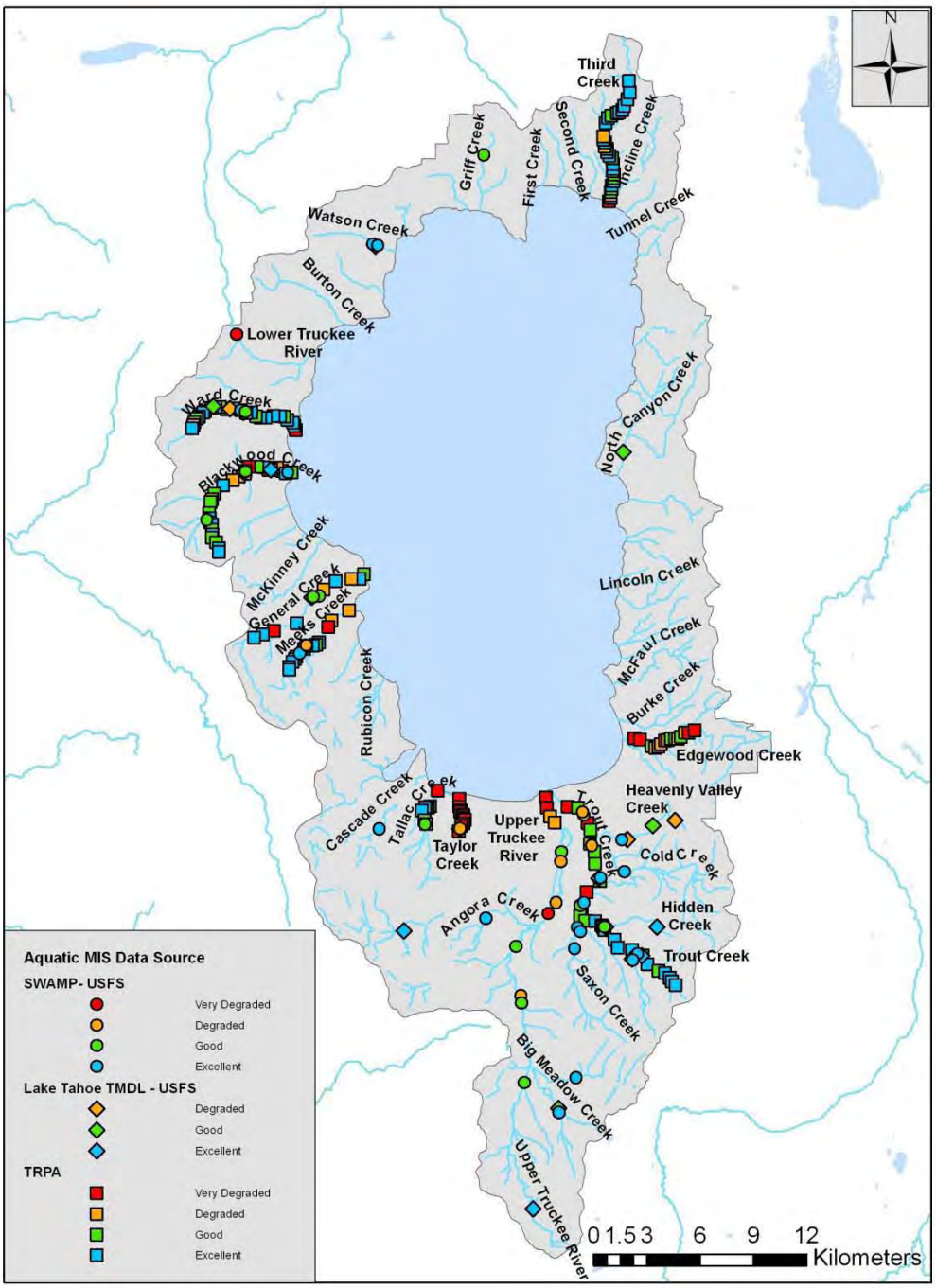


Figure 3-75. Map of Lake Tahoe Basin distribution and condition of 231 aquatic MIS sites for streams tributary to Lake Tahoe. Site condition classes are based on RIVPACS O/E scores for data sets from the LTBMU, State of California SWAMP Perennial Streams Assessment, Tahoe Regional Planning Agency (TRPA) and Lake Tahoe TMDL.

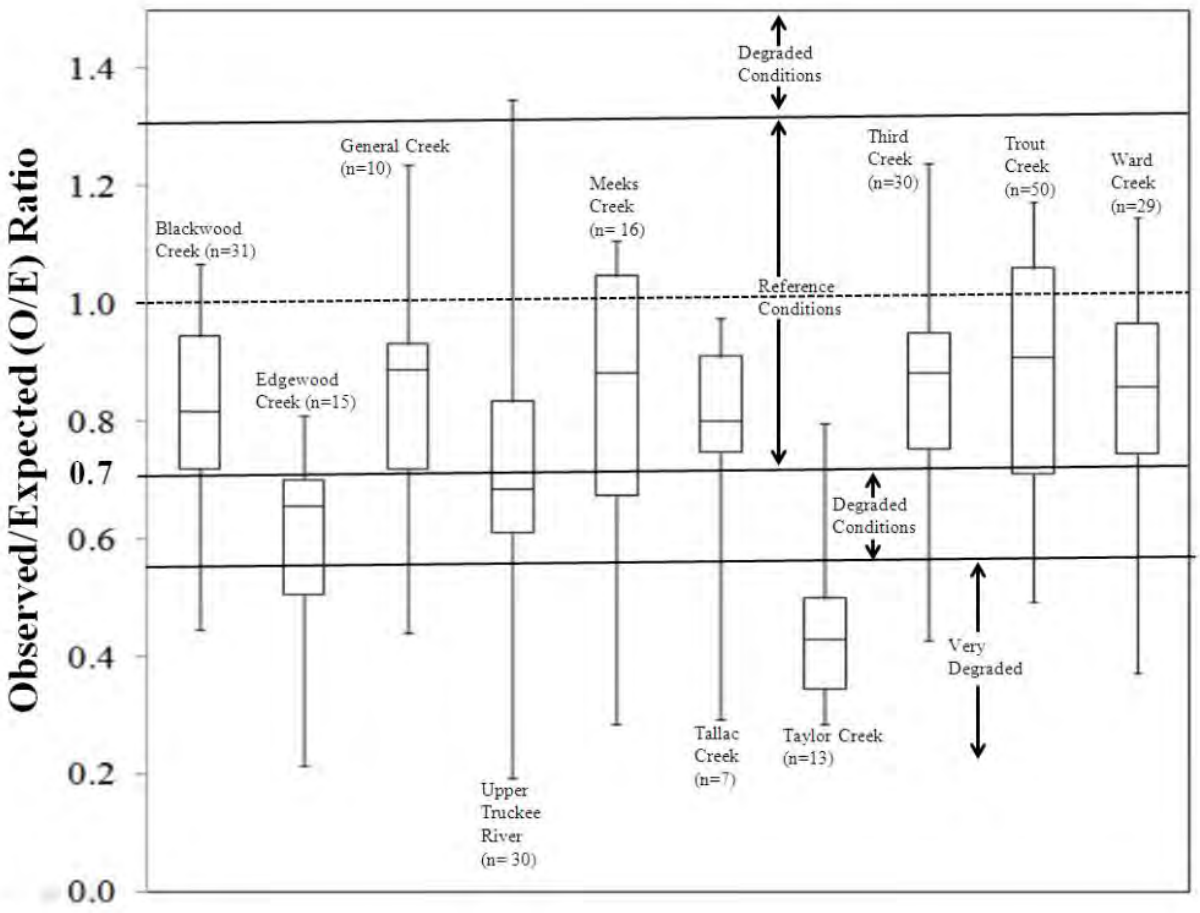


Figure 3-76. Condition scores for 231 sites sampled from 1998-2007 along 10 major tributaries of Lake Tahoe. Condition classes were assigned based on RIVPACS Observed -to-Expected ratios, with reference or undegraded scores ranging from 0.7-1.3. Community composition of degraded sites varied from conditions predicted to occur in the absence of significant human-caused disturbance by at least 30 percent. Box-and-whisker plots display and contrast the distribution of site conditions for 10 major tributaries with median, 25th and 75th percentile scores, and whiskers showing the full range of scores. Note that the Upper Truckee River had the greatest range of site condition scores. The poorest scores were concentrated in the downstream sites while the sites in the reference condition range were concentrated in the upstream reaches (e.g. above confluence with Angora Creek).

Riparian Habitat (Yellow warbler)

Reason for selection as an MIS

Yellow warbler is selected as the MIS for riparian habitat. The CWHR system indicates that the yellow warbler is associated with riparian habitats. This species is usually found in riparian deciduous habitats in summer (cottonwoods, willows, alders, and other small trees and shrubs typical of low, open-canopy riparian woodland) (CDFG 2005). Yellow warbler is dependent on both meadow and non-meadow riparian habitat in the Sierra Nevada (Siegel and DeSante 1999). This species has been monitored since 2009 as part of the Sierra Nevada Forests bioregional

monitoring (USDA Forest Service 2010). In addition, it is also monitored via the USGS's Breeding Bird Survey (BBS) (Sauer et al. 2007) and adequate data have been obtained for calculating Sierra-wide BBS trends (Siegel and DeSante 1999).

Objectives for the maintenance and improvement of habitat for this MIS by Alternative (219.19(a)): Under Alternative A, objectives for the maintenance and improvement of riparian habitat in the LTBMU will follow guidance described in the current Forest Plan, as amended by the 2004 Sierra Nevada Forest Plan Amendment. Management direction for Alternatives B,C, and D is primarily described in the Draft Forest Plan and in Appendix I. Additional objectives and strategies have been developed for riparian habitats under these alternatives and include stream restoration (Alternatives B and C only); protection of targeted rare aquatic sites; restoration of aspen stands (Alternatives B and C only); and maintenance of habitat connectivity.

Sierra Nevada Bioregional Status and Trend

Habitat. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). There are currently 38,140 acres of riparian habitat on NFS lands in the Sierra Nevada. Over the last two decades, the trend is stable.

Forest-specific habitat data: There are approximately 1,688 acres of riparian habitat in the LTBMU. Riparian habitat condition is compromised by encroaching shade tolerant conifers, especially lodgepole pine trees that are competing with native riparian vegetation.

Population Distribution. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). Monitoring of the yellow warbler across the ten National Forests in the Sierra Nevada has been conducted since 2009 in partnership with PRBO Conservation Science, as part of a monitoring effort that also includes mountain quail, hairy woodpecker, and fox sparrow (USDA Forest Service 2010a, http://data.prbo.org/partners/usfs/snmis/). Yellow warblers were detected on 13.7% of 160 riparian point counts in 2009, 19.4% of 397 riparian point counts in 2010, and 22.1% of 402 riparian point counts in 2011; additional detections were documented on upland point counts (Ibid). The average abundance (number of individuals recorded on riparian passive point count surveys) was 0.166 in 2009, 0.309 in 2010, and 0.313 in 2011. Current data indicate that the distribution of yellow warbler populations in the Sierra Nevada is stable (USDA Forest Service 2010a).

Forest-specific population distribution data: Bioregional monitoring for Sierra Nevada MIS includes sample points on the LTBMU; yellow warblers were detected at 4 of 15 riparian point count stations in 2010 and 4 of 14 riparian point count stations in 2011 (http://data.prbo.org/partners/usfs/snmis/). In addition, yellow warblers have been detected during various monitoring efforts over a number of years on the LTBMU:

- Yellow warblers were detected at 7 of 105 forest wide monitoring sites on the LTBMU between 2002-2005 (LTBMU 2007a);
- Yellow warblers were detected at all ten meadow sites monitored in the LTBMU in 2006 (Borgmann et al. 2006).

Wet Meadow Habitat (Pacific Chorus [Pacific tree] frog)

Reason for selection as an MIS

The Pacific Chorus Frog (formally known as the Pacific tree frog) is selected as an MIS for wet meadow habitat. This broadly distributed species requires standing water for breeding; tadpoles require standing water for periods long enough to complete aquatic development, which can be as long as 3 or more months at high elevations in the Sierra Nevada (CDFG 2005). During the day during the breeding season, adults take cover under clumps of vegetation and surface objects near water; during the remainder of the year, they leave their breeding sites and seek cover in moist niches in buildings, wells, rotting logs or burrows (ibid). This species has been monitored since 2002 as part of the Sierra Nevada Forest Plan Amendment Amphibian Monitoring Program, and, since 2009, the monitoring has been tracked as part of the Sierra Nevada Forests bioregional monitoring (USDA Forest Service 2010a).

Objectives for the maintenance and improvement of habitat for this MIS by Alternative (219.19(a)): Under Alternative A, objectives for the maintenance and improvement of wet meadow habitat in the LTBMU will follow guidance described in the current Forest Plan, as amended by the 2004 Sierra Nevada Forest Plan Amendment. Management direction for Alternatives B,C, and D is primarily described in the Draft Forest Plan and in Appendix I. Additional objectives and strategies have been developed for wet meadow habitat under these alternatives and include: protecting targeted rare meadow sites; ensuring that the area of high-functioning meadow vegetation is higher than in 2009 and meadow wetness is maintained or increasing; and restoring a minimum of two fens (Alternatives B and C only).

Sierra Nevada Bioregional Status and Trend

Habitat. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). There are currently 61,247 acres of wet meadow habitat on NFS lands in the Sierra Nevada. Over the last two decades, the trend is stable (USDA Forest Service 2010a).

Forest-specific habitat data. There are approximately 2,684 acres of wet meadow habitat in the LTBMU. Some wet meadow complexes in the LTBMU are at risk of desiccation from channel incision and adjacent land uses that influence water patterns and retention. In addition, conifers are encroaching on a number of meadows and meadow perimeters in the LTBMU. There are a number of ongoing restoration projects in the LTBMU aimed at restoring wet meadow conditions.

Population Distribution. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). Since 2002, the Pacific chorus frog has been monitored on the Sierra Nevada forests as part of the Sierra Nevada Forest Plan Amendment (SNFPA) monitoring plan (USDA Forest Service 2006a, 2007a, 2009, 2010b; Brown 2008). Almost 70% of sample watersheds were occupied by Pacific chorus frog at least once during the period of 2002-2007, and 79.6% of 108 historically occupied watersheds were found to be occupied by breeding frogs in 2008 (USDA Forest Service 2010a). In 2009, an estimated 95% of likely historically occupied watersheds were occupied by the Pacific chorus frog (USDA Forest Service 2010b). These data indicate that Pacific chorus frog

continues to be present at these sample sites, and current data indicate that the distribution of chorus frog populations in the Sierra Nevada is stable.

Forest –specific population distribution data: Bioregional monitoring for Sierra Nevada MIS includes sample points adjacent to the LTBMU. In addition, Pacific chorus frogs were detected during 2002-2004 on the LTBMU: in 2003-2004, Pacific chorus frogs (formerly known as Pacific treefrogs) were detected in 87 (57.2%) of 148 lentic aquatic sites sampled using visual encounter surveys, in addition to being detected at 1 of 9 pitfall trap monitoring arrays in 2002 (LTMBU 2007).

Early and Mid Seral Coniferous Forest Habitat (Mountain quail)

Reason for selection as an MIS

The mountain quail was selected as the MIS for early and mid seral coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, red fir, and eastside pine) habitat. The California Wildlife Habitat Relationships System (CWHR) system indicates that this species is highly associated with these forest habitats. Early seral coniferous forest habitat is comprised primarily of seedlings (<1” dbh), saplings (1”-5.9” dbh), and pole-sized trees (6”-10.9” dbh). Mid seral coniferous forest habitat is comprised primarily of small-sized trees (11”-23.9” dbh). The mountain quail is found particularly on steep slopes, in open, brushy stands of conifer and deciduous forest and woodland, and chaparral; it may gather at water sources in the summer, and broods are seldom found more than 0.8 km (0.5 mi) from water (CDFG 2005). Historically, the mountain quail has been monitored by the California Department of Fish and Game as part of its program to manage harvest species (CDFG 2004a). Since 2009, this species has been monitored as part of the Sierra Nevada Forests bioregional monitoring (USDA Forest Service 2010a).

Objectives for the maintenance and improvement of habitat for this MIS by Alternative (219.19(a)): Under Alternative A, objectives for the maintenance and improvement of early and mid seral habitat in the LTBMU will follow guidance described in the current Forest Plan, as amended by the 2004 Sierra Nevada Forest Plan Amendment. This guidance would also be applied under Alternatives B, C, and D but additional objectives have been developed for early and mid seral habitat under these alternatives. These objectives include: regenerating 50 acres of early seral white fir-mixed conifer type and 500 acres of early seral stage Jeffrey pine; thinning of mid seral closed stands to mid seral open stands, and thinning mid seral open stands to enhance succession to late seral open stands; and enhancing areas established as early seral forest to result in additional mid seral acreage.

Sierra Nevada Bioregional Status and Trend

Habitat. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). There are currently 530,851 acres of early seral and 2,776,022 acres of mid seral coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat on NFS lands in the Sierra Nevada. Over the last two decades, the trend for early seral is decreasing (changing from 9% to 5% of the acres on NFS lands) and the trend for mid seral is increasing (changing from 21% to 25% of the acres on NFS lands).

Forest-specific habitat data: There are currently 3,773 acres of early seral habitat and 40,378 acres of mid seral habitat in the LTBMU. Although recent fires in the LTBMU (i.e., Gondola, Showers, Angora, Washoe) have resulted in the creation of some early seral vegetation, they weren't deliberate restoration efforts and there has not been deliberate restoration of early seral stages in the LTBMU over the life of the current Forest Plan. Overall, there is a predominance of mid seral stages in the LTBMU that are moving towards late seral conditions (see *Forest Vegetation Resources* section).

Population Distribution. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). Monitoring of the mountain quail across the ten National Forests in the Sierra Nevada has been conducted since 2009 in partnership with PRBO Conservation Science, as part of a monitoring effort that also includes fox sparrow, hairy woodpecker, and yellow warbler (USDA Forest Service 2010a, http://data.prbo.org/partners/usfs/snmis/). Mountain quail were detected on 40.3 percent of 1659 point counts in 2009, 47.4% of 2266 point counts (and 56.7% of 464 playback transects) in 2010, and 40.8% of 2342 point counts (and 48.9% of 472 playback transects) in 2011, with detections on all 10 national forests all three years (Ibid). The average abundance (number of individuals recorded on passive point count surveys) was 0.103 in 2009, 0.081 in 2010, and 0.078 in 2011. These data indicate that mountain quail continue to be distributed across the 10 Sierra Nevada National Forests, and current data indicate that the distribution of mountain quail populations in the Sierra Nevada is stable (USDA Forest Service 2010a).

Forest -specific population distribution data: Bioregional monitoring for Sierra Nevada MIS includes sample points on the LTBMU; mountain quail were detected at 4 of 10 upland point count stations in 2009, 6 of 8 upland point count stations in 2010, and 6 of 20 upland point count stations in 2011, in addition to detections at the riparian point count stations in 2010 and 2011 (http://data.prbo.org/partners/usfs/snmis/). In addition, mountain quail were detected at 62 of 105 forest wide monitoring sites on the LTBMU, and were detected in all sub-watersheds, between 2002-2005 (LTBMU 2007a).

Late Seral Open Canopy Coniferous Forest Habitat [Sooty (blue) grouse]

Reason for selection as an MIS

The sooty grouse (formally known as the blue grouse) is selected as the MIS for late seral open canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, red fir, and eastside pine) habitat. This habitat is comprised primarily of medium/large trees (equal to or greater than 24 inches dbh) with canopy closures less than 40%. The CWHR system indicates that sooty grouse is highly associated with this habitat. This species occurs in open, medium to mature-aged stands of fir, Douglas-fir, and other conifer habitats, interspersed with medium to large openings, and available water, and occupies a mixture of mature habitat types, shrubs, forbs, grasses, and conifer stands (CDFG 2005). Empirical data from the Sierra Nevada indicate that Sooty Grouse hooting sites are located in open, mature, fir-dominated forest, where particularly large trees are present (Bland 2006). Sooty Grouse is being monitored by California Department of Fish and Game as part of its program to manage harvest species (Bland 2006), as well as through the Breeding Bird Survey (BBS) (Siegel and DeSante 1999, Sauer et al. 2007).

Objectives for the maintenance and improvement of habitat for this MIS by Alternative (219.19(a)): Under Alternative A, objectives for the maintenance and improvement of late seral open canopy habitat in the LTBMU will follow guidance described in the current Forest Plan, as amended by the 2004 Sierra Nevada Forest Plan Amendment. Management direction for Alternatives B,C, and D is primarily described in the Draft Forest Plan and in Appendix I. Additional objectives have been developed for late seral open canopy habitat under these alternatives. These objectives include: thin approximately 1200 acres of mid seral open Jeffrey pine forest to enhance succession to late seral open; and thin approximately 1500 acres of mid seral closed canopy Jeffrey pine forest to mid seral open stands to enhance succession to late seral open.

Sierra Nevada Bioregional Status and Trend

Habitat. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). There are currently 63,795 acres of late seral open canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, red fir, and eastside pine) habitat on NFS lands in the Sierra Nevada. Over the last two decades, the trend is decreasing (changing from 3% to 1% of the acres on NFS lands).

Forest-specific habitat data: There are currently 13,362 acres of late seral open canopy coniferous forest in the LTBMU. The average percent of white fir mixed conifer, red fir-white fir, and red fir-western white pine in late seral open conditions in the LTBMU is fairly comparable to reference (modeled) conditions. The average percent of Jeffrey pine late seral open forest stands in the LTBMU are far below reference (modeled) conditions. See the Draft Forest Plan, Chapter 1, Table 1 for additional information regarding reference conditions.

Population Distribution. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). The sooty grouse has been monitored in the Sierra Nevada at various sample locations by hunter survey, modeling, point counts, and breeding bird survey protocols, including California Department of Fish and Game Blue (Sooty) Grouse Surveys (Bland 1993, 1997, 2002, 2006); California Department of Fish and Game hunter survey, modeling, and hunting regulations assessment (CDFG 2004a, CDFG 2004b); Multi-species inventory and monitoring on the LTBMU (LTBMU 2007a); and 1968 to present – BBS routes throughout the Sierra Nevada (Sauer et al. 2007). These data indicate that sooty grouse continue to be present across the Sierra Nevada, except in the area south of the Kern Gap, and current data indicate that the distribution of sooty grouse populations in the Sierra Nevada north of the Kern Gap is stable.

Forest-specific population distribution data: Monitoring conducted by the California Department of Fish and Game related to hunter surveys, modeling, and hunting regulations assessment includes the LTBMU (CDFG 2004a, 2004b). In addition, sooty grouse (also known as blue grouse) were detected at 32 of 105 forest wide monitoring sites and 10 of 148 lentic sites (17% of all combined sites) on the LTBMU, and were detected in all sub-watersheds, between 2002-2005 (LTBMU 2007a).

Late Seral Closed Canopy Coniferous Forest Habitat (California spotted owl, American marten, and northern flying squirrel)

Reasons for selection as an MIS

California spotted owl

The California spotted owl is selected as an MIS for late seral closed canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat. The CWHR system and various data from the Sierra Nevada (USDA Forest Service 2001) indicate that this species is highly associated with closed-canopy late seral coniferous forest. This habitat is comprised primarily of medium/large trees (equal to or greater than 24 inches dbh) with canopy closures above 40% within ponderosa pine, Sierran mixed conifer, white fir, and red fir coniferous forests, and multi-layered trees within ponderosa pine and Sierran mixed conifer forests. The California spotted owl is strongly associated with forests that have a complex multi-layered structure, large-diameter trees, and high canopy closure (CDFG 2005, USFWS 2006). It uses dense, multi-layered canopy cover for roost seclusion; roost selection appears to be related closely to thermoregulatory needs, and the species appears to be intolerant of high temperatures (CDFG 2005). Mature, multi-layered forest stands are required for breeding (Ibid). The mixed-conifer forest type is the predominant type used by spotted owls in the Sierra Nevada: about 80 percent of known sites are found in mixed-conifer forest, with 10 percent in red fir forest (USDA Forest Service 2001). California spotted owl has been monitored in the Sierra Nevada since the late 1980s (USDA Forest Service 2006), and, since 2009, the monitoring has been tracked as part of the Sierra Nevada Forests bioregional monitoring (USDA Forest Service 2010a).

Objectives for the maintenance and improvement of habitat for this MIS by Alternative (219.19(a)): Under Alternative A, objectives for the maintenance and improvement of late seral closed canopy habitat in the LTBMU will follow guidance described in the current Forest Plan, as amended by the 2004 Sierra Nevada Forest Plan Amendment. Management direction for Alternatives B,C, and D is primarily described in the Draft Forest Plan and in Appendix I. Additional objectives, strategies, standard operating procedures, and standards and guidelines have been developed for spotted owl habitat in late seral closed canopy habitat under these alternatives. These measures include the restoration of habitat in targeted spotted owl Protected Activity Centers (PACs) (Alternatives B and C only); maintenance of habitat connectivity between PACs and adjacent habitat; and maintenance of habitat features in PACs during vegetation treatments.

American Marten

The American marten is selected as an MIS for late seral closed canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat. The CWHR system and various data from the Sierra Nevada (USDA Forest Service 2001) indicate that this species is highly associated with closed-canopy, late seral coniferous forest. This habitat is comprised primarily of medium/large trees (equal to or greater than 24 inches dbh) with canopy closures above 40% within ponderosa pine, Sierran mixed conifer, white fir, and red fir coniferous forests, and multi-layered trees within ponderosa pine and Sierran mixed conifer forests. Martens prefer coniferous forest habitat with large diameter trees and snags, large down logs, moderate-to-high canopy closure, and an interspersion of riparian areas and meadows. Important habitat attributes are: vegetative diversity, with predominately mature forest; snags; dispersal

cover; and large woody debris (Allen 1982). Key components for westside and eastside marten habitat can be found in the Sierra Nevada Forest Plan Amendment FEIS (USDA Forest Service 2001), Volume 3, Chapter 3, part 4.4, pages 20-21. The American marten has been monitored since 2002 as part of the Sierra Nevada Forest Plan Fisher and Marten Status and Trend Monitoring, and, since 2009, the monitoring has been tracked as part of the Sierra Nevada Forests bioregional monitoring (USDA Forest Service 2010a).

Objectives for the maintenance and improvement of habitat for this MIS by Alternative (219.19(a)): Under Alternative A, objectives for the maintenance and improvement of late seral closed canopy habitat in the LTBMU will follow guidance described in the current Forest Plan, as amended by the 2004 Sierra Nevada Forest Plan Amendment. Management direction for Alternatives B,C, and D is primarily described in the Draft Forest Plan and in Appendix I. Additional objectives, strategies, and standards and guidelines have been developed for habitat features of late seral closed canopy habitat that are valuable to marten under these alternatives. The measures include the ones described above for spotted owl and also the identification of potential movement corridors or area of habitat connectivity and provide well distributed/connected habitat for Forest Service Sensitive species; the maintenance of coarse woody debris and snags during forest health, fuel reduction, and post-disturbance restoration projects for wildlife habitat; retention of the largest available snags in various forest types (e.g., red fir); sand implementation of Limited Operating Periods for the protection of denning martens.

Northern flying squirrel

The northern flying squirrel is selected as an MIS for late seral closed canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat.

The CWHR system indicates that this species is highly associated with closed-canopy, late seral coniferous forest. This habitat is comprised primarily of medium/large trees (equal to or greater than 24 inches dbh) with canopy closures above 40% within ponderosa pine, Sierran mixed conifer, white fir, and red fir coniferous forests, and multi-layered trees within ponderosa pine and Sierran mixed conifer forests. The northern flying squirrel occurs primarily in mature, dense conifer habitats intermixed with various riparian habitats, using cavities in mature trees, snags, or logs for cover (CDFG 2005).

Objectives for the maintenance and improvement of habitat for this MIS by Alternative (219.19(a)): Under Alternative A, objectives for the maintenance and improvement of late seral closed canopy habitat in the LTBMU will follow guidance described in the current Forest Plan, as amended by the 2004 Sierra Nevada Forest Plan Amendment. Additional objectives, strategies, and standards and guidelines have been developed for habitat features of late seral closed canopy habitat that are valuable to marten under these alternatives. The measures include the ones described above for spotted owl and marten above.

Sierra Nevada Bioregional Status and Trend

Habitat. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). There are currently 1,006,923 acres of late seral closed canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat on NFS lands in the Sierra Nevada. Over the last

two decades, the trend is slightly increasing (changing from 7% to 9% of the acres on NFS lands); since the early 2000s, the trend has been stable at 9%.

Forest-specific habitat data: There are currently 32,233 acres of late seral closed canopy coniferous forest habitat in the LTBMU. The average percent of white fir mixed conifer is fairly comparable to reference (modeled) conditions. The average percent of Jeffrey pine, red fir-white fir, and red fir-western white pine late seral open forest stands in the LTBMU are below reference (modeled) conditions. See the Draft Forest Plan, Chapter 1, Table 1 for additional information regarding reference conditions.

Population Distribution. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a).

California spotted owl

California spotted owl has been monitored in California and throughout the Sierra Nevada through general surveys, monitoring of nests and territorial birds, and demography studies (Verner et al. 1992; Gutierrez et al. 2008, 2009, 2010; USDA Forest Service 2001, 2004, 2006; USFWS 2006; Sierra Nevada Research Center 2007, 2008, 2009, 2010). Current data indicate that, although there may be localized declines in population trend [e.g., localized decreases in "lambda" (estimated annual rate of population change)], the distribution of California spotted owl populations in the Sierra Nevada is stable.

Forest-specific population distribution data: There are currently 21 California spotted owl Protected Activity Centers (PACs) and Home Range Core Areas (HRCAs) on the LTBMU, following a re-mapping effort in 2008 to incorporate the most up-to-date detection, nest location, and land boundary information available. Spotted owls have been detected in 16 (76%) of the 21 PACs between 2001 and 2010. There are 15 identified nests in the Lake Tahoe Basin, 11 of the nests are located on NFS lands. Nest occupancy fluctuates annually.

American marten

American marten has been monitored throughout the Sierra Nevada as part of general surveys and studies since 1996 (e.g., Zielinski et al. 2005, Moriarty 2009). Since 2002, the American marten has been monitored on the Sierra Nevada forests as part of the Sierra Nevada Forest Plan Amendment (SNFPA) monitoring plan (USDA Forest Service 2005a, 2006, 2007c, 2009, 2010b). Current data indicate that, although marten appear to be distributed throughout their historic range, their distribution has become fragmented in the southern Cascades and northern Sierra Nevada, particularly in Plumas County. The distribution appears to be continuous across high-elevation forests from Placer County south through the southern end of the Sierra Nevada, although detection rates have decreased in at least some localized areas (e.g., Sagehen Basin area of Nevada County).

Forest-specific population distribution data: Marten appear to be well distributed in the western and southern portions of the LTBMU but are comparatively rare in the northern and eastern portions (Slauson and Zielinksi 2008). Slauson and Zielinski (2008) analyzed data from several marten surveys that were conducted in the LTBMU between 1993 and 2005 and found that marten were detected at 36% of all sample units that were surveyed. The majority of

detections were made in the western (50% of sites) and southern (31% of sites) regions of the LTBMU. Detections in the northern and eastern portions of the basin were scarce despite 30% of the total survey effort occurring in these two areas, and the authors suggested that these areas may have supported less suitable habitat conditions (e.g., open canopy) due to drier conditions. One marten den has been identified in the Lake Tahoe basin although there are likely greater than 30 breeding females in the LTBMU in any given year, each using many dens for kit rearing (Slauson, pers. comm. 2011). The single known den was discovered opportunistically in 2009 and is located on the west shore.

Northern flying squirrel

The northern flying squirrel has been monitored in the Sierra Nevada at various sample locations by live-trapping, ear-tagging, camera surveys, snap-trapping, and radiotelemetry: 2002-present on the Plumas and Lassen National Forests (Sierra Nevada Research Center 2007, 2008, 2009, 2010), and 1958-2004 throughout the Sierra Nevada in various monitoring efforts and studies (see USDA Forest Service 2008d, Table NOFLS-IV-1). These data indicate that northern flying squirrels continue to be present at these sample sites, and current data indicate that the distribution of northern flying squirrel populations in the Sierra Nevada is stable.

Forest-specific population distribution data: Northern flying squirrel were detected at 17 of 105 small mammal live trapping surveys on the LTBMU, and were detected in 6 of 9 sub-watersheds, between 2002-2005 (LTBMU 2007a).

Snags in Green Forest Ecosystem Component (Hairy woodpecker)

Reason for selection as an MIS

The hairy woodpecker is selected as the MIS for the ecosystem component of snags in green forests. The CWHR system indicates that this species is strongly associated with this ecosystem component. Medium (diameter breast height between 15 to 30 inches) and large (diameter breast height greater than 30 inches) snags are most important. The hairy woodpecker uses stands of large, mature trees and snags of sparse to intermediate density; cover is also provided by tree cavities (CDFG 2005). Mature timber and dead snags or trees of moderate to large size are apparently more important than tree species (Siegel and DeSante 1999). Historically, the hairy woodpecker has been monitored by the USGS's the Breeding Bird Survey (BBS) (Sauer et al. 2007) and adequate data has been obtained for calculating Sierra-wide BBS trends (Siegel and DeSante 1999), as well as monitoring on the Plumas and Lassen National Forests (Sierra Nevada Research Center 2010). Since 2009, this species has been monitored as part of the Sierra Nevada Forests bioregional monitoring (USDA Forest Service 2010a).

Objectives for the maintenance and improvement of habitat for this MIS by Alternative (219.19(a)): Under Alternative A, objectives for the maintenance and improvement of snags in green forest ecosystem component in the LTBMU will follow guidance described in the current Forest Plan, as amended by the 2004 Sierra Nevada Forest Plan Amendment. Management direction for Alternatives B,C, and D is primarily described in the Draft Forest Plan and in Appendix I. Additional strategies and standards and guidelines have been developed for this ecosystem component under these alternatives. These measures include the management of snags for wildlife habitat as part of forest health or fuels reduction treatments and during post-disturbance (e.g., beetle outbreak) restoration projects; management actions that provide for a

sustainable population of medium- and large-diameter snags that exhibit characteristics important to wildlife (e.g., broken tops, large cavities, etc.); prioritization of retaining snags with cavities or consideration to install nest boxes for cavity nesters; and retention of a minimum number of the largest snags in each of the representative forest types (e.g., red fir). In addition, a higher than average level of snags (for the stand type) in diverse decay classes would be distributed unevenly in PAC habitat.

Sierra Nevada Bioregional Status and Trend

Ecosystem Component. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). The current average number of medium-sized and large-sized snags (> 15" dbh, all decay classes) per acre across major coniferous and hardwood forest types (westside mixed conifer, ponderosa pine, white fir, productive hardwoods, red fir, eastside pine) in the Sierra Nevada ranges from 1.5 per acre in eastside pine to 9.1 per acre in white fir. In 2008, snags in these types ranged from 1.4 per acre in eastside pine to 8.3 per acre in white fir (USDA Forest Service 2008).

Data from the early-to-mid 2000s were compared with the current data to calculate the trend in total snags per acre by Regional forest type for the 10 Sierra Nevada national forests and indicate that, during this period, snags per acre increased within westside mixed conifer (+0.76), white fir (+2.66), productive hardwoods (+0.35), and red fir (+1.25) and decreased within ponderosa pine (-0.16) and eastside pine (-0.14)

Detailed information by forest type, snag size, and snag decay class can be found in the 2010 SNF Bioregional MIS Report (USDA Forest Service 2010a).

Forest-specific ecosystem component data: There are approximately 1.1 million snags greater than 15 inches dbh in the LTBMU with an average of about 7.15 snags/acre. Of the total snag count, approximately 850,000 are estimated to be snags in green forest. Total number of snags was derived by obtaining snags/acre Geographic Information Systems (GIS) data for each strata from the USDA Forest Service Remote Sensing Lab (RSL) website Tree Report for the Lake Tahoe Basin and linking with the LTBMU GIS strata layer and acreage within each strata on the LTBMU. The highest number of snags/acre is found in the mixed conifer-white fir and Jeffrey pine medium size class 920-30 inches QMD), medium density (40-70%). The mixed conifer-white fir type has the highest total number of snags, in part because this habitat type has the largest acreage in the LTBMU.

Population Distribution. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). Monitoring of the hairy woodpecker across the ten National Forests in the Sierra Nevada has been conducted since 2009 in partnership with PRBO Conservation Science, as part of a monitoring effort that also includes mountain quail, fox sparrow, and yellow warbler (USDA Forest Service 2010a, http://data.prbo.org/partners/usfs/snmis/). Hairy woodpeckers were detected on 15.1% of 1659 point counts in 2009, 16.7% of 2266 point counts (and 28.6% of462 playback transects) in 2010, and 11.8% of 2342 point counts (and 23.5% of 472 playback transects) in 2011, with detections on all 10 national forests in all years. The average abundance (number of individuals recorded on passive point count surveys) was 0.116 in 2009, 0.107 in

2010, and 0.100 in 2011. These data indicate that hairy woodpeckers continue to be distributed across the 10 Sierra Nevada National Forests, and current data indicate that the distribution of hairy woodpecker populations in the Sierra Nevada is stable.

Forest-specific population distribution data: Bioregional monitoring for Sierra Nevada MIS includes sample points on the LTBMU; hairy woodpecker were detected at 5 of 10 upland point count stations in 2009, 1 of 8 upland point count stations in 2010, and 5 of 20 upland point count stations in 2011, in addition to detections at the riparian point count stations in 2010 and 2011 (http://data.prbo.org/partners/usfs/snmis/). In addition, hairy woodpecker were detected at 75 of 105 forest wide monitoring sites on the LTBMU, and were detected in all sub-watersheds, between 2002-2005 (LTBMU 2007a).

Snags in Burned Forest Ecosystem Component (Black-backed woodpecker)

Reason for selection as an MIS

The black-backed woodpecker is selected as the MIS for the ecosystem component of snags in burned forests. Recent data indicate that black-backed woodpeckers are strongly associated with snags created by mid- and high-severity fires (severity classes indicating moderate to complete mortality of the tree layer) (Hutto 1995, Kotliar et al. 2002, Smucker et al. 2005, Saracco et al. 2011, Siegel et al. 2011).

Objectives for the maintenance and improvement of habitat for this MIS by Alternative (219.19(a)): Under Alternative A, objectives for the maintenance and improvement of snags in burned forest ecosystem component in the LTBMU will follow guidance described in the current Forest Plan, as amended by the 2004 Sierra Nevada Forest Plan Amendment. Management direction for Alternatives B,C, and D is primarily described in the Draft Forest Plan and in Appendix I. Additional strategies and standards and guidelines have been developed for this ecosystem component under these alternatives. In large disturbance restoration projects from wildfire, at least 10% of an area burned by mid- to high-severity wildfire would be retained where there are medium and large snags exist. Snags with cavities would be retained where feasible.

Sierra Nevada Bioregional Status and Trend.

Ecosystem Component. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). The current average number of medium-sized and large-sized snags (> 15" dbh, all decay classes) per acre across major coniferous and hardwood forest types (westside mixed conifer, ponderosa pine, white fir, productive hardwoods, red fir, eastside pine) in the Sierra Nevada ranges from 1.5 per acre in eastside pine to 9.1 per acre in white fir. In 2008, snags in these forest types ranged from 1.4 per acre in eastside pine to 8.3 per acre in white fir (USDA Forest Service 2008).

Data from the early-to-mid 2000s were compared with the current data to calculate the trend in total snags per acre by Regional forest type for the 10 Sierra Nevada national forests and indicate that, during this period, snags per acre increased within westside mixed conifer (+0.76), white fir (+2.66), productive hardwoods (+0.35), and red fir (+1.25) and decreased within ponderosa pine (-0.16) and eastside pine (-0.14).

Detailed information by forest type, snag size, and snag decay class can be found in the 2010 SNF Bioregional MIS Report (USDA Forest Service 2010a).

These data include snags in both green forest and burned forest. Between 2000 and 2007, 211,000 acres underwent severe burn and 176,000 acres underwent moderate burn in the Sierra Nevada.

Since 2009, the bioregional monitoring effort for black-backed woodpecker has created a sampling frame of all fires that occurred within the 10 preceding years that included at least 124ac (50 ha) of conifer forest that burned at mid-severity and/or high-severity on one or more of the ten national forest units within the Siera Nevada. The acreage within this sampling frame was 271,788 ac in 2009, 252,673 ac in 2010, and 543,917 ac in 2011.

Forest-specific ecosystem component data: Over the last 10 years, approximately 4500 acres have burned from wildfire in the LTBMU. Current wildfire severity monitoring studies in mixed conifer forests in the northern and central Sierra Nevada (USDA 2008) indicate that fires greater than 300 acres in mixed conifer forest under current conditions burn at severity proportions of 24% low severity (>40% mortality), 29% moderate severity (40-80% mortality) and 37% high severity (>80% mortality). We estimated the number of snags in burned forest based on the total number of snags estimated to be in the LTBMU (1.1 million), the assumptions for fire severity and mortality described above, and the assumption that the average stand in the LTBMU has approximately 100 trees/acre that are greater than 15 inches diameter-at-breast-height (dbh). Approximately 750 acres of forest burned from the Angora fire have had most of the snags removed so this area does not have the same level of standing snags as other burned areas. Based on these assumptions, total estimated number of snags in burned forest in the LTBMU is 246,000.

Population Distribution. Bioregional monitoring for Sierra Nevada MIS to date is summarized in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a). Monitoring of the black-backed woodpecker across the 10 National Forests in the Sierra Nevada has been conducted since 2008 in partnership with the Institute for Bird Populations (IBP) (USDA Forest Service 2010a, http://www.birdpop.org/Sierra/bbwo.htm). In 2008, black-backed woodpeckers were detected at 68 survey stations distributed across 10 of the 19 fire areas surveyed. In 2009, black-backed woodpeckers were detected at 169 survey station distributed across 28 of the 51 fire areas surveyed. In both years, black-backed woodpeckers were detected on all 10 national forests. In 2010, black-backed woodpeckers were detected at 132 survey stations distributed across 29 of the 49 fire areas surveyed, within 9 of the 10 national forests (Siegel et al. 2011). In all 3 years, occupied sites were well distributed across on both the west and east sides of the Sierra crest, and across nearly the full latitudinal range of the monitoring area, included burned areas of a variety of sizes, and included areas 1 to 10 years post-fire. These data indicate that black-backed woodpeckers continue to be distributed across the 10 Sierra Nevada National Forests.

Additionally, mean occupancy probability for stations surveyed was 0.227 during 2009 (95% credible interval: 0.209 – 0.248) and 0.231 during 2010 (95% credible interval: 0.199 – 0.271); applying this probability across the 10 national forests yields an estimate that approximately 61,696 ha (i.e., 22.7%) of the 271,788 ha of burned forest on the ten national forest units within

the sampling frame was occupied by Black-backed Woodpeckers in 2009 (or a range based on the 95% credible interval of 71,921 – 93,610 ha), and approximately 58,367 ha (i.e., 23.1%) of the 252,673 ha of burned forest was occupied in 2010 (95% credible interval: 50,282 – 68,474 ha) (Siegel et al. 2011).

Therefore, current data indicate that the distribution of black-backed woodpecker populations in the Sierra Nevada is stable.

Forest-specific population distribution data: Bioregional monitoring for Sierra Nevada MIS includes sample points on the LTBMU; black-backed woodpecker were detected within 3 of 3 surveyed fire areas (Angora, Gondola, and Showers) in both 2009 and 2010 and within 1 of 1 surveyed fire area (Angora) in 2011 **(**http://www.birdpop.org/Sierra/bbwo.htm, Siegel, pers. comm). Black-backed woodpeckers were also detected at the following LTBMU sites during the green forest MIS bird monitoring: 6 of 10 upland sites in 2009, 1 of 15 riparian sites in 2010, and 3 of 20 upland sites in 2011 (http://data.prbo.org/partners/usfs/snmis/). In addition, black-backed woodpeckers were detected at 12 of 105 forest wide monitoring sites and at 9 of 148 lentic monitoring sites on the LTBMU, and were detected in 7 of the 10 sub-watersheds, between 2002-2005 (LTBMU 2007a).

3.4.14.3. Environmental Consequences

This section evaluates the planning alternatives of the Lake Tahoe Basin Management Unit Land and Resources Management Plan in terms of both amount and quality of habitat and of animal population trends of the MIS, and documents the effects of the planning alternatives on the habitats of the MIS, as required by the 1982 Planning Rule (1982: 36 CFR 219.19(a)(1)). Descriptions of the Forest Plan alternatives are found in Chapter 2.

Effects are described at the scale of the LTBMU and are based on an evaluation of the proposed management activities that differ under each alternative. Effects are not evaluated for actions that are not directly associated with management direction. For example, the evaluation of effects to snags in green forest does not include effects from hazard tree removal which is not part of direct management activities.

Lacustrine/Riverine Habitat (Aquatic Macroinvertebrates)

Alternative A

Direct and Indirect Effects to Habitat

There are approximately 2400 acres of lacustrine and 400 miles of riverine habitat in the LTBMU. The acres and miles of habitat are not expected to change over the next 15 years across the four Plan alternatives.

The emphasis of this alternative is to protect and conserve aquatic habitat. Alternative A would continue to recognize the need and importance of healthy watersheds, stable stream channels, as well as the critical role of SEZs for their contribution to local water quality and lake clarity goals. This alternative would continue to recognize that activities adjacent to SEZs have the potential to deliver sediment to stream channels. Restoration of streams and related watershed processes is primarily linked to decreasing or eliminating sediment sources (stream banks, roads, and other

infrastructure) and other non-point pollution sources with improving aquatic habitat conditions as secondary goals. The highest priority if a conflict in management would occur was given to 'the protection of water quality and the enhancement of the clarity of water in Lake Tahoe." The benefits of this work would be measured through assessments of watershed and stream channel condition, and contributions to achieving total maximum daily load (TMDL) milestones.

Vegetation resources management techniques under all alternatives pose some level of short term risk of soil erosion and subsequent impacts to water quality. These risks will be managed by a variety of established BMPs, and the standards and guidelines. BMPS and standards and guidelines are "measures to mitigate adverse effects" under all alternatives. Vegetation management activities will not adversely affect current 303d listings, or impact the forests ability to achieve TMDL milestones for upland source areas. The most significant risk to water quality as it relates to vegetation management practices are those associated with both permanent and temporary roads utilized as part of vegetation management projects. This is because roads can create linear conduits for concentrating flows and eroded sediments, if BMPS are not properly implemented and maintained.

While there are currently no active allotments on the LTBMU, livestock grazing often impacts to stream, wetland and meadow form and function within a designated allotment. Livestock grazing has been known to widen channels, reducing the amount of pool habitat and raising water temperatures thus reducing dissolved oxygen (Hubert et al. 1984, Stuber 1985). These alterations in channel form and function reduce spawning habitat for salmonids and other aquatic organisms.

Alternative A allows for 10% expansion of developed recreation sites within the designated permit area and into the general forest. Alternative A also identifies a number of site-specific areas where recreation facilities could be expanded and new recreation facilities could be developed based on direction from the 1988 LTBMU Forest Plan (as amended). If pursued, new facilities, such as a new boat launch facility, or increased recreation activity pose high potential for both expansion of existing AIS and new introductions where developed recreation sites expand and provide direct/indirect access to waterbodies. Both water quality and biological communities are impacted by AIS.

For example, Asian clams, which are established in Lake Tahoe: 1) excrete elevated levels of nitrogen and phosphorus into the water at the lake-sediment interface where they reside, 2) filter high volumes of water (Way et al. 1990), and 3) are strongly correlated with algal growth, and 4) are an actively reproducing community in Lake Tahoe—producing at least two cohorts per season. Potential impacts include increases in benthic algal blooms, the decline of phytoplankton and zooplankton communities, degradation of aesthetic and recreational beach use through excess shell material deposition, disruption to Lake Tahoe fishes, increased levels of calcium through the concentration of dead shell matter with a promotion of other regional exotic species (e.g., the quagga mussel 2 *Dreissena rostriformis bugensis*), and out-competing Tahoe's native benthic invertebrates such as the Montane Pea clam (*Pisidium* spp.) and the Ramshorn snail (Planorbidae). Additionally, dense Eurasian watermilfoil mats alter water quality by raising pH, decreasing oxygen under the mats, and increasing temperature (Whittman et al. 2008).

Although newly established or expanded recreation infrastructure could contribute to increased potential for AIS establishment, other potential consequences of recreation expansion on soil erosion and water quality would be minimized through established standards and guidelines and BMPs. These measures would be part of any proposed changes in recreation infrastructure as well as roads, trails, and associated access facilities. In addition, the LTBMU will continue to pursue opportunities to either retrofit, relocate, or decommission roads and trails to reduce potential sediment and nutrient loading to Lake Tahoe, as part of the Uplands Forest TMDL management strategy.

The status of aquatic macroinvertebrates would be influenced by trends in the condition of lacustrine and riverine habitats. Because these habitats are anticipated to remain stable or improve over the life of the Plan in the LTBMU, the status of aquatic macroinvertebrates in this location is expected to remain stable. However, there is potential for challenges to the status of macroinvertebrates where AIS and/or livestock grazing could degrade habitat quality.

Alternative B

This alternative does not differ substantially in actions that would have anticipated effects on lacustrine and riverine habitat nor in the strategies, objectives, and standard and guidelines proposed except there is less potential for recreation expansion. Therefore, effects, protection measures (e.g., BMPs), and conditions of lacustrine/riverine habitat as described in Alternative A are expected to be the same as those for Alternative B with minor reductions in the threat of AIS invasion or expansion with reduced potential for recreation expansion.

Alternative C

Restoration efforts are expected to maintain or improve aquatic habitat condition under this alternative. However, aquatic habitat condition has the potential to diminish as miles of road open to passenger vehicles increases by 22 miles, which includes a combination of native, graveled, and paved surfaces. Where roads are paved, surface runoff of substances such as motor oil, gasoline, heavy metals, as well as toxic substance used in de-icing programs has the potential to reach aquatic habitats (Noss, 1995). However, an aggressive BMP retrofit program has disconnected most roads from stream channels. The recommendation for wilderness designation of Dardanelles Inventoried Roadless Area under Alternative C would result in limitations on any future watershed restoration activities that would involve the use of mechanical equipment.

Alternative D

Under alternative D, additional future projects would not be planned to actively restore degraded stream channels. Some implementation of the National Watershed Improvement Program would occur, through removal of existing active stressors on these systems, (such as poorly designed stream channel crossings or hydrologic diversions). However systems that are out of equilibrium (as exhibited by headcuts, incision, accelerated bank erosion) as a result of past land use practices, climate change or other stressors not under the control of the USFS management, would be allowed to adjust through natural processes.

Currently planned USFS stream channel and watershed improvement restorations are expected to be achieved within the next 15 years, and the benefits of this work measured through

assessments of watershed and stream channel condition, and contributions to achieving TMDL milestones. However under Alternative D, the achievement of longer term TMDL stream channel milestones and geomorphic equilibrium from reaches on NFS lands, may take several decades longer than could be achieved through active restoration.

Alternative D creates a greater risk to water quality with a reduction in vegetation management activities, because with limited active fuels management there is a subsequently greater risk of catastrophic wildfire. A synthesis of research on the impacts of wildfire on water quality was published by the Rocky Mountain Research Station of the US Forest Service (RMRS, 2005). The results from this synthesis conclude that the magnitude of effects on water quality is driven primarily by fire severity, which is a qualitative term describing the amount of fuel consumed. Wildfires are more severe than prescribed fire, and as a result are more likely to produce significant effects on water quality in terms of sediment and nutrients. Canopy-consuming wildfires are expected to be the greatest concern to managers because of the loss of canopy coupled with the destruction of soil aggregates. These losses present the worst-case scenario in terms of impacts to water quality, particularly if followed by heavy rains on recently burned lands.

Through the passive management approach proposed in Alternative D, which includes removal of only high priority AIS and passive restoration, lacustrine and riverine habitat status and trend could decline through the life of the plan as there is a potential for a reduction in water quality/chemistry, lack of flood plain connectivity and associated stream shade, increased w/d ratios, increase of warm water fish and other medium to low priority AIS species, such as bullfrogs. Improvements, beyond just removing known stressors, to physical, chemical, or biological habitat elements would only be employed in cases that are needed to restore TE, candidate, or proposed species life history traits.

Finally, recommendation for wilderness designation of Dardanelles and Freel Inventoried Roadless Areas under Alternative D would result in limitations on any future watershed restoration activities that would involve the use of mechanical equipment.

The status of aquatic macroinvertebrates in the LTBMU is expected to remain stable with potential for challenges to status where restoration is not implemented and habitat conditions do not meet life history requirements.

Riparian Habitat (Yellow warbler)

Alternative A

There are approximately 1,668 acres of riparian habitat in the LTBMU. The acres of habitat are not expected to change over the next 15 years across the four Plan alternatives.

Under this alternative, watershed and aquatic habitat restoration would continue to maintain and improve riparian habitat where possible. Ongoing restoration projects in the LTBMU plant native riparian vegetation such as willow and aspen in project locations. Restoration projects also remove encroaching conifers from riparian habitat as part of the project design. In addition, a number of current projects focus on the restoration of aspen stands throughout the LTBMU by removing encroaching conifers. Although these efforts have been successful, limits on the size

of trees (30 inch dbh) that can be removed from stands under this alternative can substantially restrict the ability of these activities to remove larger encroaching conifers from aspen and other riparian stands.

The integrity of riparian habitat under this alternative can be challenged if livestock grazing is authorized and by increased developed recreation infrastructure. Livestock may not only degrade water quality but also feed and trample on native riparian vegetation. Alternative A allows for 10% expansion of developed recreation sites within the designated permit area and into the general forest. Alternative A also identifies a number of site-specific areas where recreation facilities could be expanded and new recreation facilities could be developed based on direction from the 1988 LTBMU Forest Plan (as amended). If pursued, new and expanded facilities could degrade riparian habitat where it exists in proximity to this habitat type.

Ongoing and future restoration efforts under this alternative are expected to contribute to maintained or improved riparian habitat conditions. The condition of riparian habitat could face challenges where livestock grazing is permitted in riparian areas and/or where facilities are expanded or created in or adjacent to riparian habitats.

The status of yellow warbler in the LTBMU is expected to remain the same as the current condition with potential for improvement where restoration of riparian vegetation meets the life history needs of the species and facilitates riparian vegetation recruitment in future years. Challenges to this species in the LTBMU could occur with implementation of grazing in suitable habitat for yellow warbler and/or where expanded developed recreation occurs within or adjacent to occupied or otherwise suitable habitat.

Alternative B

Restoration of riparian habitat would be the same as that described for Alternative A except the strategy of this alternative allows the removal of larger conifers from stands, including riparian stands. Therefore, restoration of riparian habitats that are threatened by encroaching conifers may be more effectively restored under this alternative.

In addition, this alternative allows for the potential expansion of developed recreation facilities by 5% at each site, half of what is allowed under Alternative A. This alternative would focus on deferred maintenance of a facility before construction of a new one. Unlike Alternative A, improvements to forest access through trail and road upgrades could challenge the condition of riparian habitat where these access points traverse or occur in proximity to riparian habitat.

Ongoing and future restoration efforts under this alternative are expected to contribute to maintained or improved riparian habitat conditions. The condition of riparian habitat could face challenges where recreation facilities are expanded but at a level less than Alternative A. Riparian habitat could face challenges where roads or trails traverse or are adjacent to this habitat type.

The status of yellow warbler in the LTBMU is expected to remain in current condition with potential for improvement where restoration of riparian vegetation meets the life history needs of the species and facilitates riparian vegetation recruitment in future years. Challenges to this species in the LTBMU could occur where expanded developed recreation occurs, grazing is

implemented, and trail/road improvements are conducted within or adjacent to occupied or otherwise suitable habitat.

Alternative C

The status of riparian habitat condition and yellow warbler are expected to be the same as those under Alternative B except that this alternative includes the potential for up to 15% expansion of developed recreation facilities, an increase in road and trail upgrades, and the recommendation of Dardanelles Inventoried Roadless Area as a Wilderness Area. Increased developed recreation, and trail and road access could challenge riparian habitat conditions where these facilities or features traverse or occur adjacent to riparian habitat. Habitat could be degraded from infrastructure construction and or increased human use, and fragmented by trails or roads. The recommendation for wilderness designation of Dardanelles Inventoried Roadless Area under this alternative would result in limitations on any future watershed restoration activities that would involve the use of mechanical equipment.

Although riparian habitat condition and the status of yellow warbler in the LTBMU are expected to remain in current condition with the potential to improve under this alternative from restoration activities targeting riparian habitat, there is a potential for diminished condition in habitat or status of the yellow warbler in the LTBMU where recreation and access degrade or fragment habitat or where restoration opportunities are limited within a new Wilderness Area.

Alternative D

Under alternative D, future projects would not be planned to actively restore degraded riparian habitat following the completion of currently planned projects. Natural processes would be favored as a means of maintaining riparian habitat condition.

Vegetation management under this alternative emphasizes the use of prescribed and managed wildfire to meet desired conditions. Wildfire can assist in riparian habitat improvements such as aspen suckering. However, implementation of prescribed fire as the primary tool for vegetation treatments could be complicated by the need for ideal weather conditions, air quality concerns, public safety concerns, among other potential limitations.

This alternative proposes a potential for reduction of recreation facilities by up 15% at each site, a perceived benefit where facilities that are decommissioned occur in or adjacent to riparian habitat.

Recommendation for wilderness designation of Dardanelles and Freel Inventoried Roadless Areas under Alternative D would result in limitations on any future watershed restoration activities that would involve the use of mechanical equipment.

The condition of riparian habitat and status of yellow warbler in the LTBMU is expected to remain the same as the current condition with potential for diminished productivity and distribution where restoration is not implemented and habitat conditions no longer meet life history requirements.

Wet Meadow Habitat (Pacific Chorus (Pacific tree) frog)

Alternative A

There are approximately 2,684 acres of wet meadow habitat in the LTBMU. Alternative A would continue ongoing restoration efforts that are expected to benefit wet meadow condition. Therefore, the condition of wet meadow habitat is anticipated to stay the same with potential to improve throughout the LTBMU with ongoing and future restoration projects.

Vegetation management may improve meadow conditions where encroaching conifers are thinned from meadows and meadow perimeters and where prescribed fire is used as a restoration tool.

The condition of wet meadow habitat could experience pressures from developed recreation under this alternative. The potential expansion of developed recreation facilities by 10% at each site and creation of new sites could cause habitat degradation if recreation facilities are built in proximity to wet meadow sites and/or attract visitors to use wet meadow sites more frequently.

Additionally, wet meadow habitat could be impacted as a result of livestock grazing, which if authorized could reduce native vegetation, increase soil compaction, increase erosion and sediment transport, and reduce water quality. These and other potential impacts could be confounded as a result of climate change which could reduce water availability to wet meadows.

The status of the pacific tree frog in the LTBMU is expected to remain the same as the current condition under this alternative with potential to improve where restoration efforts improve wet meadow condition. Habitat condition and status of the pacific tree frog in the LTBMU could be challenged where recreation expansion and livestock grazing degrades wet meadow habitat.

Alternative B

Similar to Alternative A, watershed and aquatic habitat restoration projects are expected to benefit wet meadow condition. Likewise, vegetation management that involves conifer removal and the use of prescribed fire within or at the perimeter of meadows is also expected to benefit meadow condition. The vegetation management strategy for this alternative allows for the removal of larger diameter trees than Alternative A; the ability to remove larger diameter trees may assist in reclaiming meadows and meadow perimeters under this alternative where meadow condition is threatened by large conifers. These effects could also reduce the impacts of climate change within wet meadows.

This alternative includes additional objectives for the maintenance and protection of wet meadow conditions that are not included under Alternative A. This alternative also includes objectives to restore historic and occupied willow flycatcher habitat (wet meadows).

The condition of wet meadow habitat could experience pressures from developed recreation under this alternative but at a level less than Alternative A. This alternative also allows grazing as a suitable use. The potential expansion of developed recreation facilities by 5% at each site could cause habitat degradation if recreation facilities are built in proximity to wet meadow sites and/or attract visitors to use wet meadow sites more frequently. The potential for enhanced

access to dispersed recreation activities under this alternative could also contribute to degraded meadow condition where trails would be in close proximity to this habitat type.

The status of the pacific tree frog is expected to remain the same as the current condition under this alternative with potential to improve where restoration efforts improve wet meadow condition. Similar to Alternative A, habitat condition and status of the pacific tree frog in the LTBMU could be challenged where recreation expansion and livestock grazing degrades wet meadow habitat.

Alternative C

Alternative C is similar to Alternative B with respect to restoration, vegetation management strategies, and meadow protection and restoration objectives except Alternative C has the potential to increase developed recreation facilities by 15% at each site and proposes a number of upgrades for trails and roads. Although alternative C has fewer acres of anticipated prescribed fire than all other alternatives, the difference is very small and not expected to substantially change the ability to restore meadow conditions.

This alternative allows the most potential expansion of developed recreation facilities (up to 15% at each site) of all alternatives. However, Alternative A also proposes the creation of a number of new sites in addition to the potential for up to 10% expansion of existing sites. The potential expansion could cause habitat degradation if recreation facilities are built in proximity to wet meadow sites and/or attract visitors to use wet meadow sites more frequently. In addition, the potential for enhanced access to dispersed recreation activities through road and trail upgrades under this alternative could also contribute to degraded meadow condition where roads and/or trails would be in close proximity to this habitat type. As with the other alternatives, grazing is considered a suitable land use under this alternative.

Wilderness recommendation of Dardanelles Inventoried Roadless Area could increase dispersed recreation in currently undisturbed wet meadow habitat. Although this would reduce the use of mechanized use in the area, there is potential for an increase in hiking, camping, pack animals, and domestic animals (dogs) to impact wet meadows. In addition, where the condition of wet meadows is being compromised in this area, future opportunities for restoration are limited.

The status of the pacific tree frog is expected to remain the same as the current condition in the LTBMU under this alternative with potential to improve where restoration efforts improve wet meadow condition. Habitat condition and status of the pacific tree frog could be challenged due to recreation expansion and grazing activities that could degrade wet meadow habitat.

Alternative D

In the absence of restoration under Alternative D, following the completion of currently planned projects, it can be expected that the condition of wet meadows would remain stable but have the potential for diminished condition from conifer encroachment and possible meadow desiccation. This alternative also places a 12 inch dbh limit on trees that can be removed outside the WUI defense zone. This limit could restrict removal of encroaching conifers from meadows and meadow perimeters. The emphasis on the use of prescribed fire under this alternative can help

improve meadow conditions where prescribed fire is used for this purpose but the feasibility of implementation given weather conditions, air quality concerns, and public concerns, is low.

As active restoration activities decline, potential impacts of climate change could result in reduced habitat conditions as water availability declines.

Wilderness recommendation of Dardanelles and Freel Inventoried Roadless Areas could increase dispersed recreation in currently undisturbed wet meadow habitat. Although this would reduce the use of mechanized use in the area, there is potential for an increase in hiking, camping, pack animals, and domestic animals (dogs) to impact wet meadows. In addition, where the condition of wet meadows is being compromised in this area, future opportunities for restoration are limited.

The status of the pacific tree frog is expected to remain the same as the current condition in the LTBMU under this alternative with potential to improve where restoration efforts improve wet meadow condition. There is a potential for diminished condition of habitat and challenges to the status of the pacific tree frog where meadow conditions are degraded or lost.

Early and Mid Seral Coniferous Forest Habitat (Mountain quail)

Alternative A

There are currently 3,773 acres of early seral coniferous forest and 40,378 acres of mid seral coniferous forest. Both forest types are projected to decrease under Alternative A over the next 30 years. Early seral coniferous forest is projected to decrease by approximately 2% and mid seral coniferous forest is projected to decrease by an estimated 48%. The anticipated change in early seral conditions is relatively small for the size of the LTBMU over the next 30 years. The change in mid seral conditions is due in part to growth of trees into the next size class (late seral) over the next 30 years but is due primarily to the current program of understory thinning. Under the current direction, mid seral is moved to late seral conditions by cutting smaller diameter trees which changes the forest type. Therefore, changes in mid seral habitat under this alternative represent the movement of mid to late seral habitat as well as the current method of treatment that can change stand size which can be influenced by a large proportion of smaller diameter trees in the understory.

The condition of early and mid seral habitat could experience pressures from developed recreation under this alternative. The potential expansion of developed recreation facilities by 10% at each site and creation of new sites could cause habitat degradation if recreation facilities are built in proximity to these habitat types and/or attract visitors to use these sites more frequently.

Mountain quail have been detected at many upland sites within the LTBMU. The status of the mountain quail in the LTBMU is expected to remain the same as in current condition under this alternative. However, there is a potential for challenges to the status of the mountain quail where early seral stage habitat moves to mid seral and is not replaced on the landscape by management activities or natural processes such as fire. Likewise, the status of mountain quail may face challenges where mid seral habitat moves to late seral and is not replaced on the landscape. The status of mountain quail could also face challenges where expanded or newly created developed recreation sites are in close proximity to suitable habitat and cause increased disturbance.

Alternative B

Vegetation management is expected to increase the amount of early seral coniferous forest from 3,773 to 11,399 over the next 30 years, an estimated increase of 202%. This change is primarily due to the creation of small openings and use of prescribed fire to move some of the mid seral stage stands to early seral stage in an effort to improve the sustainability of the forest overall. Creation of early seral stages can not only improve long-term sustainability but also increase habitat heterogeneity on the landscape, promote use of this habitat and increased productivity by early seral associated species such as mountain quail, and increase foraging habitat condition and productivity in predators of early seral associated species.

Mid seral coniferous forest is estimated to decrease by approximately 54% from 40, 378 acres to 18,745 over the next 30 years. Mid seral habitat would be converted under this alternative to early seral stages where appropriate to meet vegetation restoration objectives and also thinned to facilitate growth to late seral conditions.

The condition of early and mid seral habitat could experience pressures from developed recreation under this alternative but at a level less than Alternative A. The potential expansion of developed recreation facilities by 5% at each site could cause habitat degradation if recreation facilities are built in proximity to these habitat types and/or attract visitors to use these sites more frequently. The potential for enhanced access to dispersed recreation activities under this alternative could also contribute to degraded habitat condition where trails would traverse or be in close proximity to this habitat type.

The objectives under this alternative emphasize the creation of early seral habitat from mid seral habitat and the enhancement of areas established as early seral forest to result in additional mid seral acreage. The status of mountain quail in the LTBMU is expected to remain the same as the current condition under this alternative with potential for the status to improve with an increase in the amount and condition of early seral habitat. The loss of mid seral habitat is not expected to result in an adverse effect on the status of mountain quail in the LTBMU because much of this habitat would be converted to early seral stages or to mid seral open, habitat types that are used by mountain quail.

Alternative C

Under this alternative, early seral forested habitat is estimated to increase from 3,773 acres to 14,883 acres over the next 30 years, a 295% increase. Mid seral forested habitat is estimated to decrease by approximately 56% from 40,379 to 17,767 over the next 30 years. These trends are similar to those that would occur under Alternative A. In addition, the desired conditions, objectives, standards and guidelines under this alternative are very similar to those under Alternative B. Therefore, the anticipated trend in mountain quail from improved habitat condition and long-term sustainability of habitat is expected to be similar to those described for Alternative B.

Alternative C has the potential to use more aggressive techniques to create early seral openings and thin mid seral habitats than any other alternative and these methods could create short term (i.e., implementation) effects on mountain quail. However, protection measures for biological

resources that would avoid or minimize potential disturbance events during the implementation of forest vegetation treatments would be in place.

This alternative allows the most potential expansion of developed recreation facilities (up to 15% at each site) of all alternatives. However, Alternative A also proposes the creation of a number of new sites. The potential expansion could cause habitat degradation if recreation facilities are built in proximity to early and mid seral habitat types and/or attract visitors to use these sites more frequently. In addition, the potential for enhanced access to dispersed recreation activities through road and trail upgrades under this alternative could also contribute to degraded habitat condition where roads and/or trails would be in close proximity to this habitat type.

Although the status of the mountain quail in the LTBMU could improve from the increase in the amount and condition of suitable habitat, the status of the mountain quail could be challenged by increased developed recreation as well as increased use of roads and trails throughout the LTBMU.

Alternative D

Similar to Alternative A, the amount of early seral coniferous forest is not anticipated to change over the next 30 years and the amount of mid seral coniferous forest is expected to decrease by approximately 53% from 40,378 to 19,110 acres. This alternative emphasizes the use of prescribed fire to achieve desired conditions for these seral stages which can be a useful tool, especially for the maintenance of early seral habitat. However, the use of prescribed fire as the primary tool for forest structure restoration is limited by the need for appropriate weather conditions to burn, air quality concerns, public safety concerns, among others.

The status of the mountain quail in the LTBMU is expected to remain the same as the current condition under this alternative. However, the condition of habitat and status of the mountain quail in the LTBMU could be challenged where early seral stage habitat moves to mid seral and is not replaced on the landscape by management activities or natural processes such as fire. Likewise, the status of the mountain quail in the LTBMU may face challenges where mid seral habitat moves to late seral and is not replaced on the landscape.

Late Seral Open Canopy Coniferous Forest Habitat (Sooty blue grouse)

Alternative A

The amount of late seral open canopy forest is expected to increase by 126% over the next 30 years from 13,362 to 30,233 acres. Throughout the literature related to historic conditions of forest structure, the late stage in the Lake Tahoe Basin would have been open (Section 3.4.11: Forest Vegetation Resources). Therefore, this alternative achieves the desired conditions for improving the representation and condition of this habitat type throughout the LTBMU. The status of the sooty grouse is expected to remain the same as the current conditions under this alternative with the potential to respond positively to the increased amount of late seral open canopy forest on the landscape.

Challenges to habitat condition and status of sooty grouse could occur where developed recreation expands or new facilities are created in late seral open canopy habitat in the LTBMU. The potential expansion of developed recreation facilities by 10% at each site and creation of

new sites could cause habitat degradation if recreation facilities are built in proximity to these habitat types and/or attract visitors to use these sites more frequently.

Alternative B

The amount of late seral open canopy forest is expected to increase by 141% over the next 30 years from 13,362 to 32,295 acres. Although the difference is relatively minor, this alternative achieves desired conditions for late seral open canopy habitat more rapidly than Alternative A. As with Alternative A, the status of the sooty grouse is expected to remain the same as the current conditions under this alternative with the potential to respond positively to the increased amount of late seral open canopy forest on the landscape.

Challenges to habitat condition and status of sooty grouse could occur where developed recreation expands in late seral open canopy habitat in the LTBMU although this alternative allows less expansion than Alternative A.

Alternative C

Similar to Alternatives A and B, the amount of late seral open canopy forest is expected to increase by 139% over the next 30 years from 13,362 to 31,880 acres. Therefore, the status of the sooty grouse is expected to remain at current conditions under this alternative with the potential to respond positively to the increased amount of late seral open canopy forest on the landscape.

Challenges to habitat condition and status of sooty grouse could occur where developed recreation expands in late seral open canopy habitat and where upgrades to roads and trails allow for more dispersed recreation in this habitat type.

Alternative C has the potential to use more aggressive techniques to treat habitat than any other alternative and these methods could create short term (i.e., implementation) effects on the status of sooty grouse. However, protection measures for biological resources that would avoid or minimize potential disturbance events during the implementation of forest vegetation treatments would be in place and minimize the potential for short term disturbances.

Alternative D

The amount of late seral open canopy forest is expected to increase by 141% over the next 30 years from 13,362 to 32,248 acres. This alternative includes the potential for a reduction in recreation facilities by up to 15% at each site. The status of the sooty grouse is expected to remain the same as the current conditions in the LTBMU under this alternative with the potential to respond positively to the increased amount of late seral open canopy forest on the landscape.

Late Seral Closed Canopy Coniferous Forest Habitat (California spotted owl, American marten, and northern flying squirrel)

Alternative A

The amount of late seral closed canopy forest is expected to increase by approximately 9% over the next 30 years from 32,233 to 34,984 acres. The positive trend towards more late seral closed canopy forest under this alternative can mean more available habitat for California spotted owl,

American marten, and northern flying squirrel. However, the increasing density of late seral closed canopy conditions on the landscape could put these stands at a higher risk of vulnerability from bark beetles, drought, and other effects of a changing climate. In addition, this alternative limits the size of trees that can be cut to 30 inches under all circumstances and canopy closure in a stand to no less than 40% closure. As trees continue to grow in size and density under this alternative, these limits will inhibit managers to enhance older stands of trees and would likely result in a more rapid decline in late seral conditions. Please refer to the *Forest Vegetation Resources* section for more detailed information on the potential consequences of increasing late seral closed canopy conditions.

Habitat condition under this alternative could be challenged by the potential for recreation facilities to increase by up to 10% at each site and the potential for ski area permit boundaries to expand. Expansion of recreation infrastructure, especially ski resorts, can cause adverse effects on species associated with late seral habitat. Expansion of ski resorts can lead to habitat degradation and fragmentation, high levels of human disturbance that may create effective use barriers for wildlife, loss of snags because of safety hazards, and increased night disturbance from lighting and trail grooming (Manley et al. 2010).

The status of the California spotted owl, American marten, and northern flying squirrel in the LTBMU is expected to remain the same as the current condition under this alternative. Challenges to habitat condition and the status of these species could occur where dense conditions compromise stand integrity and where recreation expansion and activities degrade habitat and disturb individuals.

Alternative B

The total amount of late seral closed canopy forest is expected to decrease by approximately 15% from 32,233 to 27,293 acres as it is actively converted into late seral open canopy forest under the management direction proposed in this alternative. The loss of late seral closed canopy habitat conditions could reduce the amount of roosting, nesting, and foraging habitat available for spotted owls as well as denning, resting, and foraging habitat for marten and northern flying squirrels. However, spotted owl may benefit from the increased hetereogeneity on the landscape (Williams et al. 2011). In addition, marten rely on a diverse prey base that inhabits various seral stages so increasing landscape heterogeneity could increase foraging opportunities but the effects of increased heterogeneity on habitat use and foraging success are unknown. Finally, the condition and sustainability of the overall habitat on the landscape would be improved for wildlife with these management activities. Without some kind of management and an increase in stand densities, simulated fire on the landscape can be catastrophic and result in the loss of habitat (Thompson et al. 2011, Lee and Irwin 2005). Moreover, the dense condition of late seral stands under this alternative could make these stands more vulnerable to insect outbreak, drought stress, and other effects of climate change.

Habitat condition for spotted owls in Protected Activity Centers has the potential for improvement with desired conditions, objectives, and standards and guidelines that focus on restoration of degraded habitat in PACs.

Habitat condition under this alternative could be challenged by the potential for recreation facilities to increase but at a level less than Alternative A. Increased access to Forest System

lands through upgraded roads and trails could degrade habitat where it traverses late seral closed canopy forest and disturb wildlife species.

The status of the California spotted owl, American marten, and northern flying squirrel in the LTBMU is expected to remain the same as the current condition under this alternative with potential for improvement where habitat conditions improve on the landscape. Challenges to and the status of these species could occur where enhanced access to Forest System lands degrades habitat and/or disturbs individuals.

Alternative C

The total amount of late seral closed canopy forest is expected to decrease by approximately 22% from 32,233 to 25,205 acres over the next 30 years as it is actively converted into late seral open canopy forest under the management direction proposed in this alternative. Alternative C is similar to Alternative B in desired conditions, objectives, and standards and guidelines for late seral closed canopy forest and associated species. Therefore, the effects on habitat condition and status of California spotted owl, American marten, and northern flying squirrel in the LTBMU are expected to be the same as those described under Alternative B. However, Alternative C has a greater potential for expansion of recreation facilities and roads and trails which could challenge the status of late seral-associated species in the LTBMU where such expansion is in close proximity to occupied or otherwise suitable habitat.

Alternative D

Similar to Alternative A, the total amount of late seral closed canopy forest is expected to increase by approximately 7% from 32,233 to 34,577 acres over the next 30 years. This alternative limits the size of trees that can be cut outside the WUI to 12 inches dbh. Without the ability to continue to thin stands of trees where diameters exceed 12 inches dbh, the health of forest stands would steadily decline. As with Alternative A, dense stand conditions under this alternative could have disastrous consequences on the longevity and health of the habitat.

The status of California spotted owl, American marten, and northern flying squirrel in the LTBMU is expected to remain the same as the current condition under this alternative but challenges could occur where dense conditions compromise stand integrity.

Snags in Green Forest Ecosystem Component (Hairy woodpecker)

Alternative A

Under Alternative A, the number of snags greater than 15 inches dbh is expected to increase over time. Once a tree exceeds 30 inches dbh, the LTBMU is limited in the ability to remove this tree due to the standards and guidelines in place. Therefore, stand density would be expected to increase in such as way that would make the stand more vulnerable to stress from competition or drought. More importantly, over the life of the Plan, the stand would be at a high risk for insect (e.g., beetle) outbreak that could exponentially increase tree mortality.

It is expected that the status of the hairy woodpecker in the LTBMU would remain the same as the current condition under this alternative. This species has been detected at a number of upland and riparian sites and in every subwatershed of the LTBMU. Because snags are expected

to increase under this alternative, it is expected that the status of the hairy woodpecker in the LTBMU would continue to be the same as previously documented but may also respond positively to the increase in potential habitat. However, stands under this alternative may be more dense than conditions that are considered suitable for the hairy woodpecker, a species that is strongly associated with stands of sparse to intermediate density.

Alternative B

Snags greater than 15 inches dbh are expected to increase over time under this alternative but with a potentially slower rate of snag recruitment than under Alternative A. Under this alternative, there are fewer constraints for removal of large trees through forest health-related treatments. Trees greater than 30 inches dbh can be removed where necessary to maintain the health of the stand and of nearby trees. Therefore, stands managed under Alternative B could experience fewer incidences of insect outbreaks, lower rates of disease transmission, and die offs from stress-related causes (i.e., drought, competition, etc.) than under Alternative A. Under this management direction, stands may have larger live trees than under Alternative A as well as conditions wherein snags are recruited over time and not created all at once and a landscape that is heterogeneous in nature as opposed to homogenous.

It is expected that the status of the hairy woodpecker in the LTBMU would remain the same as the current condition under this alternative. This species has been detected at a number of upland and riparian sites and in every subwatershed of the LTBMU. Because snags are expected to increase under this alternative, albeit at a rate potentially slower than Alternative A, it is expected that the status of the hairy woodpecker in the LTBMU would continue to be the same as previously documented. The status of this species may improve where there is an increase in stands of large and mature trees of sparse to intermediate density.

Alternative C

Snags greater than 15 inches dbh are expected to increase over time under this alternative but with a potentially slower rate of snag recruitment than under Alternatives A and B. Similar to Alternative B, trees greater than 30 inches dbh can be removed under this alternative as part of forest health-related treatments. However, management under this alternative is more aggressive than under Alternative B in that treatments can reduce stand density further than under Alternative B and in twice as many acres over the life of the Plan. Alternative C may not always thin to a stand density less than proposed under Alternative B but does have more flexibility to accomplish forest health and restoration goals by allowing for more intense treatments than Alternative B. In the long term (i.e., 50 years), the forest conditions under this alternative are expected to be more resilient than those under Alternative B because neighboring trees are expected to have less competition for limited resources, and snag recruitment will occur but is projected to occur at a rate less than under Alternative B.

It is expected that the status of the hairy woodpecker in the LTBMU would remain the same as the current condition under this alternative. This species has been detected at a number of upland and riparian sites and in every subwatershed of the LTBMU. Because snags are expected to increase under this alternative, albeit at a rate potentially slower than both Alternatives A and B, it is expected that the status of the hairy woodpecker in the LTBMU would continue to be the same as previously documented. The status of the species may face shorter term challenges in the

LTBMU where treatments reduce the potential for widespread snag creation from insect outbreak, disease transmission, stress, or other mortality agents associated with dense stand conditions. However, in the long term, the status of the species may respond positively to the potential for an increase in stands of large and mature trees of sparse to intermediate density.

Alternative D

The effects of this alternative are expected to be similar to those under Alternative A but with a greater potential for snag recruitment from even more limited restrictions on the size of trees that can be removed (12 inches dbh) outside of the WUI. Therefore, there is expected to be much greater stand competition for limited resources, greater vulnerability to insect outbreak and wildfire than under any other alternative. As a result, there may be a higher potential for widespread snag creation from insect outbreak or other stress agent over several years as compared to all other alternatives.

It is expected that the status of the hairy woodpecker in the LTBMU would remain the same as the current condition under this alternative. This species has been detected at a number of upland and riparian sites and in every subwatershed of the LTBMU. Because snags are expected to increase under this alternative, and at the fastest rate of all alternatives, it is expected that the status of the hairy woodpecker in the LTBMU would be the same as previously documented but may also improve in response to an increase in potential habitat. However, stands under this alternative may be more dense than suitable for the hairy woodpecker, a species that is strongly associated with stands of sparse to intermediate density.

Snags in Burned Forest Ecosystem Component (Black-backed woodpecker)

Alternative A

Under this alternative, current procedures for prescribed fire would continue. An estimated 1,900 acres of prescribed fire (pile and understory burning) would be conducted annually under this alternative. The acceptable mortality of trees under prescribed burning is generally less than 20%. Therefore, it would be expected that the number of snags produced and recruitment of snags in burned forest would be similar to current conditions.

Under this alternative, it is estimated that a maximum of 286 acres would burn annually as managed wildfire which burns in varying degrees of intensity. This alternative would produce the least amount of snags in burned forest using managed wildfire because it allows managed wildfire only in Desolation Wilderness. See the *Fires and Fuels* section for details on modeling for managed wildlife.

It is expected that the status of black-backed woodpeckers in the LTBMU would remain the same as current condition under this alternative.

Alternative B

In general, the strategies, acreage treated, and acceptable mortality from prescribed burning are the same as in Alternative A. Therefore, the effects on snags in burned forest from prescribed fire are expected to be similar to those under Alternative A.

Under Alternative B, it is estimated that a maximum of 1,104 acres would burn annually as managed wildfire. Therefore, it could be expected that Alternative B has a greater potential to produce snags in burned forest from managed wildfire than Alternative A.

It is expected that the status of black-backed woodpeckers in the LTBMU would remain the same as current condition under this alternative with potential to improve where managed wildfire is allowed outside of Desolation Wilderness.

Alternative C

This alternative proposes to conduct prescribed burning on 400 more acres (2300 annually) than Alternatives A and B. The acceptable mortality will be the same as Alternatives A and B. It can be expected that prescribed burning under this alternative would produce slightly more snags in burned forest than Alternatives A and B.

Under Alternative C, it is estimated that a maximum 722 acres would burn annually. Therefore, it could be expected that this alternative could produce fewer snags in burned forest than Alternative B and more than Alternative A.

It is expected that the status of black-backed woodpeckers in the LTBMU would remain the same as current condition under this alternative with potential to improve where managed wildfire is allowed outside of Desolation Wilderness.

Alternative D

Alternative D proposes to treat the most acres (2550) with prescribed fire annually. This alternative emphasizes the use of prescribed fire more than any other alternative. Rather than using mechanical treatments to remove trees as in Alternative C, Alternative D is trying to accomplish this by fire, not with mechanical treatments first. In addition, this alternative would produce more mortality than any other alternative from prescribed fire. Therefore, in theory, this alternative would create the most snags in burned forest because fire is used as the primary tool to thin the forest for achieving restoration goals. However, this alternative has significant implementation limitations that could restrict the ability of this alternative to meet desired conditions. Limitations include current forecasted weather conditions, public concern, air quality concerns, among others that could preclude implementation.

It is estimated that the same number of acres would burn as managed wildfire annually under Alternative D as Alternative B. However, stands were thinned more conservatively under Alternative D (12 inch dbh limit) and more snags may be produced because of a greater potential for crown fire. Also, if wildfire were to occur under this alternative, the potential for mortality from wildfire is greater than alternative B because of the strong emphasis on the use of fire as a management tool. Therefore, although same acres of wildland fire would be managed under alternatives B and D, this alternative may produce more snags.

It is expected that the status of black-backed woodpeckers in the LTBMU would remain the same as current condition under this alternative with potential to improve because of the emphasis of this alternative on prescribed fire and managed wildfire to achieve desired conditions.

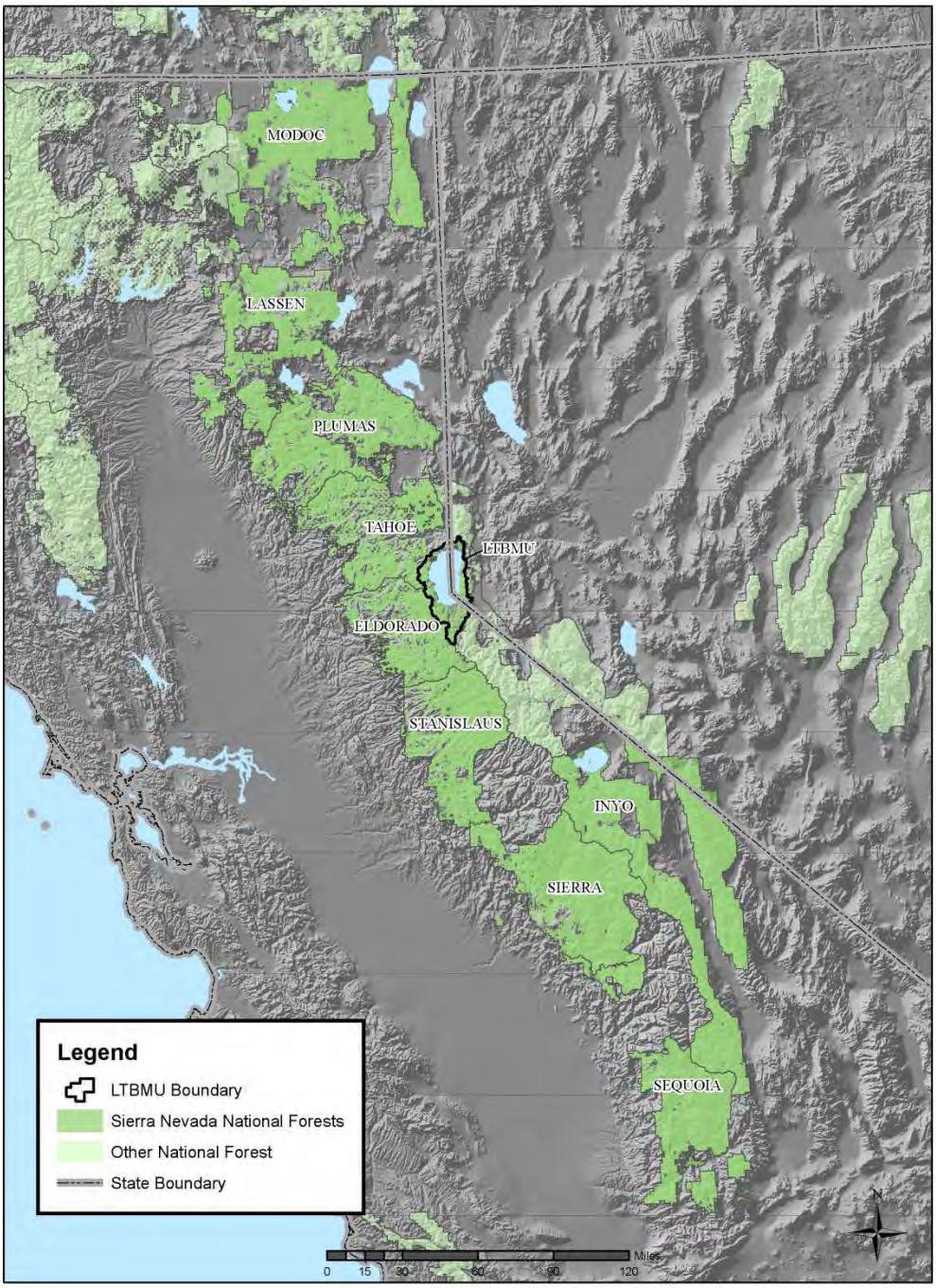


Figure 3-77. Map of the Sierra Nevada bioregion for MIS, comprised of ten national forests (including the LTBMU)

3.4.15 Natural Hazards

3.4.15.1. Introduction

This section evaluates the environmental consequences of the alternatives as it relates to natural hazards, primarily in terms of geologic hazards. Geologic hazards include a litany of processes such as landslides (i.e., rockfall, landslides, debris flows and torrents), snow avalanches, seismic activity, lake tsunamis (i.e., seiches), and volcanic activity.

Methodology

Estimation of natural hazard risk potential based on the Natural Hazard Study for the Lake Tahoe Basin Management Unit (Kohler, 2008).

3.4.15.2. Overview of the Affected Environment

The Lake Tahoe area, including the LTBMU, is geologically active with the potential for a variety of geologic hazards to occur, however the risk is relatively low.

Currently the risk from geological hazards and floods to existing roads, houses and other infrastructure is relatively low in the Tahoe Basin, because these features are not located in areas of high geologic hazards (ie. steep slopes and avalanche paths). For future development, the current Terrestrial Ecological Unit Inventory information provides a starting point for land use planning and permitting by both the USFS and the Tahoe Regional Planning Agency.

The available information provided and cited in the Natural Hazards Study (Kohler, 2008) should be considered in evaluating the potential impacts of geohazards to projects and the potential impacts that the projects may have on underlying or adjacent geohazard-prone areas.

3.4.15.3. Environmental Consequences

Hazard and risk are not synonyms in the risk management sciences. In a geologic risk analysis the hazards are evaluated for the likelihood (i.e., chance or probability) that the geologic process will occur. The next step in the risk analysis is to predict what the consequences will be for a particular hazard likelihood.

We determined the likelihood by using two approaches in this project. In the first approach, for landslides and snow avalanches, we used the steepness of the hill slope. In the second approach, for seismic activity, seiches and volcanic activity, we used the geologic history of the Lake Tahoe Basin. In the first approach we know from the scientific literature as well as empirical studies on the adjacent Eldorado National Forest, that the hill slopes with gradients of 60% or greater (approximately 58°) are more likely to have landslide movement than the gentle slopes of 59% or less. Therefore the hill slope gradient of 60% was used as a “threshold value” for assigning a high likelihood of landslide movement. For the gentle slopes the hazard was assigned lower likelihoods.

In the second approach we know from the geologic history of the Basin that volcanism last occurred sometime between several thousand years ago to a few million years ago. Therefore, in the next ten to fifty years it is unlikely that a volcanic event will occur (if it last occurred several thousand years ago it is unlikely that it will occur again soon). And in a similar vein we did the same with lake tsunamis (seiches). Although seiches do occur on Lake Tahoe, they are not known to occur with any regularity and the most recent is estimated to have occurred several hundred years ago. Therefore seiches were assigned lower probabilities for occurring than for the landslides.

Table 3-39 displays the estimated geologic hazards, consequences and risks within the LTBMU.

Table 3-39. Estimated geologic hazards, consequences and risks within the LTBMU.
Delineation between slopes with greater than 60% and those with 60% or less is based on a shear strength study by Prellwitz and Koler (2003).

Hazard	GIS Geomorphic Map Unit	Estimated Hazard Rating		Possible Consequences	Estimated Risk Rating	Possible Mitigation Options	
> 60% Hill Slope Gradient		**≤ 60% Hill Slope Gradient**		**> 60% Hill Slope Gradient**		**≤ 60% Hill Slope Gradient**	
Snow Avalanche Chutes	GE[1]	Possible to Almost Certain	Rare	Some damage to Highway 50 (Minor to Medium)	Low to High	Very Low to Low	Caltrans currently provides mitigation for minimizing avalanche hazards from occurring
Rockfall	MW[2] MW/GE and MW/GD[3]	Unlikely to Almost Certain	Rare	Medium to Catastrophic	Low to Very High	Very Low to Moderate	Warning systems, deflection walls, and nets
Landslides	MW[4]	Unlikely to Almost Certain	Rare to Possible	Medium to Catastrophic	Low to Very High	Very Low to High	Warning systems, retaining structures, dewatering of landslide mass
Debris Flows and Torrents	MW	Possible to Almost Certain	Rare to Possible	Medium to Catastrophic	Moderate to Very High	Very Low to High	Warning systems and deflection structures
Seismic	----	Rare to Almost Certain		Minor to Catastrophic	Very Low to Very High	All structures meet seismic design criteria under the Unified Building Code	
Seiches	----	Rare to Possible		Minor to Catastrophic	Very Low to High	Warning systems	
Volcanic	----	Rare		Minor to Catastrophic	Very Low to Moderate	----	

1 Although there are no avalanche chutes mapped within the LTMBU GIS geomorphic layer, they are included as inclusions within the glacial erosional map unit (GE).

2 MW represents mass-wasting which not only includes rockfall but also landslides and debris flows.

3 MW/GD represents mass-wasting within glacial deposits (GD).

4 MW may also include secondary geomorphic processes such as fluvial (F), glacial erosional and depositional processes (GE and GD). For the polygons that have a fluvial dominate process with mass-wasting as a secondary process (F/MW), the mass-wasting is usually stream bank failure or the materials through which the stream is cutting its course may be mass-wasting deposits.

3.4.15.4. Analytical Conclusions

Comparison of Consequences by Alternative

There is no difference in environmental consequences between any of the alternatives as it relates to natural hazards. Projects would include site-specific hazard evaluation. Risks would be mitigated through project design, either through use of BMPs or through avoidance of the hazardous areas.

How the Alternatives Maintain or Achieve the Desired Conditions

Under all the alternatives standards and guidelines and the available information provided and cited in the Natural Hazards Study (Kohler, 2008) will be considered in evaluating the potential impacts of geohazards to projects and the potential impacts that the projects may have on underlying or adjacent geohazard-prone areas. There would be no difference between the alternatives in how desired conditions are maintained or achieved.

3.4.16 Noise

3.4.16.1. Introduction

Noise by definition, is "unwanted sound," and is a subjective reaction to acoustical energy or sound levels. It was identified in the 1988 Forest Plan as a resource environment concern within the National Forest. The LTBMU adopted the TRPA (Tahoe Regional Planning Agency) noise thresholds for the Tahoe Basin for the NFS lands within the Lake Tahoe Basin. The LTBMU Forest Plan DEIS identifies noise as a potential environmental consequence that needs to be addressed.

Visitors and residents have expressed concerns about the level of noise they've encountered from such sources as off-highway vehicles, on-highway traffic, over-snow vehicles, chainsaws, watercraft, aircraft, and occasionally from other forest visitors. While noise levels within the LTBMU lands have been generally stable since the 1988 Forest Plan, increasing urbanization and visitation have contributed to some increases. In recent years, management of noise has become a growing concern in the Tahoe Basin and on lands administered by the Forest Service. A Monitoring Plan was identified in the 1988 Forest Plan to determine if activities on NFS lands are within human and animal tolerance levels. The Plan also stated that the Forest Service would cooperate with the TRPA and other agencies in the reading of single and cumulative noise event levels at selected locations. Noise monitoring was intended to occur annually, however noise monitoring on the LTBMU has been limited to random monitoring of snowmobiles and off-highway vehicles.

The Plan also contained a summary of noise environmental thresholds, which were developed by the TRPA and adopted by the LTBMU. The TRPA as recently as 2011, has been conducting a noise monitoring program, sampling noise levels around the basin (Community Noise Equivalent Levels or CNELs, and single noise events). In 2010 their noise monitoring focused on watercraft generated noise around the basin. Monitoring reflects a general compliance with established noise thresholds, however there are exceptions, and a need for additional monitoring and review of noise levels around the basin and LTBMU lands.

Research needs were also identified in the Forest Plan to determine the natural background levels for noise in the environment, especially in the wilderness, and for habitat of wildlife indicator species, along with a determination of the level of change that can be tolerated by wildlife. To date, research has been limited, inconclusive or non-existent regarding the impacts of noise on indicator wildlife in the Lake Tahoe Basin. There is a general recognition that sudden (unexpected) noise can cause a flight response in some wildlife species, while continuous, and "predicable" noise sources are less intrusive (such as the sound of an approaching OHV). Excessive noise however, does have the potential of creating habitat or behavioral disturbance, and additional research is needed. In summary, noise can have a deleterious effect on both humans and wildlife.

Methodology

Monitoring Noise

Noise monitoring has been conducted throughout the Lake Tahoe Basin by the TRPA, using calibrated sound level meters. Monitoring is conducted to evaluate compliance with single event noise (e.g. aircraft, watercraft, motor vehicles, off-road vehicles, snowmobiles), and community noise standards. Precision Larson Davis Laboratories noise monitoring systems are used, using sound level meters meeting ANSI Type 1 and IEC Class 1 technical specifications. TRPA has established, and the LTBMU in its 1988 Forest Plan has adopted a noise standard for various land use categories ranging from wilderness areas (45 dB) to industrial areas (65 dB). In addition, individual off-highway vehicles and or snowmobiles are monitored using A-weighted sound meters, and tested using established protocols as adopted by the Society of Automotive Engineers (SAE) under Standard J-1287 as applicable.

Monitoring Noise in the Lake Tahoe Basin

Noise monitoring has been focused on specific sources and areas. The sources and areas where the Forest Service monitors include:

- Off-Highway Vehicles are monitored for noise. The noise threshold for off-highway vehicles is 72 dB at a speed of less than or equal to 35 mph and a standard of 86 dB at 50 feet at speeds over 35 mph. TRPA OHV standards are both more and less restrictive than the California Vehicle Code standards, which are not speed dependent (limit is 82 dB at 50 feet). The California standards are applied to the sale of a new OHV. There is also a standard that requires in-use OHVs be equipped with a silencer to meet a standard of 96 dB at a distance of 20 inches, using techniques established by the Society of Automotive Engineers (SAE J-1287). This is the same standard enforced by the Forest Service under the Federal Code of Regulations that requires the USFS to apply established state standards (Nevada has no such standard).

- Over-Snow Vehicles (e.g. snowmobiles) are monitored for noise. Environmental Threshold for over-snow-vehicles (OSVs): 82 dB at 50 feet at less than 35 mph. TRPA monitoring has reflected that most OSVs are in compliance. The Forest Service also monitors OSV noise to determine if desired conditions are being met, and may soon adopt a new stationary noise test developed by the Society of Automotive Engineers (J-2567) if the State of California also adopts this testing standard. LTBMU monitoring also has reflected that most OSVs have been in compliance.

Most noise sources are outside of the Forest Service's authority to regulate (e.g. transportation, aircraft, urban noise sources, boats, on-highway motorcycles). However, the Forest Service does have some regulatory authority over general noise sources that occur on NFS lands within the Lake Tahoe Basin.

Assumptions

In the analysis for this resource, the following assumptions have been made:

- Noise monitoring will continue, with potential changes in the noise thresholds and standards as established by the TRPA. The LTBMU will continue to monitor CFR regulations respective to noise issues, and so will other agencies. Noise generated by recreation activities such as events, over-snow vehicle uses may receive more attention because of public concerns.
- Prior to the issuance of a special use permit for an event, or a new activity on NFS lands, an analysis of projected compliance with existing noise standards should be completed. The LTBMU should try to adopt the best available technology to minimize noise exceedences, along with seeking to use operating practices that minimize noise levels. Much of the sound level monitoring and noise compliance monitoring will be conducted by the TRPA within the Tahoe Basin, although the LTBMU and the responsible agencies will conduct their own monitoring and compliance activities, primarily on OHVs and OSVs. Monitoring models will follow established acoustical procedural methodology or appropriate SAE standards.
- Noise is not a resource condition that is "desired," as by its definition is "unwanted sound."

3.4.16.2. Overview of the Affected Environment

Existing Condition

Noise monitoring has been conducted around the Lake Tahoe Basin for over 20-years. In some areas, noise levels have increased, while in other situations, noise levels have been stable and occasionally decreasing. As stated in the 1988 Forest Plan: "noise is becoming a major concern in administering the National Forest. There are occasional complaints about chain saws, OHV and low-flying aircraft over Desolation Wilderness. As noise measurements are taken in the future, actions may be necessary to meet single event and cumulative event noise standards that have been established for the area." Monitoring Plan directions at the time were to "cooperate with TRPA and other agencies in the reading of single and cumulative noise event levels at selected locations." Since that time, the LTBMU has cooperated with TRPA and other agencies to conduct noise monitoring.

TRPA has conducted a focused review of Basin noise standards and thresholds as part of the Pathway 2007 evaluation progress, and staff forwarded a number of recommendations that have yet to be adopted. In particular, CNEL measures (which measure overall, weighted sound levels over 24-hours), have been deemed as ineffective because of the time period. Discussions at Pathway public meetings suggested creating a new noise monitoring protocol for the Tahoe Basin (including NFS lands) for a 1-hour measuring standard to limit noise sources that are not subject to the single event noise source regulations or violate the 24-hr CNEL standards. The goal is to develop the necessary noise monitoring strategies needed to preserve community

serenity and also provide abundant quiet recreation areas. Note that it was observed in the Pathway noise reviews, that one or more intrusive outbursts of loud noise could occur during a 24-hour CNEL monitoring period, and still fall within established noise level standards, if it were relatively quiet during the majority of time remaining in that monitoring period.

Overall, the Existing Condition for noise remains the same as identified in the 1988 Forest Plan for the LTBMU: noise remains an issue within the LTBMU, and the Forest Service has limited noise enforcement authority or responsibility, however as a Desired Future Condition, the LTBMU has and will continue to address noise issues respective to recreation events, motorized vehicles (including snowmobiles), and noise generated by either resource management and/or recreation activities on the National Forest. The LTBMU should continue to try to adopt the best available technology to minimize noise exceedences along with seeking to use operating practices that minimize noise levels.

Noise is partially subjective, as tolerance does vary according to such factors as its intensity, time of occurrence, duration, source and individual sensitivity based upon such factors as individual expectations and values.

3.4.16.3. Environmental Consequences

The consequences of noise are well documented, as noise can be an obvious intrusion on neighborhood tranquility or serenity or negatively impact the recreational experience of forest visitors. Noise can also be impacting on wildlife, though more research on this is needed.

Common to All Alternatives:

Noise issues will need to be addressed in all Alternatives. Consideration for the quality of the resident, visitor and recreationist experience and community tranquility will need to be part of plan implementation, both to meet established laws and regulations and noise standards and thresholds, but also on how noise affects the overall Basin environment.

Summary of Management Direction by Alternative

- Alternative A (No Action)
- Alternative B (Proposed Action)
- Alternative C (Continued Active Restoration)
- Alternative D (After Planned Projects Completed, Rely on Natural Processes for Recovery – No Active Restoration)

ALTERNATIVE A - No Action

Since this Alternative continues current management direction from the 1988 LTBMU Land and Resource Management Plan, as amended (including 2004 SNFPA), noise standards and monitoring protocols or programs that have been discussed under the “Methodology” section would continue around the basin. However, this Alternative also assumes future expansion of

recreation infrastructure and development of new sites and trailheads. Should those developments or expansions occur, influence on existing noise levels would need to be addressed in any environmental documentation.

Even if there is no change from current conditions, noise issues will continue to grow with increasing urbanization and or visitation or expanded motorized public access into the National Forest.

ALTERNATIVE B - Proposed Action

Noise levels will likely increase in some areas with expanded access and motorized uses above Alternative A. An increase is likely to accompany more concentrated public use, along with expanded motorized activity, more public access and noise generating activities (e.g. expanded facilities, conveniences, transit services, parking lots…). This Alternative will expand current forest areas to accommodate moderate to high densities of groups and individuals (winter and summer periods), and that will contribute to noise levels. Conversely, expanding current acreage managed as "Semi-Primitive Non-Motorized" would contribute to a "quieter" noise environment with lower overall sound levels.

ALTERNATIVE C

Similar to Alternative B with some anticipated noise increase as roads are upgraded and road speed and volume will likely increase, as will any expansion of recreation access or facilities. Resource restoration activities would likely generate some short-term noise (especially when mechanical forest vegetation treatment is involved), and effects on any adjacent urban areas would need to be evaluated prior to field operations. Dardanelles recommendation for Wilderness designation would have minimal effect on noise levels since the area is already non-motorized (summer and winter).

ALTERNATIVE D

With reduction of developed recreation areas, noise sources may shift as public changes their destinations or activities. Affected areas will see an influence on noise generated, but not on activities and areas unaffected by this Alternative. Reduced miles of roads and trails to motorized use would contribute to a lower noise environment.

3.4.16.4. Analytical Conclusions

Noise levels are expected to increase because of projected increases in visitation and population levels over the coming years. Because of that, action alternatives involving use or access expansions should address noise as a consideration when completing environmental analysis.

Noise by definition is "unwanted sound." Accordingly, the less of it, the better as a general summary statement. Its management will be dependent upon a number of factors, including how aggressive and successful noise monitoring will be on all regulated noise sources, of which the Forest Service has limited authority (being dependent upon multiple agencies and enforcement

authorities as identified in the “relevant laws, regulations, and policy” section). The LTBMU can and should work to conduct noise monitoring where it has the authority to do so (enforcement of the respective CFRs), and too, consider any “significant” noise impacts that might be the result of a resource management decision. Since noise is partially a “social” issue and a “quantitative” issue, it has been identified as a “resource” issue, with many sources that will remain as a “challenging” issue on the LTBMU.

Comparison of Consequences by Alternative

Within each alterative noise mitigation actions can be considered, such as allowed uses, time of day those activities are allowed (i.e. noise generated during daylight hours is not weighted (penalized) as noise that occurs during evening and overnight hours because of the intrusive nature of noise during those periods). Management considerations could also include such mitigations as muffler requirements, overall decibel levels allowed in a single event, seasonal closure periods or hours for noisy events or activities.

Respective to noise levels, the alternative that reduces or constrains public uses or activities will most likely result in lower overall noise being generated. That is Alternative D.

How the Alternatives Maintain or Achieve the Desired Conditions

Respective to noise, the Desired Condition is to not exceed existing noise standards and thresholds, and reduce noise levels wherever possible or practical. The presented alternatives do not specifically address noise levels or potential noise mitigation measures. Management actions to implement the full spectrum of described actions within each described Alternative need to consider the noise impacts and appropriate actions identified and implemented.

3.4.17 Recreation

3.4.17.1. Introduction

This section establishes the affected environment and discloses the potential environmental consequences on recreation resources that may result with the adoption of a revised land management plan. It examines, in detail, four different alternatives for revising the 1988 Lake Tahoe Basin Management Unit Land and Resource Management Plan as amended (1988 forest plan).

Methodology

The National Visitor Use Monitoring (NVUM) 2000, 2005 & 2010 surveys and the National Survey on Recreation and the Environment (NSRE) 2005 are two valuable studies used to help characterize recreation use on the Basin by measuring quality trends in recreation demand and visitor satisfaction. Effects will be assessed by how forest management activities influence the quality and quantity of recreation resources as determined by the measurement indicators discussed below.

For purposes of analysis, recreation resources are generally characterized as:

- Recreation Opportunities
  - Recreation Opportunity Spectrum
- Access -Dispersed Recreation
  - Visitor Access –Summer
    - Non-Motorized and Mechanized
    - Motorized
  - Visitor Access – Winter
    - Non-Motorized
    - Motorized
- Recreation Development
  - Developed Recreation
  - Winter Sports (Alpine Skiing)
- Stewardship
  - Interpretive and Conservation Education Services
  - Sustainable Recreation
- Climate Change

Issues and Indicators

Recreation Issues

Public participation and collaboration identified several key issues as discussed in Chapter 1, Recreation Issues. They include:

Recreation Opportunities - Having a continued range of desired recreation opportunities and settings

Access – Providing access to public lands and shorelines**.**

Recreation Development - Maintaining recreation development to respond to recreation demand and enhance economic opportunities

Stewardship - Providing recreation opportunities, interpretive and conservation education services while maintaining the integrity of natural resources and responding to climate change.

Indicators

Measurement indicators respond to the Issues and allow for analysis of the Recreation Resource by alternative. These recreation indicators are depicted in detail below and in Table 3-40.

1. **Satisfaction –** Satisfaction ratings, as measured by National Visitor Use Monitoring (NVUM). The degree that alternatives provide and maintain a desirable mix of recreation opportunities.

2. **Recreation Settings -**Acres of ROS classes are used to measure the existing supply of recreation settings. The degree that alternatives increase, decrease, or change the various ROS classes will be used to compare the impact of alternatives.

3. **Visitor Access –** Miles of roads and trails and number of trailheads available to assess effects to different recreation user groups (see Table 3.41)

4. **Developed Permitted Recreation -** Acres of Recreation Sites under permit are used as a measure of existing recreation opportunities. The degree that alternatives respond to demand by increasing or decreasing the available developed recreation acres will be used to compare the impacts of alternatives.

5. **Developed Overnight -** Overnight accommodation units are an indicator of the number of cabins, lodges, and campsites available to the visiting public. The degree that alternatives increase or decrease overnight accommodations, addresses our ability to accommodate overnight recreation demand and will be used to compare the impacts of alternatives.

6. **Developed Day Use -** The number of day use parking spaces is a function of the public ability to access dayuse recreation. The degree that alternatives increase or decrease day use parking spaces, addresses our ability to accommodate recreation demand and will be used to compare the impacts of alternatives.

7. **Ski Areas Operational Boundary–** The acres within the ski area permit boundary that are used for runs, lifts, and structures.

Table 3-40. Recreation Indicators

Indicator	Unit of Measure	*Existing Condition*	Alt A (+10%)*	Alt B (+5%)*	Alt C (+15%)*	Alt D (15%)*
Visitor Satisfaction	Ratings	*Very Satisfied*	Very Satisfied	Very Satisfied	Very Satisfied	Somewhat Satisfied
Setting (ROS)	Acres	*Existing*	Existing	Existing	Existing	More SPNM, Less SPM, Less RN
Dispersed Visitor Access	Percent of Miles of Trails and Roads from Existing Inventory	*See Table 3-41 Below*	See Table 3-41 Below	See Table 3-41 Below	See Table 3-41 Below	See Table 3-41 Below
Developed Permitted Recreation	Acres	*1,300*	1,430 *+130*	1,365 *+65*	1,495 *+195*	1,105 *-195*
Developed Overnight	Accommodation Units	*1,072*	1,179 *+107*	1,126 *+54*	1,233 *+161*	911 *-161*
Developed Day Use	Parking Spaces	*2,260*	2486 *+226*	2,373 *+113*	2,599 *+339*	1,921 *-339*
Developed Ski Areas	Operational Footprint Acres	*3491*	8061 +4570	3665 +174	4015 +524	2967 -524

** The ability to accommodate recreation demand is a projection only for comparison purposes. The ability is dependent upon funding sources.*

Table 3-41. Visitor Access Opportunities by Trail and Road Miles

Miles of Trails	Existing Authorized Trails	Alternative A	Alternative B	Alternative C	Alternative D
Trails - Non-Motorized					
Miles of trails open for Hiking	326	388	378	370	388
Miles of trail open to mechanized	187	217	217	207	207
Roads and Trails - Motorized					
Miles Roads Open to Passenger Vehicles	84	84	89	106	74
Miles roads Open to High-Clearance Vehicles	148	148	150	138	148
Miles Road Open to OHV	115	115	115	110	130
Miles Trails Open to Motorized Use	15	15	15	20	10
Acres open to Over Snow Vehicles (OSV)	80,458	80,458	80,458	80,458	71,374

Assumptions

Recreation Stewardship – Interpretive, Conservation Education, and Visitor Services are anticipated to remain consistent for all alternatives. Opportunities to enhance or improve these services will be driven by available funding over the life of the plan.
Recreation Demand – Recreation demand is expected to grow in all alternatives for the life of the plan.

Recreation Infrastructure – Recreation infrastructure will continue to be upgraded, retrofitted, relocated, or decommissioned to reduce deferred maintenance or facilitate recreation demand. Examples of these activities include:

- BMP's and Universal Accessibility upgrades will be implemented at recreation sites.
- Updating existing lodging and support facilities at resorts and recreation sites to provide quality recreation experiences.
- Replacing or repairing existing restrooms at recreation sites (includes adding showers at campgrounds)
- Decommissioning sites that are not in use or economically feasible to maintain.
- All alternatives will emphasize "hardening "of existing developed or dispersed public use areas as needed to allow recreation use to continue. Hardening a site means using design and construction principles to increase a site's ability to withstand use without facility or natural resource deterioration.

Special Use Permits/Concessionaires – Use of concessionaires to manage and operate existing resorts, ski areas, and recreation sites (campgrounds and day use areas) will continue.

3.4.17.2. Overview of the Affected Environment

Current Conditions

Recreation Setting

The Lake Tahoe Basin is a world-renown tourism destination providing year-round outdoor-recreation opportunities nestled in a scenic, high-alpine setting. The Tahoe "brand" of outdoor recreation activities range from the highly challenging, thrill-seeking experiences sought in popular resort settings to the tranquility of remote areas where visitors can find solitude and spiritual renewal. People live in Lake Tahoe to enjoy the quality of life benefits associated with a mountain environment; people visit Lake Tahoe to test their outdoor skills and simply take a "time-out" from the crush of their workweek. Lake Tahoe is commonly known as the "Jewel of the Sierra"-- its social, economic and environmental value cannot be overstated. The deep azure lake is the region's central iconic feature that draws well over 4 million visitors annually – the highest concentration of visitor use among national forests. The challenge is to sustain Lake Tahoe's intrinsic character, while providing high-quality recreation settings and opportunities that contribute to a thriving economic base.

The Lake Tahoe Basin Management Unit (LTBMU) is 154,784 acres in size and spans two states. Elevations range from 6,225' at Lake Tahoe's shoreline to 10,891 at the rounded top of Mount Freel. Much of the LTBMU's landscapes remains natural appearing and provides the beautiful visual backdrop that draws visitors from around the world. The area's seasonal changes are dramatic, with snowy winters, vibrant fall colors, and mild spring and summer periods. With the exception of periods of inclement weather, the skies are clear, providing a picturesque contrast to the verdant mountains that rim the basin. There are cultural and historic sites representing many periods of the LTBMU's history.

The LTBMU has 5 mountain resorts that provide high-quality downhill skiing opportunities. There are 326 miles of non-motorized trails that provide day-long and overnight opportunities for hiking/walking. The Pacific Crest Trail traverses the Basin on its western boundary. There are 12 developed campgrounds (3 are operated by resorts) and 8 day use sites for picnic and scenic viewing. There are 5 designated swimming beaches that are included in over 14 miles of public-accessible shoreline that providing opportunities for water play and other water-related activities. The LTBMU provides 84 miles of passenger-vehicle roads that are outstanding for viewing the region's natural features; and 148 miles for more rugged backcountry motorized touring for high clearance vehicles. Over 64% of the LTBMU is classified as being in a "semi-primitive "condition, with 23,955 acres of the area currently designated as wilderness.

Recreation Management

Recreation resources are managed to be sustainable. Sustainable recreation is a multi-faceted management approach that aims to provide high-quality recreation opportunities while protecting, conserving, and where possible, improving social, economic, and environmental themes. Sustainable recreation emphasizes the management of existing recreation needs and impacts as well as future recreation demands.

Recreation Visitation

Based upon the National Visitor Use Monitoring (NVUM) project that monitors visitor use every 5 years, the LTBMU receives visitors primarily from throughout California and Nevada (76%). This constitutes the LTBMU's primary market area. The remaining 24% of visitors come from other parts of the United States and abroad. The ethnic and racial make-up of the primary visitors are more than 90% white which does not reflect the general composition of these counties (See Appendix F – Social and Economic Assessment for more information regarding the demographic profile of visitors).

More specifically, these studies have demonstrated that 52% of visitors to the Lake Tahoe basin come from a distance of 200 miles for recreation opportunities. This equates to approximately one tank full of gas or a one day drive from the Basin. Table 3-42 provides a summary of the percent of National Forest visits by distance traveled.

Supporting data from the National Survey on Recreation and the Environment (NSRE) indicates that the larger visitor market area for the LTBMU includes the majority of California, southern Oregon, and western and southern Nevada.

Based upon the NVUM data there was an estimated 5.7 million national forest visits to the Lake Tahoe Basin Management Unit in 2010. This figure is higher than what was projected in 1988 (NVUM). The increase in visitation has resulted in increased demands for site access during peak seasons, related transportation congestion, and a perception of crowding in recreation areas. Table 3-42 provides the annual visitation estimates projected to 2025.

Table 3-42. Forest Visits (in 1000's)

Forest Visits §	1988	2000	2005#	2010#	2025*
Total Estimated National Forest Visits §	1,081 (Under reported)	3,105	4,391	5,786	7,001

§ A National Forest Visit is defined as the entry of one person upon a national forest to participate in recreation activities for an unspecified period of time. A National Forest Visit can be composed of multiple Site Visits.

Actual NVUM values. These values defines the upper and lower bounds of the visitation estimate at the 90% confidence level, for example if the visitation estimate is 100 +/-5%, one would say "at the 90% confidence level visitation is between 95 and 105 visits.

*2025 - 21% increase from 2010 assuming 1.4% annual growth rate.

Visitation Trend

As discussed in the 2006 Comprehensive Evaluation Report, the annual number of basin visitors has been higher than was projected in 1988 (NVUM). As visitation has increased, the LTBMU has not expanded its capacity, but has strived to maintain and improve the quality and level of services through concessionaires, permittees, and partnerships.

Recreation Visitor Demand

Though the growth in populations in these California and Nevada market areas have temporarily subsided, they are still projected to grow 1.4% annually or approximately 15% in the next 10 years and 21% in the next 15 years according the U.S. 2010 census data. Increased population growth is anticipated to increase visitor demand for recreational opportunities, services and development at the LTBMU.

Demand for national forest access has grown even though most developed improved facilities have not increased in capacity. At peak periods, developed facilities often reach vehicle site capacity. Also, as more users share the same forested area or trail system, conflicts can occur such as when motorized recreation conflict with non-motorized activities.

When these activities are compared to previous documented primary activities on the LTBMU, some changes are noted. In Table 3-43 the order of popularity of the following primary activities were reported:

Table 3-43. Main Recreation Activities Comparison

1988 Activities	2000 Activities	2005 Activities	2010 Activities
Driving around basin viewing scenery	Hiking or Walking	Downhill Skiing	**Downhill Skiing**
Downhill skiing	Downhill skiing or Snowboarding	Hiking/Walking	**Relaxing**
Overnight camping	Relaxing	Relaxing	**Hiking/Walking**
Swimming-beach use	Viewing Natural Features	Viewing Natural Features	**Viewing Natural Features**
Recreation cabin use	Other Non-Motorized Activities	Driving for Pleasure	**Bicycling**
Hiking and walking	Overnight camping	Other Non-Motorized	**Other Non-Motorized**

1988 Activities	2000 Activities	2005 Activities	2010 Activities
		Activities	**Activities**
-	Driving for Pleasure	Cross Country Skiing	**Driving for Pleasure**
-	Snowmobiling	Bicycling	**Non-Motorized Activities**
-	Bicycling	Motorized Water Activities	**Some other Activity**
-	Cross Country Skiing	Picnicking	**Cross Country Skiing**

Visitor Demand Trend 1 – Demand is expected to continue to outstrip supply for these popular recreation activities in some areas at certain times of the year. Agency managers will face increasingly difficult decisions about recreation management and resource protection conflicts.

Visitor Demand Trend 2 - With increased future demand, more use will occur at existing sites and areas, and additional use will occur at those sites and areas that are now only lightly being used or not used at all.

Visitor Demand Trend 3 - It is expected that currently popular short-term day-use recreation activities will continue to increase at a higher rate as a primary activity, than more traditional extended-duration activities such as staying at resorts and camping.

Recreation Visitor Satisfaction

An important element of the outdoor recreation program delivery is evaluating customer satisfaction with the supply of recreation settings, facilities, and services provided. Satisfaction is a core piece of data for national and forest level performance measures. Satisfaction information helps managers decide where to invest in resources and to allocate resources more efficiently toward improving customer satisfaction. Based upon NVUM data, the overall LTBMU recreation visitor satisfaction results are very high. Ninety-eight percent of visitors gave a rating of very satisfied or somewhat satisfied for their overall recreation experience. The agency's national target for this measure is 85%.

Visitors are generally satisfied when there is an ample supply of facilities for lodging, camping, picnicking, beach use, skiing, trailheads, visitor information and the like, to support the demand. . Results for the composite index items were somewhat lower. Table 3-42, depicts overall satisfaction ratings for visitor experiences in the Lake Tahoe Basin Management Unit in 2005 and 2010.

Table 3-44. Percent of Overall Satisfaction Rating 2005/2010

Satisfaction Rating	Percent Satisfied 2005	Percent Satisfied 2010
Very Satisfied	85.0%	89.8%
Somewhat Satisfied	13.08%	8.8%
Neither Satisfied nor Dissatisfied	1.8%	0.7%
Somewhat Dissatisfied	0.1%	0.3%
Very Dissatisfied	0.1%	0.4%

The ratings for the developed site condition index were below 80 percent for all types of sites. However, the rating for perception of safety was over 90 percent for all types. See Table 3-45.

Table 3-45. 2010 Percent Satisfied Respondents

Satisfaction Element	2010 Satisfied Survey Respondents (%a)		
	Developed Sites	Undeveloped Areas	Designated Wilderness
Developed Facilities	87.0	71.6	67.2
Access	67.4	88.3	83.3
Services	79.5	77.9	72.7
Feeling of Safety	99.1	97.6	99.1

The NVUM performance ratings have characterized that there is potential room for improvement in value of the service received for the fee paid. In other words, the current pricing structure for forest fees may be near the top of what the public is willing to pay in certain circumstances.

Visitor Satisfaction Trend - Satisfaction ratings are expected to remain high during the planning period, depending on the Forest Service's ability to maintain a supply of high quality developed facilities, access, and services; and continue to provide a feeling of safety.

Recreation Opportunities

Recreation Opportunity Spectrum

For planning purposes, recreation supply to a recreationist is defined as the opportunity to participate in a desired recreation activity in a preferred setting to realize desired and expected experiences. Recreationists choose a setting and activity to create a desired experience. While the goal of the recreationist is to obtain satisfying experiences, the goal of the recreation resource manager becomes one of providing the opportunities for obtaining these diverse experiences while maintaining the balance of natural resource concerns. Managers provide a supply of recreation opportunities by managing settings, activities, and facilities, which in turn allow visitors to have recreation experiences.

One of the tools that Forest Service managers use to help provide a variety (supply) of appropriate recreation settings is the Recreation Opportunity Spectrum (ROS). The ROS system is used to assign a variety of existing and potential recreation activities and opportunities to NFS lands. The tool identifies the supply of recreation settings on NFS lands by evaluating various levels of access, remoteness, naturalness, facilities, social encounters, visitor impacts, and visitor management. The spectrum employs six classifications: 1) Primitive, 2) Semi-primitive Non-motorized (SPNM), 3) Semi-primitive Motorized (SPM), 4) Roaded Natural (RN), 5) Rural (R), and 6) Urban (U). Definitions of these classifications are provided in the Glossary.

Only four of the classifications have been inventoried on the LTBMU. There are no areas on the LTBMU that met the inventory criteria for Primitive. Though there are portions of the three Wilderness Areas in the Basin that are managed as primitive, their proximity to roads and urbanization and the intensity of use rules out a ROS Primitive designation. There were also no areas on the LTBMU that met the inventory criteria for Urban. Though some undeveloped NFS lands may exist within urban neighborhoods in the form of scattered parcels, they are classified as rural as they offer visual and recreational relief from the adjacent urban development. Table 3-46 displays the existing Recreation Opportunity Spectrum on the LTBMU.

Table 3-46. ROS Classification (2011)

2011 ROS Classification	Basin Wide ROS Acres	Forest Service ROS Acres	Percent of Forest Service ROS to Basin ROS	Percent of @ Forest Service ROS Class to Total Basin ROS Acres (207,420)	Percent of @ Forest Service ROS Class to Total Forest Service ROS Acres (154,784)
Primitive	0	0	0	0	0
Semi-Primitive Non-Motorized	83,465	78,521	94%	41%	51%
Semi-Primitive Motorized	24,051	20,370	85%	8%	13%
Roaded Natural	51,556	39,812	77%	18%	26%
Rural	36,902	16,081	44%	8%	10%
Urban	11,446	0	0	0	0
Total	207,420	154,784	NA	75%	100%

These figures show that the LTBMU provides most of the SPNM (94%), SPM (85%), and RN (77%) opportunities in the basin. There are relatively fewer Rural (44%) and no Urban opportunities in terms of acreage. These acreages depict that the basin is relatively undeveloped outside the ring of urban and rural land classifications that surround Lake Tahoe's shoreline.

Today, approximately 25% of the NFS lands provide a more developed environment (RN and R), 50% in the basin provide a semi-primitive environment (SPM and SPNM). As a general characterization, developed recreation occurs in the RN and R classes. Conversely more dispersed recreation activities occurs in the semi-primitive ROS classes (SPM and SPNM).

Access - Dispersed Recreation

Dispersed recreation activities on NFS lands are defined as those activities that occur outside of developed recreation sites. Dispersed activities typically do not require the use of improved facilities other than access points such as trailheads and the roads and trails systems themselves. Dispersed recreation activities are categorized for management purposes as either Dispersed Summer or Winter and are further categorized by the mode of Access. Access is categorized as either:

- **Summer -Non-Motorized** (Hiking and Equestrian) /**Mechanized** (Mountain Bikes) or **Motorized.**
- **Winter–Non-Motorized** (Cross-Country skiing, backcountry skiing, snowshoeing etc.) and **Motorized** (Over Snow Vehicles OSV's)

Much of the outdoor recreation occurring in the Lake Tahoe Basin is dispersed recreation that occurs at more remote locations. Some of the more popular areas include Desolation Wilderness, Meiss Country, and East Shore Beaches. There were 1,300,000 dispersed site visits (General Forest visits plus Wilderness visits) to the LTBMU in 2010 or roughly 23% (22.4) of the total forest site visits (NVUM 2010). Approximately 54% of the main activities reported by forest visitors were dispersed activities. As previously mentioned, the main dispersed recreation activities reported by visitors primarily include Hiking and Walking, Relaxing, Viewing Natural Features, Driving for Pleasure, Cross Country Skiing, Picnicking, and Viewing Wildlife. Other popular activities include mountain biking, dispersed camping, rock climbing, and beach and water play. A large amount of the current use occurs because of the existence of forest, state and county highways and of local communities and often happens without any inducement by the Forest Service.

Dispersed Camping is allowed in specific areas on the LTBMU and is categorized as either overnight backpacking or vehicle camping. The LTBMU provides a unique niche for this activity as it provides the majority of the dispersed backcountry camping in the Basin. Overnight backpacking is allowed primarily in wilderness areas such as Desolation, Mt. Rose and Granite Chief, the Dardanelles Inventoried Roadless Area (Meiss Management Area), and along the Pacific Crest Trail and the Tahoe Rim Trail. Though backpacking in the Lake Tahoe Basin not a high participation activity as defined by NVUM surveys, less than 1%, it is an activity that visitors are very passionate about and the Forest Service goes to great lengths to assure that high quality opportunities continue to be available. The Desolation Wilderness is one of the most heavily used wilderness areas in the nation. Most areas are patrolled on a regular basis by rangers and volunteers who contact and educate the public on 'Leave No Trace' backcountry ethics and regulate user impacts such as campfires, litter, and sanitation. Camping along the PCT and TRT is only allowed within 300 ft. of the trail corridor to protect sensitive resources. The 1988 plan calls for increasing dispersed recreation opportunities.

Dispersed vehicle camping on the LTBMU is unlike that permitted in many national forests that allow camping in most General Forest Areas. In the Basin, vehicle camping is limited to a 300 ft. corridor along certain sections of the Genoa Peak Road, Logan House Loop and along the McKinney-Rubicon Road. The intent of this regulation is to continue to allow dispersed

camping opportunities while still constraining vehicles primarily to the roadway for resource protection.

Recreation Special Uses - Resorts and outfitter guides currently offer services for snowmobile tours, cross country skiing, horseback riding, and weddings. Numerous requests have been received for outfitter/guide permits to lead tours on NFS lands. New special use permits may be granted for outfitting and guiding based on need assessments or capacity analysis that are used to assure compatibility with public use of the National Forest. Limitations on activities that potentially damage or disrupt sensitive species and habitat areas are generally included as conditions for permit approval. There are currently 8 annual events under special use permit such as the Tahoe Marathon and the Renaissance Fair.

Dispersed Summer Recreation - Non-Motorized/Mechanized - Summer non-motorized access to more remote areas of the national forest is gained primarily via trails that are shared by hikers, equestrians, and mountain bikers alike. Trails in the Basin, similar to roads, are maintained by miles of trail available primarily to these different user groups. There are currently 326 miles of total trails available in basin, all of which are available for hiking and equestrian and 187 miles available for mechanized use. The Lake Tahoe area is popular as a mountain biking destination and many trails throughout the Basin are now designed specifically to appeal to different levels of mountain biking abilities. Mountain biking is allowed anywhere in the Basin with the exception of wilderness areas, the Pacific Crest Trail and along sections of the Tahoe Rim Trail.

There are 10 trailheads in the Tahoe Basin that receive significant use by hikers that provide developed parking and accessory facilities. The rest of the trailheads are dirt turnouts on the shoulders of roads. Soil erosion, adverse visual quality impacts, and highway safety problems are usually associated with these undeveloped trailheads.

Nationally recognized trails within the Tahoe Basin include the Pacific Crest National Scenic Trail and National Recreation Trails including the Hawley Grade Trail and portions of the Tahoe Rim Trail. From 1999 to 2002, the entire trail network on LTBMU managed lands was inventoried and cataloged. (Please see Access Section for more comprehensive discussion of trails, trailheads and general access).

Dispersed Summer Recreation - Motorized - The LTBMU has managed OHV routes as a designated system since the 1976 Off-Highway Vehicle Plan was completed. The Plan established policies and provided for procedures that helped to ensure that the use of off-road vehicles on public lands would be controlled and directed in order to protect the resources, promote the safety of all users of the public lands, and to minimize conflicts among the various users of these lands. The majority of the managed road system has been upgraded as a result of the Road Access and Travel Management Plan that was completed in 1999. Designated road systems are now depicted on the resulting Motor Vehicle Use Map (MVUM).

Roads and trails in the Basin are generally maintained to different class levels by miles available to different user groups: Passenger cars, High clearance Vehicles and OHV. Generally speaking, the higher the Class of road and trail the more improved it is. Class 5 and 4 roads are accessible to passenger cars and facilitate those visitors who enjoy driving for pleasure and witnessing

forest settings from a high quality road in the comfort of their passenger cars. Class 3 roads generally allows use by high clearance 4x4 vehicles for those visitors who have the equipment to travel those more rugged roads that lead to more remote locations in the forest. Class 2 roads and trails are those that are less maintained and are open to unlicensed OHV's who appreciate the challenges and rewards of navigating very rough terrain.

In 1976 the LTBMU adopted a restrictive policy towards the management of summer OHV and winter OSV activity on NFS lands because of the emphasis on protecting the water quality of Lake Tahoe and concerns for minimizing the social conflicts between area residents and OHV users. OHV activities were recognized as a legitimate use of the national forest, but were permitted on designated routes or areas only. This recreational activity is not permitted or encouraged where urban areas interface the National Forest, in environmentally sensitive areas, or within administratively closed areas of the Basin. In general, OHV routes have not expanded since the 1988 Forest Plan.

The current direction for the LTBMU is to designate OHV summer routes/sites and winter areas throughout the basin in appropriate areas while closing those existing routes/areas where this activity is not considered as either compatible or suitable with the environment or other uses. Route designation requires the preparation of environmental assessment documentation and public review before being implemented. Designated routes are shown on readily available maps and signed so that recreationists will know where they can legally operate vehicles. Providing adequate signage is a management challenge and users are sometimes not aware that they are using closed roads and trails.

Enforcement of OHV regulations remains a challenge because of limited Forest Service funding that has depended on State grants for many years. Even though OHV use still remains a source of controversy, particularly where use is occurring near residential areas, some progress has been made since 1980. Many areas have been successfully closed to use, signing has been installed, education programs have helped change behavior, and steps have been taken toward the designation of routes. OHV user groups have volunteered to correct damage and to implement OHV management. Much of the recent success has resulted from the availability of "Green Sticker" OHV funds from the State of California.

Dispersed Winter Recreation - Non-Motorized - The LTBMU offers many winter recreation opportunities such as cross country skiing, snowshoeing, backcountry skiing, snow play, sledding, snow camping, though parking and access is often limited. Groomed Cross Country Ski trails are popular and are provided on NFS lands by resorts, private businesses and local municipalities. Some of these trails on NFS lands are under permit and others are not. Backcountry skiing and snowshoeing have become popular alternatives for adventure seekers who would otherwise ski at resorts. While there are many high quality backcountry ski routes within the Tahoe Basin, few have established winter parking.

State and county highway departments plow mostly roadways and a few emergency turnouts. The California State Sno-park program plows and maintains some of the most popular parking areas for dispersed winter sports. There are many areas that are not accessible even after snow removal has been completed depending upon county ordinances for winter parking. Specifically

many county snow removal and winter parking ordinances do not allow for roadside parking when snow is present which has eliminated many winter dispersed recreation opportunities such as backcountry skiing, and snowshoeing. Because dispersed winter recreation is a rapidly growing part of the total use of forest lands in winter, the LTBMU anticipates increased competition for parking, crowding, and conflict between nonmotorized and motorized recreationists. Please see Access Section for more comprehensive discussion of trails, trailheads and general access.

Dispersed Winter Recreation–Motorized - Currently OSV use is managed in accordance with the OSV plan (Snowmobile Guide) defined by the Forest Plan and supported by a Forest Order. It defines areas that are open and/or closed to snowmobiling activities. In general, riding areas for OSVs have been stable since the 1988 Forest Plan.

Snowmobiling has become much more popular since 1988 and in some instances closed areas are being accessed due to lack of information and enforcement.

Areas that have traditionally been enjoyed by cross-country skiers also now are used by OSV users and vice versa, which are causing user conflicts. Predominantly cross-country skiers report that in some areas of the Basin, noise, pollution and snow compaction negatively affect their experience as well as the view that their safety is jeopardized. There is also division within the community about what and why areas should be open or closed.

Wildlife studies are currently being conducted to characterize impacts from OSV use to species that over winter in the basin. Specifically Northern Goshawk and the yellow legged frog are being studied for potential OSV impacts at this time. Though improved OSV technology has brought most OSV's into full compliance with noise and emissions standards, their improved performance capabilities and increased use is putting more pressure on land managers to more actively manage winter uses.

Recreation Development

Developed Recreation

The LTBMU provides a wide variety of developed recreation sites that provide different levels of user comfort and convenience. Developed recreation facilities have been constructed to offer sustainable recreation opportunities, protect resources, and otherwise manage visitor activities in different outdoor settings. Developed recreation sites typically represent a significant investment in facilities and management, and include downhill ski areas, private sector resorts, campgrounds, picnic areas, swimming beaches, interpretive sites, visitor centers, historic sites, and trailheads. Often site amenities are provided only if needed for the protection of resources. The recreation infrastructure at some sites in the Basin is already built out.

In general, as visitation has increased, the LTBMU has not expanded its developed capacity, but has strived to maintain and improve the quality of services through concessionaires, permittees, and partnerships. There has been a modest increase in the development of recreation sites and facilities but primarily the LTBMU has been focusing on re-development of existing sites and

facilities. Accordingly, there have not been significant changes in the number of campsites, interpretive trails, picnic sites, trailheads, trail systems, or amount of developed swimming beach frontage.

Some land acquisitions such as High Meadows and the Dreyfus Estate have expanded the public opportunity to access and recreate on public land. Some site expansions have taken place on the LTBMU such as Heavenly Mountain; however the greatest changes have been in addressing the backlog of deferred maintenance and the redevelopment of existing facilities to modern building codes meeting universal accessibility requirements. These projects include the redesign of Inspiration Point and Nevada Beach Campground and construction of new restrooms at Kiva Picnic Area, William Kent Beach, Kaspian Beach, Eagle Falls Picnic Area, Bayview Campground, Nevada, Pope and Baldwin Beaches, and Fallen Leaf Campground. The Tahoe Rim Trail has been completed and trail development and redesign to accommodate mountain bikes has been taking place. Modernization of sites such as the Lake Tahoe Visitor Center Stream Profile Chamber, and special use sites such as Camp Richardson, Zephyr Cove, Meeks Bay and Heavenly Mountain Resort have been ongoing.

During peak periods many popular developed recreation sites are at their design capacity. Resorts and campgrounds are often full from late June through Labor Day. To satisfy peak demand development or expansion of new sites may be required on land suitable for development. Suitability is defined by flat, low erosion hazard land, close to existing roads and utilities, and preferably near water oriented attractions. Any future expansion must be sustainable from a management perspective.

Improved recreation sites have been demanded by those using overnight accommodations. Travel trailers, tent trailers and Recreational Vehicles now dominate the user mode of camping. To meet the changing needs of RV users, utility hookup facilities at Zephyr Cove and Meeks Bay campgrounds have been upgraded. One of the effects of this modification is an increase in user fees.

Recreation Special Uses - Developed recreation sites are operated by the Forest Service under guidance provided by FSM 2330, or by commercial operators (permittees) under special use permit with guidance provided by FSM 2340. Sites operated under special use permit provide outdoor recreation opportunities that are developed through the efficiencies of private investment and management. Developed sites under special use permit are more commercial in nature, and for a fee offer a variety of services. The exceptions are those sites managed by the Forest Service where a fee can be charged under Federal Lands Recreation Enhancement Act (FLREA) authority. Included are resorts, downhill ski resort development, recreation residences, improved cross-country ski trails, recreation equipment rentals, recreation events, marinas, and organizational camps. The goal is to have these recreation activities managed under special use permit, to continue to produce goods and services for national and regional markets while also being a responsive neighbor to the local communities.

There are approximately 630 special use permits issued within the LTBMU, which generate fees to the Government of over $4,000,000 annually. The LTBMU is the third largest fee base for special uses in the Pacific Southwest Region of the Forest Service (Region 5) due to the large number of recreation special uses. Table 3-47 lists the current inventory of developed recreation

sites on the basin as inventoried by the 2008 Recreation Facility Analysis.

Table 3-47. Inventory of Developed Recreation Sites

Developed Recreation Site Type (Ski Areas are discussed in Winter Sports section below)	Number of Sites (Supply)	Managed by Forest Service	Managed by Permittee
Resorts (Lodging/Beach/Camping)	7	0	7
Organization Camps	4	0	4
Campgrounds	9	3	6
Swimming Beaches	5	0	5
Day Use Sites	8	6	2
Interpretive Sites	9	6	2
Organization Camps	4		4
Recreation Facilities Supporting Dispersed Recreation (Trailheads and Remote Parking)	28	28	0

Resorts – The resorts on the LTBMU under special use permit are Camp Richardson Resort, Meeks Bay Resort, Zephyr Cove Resort, Round Hill Pines Resort, Angora Resort, Echo Chalet, Valhalla and the Camp Richardson Corral. Several resorts not only offer overnight lodging, but overnight camping, dayuse sites and swimming beaches as well. Many of the resorts were developed under private ownership between 1900-1950 before being acquired by the Government. (Ski resorts are discussed in more detail below in the Winter Sports Section.)

Campgrounds - Campgrounds on the LTBMU are managed by the Forest Service and under special use permit via concessionaires. Those campgrounds managed by the Forest Service include, Luther Pass, Blackwood Canyon and Watson Lake. Campgrounds managed under special use permit include William Kent, Kaspian, Meeks Bay, Bayview, Fallen Leaf and Nevada

Beach. Three campgrounds are also managed by the Meeks Bay, Camp Richardson and Zephyr Cove Resorts mentioned above.

Swimming Beaches – Designated swimming beaches managed under special use permit include, William Kent, Meeks Bay, Baldwin Beach, Pope Beach and Nevada Beach.

Day Use Sites – Day Use sites are often picnic sites or observation sites and they are managed by the Forest Service and under special use permit. Those managed by the Forest Service include 64 Acres Lakeside, Eagle Falls Picnic Area and Trailhead, Kiva Picnic Area, Sawmill Pond, Secret Harbor, and Chimney Beach. Those dayuse sites managed under special use permit include, 64 Acres Riverside, Kaspian.

Interpretive Sites – Interpretive Services primarily serves visitors to National Forest sites. The Taylor Creek Visitor Center and the Tallac Historic Site are the major public points of contact, providing guided and self-guided activities, educational programs, and living history throughout the summer months. Two interagency partnership facilities are located at Meyers Interagency Visitor Center and Explore Tahoe Visitor Center. Minor self-guided interpretive sites include Inspiration Point Overlook, Stateline Lookout Overlook, Angora Lookout, Logan Shoals Vista, and Lam Watah Interpretive Trail.

Organization Camps – Organization Camps are summer camps operated under special use permit. They include Camp Concord and Camp Shelly, Berkley Camp and the California Alpine Club.

Recreation Residences – The LTBMU administers 594 special use permits for recreation residences within 23 tracts. The largest of these are at Echo Lakes, Echo Summit, Fallen Leaf Lake, Spring Creek, and along the Upper Truckee River. Some recreation residence tracts are adjacent to environmentally sensitive lands that are unsuitable for development. Relocation or removal of the use has been considered to protect water quality. However, current policy is to manage the use to avoid increasing the level of activity and to mitigate adverse effects such as not allowing an increase in the existing footprint of the structures. Some of the recreation residents were granted waivers to this requirement in order to upgrade from septic systems to sewers.

Capital Investment Trend – The LTBMU has focused primarily on eliminating deferred maintenance, modernization, meeting universal accessibility standards, and improving services and the quality of its recreation programs to enhance the quality of the visitor's experience. This trend is likely to continue for the life of the plan.

Winter Sports (Ski Areas)

There are 5 winter resorts addressed by the existing LTBMU Land and Resource Management Plan. The winter resorts are:

- **Heavenly Mountain Resort –** 7,700 acres on NFS lands. Authorized by the National Forest Ski Area Permit Act of 1986.
- **Alpine Meadows –** 566 acres on NFS lands. Authorized by the National Forest Ski Area Permit Act of 1986 and administered by the Tahoe National Forest.
- **Diamond Peak Ski Area** – 292 acres on NFS lands. Authorized by the Organic Act of 1897 and the Federal Lands Recreation Enhancement Act of 2005
- **Homewood Mountain Resort** – 204 acres on NFS lands. Authorized by the Organic Act of 1897 and the Federal lands Recreation Enhancement Act of 2005.
- **Northstar California**– Currently entirely on private land.

Heavenly Mountain Resort

Heavenly Mountain Resort receives the most skier visits and is the largest resort on the LTBMU. Ownership of Heavenly Mountain Resort changed in 2002, and the new owner undertook a review of facilities and operations that resulted in the 2007 Heavenly Master Plan Amendment. The 2007 Heavenly Master Plan Amendment identifies the overall objectives of Heavenly Mountain Resort and the context for on-going capital investment projects.

At build-out, the accepted 2007 Heavenly Master Plan Amendment projects 17,434 skiers at one time (SAOT). To accommodate these skiers, sufficient interconnection of facilities and ski trails are proposed, in addition to an expanded system of ski trails.

Beginning in the 2004-2005 ski season, the Forest Service approved placement of backcountry gates within Heavenly Mountain Resort to better manage out-of-bounds skiing. The backcountry gates provide the only legal means by which paid guests may leave the ski area boundary. Prior to the backcountry gates, “rope-ducking” occurred at random locations along the ski area boundary that resulted in skiers more frequently becoming lost.

Summer activities are currently provided at Heavenly Mountain Resort in the form of hiking, scenic chairlift and gondola rides, food and beverage sales, and tubing. It is anticipated that the variety of summer activities at Heavenly Mountain Resort will increase in the future as authorized by the Ski Area Recreational Opportunity Enhancement Act of 2011.

Alpine Meadows

Alpine Meadows is predominately on the Tahoe National Forest and the special use permit is administered by the Tahoe National Forest, Truckee Ranger District. However, 566 acres of the resort, including the Lakeview Chairlift and developed ski runs, occur on the LTBMU. Alpine Meadows’ 2007 Master Development Plan Update indicates the potential for additional parking in the Deer Park area of the resort, including NFS lands managed by the LTBMU. However, the 2007 Master Development Plan Update indicates the concept needs additional analysis in a separate master plan update.

Diamond Peak Ski Area

Diamond Peak Ski Area is predominately on private lands. However, 292 acres of the ski area includes NFS lands managed by the LTBMU. This includes portions of the developed ski runs known as The Great Flume; Golden Eagle Bowl, and off-piste skiing provided in Solitude Canyon. Authorized activities include grooming and snow making. Infrastructure on NFS lands includes signage, snow-fencing, and snow making lines. There are no existing proposals to additionally develop Diamond Peak Ski Area on NFS lands.

Homewood Mountain Resort

Homewood Mountain Resort is predominately on private lands. However, 204 acres of the resort includes NFS lands managed by the LTBMU. This includes portions of the developed ski runs known as Main Cirque, 55 Chutes, Wally's Folly, The Shoulder, Third Creek, and Nooncester Traverse. Authorized activities include avalanche control and grooming. Infrastructure on NFS lands includes signage and snow fencing. There are no existing proposals to expand Homewood Mountain Resort on NFS lands.

Northstar California

Currently, Northstar California is entirely on private land. The existing 1988 Forest Plan allows for expansion of the ski area on approximately 300 acres of NFS lands south and east of Mt. Pluto. However, there are no existing proposals to expand Northstar California on NFS lands.

Stewardship

Interpretive, Conservation Education and Public Services – Providing a coordinated system of interpretive and education facilities and programs is an important way to help residents and visitors understand the connection between their behavior and the sustainability of Lake Tahoe's special environment. The Taylor Creek Visitor Center and the Tallac Historic Site are the major public points of contact providing guided and self-directed activities, education programs, and living history throughout the summer months. Using partnerships has also effectively leveraged the LTBMU's ability to provide recreation services. (See more information on Interpretive, Conservation Education and Public Services in its separate section).

Sustainable Recreation - Providing sustainable recreation opportunities on the LTBMU is accomplished by managing the settings, activities, and access on public lands, improving the infrastructure necessary to support increasing visitor use, and protecting natural ecosystems, scenic qualities, and cultural resources. It is anticipated that certain recreation facilities may require upgrading, retrofitting or relocating to address deferred maintenance, or to improve the visitor's experience. This sustainable recreation approach is achieved while operating in a complex regulatory environment with growing user demands.

The most prominent practices, which could have an effect on recreation program services throughout the planning period include, Watershed Restoration, Control of Aquatic Invasive

Species, Vegetation and Fuels Management and Species Recovery Habitat Restoration (refer to those sections of the document for a full discussion of these activities).

Stewardship Trend – While Interpretive, Conservation Education, and Visitor Service programs will continue to be vital components of the LTBMU's future mission, more dependence on partnerships and volunteers will be needed to assure viable continuity of the programs.

Climate Change

As stated in Appendix C Climate Change - Mean annual temperatures in the LTBMU planning area have risen by about 2 degrees Fahrenheit over the last century, with most of the change occurring in nighttime temperatures. The occurrence of nighttime freezing temperatures has decreased over the last century, and for the first time on record, the annual mean minimum temperature at lake level is now above freezing.

The average number of days in a year on which the average air temperature remains below freezing has dropped by 27 days since 1910. Average annual precipitation during the last 100 years is increasing, but inter-annual variability is also increasing. While average annual precipitation is increasing, the amount falling as snow is decreasing, as well as average winter snow pack. Further, spring thaw is occurring 5-30 days earlier than several decades ago.

These observed trends are already affecting recreation resources in a variety of ways, but it is most evident with the wide swings in yearly precipitation rates. Currently, ski areas are experiencing more pronounced differences in snow pack from year to year. The winter of 2011 was a record breaking snow year that has been followed by one of the lowest precipitation years on record in 2012. More snow making occurs in the early season in drought years to provide skiable snow packs. Also noticeable is that campgrounds and recreation sites that rely on springs for water supplies are running out of water earlier in the season during low water years.

3.4.17.3. Environmental Consequences

Recreation

There are no direct effects on recreation resources at the programmatic level, because there will be no ground disturbing activities. The effects discussed in this section are indirect effects. Recreation resources that may have consequences from other forest management actions include: Recreation Opportunities, Access - Dispersed Recreation, Capital Investments in Developed Recreation, and Winter Sports (Ski Areas). Management actions related to Forest Stewardship will be the same for all alternatives.

Organization of Effects

The effects of the alternatives on the following major categories of activities and uses to the recreation resources will be discussed when applicable:

- **Recreation Opportunity Spectrum Classes –** Changes in ROS classes could change the balance of the existing recreation opportunities and setting currently available in the Basin. (e.g. Shifting Semi-Primitive Motorized acres to Semi-Primitive Non-motorized acres would reduce the number of miles of roads available for those recreationists who enjoy driving for pleasure or OHV opportunities).

- **Recommended Wilderness –** Increased acres of lands managed as wilderness will change recreation opportunities (e.g. recommended wilderness status would enhance hiking, equestrian and back country camping opportunities in wilderness settings, while reducing miles of trails currently used by mountain bikers).

- **Modifying Developed Recreation Facilities –** Actions generated from the modification of developed recreation facilities that would either enhance or diminish recreation capacity and opportunities (e.g. Increasing the size of a campground to accommodate increased future demand).

- **Dispersed Recreation Management –** Actions that could result in changes to existing dispersed recreation opportunities (e.g. Improvements or elimination of existing trailheads or the construction of new trailheads).

- **Access and Travel Management –** The elimination or construction of new roads and trails or changes to the maintenance levels of existing roads can impact various recreation opportunities (e.g. Improving the maintenance levels of an existing road from Level 2 to Level 4 would allow more passenger vehicles to utilize the road and enhance a visitor's experience who enjoys driving for pleasure).

- **Watershed (Stream Channel and Habitat) Restoration –** Watershed restoration actions that would potentially remove or modify existing recreation infrastructure or diminish existing recreation opportunities (e.g. Removal of recreation parking from stream environment zones for resource restoration).

- **Fuels Reduction And Vegetation Restoration –** Actions generated from vegetation restoration such that may impact recreation opportunities (e.g. A fuel treatment project may encourage off road/trail incursions and damage resources).

- **Aquatic Invasive Species –** Actions initiated for the control of Aquatic Invasive Species that may affect recreation opportunities (e.g. Temporary closures of streams while treatments for eradicating non-native species are occurring).

- **Species Recovery Habitat Restoration –** Actions that may protect a species of concern may reduce acres available for recreation activities (e.g. Protecting Tahoe Yellow Cress via fence enclosures may reduce the acres of available sandy beach for recreation activities).

Consequences Related to Recreation Opportunites

Recreation Opportunity Spectrum

Those management activities that may have the most effect on Recreation Opportunity Spectrum class resources are:

- Recreation Opportunity Spectrum Classes
- Recommended Wilderness

Other actions generated from other resource management activities are not anticipated to affect the character of the existing ROS general settings enough to merit a change in an ROS class. As a general statement, no changes in ROS classes in specific areas indicate that land uses affecting recreation in the Lake Tahoe Basin are becoming relatively stable.

Recreation Opportunity Spectrum Classes

The ROS classifications reflect the overall theme and character expressed by the settings maintained for various forest management and recreation activities. As a general characterization, more dispersed recreation activities occurs in the semi-primitive ROS classes, while conversely, developed recreation occurs in the RN and R classes.

Effects from decisions in the land management plan revision to allocate areas of the LTBMU to different land use zones will not largely affect existing ROS classifications, and will have a minimal effect on recreation visitation and use in each alternative. There is little variation between the overall themes and recreation character represented between the Management Areas and the ROS classifications and each classification varies minimally between the alternatives. Comparisons of Management Areas to ROS classifications are presented in Table 3-48 below:

Table 3-48. Management Areas Comparison to Recreation Opportunity Spectrum

Land Use Zone	ROS
Wilderness Management Area	Semi Primitive Non-Motorized *
Back Country Management Area	Semi Primitive Non-Motorized
General Conservation Management Area	Semi-Primitive Motorized Roaded, Natural Roaded, and Rural
Santini-Burton / Urban Forest Parcels Management Area	Rural
* Note: Though wilderness areas on the LTBMU are classified as Semi Primitive Non-Motorized, they are in fact managed to Primitive standards.	

Acreages of ROS classifications by alternative are shown in Table 3-49,. Alternatives A, B and C will continue the current mix of settings and activities with approximately 64% of the NFS lands providing a semi-primitive environment (SPM and SPNM) and 36% providing a more developed environment (RN and R).

Alternative C is similar to A and B in its general mix of settings however up to 195 more acres of general improvements to developed recreation facilities may occur within the existing Rural Setting. Visitors will continue to enjoy the current balanced mix of recreational opportunities throughout the Basin in these alternatives.

Alternative D will shift the mix by 5% to SPNM with a 7,410 acre increase. The large majority of these acres come from the Inventoried Roadless Areas. The increase in SPNM acres will result in a 3% decrease in both SPM and RN acres. Motorized use would be limited in these new acres. This will result in less improved roads being available for those users who enjoy driving for pleasure in their passenger cars.

Table 3-49. Recreation Opportunity Spectrum (ROS) Classification by Alternative

ROS Classes	1988 Land Status	Current Basin-wide Acres	Existing Acres (NFS Lands)	Alternatives A, B & C (No Change from Existing)	Alternative D Basin-wide Acres	Alternative D Forest Service Acres
Semi-Primitive Non-Motorized	53,500	83,465	78,521	78,521 51%	91,079	85,931 56%
Semi-Primitive Motorized	17,600	24,051	20,370	20,370 13%	20,018	16,457 11%
Roaded Natural	55,700	51,556	39,812	39,812 26%	48,122	36,430 23%
Rural	11,900	36,902	16,081	16,081 10%	36,755	15,966 10%
Urban	0	11,446	0	0	11,446	0
TOTAL	138,700	207,420	154,784	154,784	207,420	154,784

Recommended Wilderness

There are no recommendations for additional wilderness in Alternatives A and B and no changes to the ROS classifications. Both alternatives will maintain the existing 24,670 wilderness acres managed in the basin between the Desolation, Granite Chief and Mt. Roe Wildernesses.

Recommendations for additional wilderness have been proposed in both alternatives C and D. The Dardanelles roadless area is recommended for designation as wilderness in Alternative C, and both Dardanelles and Freel Peak roadless areas are recommended for wilderness designation in Alternative D. Wilderness recommendations will not change the ROS classifications from SPNM. Both of the recommended areas proximity to roads and urbanization rule out the inventory criteria for a Primitive ROS classification.

The sliding scale below depicts the balance of the Alternatives between the ROS classes and how Alternative D has more SPNM than the other Alternatives.

Consequences Related to Access - Dispersed Recreation

Dispersed Recreation Overview – Dispersed recreation on NFS lands are defined as those activities that occur outside of developed recreation sites in more remote areas of NFS lands. Impacts are generated by visitors as they access remote areas and participate in their chosen activities. The types of impacts generated from dispersed recreation activities will be similar for all alternatives but the intensity can vary with increased visitation. Each alternative provides differing amounts of access as measured by miles of roads and trails.

Satisfaction ratings are generally improved by meeting demand with more access via roads, trail, and trailheads. More access will create more opportunities for dispersed activities to occur and potentially reduce crowding and reduce user conflicts. More access can in turn increase demands on management and enforcement efforts to assure that the integrity of the environment is maintained and not degraded.

Often dispersed recreation activities are concentrated into small geographical areas, such as stream, meadows, riparian and other sensitive areas. Common impacts generated from dispersed

recreation activities can include: hiking, or mountain biking off route which creates user routes and potentially tramples plants and disrupts wildlife, littering which is not only unsightly but can be harmful to wildlife, improper disposal of human waste, and making campsites that may disturb or destroy habitat. More access to remote areas can increase the likelihood that impacts to natural resources may occur.

Conflicts can occur among users as available space becomes more crowded, where incompatible uses are not separated, or where desired opportunities are not available. Because of the diverse desires for outdoor recreation activities, experiences may be affected by behavior or mode of travel by other recreational users in the same area. Examples of these effects are horseback riding, mountain biking, and hiking; off-highway vehicles and nature watching; and alpine skiing and snowboarding. Non-motorized recreationists seeking solitude from the noise of motorized activities or people desiring group or family associations may conflict with individuals seeking solitude or testing their independence and backwoods skills.

User behavior can be modified through interpretive and conservation education to reduce some types of conflicts and resource impacts. Facilities and trails may be designed, built and maintained to better protect sensitive resources and enhance recreation opportunities. Because desired uses vary considerably, each alternative has general advantages for certain groups of users while being less desirable for other groups.

Those management activities that may have the most effect on Dispersed Recreation resources are:

- Recreation Opportunity Spectrum Classes
- Recommended Wilderness
- Access and Travel Management
- Vegetation and Fuels Management
- Aquatic Invasive Species Management
- Species Recovery Habitat Restoration

Recreation Opportunity Spectrum Classes

As mentioned in the ROS section above, Alternatives A and B and C will continue the current mix of settings and activities. Alternative D will shift the mix by 5% to SPNM with a 7,410 acre increase. The large majority of these acres come from the Inventoried Roadless Areas. The increase in SPNM acres will result in a 3% decrease in both SPM and RN acres. Motorized use would be limited in these new acres. This will result in less improved roads being available for those users who enjoy driving for pleasure in their passenger cars.

Recommended Wilderness

Alternatives A and B are unchanged from existing conditions. The wilderness recommendations in Alternatives C and D will effect both summer and winter dispersed recreation activities as discussed in the Access sections below. (Please see the Wilderness and ROS discussions for further evaluations.

Access and Travel Management

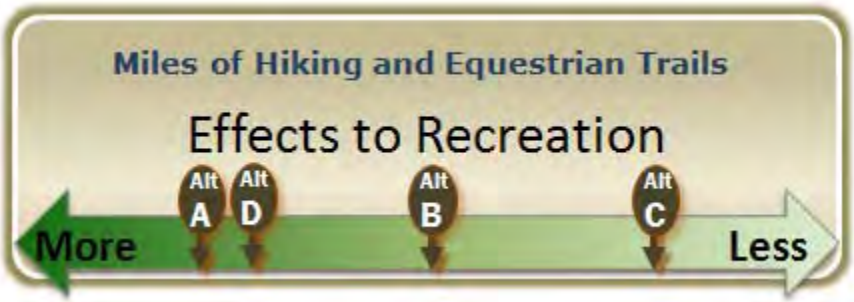
Dispersed Summer Recreation Non-Motorizes and Mechanized Access - Availability of summer dispersed recreation activities are affected primarily by the type of access to public lands that are needed to allow that activity to happen. For the purposes of this analysis, access is categorized by the quantity of miles of trails open to hiking and equestrian use and trails open to mechanized use. Table 3-50 displays the miles of trails available for both uses by alternative.

Table 3-50. Miles of Trails, by Recreation use

Miles of Trails	Existing Authorized Trails	Alternative A	Alternative B	Alternative C	Alternative D
Miles of trails open for Hiking and Equestrian Use	326	388 +19%	378 +16%	370 +11%	388 +19%
Miles of trail open to mechanized	187	217 +16%	217 +16%	207 +11%	207 +11%

Miles of Hiking and Equestrian Trails - Hikers and equestrians will find satisfying experiences under all alternatives though the experience will vary by alternative. More miles of trails are available in Alternatives A and D where the approximately 62 miles of unauthorized trails eligible for adoption would be added to the existing inventory of 326 miles for a total of 388 miles (+19%) of trails.

Alternatives C and D however offer increasingly more primitive experiences due to potential wilderness designations. Alternative C will have fewer miles available for hiking than the other alternatives with approximately 44 miles (+11%) of additional adopted trails for a total of 370 miles of trails open to hiking. Under this alternative less hiking trail would be available due the designation of use specific trails for mountain bike only trails or motorcycle only trails. There will however be 42.5 more miles of wilderness hiking.



Miles of Trails Open to Mechanized Use – Mountain Bikers will have more riding opportunities and potentially be more satisfied with Alternatives A and B as more miles of trails (+16%) are available and popular routes in the Dardanelles and Freel areas will remain open.

Alternatives C and D offers an increase of 20 miles (+11%) of additional trails upgraded for mechanized use. Some trails would be shared with motorized and non-motorized uses outside of wilderness areas and include fully or highly developed trails and bike paths. In Alternative C and D however, some popular mountain biking trails would become off limits due to the Dardanelles and Freel Peak wilderness recommendations.

In Alternative C, a Dardanelles wilderness recommendation will prohibit mechanized use on approximately 12.3 miles of trails including the trail from Big Meadow through Round Lake to the Pacific Crest Trail, the Dardanelles Trail, and the Christmas Valley Trail.

A wilderness recommendation in Alternative D will also prohibit mechanized use on 25.6 miles of trails in the Freel Area including popular rides such as Saxon Creek, Armstrong Pass, portions of the Tahoe Rim Trail, Star Lake and Monument trails. In Alternative D with both the Dardanelles and Freel areas recommended for wilderness, approximately 37.9 total miles would be excluded from mountain bike use. (See Wilderness Section for further discussion).

The sliding scale below depicts the general class levels by alternative.

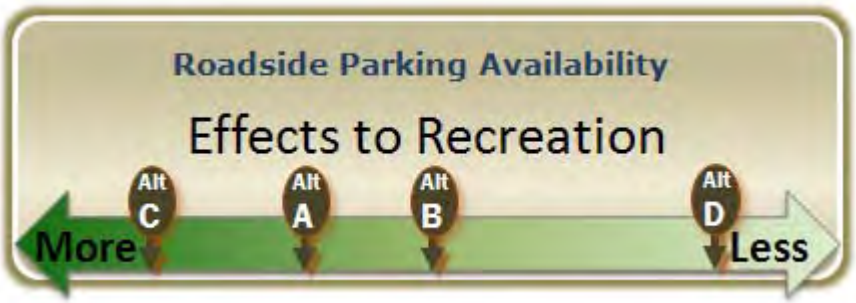
Trailheads - Trailheads serve as the portals to trail systems throughout the Basin. Trailheads can range from highly developed sites such as Eagle Falls with amenities like paved parking, restrooms and trash bins, to informal parking on the side of the road offering very few parking opportunities. Regardless of their development scale, trailheads are primarily portals for trails leading into the general forest where visitors participate in dispersed recreation activities (See

access section). The following is a general summary of trailheads available for the different levels of desired dispersed recreation experiences by alternative:

- Alternative A and B - Maintain current parking capacity by increasing managed parking areas as unmanaged areas are eliminated.
- Alternative C –Increase current parking capacity by increasing managed parking areas.
- Alternative D –Reduce current parking capacity by adding minimal managed parking and reducing unmanaged parking.

In all alternatives roadside parking would be reduced where parking congestion, safety and resource impacts are determined to be unacceptable.

The sliding scale below depicts parking availability by alternative.



Dispersed Summer Recreation -Motorized Access - Existing regulations regarding operation of vehicles on non-paved forest roads and trails would not change significantly in any alternative. Vehicles will continue to be restricted to designated roads and trails in all alternatives. The emphasis on the length of designated routes available for differing user groups will vary in each alternative. Enforcement, user education, and signing will be effected by alternative.

Satisfaction levels for off-highway vehicle users will vary by the miles available to each of the different user groups: Passenger Cars, High-Clearance Vehicles and OHV's. Generally the upgrading of existing roads will reduce the quality of recreation opportunities for motorcycles, all-terrain vehicles and 4x4 vehicles because of the loss of challenge. At the same time those seeking easier access to remote locations will benefit from the relative comfort and ease of access over new or reconstructed roads.

Summer OHV users seeking challenging routes will be influenced most by the length of road and trail systems, the location of designated routes and the quality of the riding experience. For these users difficult routes would be preferred over improved routes. Table3-51 describes the mile of roads and trails available for each user group by alternative.

Table 3-51. Miles of Roads and Trails for Motorized Use

Types of Roads and Trails	Existing Authorized Roads	Alternative A	Alternative B	Alternative C	Alternative D
Miles Roads Open to Passenger Vehicles	84	84 No Change	89 +5 miles +6%	106 +22 miles +26%	74 -10 miles -12%
Miles roads Open to High-clearance Vehicles	148	148 No Change	150 +2 miles +1%	138 -10 miles -7%	148 No Change
Miles Road Open to OHV	115	115 No Change	115 No Change	110 -5 miles -4%	130 +15 miles +13%
Miles Trails Open to Motorized Use	15	15 No Change	15 No Change	20 +5 miles +33%	10 -5 miles -33%

The following is a general summary of roads available for the different levels of desired dispersed recreation experiences by alternative:

Miles of Roads: Passenger Vehicles – Visitors who enjoy driving for pleasure in their passenger cars will find the most satisfaction in Alternative C with approximately 22 more miles (+26%) of upgraded roads from existing for access to both dispersed and developed recreation sites. Scenic driving is a popular recreational activity on NFS lands in the basin.

In Alternative A, the current level of passenger car roads would be maintained with minimal changes. In Alternative B, approximately 5 more miles (+6%) would be upgraded to passenger car roads for access to both dispersed and developed recreation sites than in Alternative A. Alternative D would offer approximately 10 fewer miles than in Alternative A for visitors driving passenger vehicles on forest roads.

Miles of Roads: High Clearance Vehicles – There is little difference between Alternatives A, B and D for visitors who drive High-clearance vehicles, Alternative B with 150 miles will offer the most miles of roads maintained for that use, 2 more miles that Alternatives A and D with 148 miles. In Alternative C approximately 10 fewer miles of road than in Alternatives A and D would be managed for high clearance vehicles for access to dispersed recreation, utilities, and for forest management.

Miles of Roads open to OHV- OHV road users have more options under Alternative D with 130 miles (+13%) of roads maintained at these more challenging levels as maintenance levels of

other roads decline. In Alternatives A and B the current level of roads open to OHV's (115 miles) would be maintained with minimal changes. Alternative C would offer the fewest with 110 miles, or a reduction of 4%.

Miles of Trails Open to OHV -Alternative C offers 20 miles of trails for OHV users which is 25% more than Alternatives A and B and 50% more than Alternative D at 10 miles. Under Alternative D, approximately 5 miles of trail currently open to motorized use would be closed to motorized use within the Freel Peak wilderness recommendation. Alternative D would result in a reduction in road maintenance levels resulting in increasing the mileage of roads open to non-licensed OHV's and decreasing access for passenger car vehicles.

The sliding scale below depicts the general class levels by alternative.

Dispersed Winter Recreation Non-Motorized – Non-motorized dispersed winter recreation such as cross-country skiing, snowshoeing, and snow play is a growing part of the total use of NFS lands. While there are many high quality opportunities for these activities around the basin, few have established winter parking. Due to this situation, increased competition for parking, localized crowding, and potential conflict between recreationists is the anticipated future condition for all alternatives. The following is a general summary of dispersed winter trailheads/parking available for the different levels of desired winter recreation experiences by alternative:

- Alternatives A and D- Maintain existing winter parking capacity. Some sites may be eligible in the future for additional winter parking to support existing winter recreation opportunities.
- Alternatives B and C - Additional winter parking sites would be added to increase access to both dispersed and developed recreation activities.

The sliding scale below depicts the general class levels by alternative.

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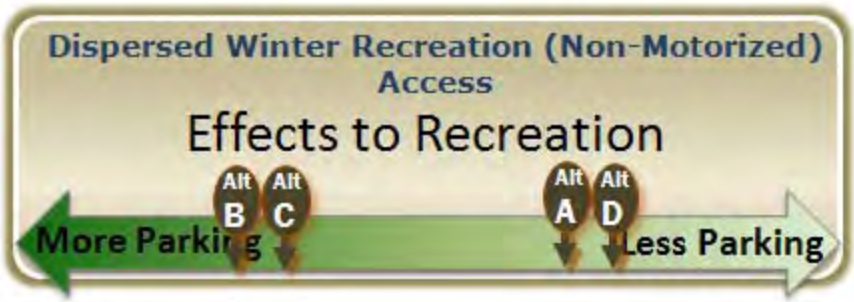
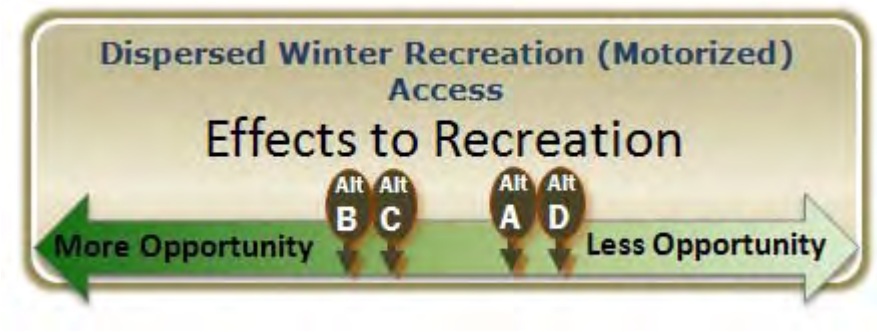


Dispersed Winter Recreation Motorized – Over Snow Vehicle (OSV) users currently have access to approximately one half of the total Forest Service acres in the basin (80,458 acres (52%) open to OSV use vs. 74,296 acres (48%) closed). Existing regulations regarding operation of OSV's as depicted in the 2010 Snowmobile Guide are expected to continue until the OSVM (Over Snow Vehicle Management) plan is completed. Over-the-snow vehicle uses are most affected by area wide closures such as those resulting from species protection, urban buffers, and wilderness designations.

In Alternatives A, B and C, opportunities for OSV use are not anticipated to change largely from existing conditions as depicted in the current Snowmobile Use Guide. Some areas traditionally used for OSV use could be closed in these alternatives in the future due to potential future development of recreation facilities and ski areas. These potential expansions are unknown at this time. In Alternative C, the recommendation of the Dardanelles Roadless area as new wilderness would not change areas currently open or closed to OSV's, as that area is already closed for OSV use.

OSV users will be displaced in Alternative D by the recommendation of wilderness destination for the 15,341 acre Freel Roadless area. Though the Freel area is designated as semi-primitive non-motorized and is closed to motorized use during the summer, 59% or 9,084 acres are currently open to winter motorized use. Snowmobile use in the Freel Peak area is currently popular with visitors and residents alike. The area provides approximately 6% of the terrain available to snowmobiling use in the Basin.

Many users of this area are residents who gain access to open terrain via their backyards. Users displaced by the area closure will have to find other areas to participate in this activity, most likely in the nearby Hope Valley in the Humboldt-Toiyabe National Forest. Users from nearby neighborhoods will have to trailer their machines to other open areas. There is a high likelihood that users will not comply with new restrictions and will continue to use the area for snowmobiling. This eventuality will increase enforcement needs in the future. The sliding scale below depicts the acres available to OSV opportunities by alternative.



Vegetation and Fuels Management

Vegetation and fuel management strategies generally result in a more stable forest condition which is more resistant to catastrophic wildfires and insect infestations. These activities overall have a positive effect on recreation activities as a healthy environment is what most visitors to forest lands would like to experience. Vegetation treatments often improve scenic conditions by opening views of the Sierra Nevada Mountains and Lake Tahoe. Vegetation and fuels management treatments have short-term impacts generated from actual project activities that generally range from 1 day to 1 month, and long term impacts visual impacts resulting from treatments that last from 1month to up to 5 years or until evidence of the treatments become largely unnoticeable.

The primary activities generated from vegetation and fuels management generally include; prescribed fire – under burning and pile burning, hand and mechanical thinning, aerial tree removal with helicopter or small mobile yarding, and temporary road construction and rehabilitation. These activities may result in short term consequences to recreation resources from temporary closures, noise and dust that are created in the preparation stages of the treatments and from helicopter yarding, the slash piles that remain on the landscape for several years to cure, the temporary smoke generated from the burning process itself, and the end result of a blackened landscape that may persist for several years.

The degree of impact to recreation resources from thinning projects and prescribed fire and is primarily short term and is largely a function of proximity, or how close they occur to where people recreate or live. The further these processes occur from these activity centers, the less impact they will have.

Other than in wilderness areas, fuels treatments can occur throughout the forest including the Wildland Urban Interface (WUI). If treatments occur close to roads and trails or other areas where people recreate and live, they may affect the experiences of those users and satisfaction levels may be lower. For example if burn piles are left close to trails for several years to cure, hikers will be exposed to the unnatural character of the piles, and once burned they will see the fire scar for up to 5 years until it heals and vegetation is reestablished. Of course if areas are temporarily closed and access is denied, users may have to momentarily adjust their expectations find other places to recreate.

Seeing and breathing smoke from prescribed burns has a larger zone of influence than other activities and is one of the unfortunate side effects of prescribed burns that may affect visitor's

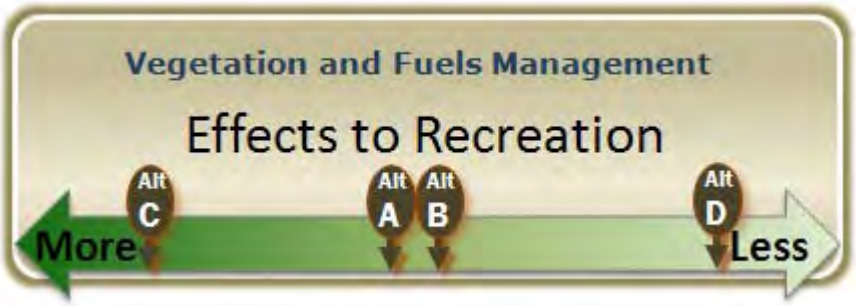
experiences and lessen satisfaction ratings. Helicopter yarding also can also be heard from larger distances that other mechanical operations and can impact a larger range of forest visitors.

Temporary roads are often constructed as a part of vegetation management projects to access areas not accessible from the permanent road system. Though these roads are temporary and closed to vehicle traffic by the general public, they are often used by hikers, equestrians and mountain bikers. This unregulated use is not problematic until resource impacts occur such as off road incursions into open forest areas, and then management actions are needed to regulate the activity.

Alternatives A, B and D propose 4,550 acres/year in all categories of fuels and vegetation treatments, while Alternative C would propose to treat a total of 5,600 acres/year.

For treatments in the WUI, Alternatives A and B will treat 3,800 acres per year and Alternative C and D would treat 4,100 acres/year or 300 more acres than Alt's A and B. People who recreate in WUI's or live near them will experience more impacts in Alternatives C and D.

For those who recreate in the Backcountry, General Conservation Areas, and on Santini-Burton urban lots, Alternatives A and B propose 750 acres of fuels and vegetation treatments. Alternative C would propose to treat 1500 acres/year (double Alternatives A and B) therefore have more short term impacts to dispersed recreation resources. Impacts from forest thinning would be lowest under Alternative D, which proposes the least amount of forest vegetation treatment at 450 acres.



Aquatic and Terrestrial Invasive Species Management

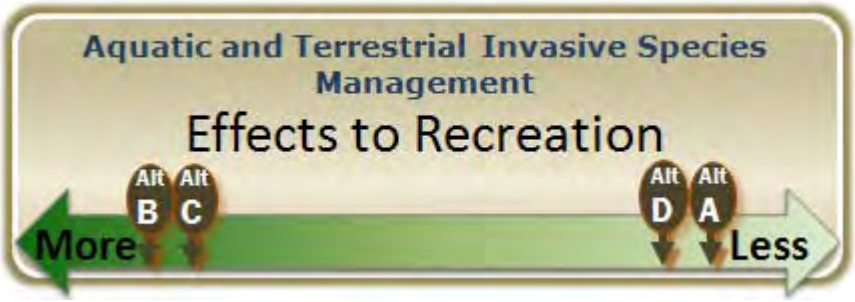
Effects to dispersed recreation resources from aquatic and terrestrial species management will be similar in all alternatives. As mentioned in more detail in the Developed Recreation section, activities generated from Aquatic and Terrestrial species management are generally short term in nature and include prevention, control and eradication techniques.

Aquatic control and eradication strategies include; manual removal using electro shockers, gill nets and traps, and chemical removal. Terrestrial control and eradication strategies include removing weeds by hand or with tools, using herbicides, and using thermal methods such as torching among others. These methods are used on a project by project basis and are not used if they present any danger to visitors.

Most aquatic and terrestrial species management actions are considered to be short term as they do not generate long-term closures or modifications to recreation areas. Short term closures of up to several months may occur at lakes or streams as treatments are applied and for up the several days for terrestrial species treatments.

Effects to recreation resources from aquatic species management activities are most likely in Alternatives B and C as there will be from 0.5 -1 mile of streams treated. Alternative A and D will have fewer effects as there will be from 0 to .5 miles treated respectively.

Effects to recreation resources from terrestrial invasive species management are most likely in Alternatives B and C as there will be from 5 – 40 acres eradicated. Alternative A and D will have fewer effects as there will be from 0 to 5 acres treated respectively.



Species Recovery Habitat Restoration

The primary species of interest in Backcountry areas on the LTBMU are the Lahontan Cutthroat Trout and Sierra Nevada Yellow Legged Frog. Impacts to dispersed recreation activities from species recovery and habitat restoration can occur when areas are closed to recreation activities for varying periods of time or when activities are prohibited or displaced.

Short term impacts (from several hours to several days depending on the species and type of treatments) may arise from management strategies such as the reintroduction of the Lahontan Cutthroat Trout (LCT) into local streams and rivers. This is often accomplished by eliminating

the current populations of non-native rainbow, brown or brook trout so that new populations of LCT can be established. Fishing patterns may be disrupted for periods of time as treatments are applied and new LCT populations are introduced and become stable enough to reintroduce fishing.

Long term impacts from aquatic species management may occur when existing recreation opportunities are changed or eliminated. An example would be if the actions initiated for the control of aquatic invasive species, modified recreation opportunities such as ending fishing opportunities in some alpine lakes by eliminating non-native brook trout species to enhance habitat for the yellow-legged frogs. In this case, recreationists who enjoy fishing for brook trout will be disappointed if fishing in those particular lakes was their favorite activity. Displaced fisherman may then move on to other lakes and increased impacts may occur at these new locations

Long term impacts to winter motorized activities from Species Recovery Habitat Restoration actions are generated when access to terrain is limited or closed to OSV's. All alternatives proposed to maintain 1 Sierra Nevada Yellow Legged Frog sub-population and to restore 9. These actions may close terrain that OSV's currently access such as Hell Hole in the Freel Roadless area.

Consequences Related to Recreaton Develoment

Developed Recreation

Developed Recreation Overview - Under all alternatives, as the diversity of recreation visitors increases, satisfaction of users becomes more contingent upon a diverse mix of recreation opportunities. So long as users continue to receive visitor information describing experiences they are likely to encounter during peak periods, and construction of facilities for lodges, camping, picnicking, beach use, and the like occur at a rate sufficient to support most of the future demand for those activities, users could expect to have a high quality experience and be satisfied.

The quality and quantity of developed recreation opportunities would vary in all alternatives depending on the supply and type of facilities developed. Should demand exceed available supply, recreationists would be adversely affected as prices and crowding increase. Concessionaires, whose livelihoods depend on the ability to provide facilities and services to meet demand, will find more opportunities under those alternatives that provide for increasing the supply of facilities.

Development of new sites could help meet demand from the growing population but may not reduce the use of existing popular sites. Without an increase in supply at popular developed sites, visitors will continue to be displaced during peak use periods. Typically these displaced visitors seek their preferred experience in the vicinity of the developed site or find alternatives in nearby undeveloped areas. This increases the potential for resource damage in the surrounding area. Building new recreation sites may be possible in some instances however since most of the premiere recreation sites have already been developed, any newly developed sites may not be as desirable as the visitors original destination.

As populations continue to increase and the ability to meet public demand diminishes, some sites will become increasingly overused and crowded. This currently occurs at peak times such as holidays and weekends, but over time this could extend to much of the primary recreation season from Memorial Day to Labor Day. This will result in lower satisfaction levels and some visitors will have unmet expectations. Some will seek the supply of developed recreation on state, county and private lands.

Those management activities that may have the most effect on Developed Recreation resources are:

- Modifying Developed Recreation Facilities
- Access and Travel Management
- Watershed (Stream Channel and Habitat) Restoration
- Vegetation and Fuels Management
- Aquatic Invasive Species Management
- Species Recovery Habitat Restoration

Activities generated from other management actions such as; Wilderness and Recommended Wilderness, changes in Recreation Opportunity Spectrum Classes and Dispersed Recreation are not anticipated to affect developed recreation resources to a large degree. Some minor impacts may be generated from resource management activities that are ongoing and not considered in this analysis. For example it is understood that some seasonal closures or restrictions may be placed on recreation uses in key wildlife habitat areas during the nesting or wintering season for certain species. Also it is understood that a broad spectrum of dispersed recreation opportunities will encourage more visitation to the Basin and result in positive economic benefits to concessionaires and to the local community. Visitor use is not anticipated to be influenced by general resource management activities as recreation demand is not driven by forest management practices. In summary, recreation visitation and use will increase in all alternatives: however the location, type, rate and intensity will vary by alternative.

Modifying Developed Recreation Facilities

Recreation visitation and resulting demand and use is anticipated to increase in all alternatives and none of the alternatives are anticipated to accommodate all the projected demand during the peak season from July 4th thru Labor Day. At a minimum, all alternatives will focus on deferred maintenance or modification of existing facilities to help achieve accessibility and sustainability of recreation opportunities.

Quantities of recreation infrastructure will vary as each alternative provides more or less supply by expanding or reducing developed infrastructure in response to future recreation demand. Alternatives A and C will have the most potential to respond to increased public demand by retrofitting existing facilities or building new ones. Alternative A can increase supply by up to 10% (+ 130 Acres, + 107 Overnight Units, and + 226 Dayuse Parking), Alternative C up to 15% (+195 acres, +161 Overnight Units, +339 Dayuse Parking) respectively. Alternative B will allow up to a 5% increase (+65 Acres, +54 Overnight units, +113 Dayuse Parking) in new or expanded facilities. The greatest effects from unmet demand will come from Alternative D as it will have the least ability to respond to demand as developed recreation infrastructure is

potentially lost to resource restoration. This is a possible 15% loss of infrastructure equaling - 195 acres, - 161 Overnight units and - 339 Dayuse Parking Spaces.

Visitor's, who desire more developed recreation infrastructures for their activities, could expect a higher quality experience in Alternatives A, B and C, so long as the maintenance and construction of facilities occur at a sufficient rate to support most of the demand. Alternative C has the most opportunity to provide more developed infrastructure to meet increased future demands. In Alternative D, as demand exceeds available services due to the loss of developed facilities, recreationists will be adversely affected as prices and crowding increase and their sense of satisfaction lessens. Conversely, Alternative D may suit those visitors who prefer dispersed recreation activities such as hiking/walking that rely less on constructed infrastructure.

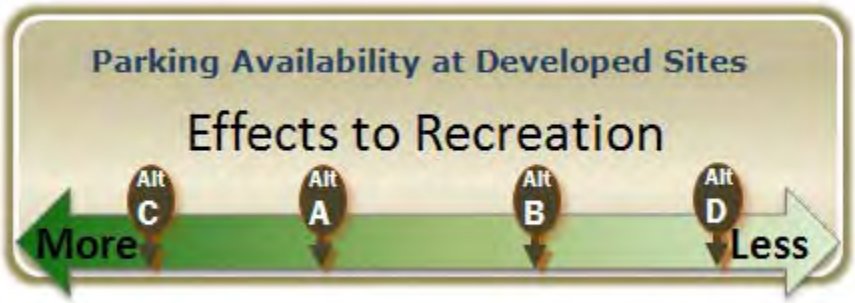
Accessibility improvements will continue in all alternatives. Effects from accessibility improvements include a greater satisfaction for users of all abilities as more sites become accessible. Families of all ages and ability levels can share the same facilities and site furnishing, and visitors with accessibility needs will find their choices have broadened in selecting campsites, picnic sites and other types of developed recreation sites.

There will be more short term construction impacts (1 month to 1 year) in Alternative C than in the other alternatives since there is the potential for more retrofitting or expansion of developed facilities. In general these impact will include: initial site construction (grading of sites for roads, campsites and parking spurs), clearing of vegetation (tree removal), grading of sites, asphalt and concrete installation (non-permeable surfaces such as roads, parking lots, and structures), and trenching for utilities. These impacts may generate short term detours or closures in recreation sites, and some inconveniences to visitors from construction related noise and dust. Some short term impacts may be substantial if recreation sites are closed for improvements during the peak season and visitors are displaced to other locations. These impacts must be weighed in relation to the long term gain of the approved project. There will be fewer short term construction impacts in Alternative D than in the other alternatives since there will be fewer construction projects.

The availability of developed recreation facilities to meet demand per alternative is depicted on the sliding scale below:

Access and Travel Management

As stated in the access section of this EIS, general access to developed recreation sites for all alternatives, would tend to shift towards consolidated access routes and parking facilities that would incorporate mode transfer to promote use of transit or bike path systems over the private automobile. In Alternatives A, B, and C where roadside parking is reduced or eliminated outside of developed recreation sites, some of the parking demand would be absorbed within managed recreation sites or by expanding associated parking facilities. All alternatives would result in a reduction in overall parking as roadside parking is eliminated and access shifts toward transit and bike path systems. In Alternative D, a reduction in overall developed recreation sites could result in reduced parking facilities and vehicle access to sites that are removed creating addition demand for alternative transportation and other parking options. The sliding scale below depicts the general class levels by alternative.



Watershed (Stream Channel and Habitat) Restoration

Stream Channel and Habitat Restoration activities would result in short term impacts of limited extent and net long term gains as stream zones are stabilized. Generally speaking, a resource action that protects and enhances the overall environmental health and integrity of the Lake Tahoe Basin is beneficial to recreation interests if they do not reduce recreation opportunities or restrict access. A healthy environment is a primary reason that recreationist enjoy the Lake Tahoe Basin.

Short term impacts (1month to 1 year) from stream channel restoration on developed recreation resources results from the use of heavy equipment (excavators, dozers, dump trucks) and from restoration activities such as sod borrowing, stock piling materials, de-watering streams, and short term closures. Meadow restoration activities such as broadcast burning, hand thinning, and mechanical thinning also generate short term impacts. These restoration activities are generally transitory in nature but will effect nearby developed recreation facilities by the creation of noise, dust, smoke from broadcast burning, and potential closures for the life of the project. The recreating public may be temporarily inconvenienced by these activities.

There are some potential long term detrimental effects from restoration actions to existing recreation infrastructure that would potentially affect quality (modification), quantity (removal), and access (road closures or decommissioning) of exiting recreation resources. Actions that

affect recreation management's effort to meet demand by reducing supply will change the overall recreation experience from existing. For example if restoration activities remove a recreation amenity from a stream environment zone for resource enhancement, visitors accustomed to using that facility may be disappointed if they are unable to enjoy that specific location. Displaced visitors may not be able to duplicate their high expectations at newly provided locations or experience crowding if there is an overall loss of capacity. New visitors looking for a less developed environment may enjoy the restoration result. The number and type of those recreationists served in each instance may be very different.

The proposed watershed restoration actions for each of these activities do not differ between the Alternatives A, B, and C as restoration projects are now fully funded and more work cannot be accomplished. In Alternative D, currently planned watershed restoration projects will continue until completed, and then the strategy for watershed management will be to rely on natural processes for recovery. Effects from these activities on developed recreation resources are more likely under Alternatives A, B and C as they will be restoring the most miles/acres and have the most potential to remove or relocate existing developed recreation features from sensitive resource areas. The direct effects from these actions would be analyzed on a project by project basis. The sliding scale below depicts the general class levels by alternative.

Vegetation and Fuels Management

Please see the Vegetation and Fuels Management in the Access - Dispersed Recreation Section. Impacts from vegetation and fuels management are similar for both dispersed and developed recreation activities.

As previously stated, vegetation and fuel management strategies generally result in a more stable forest condition which is more resistant to catastrophic wildfires and insect infestations. These activities overall have a positive effect on recreation activities as a healthy environment is what most visitors to NFS lands would like to experience. Vegetation treatments often improve scenic conditions by opening views of the Sierra Nevada Mountains and Lake Tahoe. Vegetation and fuels management treatments have short-term impacts generated from actual project activities that generally range from 1 day to 1 month, and long term impacts visual impacts resulting from treatments that last from 1month to up to 5 years or until evidence of the treatments become largely unnoticeable.

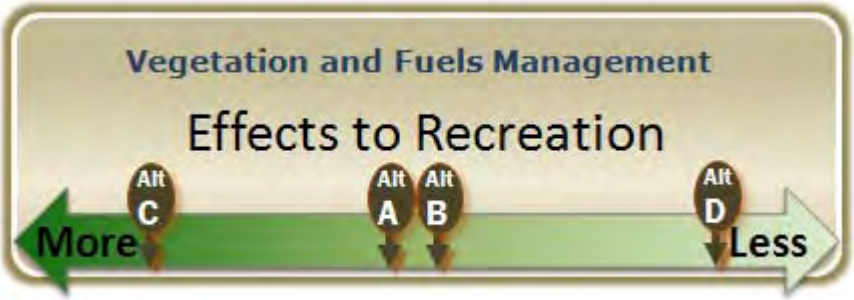
Impacts to developed recreation resources from vegetation and fuels management will primarily be generated by treatments within the Wildland Urban Interface (WUI) where most developed recreation site exist. The degree of impacts to developed recreation resources from treatments that include thinning projects and prescribed fire, is largely a function of proximity or how close

they occur to where people recreate. The further these processes occur from recreation activity centers, the less impact they will have. If these activities occur close to resorts, campgrounds, or dayuse areas, they may affect the experiences of those users and satisfaction levels may be lower.

Seeing and breathing smoke from prescribed burns has a larger zone of influence than other activities and is one of the unfortunate side effects of prescribed burns that may affect visitor's experiences and lessen satisfaction ratings. Helicopter yarding can also be heard from larger distances than other mechanical operations and can impact a larger range of forest visitors. There is also the potential to remove vegetation from developed recreation sites that previously screened development. An example would be the removal of young trees in campgrounds to reduce their density, that currently provide screening and privacy from other campsites or from nearby roadways.

Longer-term impact may result from fuel treatments and may be evident for some time. For example, the blackened landscape left after broadcast burning may take several years to recover and affect visual experiences (See Scenic Section).

For treatments in the WUI, Alternatives A and B will treat 3,800 acres per year and Alternative C and D would treat 4,100 acres/year or 300 more acres than Alt's A and B. Visitors in developed recreation sites near WUI treatments will experience more impacts in Alternatives C and D.



Aquatic and Terrestrial Invasive Species Management

Effects to developed recreation resources from aquatic and terrestrial species management will be similar in all alternatives. Activities generated from Aquatic and Terrestrial species management are generally short term in nature (1 day to 1 month) and include prevention, control and eradication techniques.

Prevention methods for Aquatic Invasive Species include using signs, education, boat inspections and boat washing stations. Aquatic control and eradication strategies include; manual removal using electro shockers, gill nets and traps, and chemical removal. Most aquatic and terrestrial species management actions are considered to be short term as they do not generate long-term closures or modifications to recreation sites. Short term closures of some sites such as marinas may occur as treatments are applied. Also visitors with water craft may

experience delays of up to several hours as boats are inspected for aquatic invasive species and boats are washed if needed.

Terrestrial control and eradication strategies include removing weeds by hand or with tools, using herbicides, and using thermal methods such as torching among others. Some recreation sites may experience short term closures as weed abatement techniques are applied. These methods are used on a project by project basis and are not used if they present any danger to visitors.

Species Recovery Habitat Restoration

Impacts from species recovery habitat restoration will be the same in all alternatives. Restoration activities may reduce the availability of recreation settings if areas closed to public access. Impacts related to recreation activities are expected to be minimal in all alternatives depending on the location and scale of the closures. An example would the potential loss of available sandy beach for recreation activities by protecting Tahoe Yellow Cress via fence enclosures. The current enclosures are usually less than ¼ acre and do not represent a large percentage decrease of available sandy beach acres. There are currently 8 enclosures at various beaches around the Basin however the number and locations of the enclosures are not static, nor dependent on alternative.

Winter Sports (Alpine Skiing)

Privately developed downhill skiing on the LTBMU provides a major economic and recreation benefit to the Region. In all alternatives, the operation and maintenance of the existing developed ski areas continues including summertime use that is consistent with laws, regulations, and Forest Service policy pertaining to that use.

For the purposes of this analysis, the operational boundary of existing ski areas was used to measure environmental consequences of the proposed action and alternatives. This considers that the operational boundary, including cleared ski runs, and developed facilities better represents the area in which there is likely to be direct and indirect effects on natural and cultural resources. The operational boundary also represents the area in which expansion is likely to occur.

Those management activities that may have the most effect on Winter Sports resources are:

- Modifying Developed Recreation Facilities
- Vegetation and Fuels Management
- Species Recovery Habitat Restoration

Modifying Developed Recreation Facilities

In all alternatives, in order to maintain a high quality experience, emphasis will include the need to balance chairlift up-hill capacity and terrain/downloading capacity. Generally, alternatives that provide flexibility to meet demand while enhancing the skiing experience, will allow ski areas on the LTBMU to remain competitive and maintain their existing share of the total market.

Alternative A

Heavenly Mountain Resort – Currently, chairlifts, cleared ski runs, lodges, support facilities, and intensive off-piste tree skiing occurs on a footprint of approximately 2,890 acres. Alternative A confines intensive ski area development to approximately 4,200 acres within the 7,700 acre special use permit boundary. This is due to existing LRMP direction that applies the Maintenance Management Area Prescription to a large portion of lands within the special use permit boundary.

While the Maintenance Management Area Prescription does not preclude all ski opportunities, the emphasis for these areas is to serve as a scenic backdrop to Lake Tahoe, left in a nearly natural condition. This includes the steep northwest facing slope of East Peak. Alternative A may allow glading and off-piste terrain/vegetation modification within the Maintenance Management Area Prescription if those activities comply with visual quality and watershed objectives.

Alternative A allows for new ski run construction and widening within the "Alpine Skiing Management Prescription". Alternative A allows for the development of additional support facilities and lodges.

Alpine Meadows - Alternative A allows for expansion of the existing ski area, including portions of NFS lands currently not under special use permit. Alternative A maintains the "Alpine Skiing Management Prescription" on approximately 2,605 acres in the Ward Management Area.

Diamond Peak Ski Area - Ski area expansion may not occur beyond the existing special use permit boundary because the "Alpine Skiing Management Prescription" is identical to the special use permit boundary. However, Alternative A allows for more intensive development within the existing special use permit boundary

Homewood Mountain Resort - Alternative A allows for expansion of the existing ski area, including portions of NFS lands currently not under special use permit. Alternative A maintains the "Alpine Skiing Management Prescription" on approximately 760 acres in the McKinney Management Area.

Northstar California – Currently, Northstar California is entirely on private land. Alternative A allows for expansion of the ski area onto NFS lands south and east of Mt. Pluto. Alternative A maintains the "Alpine Skiing Management Prescription on approximately 300 acres in the Watson Management Area.

Alternative B

Heavenly Mountain Resort - Alternatives B removes the "Maintenance Management Area Prescription" and ski area expansion beyond the special use permit boundary may occur. Ski area development in Alternative B may occur in lands previously designated as "Maintenance Management Area." Existing special use permit boundary may expand by 5%.

Alpine Meadows – Alternative B allows ski area expansion beyond the existing special use permit boundary. Areas of expansion would be limited by specific resource concerns. In Alternative B, the elimination of the 2,605 "Alpine Skiing Management Area Prescription" adjacent to the existing special use permit boundary restricts future expansion of the special use permit boundary to 5%.

Diamond Peak Ski Area – Alternative B allows ski area expansion beyond the existing special use permit boundary. Areas of expansion would be limited by specific resource concerns. Existing special use permit boundary may expand by 5%.

Homewood Mountain Resort – Alternative B allows ski area expansion beyond the existing special use permit boundary. Areas of expansion would be limited by specific resource concerns. Existing special use permit boundary may expand by 5%.

Northstar California -Northstar California is entirely on private land and is not affected by this alternative.

Alternative C

Heavenly Mountain Resort – Heavenly Mountain Resort - Alternatives C removes the "Maintenance Management Area Prescription" and ski area expansion beyond the special use permit boundary may occur. Ski area development in Alternative C may occur in lands previously designated as "Maintenance Management Area." Existing special use permit boundary may expand by 15%.

Alpine Meadows – Alternative C allows ski area expansion beyond the existing special use permit boundary. Areas of expansion would be limited by specific resource concerns. In Alternative C, the elimination of the 2,605 "Alpine Skiing Management Area Prescription" adjacent to the existing special use permit boundary special use boundary may expand by only 15%.

Diamond Peak Ski Area – Alternative C allows ski area expansion beyond the existing special use permit boundary. Areas of expansion would be limited by specific resource concerns. Existing special use permit boundary may expand by 15%.

H**omewood Mountain Resort** – Alternative C allows ski area expansion beyond the existing special use permit boundary. Areas of expansion would be limited by specific resource concerns. Existing special use permit boundary may expand by 15%.

Northstar California - Northstar California is entirely on private land and is not affected by this alternative.

Alternative D

Alternative D restricts all ski areas to their existing special use permit boundary with no opportunity to expand. Alternative D allows for the replacement of existing improvements such as lodges, and chairlifts. Alternative D does not allow for new ski run construction or widening. National Forest System lands not developed may be removed from future special use permits when reissued.

Alternative D mostly affects Heavenly Mountain Resort and would eliminate new ski run terrain identified in the 2007 Master Plan Amendment.

The sliding scale below depicts availability of winter ski opportunities by alternative.

Table 3-52 displays the existing ski area acreage and maximum ski area acreage in each alternative.

Table 3-52. Maximum Ski Area Special Use Permit Acreage

Ski Area	Existing Special Use Permit Boundary (NFS Lands)	Alternative A[1]	Alternative B[2]	Alternative C[3]	Alternative D[4]
Heavenly Mountain Resort	7,700	7,700	8,085	8,855	6,545
Alpine Meadows	128	2,605	135	147	109
Diamond Peak Ski Area (On NFS lands)	292	292	307	336	248
Homewood Mountain Resort (On NFS lands)	204	964	214	235	173
Northstar California (On NFS lands)	0	300	0	0	0

Notes:
[1] Existing special use permit boundary and/or Alpine Skiing Management Prescription adjacent to existing special use permit.
[2] Existing special use permit boundary acreage on National Forest System lands + 5%.
[3] Existing special use permit boundary acreage on National Forest System lands +15%.
4 Existing special use permit boundary – 15%.

Vegetation and Fuels Management

Generally, vegetation management activities enhance downhill skiing by allowing better utilization of skiable terrain. For example, Solitude Canyon at Diamond Peak Ski Area provides excellent off-piste skiing opportunities. In recent years, the timber stand and ground vegetation has grown increasingly thick making skiing more difficult. Timber

stand thinning and ground vegetation treatments would clear existing slopes and improve visibility, thus enhancing downhill skiing.

Some vegetation management projects may have a detrimental short-term impact on ski terrain access due specific disposal techniques. For example, pile burning adjacent to or within ski area boundaries may pose a short-term hazard due to the placement of piles on skiable terrain.

Some long-term impacts may occur if large downed trees are not treated. Specifically, large downed trees create greater distance between the ground and the skiable surface. This results in the need for greater snow depth to avoid hitting obstacles. In all alternatives, the "Easy Street Run Prescription" is the preferred method by which downed trees and woody material are treated within developed ski runs. However, the Easy Street Run Prescription may not be implemented when it conflicts with specific resource objectives.

The term "Easy Street Run Prescription" originated from implementation of the vegetation management strategy on the Easy Street ski run at Heavenly Mountain Resort. The Easy Street Run Prescription includes the following vegetation management actions:

- Existing native shrubs within or adjacent to developed ski runs are identified and avoided.
- Noxious weeds are flagged and identified for removal.
- Felled trees and woody debris less than 10 inches are chipped, and the resulting mulch evenly distributed to an average depth of 3 inches.
- Felled trees and logs larger than 10 inches are removed to a sufficient distance from the developed ski run (e.g. adjacent tree island).
- Existing tree stumps are ground down.
- Boulders will be moved or shortened to a height between 12 and 18 inches from the ground.

Potentially, vegetation management may increase solar gain on the snowpack or affect wind-related snow loading at site-specific locations. However, such potential effects are not discernible at the Forest Plan level.

Ski areas are primarily in the Backcountry and General Conservation Areas on NFS lands. Alternatives A and B propose 750 acres of fuels and vegetation treatments in those management areas. Alternative C proposes to treat 1500 acres/year (double Alternatives A and B) therefore have more short term impacts to ski areas. Impacts from forest thinning would be lowest under Alternative D, which proposes the least amount of forest vegetation treatment at 450 acres.

Species Recovery Habitat Restoration

Impacts to ski areas from species recovery habitat restoration activities will be the same for all alternatives. Generally, a habitat restoration activity that enhances the overall environmental health and integrity of the Lake Tahoe Basin is beneficial to ski area

interests. However, there is potential for some restoration activities to affect winter sports opportunities. For example, area closures may eliminate skiable terrain causing crowding on adjacent terrain or a loss of opportunity. In any alternative that resource actions affect recreation management's effort to meet demand, the overall recreation experience will be changed from existing.

Consequences Related to Stewardship

Interpretive, Conservation Education and Public Services

There are no anticipated consequences to Interpretive, Conservation Education and Public Services from the implementation of the Forest Plan. They are the same for all alternatives. There are no programmatic differences between the alternatives. (Please see the Interpretive Services, Conservation Education, and Visitor Services Section).

Sustainable Recreation

Strategies to manage recreation sites and activities for sustainability are the same for all alternatives. There are no programmatic differences between the alternatives. (Please the discussions for other resources that manage natural resources where recreation activities exist.)

Consequences Related to Climate Change

There are no anticipated consequences to recreation resources from climate change through the implementation of the Forest Plan. There are no programmatic differences between the alternatives. Throughout the life of the plan however, variable precipitation rates can affect recreation resources in many ways including the ways people recreate and by impacting their recreation opportunities.

Skiing – Wider yearly swings in precipitation creates more boom and bust seasons in the skiing industry. Drier years can have a huge impact on the economic viability of ski areas not to mention the missed skiing opportunities by the public. Drier years create more reliance on water resources for snow making capabilities. On the other hand, a wetter winter can create ideal skiing conditions.

Water Play and Fishing – Also affected by precipitation rates are those activities that rely on dependable stream flows such as water play and fishing. Already noticeable in the Tahoe area are season when the lower Truckee River is barely flowing during drought periods. Very popular rafting activities come to a near halt at those times. Conversely in high water years rivers run strong to the benefit of river runners and Lake Tahoe fills. This can create more crowding as visitors vie for beach space.

Water Supplies –Water supplies for recreation sites that depend on springs, stream runoff and high water tables can be less reliable during drier years. Water supplies for campgrounds,

dayuse sites and even recreation residences can go dry. The public's anticipation of a high quality recreation experience can be challenged when there is little or no water.

Extended Seasons – During warmer cycles, the opportunities for experiencing summer recreation activities could be extended.. This may allow resorts and concessionaires more economic opportunities to provide services to the public and will extend the time that summer dispersed recreation activities are obtainable.

Effects To Recreation From Wildlife Resources Changes – Changing climate patterns can create shifts in migratory populations and may affect bird watching, wildlife enthusiasts, and hunters.

Summary – The seasonal unpredictableness of how climate change will be manifested over the life of the plan will require that recreation managers and providers remain flexible in how they deliver opportunities and services to the public. There will most probably be more boom and bust cycles for various recreation opportunities. The public will have to modify their expectations for the types of recreation experiences they are seeking.

3.4.17.4. Analytical Conclusions

Comparison of Consequences by Alternative

Recreation Opportunity Spectrum

The ROS classifications reflect the overall theme and character expressed by the settings maintained for various forest management and recreation activities.

- Alternatives A and B and C will continue the current mix of settings and activities with approximately 64% of the NFS lands providing a semi-primitive environment (SPM and SPNM) and 36% providing a more developed environment (RN and R). Alternative C is similar to A and B in its general mix of settings however up 195 more acres of general improvements to developed recreation facilities may occur in the already developed settings of RN and R. Visitors will continue to enjoy the current balanced mix of recreational opportunities throughout the Basin in these alternatives.

- Alternative D will shift the mix by 5% to Semi-Primitive Non-Motorized with a 7,410 acre increase. The increase in SPNM acres will result in a 3% decrease in both SPM and RN acres. This will result in less improved roads being available for those users who enjoy driving for pleasure in their passenger cars.

Access -Dispersed Recreation

Disperse Summer Recreation – Non-Motorized/Mechanized -Availability of summer dispersed recreation activities are affected primarily by the type of access to public lands that are needed to allow that activity to happen. Satisfaction ratings are generally improved by meeting demand by providing more access via roads, trails, and trailheads.

More access will create more opportunities for dispersed activities to occur and potentially reduce crowding and reduce conflicts.

- There are more miles of hiking trail access opportunities under Alternatives A and D than in Alternatives B and C. New wilderness recommendations in Alternatives C and D will enhance hiking and equestrian experiences by managing the areas for high wilderness standards of solitude and primitive characteristics and will remove interactions with mechanized use as mountain bikes are not allowed in wilderness areas. Alternative C would increase the acres available for wilderness recreation by 60% and Alternative D would number of acres available for wilderness recreation by 123%.

- Alternatives A and B are unchanged from existing conditions. Wilderness recommendations in Alternatives C and D will increase the availability of more primitive wilderness experiences, but it will change the character of mountain biking experiences in the Basin by prohibiting use on well-used trails such as Big Meadows and Christmas Valley in Alternative C, and Saxon Creek, Armstrong, and the Tahoe Rim Trail among others in Alternative D. Mountain bike trail opportunities will be decreased by 12.3 miles in Alternative C due to the Dardanelles wilderness recommendation. Mountain bike trail opportunities will be decreased by an additional 25.6 miles for a total of 37.9 miles in Alternative D. Alternative B will maintain the existing mix of trail uses and preserve the previously mentioned popular mountain biking opportunities. Dispersed camping opportunities in the Basin will increase with the Freel Peak Wilderness recommendation under Alternative D.

Disperse Summer Recreation – Motorized Vehicles will continue to be restricted to designated roads and trails in all alternatives. Satisfaction levels for off-highway vehicle users will vary in each alternative by the miles available to each of the different user groups: Passenger cars, High clearance Vehicles and OHV.

- Visitors who enjoy driving for pleasure in their passenger cars will find the most satisfaction in Alternative C with 76 miles of upgraded road for access to both dispersed and developed recreation sites and in support of scenic driving as a recreational activity. Alternative B offers 7 miles less than C. Alternatives A and D maintains the existing 64 miles.

- For visitors who drive High-clearance vehicles, Alternative B with 150 miles will offer the most miles of roads maintained for that use. Alternatives A and D follows with 148 miles and Alternative C with 138 miles.

- OHV road users have more options under Alternative D with 130 miles of roads maintained at these more challenging levels as maintenance levels of other roads decline. The current levels of roads open to OHV's (115 miles) would be maintained with minimal changes in Alternatives A, B and C.

- Alternative C offers 20 miles of trails for OHV users which is 25% more that Alternatives A and B and 50% more that Alternative D at 10 miles of trails. Under Alternative D, approximately 5 miles of trail currently open to motorized use would be closed to motorized use with the Freel Peak wilderness recommendation.

Disperse Winter Recreation – Non-Motorized Non-Motorized dispersed winter recreation such as cross-country skiing, snowshoeing, and snow play are growing part of the total winter use of forest lands. While there are many high quality opportunities for these activities around the basin, few have established winter parking. The following is a general summary of dispersed winter trailheads/parking available for the different levels of desired winter recreation experiences by alternative:

- Alternatives B and C allow for additional winter parking sites to be added to increase access to both dispersed and developed recreation activities.
- Alternatives A and D would maintain existing winter parking capacity. Some sites may be eligible in the future for additional winter parking to support winter recreation opportunities.

Disperse Winter Recreation –Motorized Over Snow Vehicle (OSV) users currently have access to approximately one half of the total acres in the basin 80,458-acres (52%) open vs. 74,296 acres (48%) closed).

- Opportunities for OSV use will not change from existing conditions as depicted in the current Snowmobile Use Guide for alternatives A B and C as new wilderness designations would not change areas currently open or closed. OSV use will not change in Alternative C even with the Dardanelles Wilderness recommendation as that area is already closed for OSV use and is not recommended to change.
- OSV users will be displaced by the recommendation of the Freel Peak Wilderness area in Alternative D. Though the Freel area is designated as semi-primitive non-motorized and is closed to motorized use during the summer, it is currently open to motorized use in the winter. Users displaced by the area closure will have to find other areas to participate in this activity, most likely in the nearby Hope Valley in the Humboldt-Toiyabe National Forest. Users from nearby neighborhoods will have to trailer their machines to other open areas. There is a high likelihood that users will not comply with new restrictions and will continue to use the area for snowmobiling. This eventuality will increase enforcement needs in the future.

Recreation Development

Developed Recreation

Recreation visitation and resulting demand is anticipated to increase in all alternatives for the life of the plan. None of the alternatives however are anticipated to accommodate all the projected demand at popular resorts, campgrounds and dayuse areas during the peak seasons. Increasing the supply of amenities such as overnight accommodations and day use parking spaces are not only strategies to respond to the existing and future demand but also ways of meeting visitors' expectations and raising satisfaction levels.

- Alternative C will have the most potential to respond to increased public demand on developed recreation by retrofitting existing facilities or building new ones. Alternatives A and B will also increase supply but not to the same levels as C. The greatest negative effects from unmet demand will come from Alternative D as it will have the least ability to respond to demand as developed recreation infrastructure is potentially lost and not replaced due to environmental restoration. In Alternative D, should demand exceed available services due to the loss of developed facilities, recreationists would be adversely affected as prices and crowding increase and their sense of satisfaction would lessen
- Effects to Developed Recreation from other management activities on the forest are generated by proposed actions that will relocate or remove existing recreation opportunities. These actions are most likely with Watershed Restoration. Effects from these activities on developed recreation resources are more likely under Alternatives A, B and C as they will be restoring the most miles/acres and have the most potential to remove or relocate existing developed recreation features from sensitive resource areas. The direct effects from these actions would be analyzed on a project by project basis. In Alternative D, currently planned watershed restoration projects will continue until completed, and then the strategy for watershed management will be to rely on natural processes for recovery.

Winter Sports (Alpine Skiing)

Privately developed downhill skiing on the LTBMU provides a major economic and recreation benefit to the Region. In all alternatives, the operation and maintenance of the existing developed ski areas continues including summertime use that is consistent with laws, regulations, and Forest Service policy pertaining to that use.

- Alternative A offers the most flexibility in responding to increased future skiing demand should it occur. The 1988 plan allows for large scale expansions from the existing footprint especially for the Alpine Meadows ski area with a large area of Ward Canyon identified for ski area development.
- Alternatives B and C also allow for expansion of the permitted areas but at a much smaller scale. Alternative C allows for more expansion opportunities than Alternative B.
- Alternative D limits ski areas to operate within the existing permit boundaries and ski amenities lost to resource restoration activities would not be replaced.

Stewarship

Interpretive, Conservation Education and Public Services

There are no anticipated consequences to Interpretive, Conservation Education and Public Services from the implementation of the Forest Plan. They are the same for all alternatives. There are no programmatic differences between the alternatives. (Please the Interpretive Services, Conservation Education, and Visitor Services Section)

Sustainable Recreation

Strategies to manage recreation sites and activities for sustainability are the same for all alternatives. There are no programmatic differences between the alternatives. (Please the discussions for other resources that manage natural resources where recreation activities exist.)

Climate Change

There are no anticipated consequences to recreation resources from climate change through the implementation of the Forest Plan. There are no programmatic differences between the alternatives.

How the Alternatives Maintain or Achieve the Desired Conditions

Sustainable recreation management endeavors to provide high-quality recreational activities while minimizing impacts to natural resources, cultural integrity, and socioeconomics. Providing sustainable recreation opportunities in the future is the overarching goal of the desired condition on the LTBMU. The desired conditions focus on providing a broad spectrum of recreation opportunities, providing public access to public lands, continuing infrastructure restoration, managing recreation sites to achieve a range of desired social expectation while maintaining the integrity of the natural resources, and using recreation special uses to leverage the LTBMU's ability to provide recreation services. Alternatives A, B and C all strive to achieve the desired conditions by allowing different degrees of modification and expansion of developed facilities in meeting the predicted increase in future recreation demands. There will be less flexibility in Alternative D to meet future demands.

- Overall, Alternative B provides the best opportunity to meet the desired conditions by continuing to provide a broad mix of recreation opportunities and by having flexibility in responding to future growth. Though not as aggressive as Alternatives C and A, it is fiscally attainable and still provides managers the ability to be responsive to current and anticipated user demands. This alternative preserves some of the most popular mountain biking opportunities in basin. Very high satisfaction ratings as reported by NVUM surveys support the notion that the current mix of recreation opportunities are generally in balance with the public’s expectations.

- Though Alternative A does allow for the expansion of recreation infrastructure, it is project specific and those projects may not appropriately meet future demand. As in Alternative B it does maintain the current mix of recreation opportunities. Future winter demand for ski areas is best addressed in Alternative A where large areas for future expansion have been identified.

- Alternative C provides the most ability to respond to public demand in providing a broad range of opportunities using and increased supply of developed infrastructure as the indicating criteria. Alternative C has off –setting benefits however as there are less miles of trail available to dispersed summer non-motorized/mechanized users. The inclusion of the Dardanelles wilderness will result in a shift in user patterns away from mountain biking opportunities toward hiking and equestrian opportunities in a more primitive wilderness setting.

Alternative D offers the least flexibility to respond to future demands as recreation infrastructure is potentially lost due to resource restoration projects. Increasing the overall wilderness acres managed will shift the current recreation use patterns in the Dardanelles and Freel IRA's away from the mechanized mountain bike use now popular in both areas, to more primitive recreation experiences available in a wilderness setting. It also expands the overall acreage available for dispersed overnight camping opportunities in the Basin with the ultimate inclusion of the Freel roadless area as wilderness.

3.4.18 Scenic Resources

3.4.18.1. Introduction

This section evaluates and discloses the potential environmental consequences on the Scenic resources that may result from alternative A, B, C and D.

Methodology

The public has expressed a strong desire to maintain the outstanding scenic quality of the Lake Tahoe Basin, while accommodating the desire for ecological restoration, hazardous fuels treatment, and development all of which may cause scenic impacts. Public participation and collaboration identified several key valued scenic attributes including:

- The scenic integrity of the natural environment
- Scenic views of and from Lake Tahoe
- Dark sky night views, and
- Built environment character consistent with the alpine setting.

The Forest Service manages scenic resources utilizing the Scenery Management System (SMS). This system replaces the previous Visual Management System (VMS). Two indicators are used to assess current scenic conditions and the potential impacts under the alternatives.

Scenic Integrity

Scenic Integrity Levels are used as a measure of existing scenic condition. They measure the degree of deviation in the landscape from the valued scenic character. These levels are also used to compare the impacts of alternatives. Scenic Integrity uses a graduated rating scale of six levels from “Very High Integrity” to “No Integrity”.

Scenic Class is a measure of an area’s relative scenic value. Scenic Class considers an area’s distinctiveness along with the distance from which it is typically viewed and the relative level of concern regarding those views. Scenic Class ranges from Class 1, “Very High scenic value” to Class 6, “No scenic value”.

Scenic Stability

Scenic Stability is an indicator of the ecological sustainability of the valued scenic attributes. Scenic Stability does not measure or evaluate the entire ecological condition. Rather, it addresses how ecosystem dynamics will affect the long-term stability of the valued scenery and its attributes. Scenic Stability uses a graduated rating scale of six levels from ‘Very High Stability to ‘No Stability’ to identify the degree to which scenery attributes are likely to be perpetuated within the ecosystem context.

Assumptions

In the analysis for this resource, the following assumptions have been made:

- Overall, the precise timing, location, configuration, landscape-level pattern, and individual characteristics of treatments and other management actions will determine the effects of such actions upon scenery (Litton 1984 [cited in USDA Forest Service 1995a).These factors are determined during site-specific planning; thus the cumulative scenic effects of the alternatives cannot be predicted with confidence. Actual effects will vary with the degree of consideration of scenery management during site-specific planning and implementation.
- Wildfire is likely to have the more severe effects on long-term scenic integrity than planned fuels treatments, based on existing condition inventory by scenic class.
- Vegetation components of the landscape are dynamic and will change over time. Rates of recovery post treatment vary by site conditions, and intensity of treatment.
- Vegetation treatments in the WUI defense zone are essentially the same in the first decade across all alternatives. The assumed short term scenic condition (decade 1) from planned treatments is class 3. WUI Defense Zone is assumed to be 44,069 acres.
- Vegetation treatments do not happen all at once. Annual rates of treatment vary slightly between alternatives. Implementing these initial treatments will take at least 2 decades, so the rates of recovery from initial treatments also vary.
- Scenic standards are in place for all alternatives. Adopted Visual Quality Objectives (AVQOs) for Alt A and Scenic Integrity Objectives (SIOs) and Minimum Scenic Stability (MSS) for alternative B, C, and D.
- As new recreation and facilities projects are built, they will follow the MSI, the Built Environment Image Guide (BEIG) and Recreation Opportunity Spectrum (ROS) guidelines for all alternatives.
- The population in the LTBMU's surrounding counties in both northern California and Nevada is projected to grow 1.4% percent annually or 21% in the next 15 years according to U.S. 2010 census data. Visitation is predicted to increase at a rate similar to the population rate increase. The projected growth has the potential to increase demand for new services and development.
- Within the Backcountry Management Area, Inventoried Roadless Areas, Grass Lake RNA, and Wilderness areas, no new developed facilities are proposed under any of the alternatives.

The long term effect of restoring ecosystems and habitats is assumed to benefit scenery.

3.4.18.2. Overview of the Affected Environment

The planning area encompasses extraordinary scenic resources, most notably Lake Tahoe. The lake is designated as an "Outstanding National Resource Water" under the Clean Water Act, primarily due to the extraordinary clarity of its waters, which is a scenic value. The East Shore Drive National Scenic Byway and east shore beaches offer outstanding unobstructed views of the lake and surrounding Sierra Nevada's. Emerald Bay is the iconic post card setting for the Lake Tahoe Basin. The Pacific Crest National Scenic Trail passes through the planning area as does, the Lake Tahoe Rim Trail. A segment of the Upper Truckee Wild and Scenic River (Recommended), a large part of the Desolation Wilderness, portions of Mt. Rose and Granite Chief Wilderness, and the Fred Peak and Dardanelles Inventoried Roadless Areas all offer relatively un-altered landscapes, characteristic of the high Sierras.

Tourism that is substantially dependent upon maintaining scenery is an economic mainstay of the Lake Tahoe region. People live in area communities, in large part, in order to benefit from high quality scenery and access to outstanding outdoor recreation. Because of its relative small size, network of roads and trails, and close proximity to intertwined communities around the lake, most of the basin is visible in either the foreground (within a quarter to one half mile) or middleground (quarter mile to five miles). Coupled with its inherently attractive landscape character, and viewed by millions of visitors every year, the landscape is very sensitive to management actions. Any changes to the natural landscape character are easily noticed.

The National Survey on Recreation and the Environment between 2000-2007displayed trends looking at the "seventeen fastest-growing activities—that is, those with days of participation growing by more than 10 percent. Of these top seventeen activities, six involve viewing, photographing, identifying, visiting, or otherwise observing elements of nature—flowers, trees, natural scenery, birds, other wildlife, nature exhibits, and wilderness. The growth in viewing and photographing plants and natural scenery has been most rapid at about 78 and 60 percent, respectively" (Cordell 2008). According to the 2010 National Visitor Use Monitoring (NVUM) report, conducted on the LTBMU, viewing natural features was the third most popular activity, with a 56% participation rate. 83% of those surveyed were very satisfied with the 'quality of the scenery'. These numbers suggest that scenery is a very important public value and perception of the condition of the scenery is very high.

Existing Scenic Integrity

The planning area exhibits extraordinary existing scenic conditions as indicated by the 88% of LTBMU lands that are inventoried Scenic Class 1-2. Landscapes with these ratings (Very High and High Integrity) are natural appearing or appear unaltered to the casual observer. The existing conditions are shown in Table 3-51 and reveal little change in the last thirty years. In fact, the overall existing conditions of scenic integrity for LTBMU lands exceed the minimum level expressed by Adopted VQO's in the 1988 Forest Plan.

Some reductions in scenic integrity have occurred since 1988. The increases in class 4 and 5 landscapes are mostly attributable to wildland fire scars. The Angora Fire (3,072 acres), Gondola Fire (643 acres), and Showers Fire (294 acres), account for most of the changes to Existing

Scenic Integrity (ESI) in the last 20 years. Additional land acquisitions encumbered with a certain amount of development have lowered some ratings, such as the purchase of High Meadows and the attached power line corridor. Other development activities in previously undeveloped areas have contributed to lowering ESI scores in certain areas, such as the gondola line construction at Heavenly Mountain Resort.

The increase in Class 1 acres represents the designation of Granite Chief and Mt. Rose Wilderness additions since the adoption of the 1988 Forest Plan.

The scenic and vegetation restoration goals are aimed at restoring landscapes that rank below scenic integrity objectives (Class 4, 5, and 6) where possible. Restoration efforts have improved scenic integrity in some areas.

Table 3-53. Existing Scenic Integrity Inventory, NFS Acres & Percent of Total Area

Existing Scenic Integrity	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Total Acres
1982 Acres	20,847	115,510	4,067	2,903	406	1,474	145,207
Percent NFS Land	14.4	79.5	2.8	2.0	.03	1.0	100%
2011 Acres	24,660	111,461	5,040	5,818	6,621	1,176	154,776
Percent NFS Land	15.9	72	3.3	3.8	4.3	0.8	100%

Existing Scenic Stability

Scenery is dependent upon a healthy ecosystem. Natural disturbance elements (including fire, flood, landslides, and avalanches) are normal ecosystem processes, and create or perpetuate natural scenic conditions. In particular, wildfire is a disturbance factor that has been profoundly affected by landscape management. The exclusion of fire through an aggressive suppression policy has led to a departure from normal fire return intervals. Most of the LTBMU's forests were logged during the Comstock era and have re-grown during this fire exclusion period. As a result, age class diversity is almost non-existent in certain vegetation types. Certain dominant scenery attributes most at risk are those related to the vegetation component of ecosystems including:

1. The relative large amounts (89%) of NFS Lands that appear natural (Class I) or unaltered (Class 2) but have little age class diversity and have the potential to be dramatically affected by wildfire and disease,
2. Aspen stands, riparian areas and meadows, valued for their visual variety and seasonal color are threatened by conifer encroachment; and

3. Large tree character and open forest canopies of the Jeffrey Pine Mixed Conifer, White Fir Mixed Conifer and Red Fir vegetation types are threatened by fire exclusion and lack of age class diversity.

Other valued scenery attributes include special places such as unencumbered views of Lake Tahoe from Emerald Bay and the east shore beaches; and cultural features such as the Tallac Historic Site and Cave Rock. Those attributes are protected equally across all alternatives with common set of standards.

Table 3-54 Existing Scenic Stability — NFS Acres and Percent of Total Area

Very High	High	Moderate	Low	Very Low	No Stability	Total NFS Acres
15,038	70,730	58,505	8,492	1,893	140	154,798
10%	46%	38%	5%	1%	0%	100%

3.4.18.3. Environmental Consequences

Scenery is affected by management activities altering the appearance of what is seen in the landscape. Short-term scenic effects are usually considered in terms of degree of visual contrast with existing or adjacent conditions that result from management activity. The scenic landscape can be changed over the long term or cumulatively by the alteration of the visual character. Management activities, which result in visual alterations inconsistent with the assigned Scenic Integrity Objectives and scenic desired conditions, affect scenery.

Management activities and plan decisions that have the greatest potential for affecting scenery and vary by alternative are:

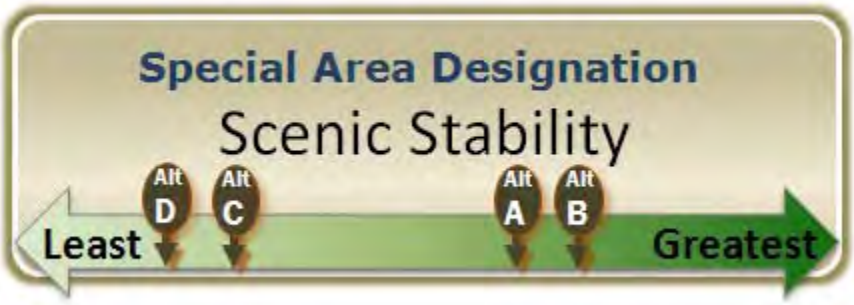
- Special area designations
- Vegetation management
- Natural processes
- Developed recreation
- Ski areas
- Other management activities

Special area designations

Special Area designation decisions can affect scenic resources by increasing or decreasing the levels of protection. Certain special area designations such as wilderness come with preservation (“Very High” SIO) scenic objectives. Limits to available management activities such as road building and fuels reduction would reduce effects associated with those activities, while simultaneously limiting the ability to actively restore areas impacted by disturbances such as fire and disease outbreaks.

The range of alternatives varies by the amount of proposed wilderness and backcountry management area. The other special areas remain the same between alternatives (Grass Lake RNA, Tallac Historic Site, etc.)

DEIS Alternatives - Alternatives A and B are similar in terms of protections afforded to existing wilderness areas with no new areas proposed. Alternative C increases protection by recommending the Dardanelles Roadless Area as wilderness; alternative D provides the most protection for scenic integrity by recommending Dardanelles and Freel Peak and by increasing the Backcountry management area allocation (See Table *2.3* Management Areas by Alternative).



Although scenic integrity may benefit from additional protections afforded by wilderness allocation, the risk of losing valued scenic attributes may increase due to limitation on the ability to treat disease outbreaks and other management activities that increase forest resilience. Scenic stability may decrease under alternatives D and C.

Vegetation Management

All of the alternatives include fuels reduction in the Wildland Urban Interface (WUI). Fuels reduction activities are highly visible in the short term. When combined with the numerous other development activities, utilities, and infrastructure found within the WUI these impacts may reduce the overall scenic integrity. See WUI Treatments described in the Table 2-1 Forest Vegetation Management section (See WUI DEIS Maps 4 and 5 for Zones).

Fuels reduction activities may result in short-term consequences to scenic integrity from cut vegetation resulting in slash piles, disturbed soils from temporary road construction, and the potential to remove vegetation that previously screened development. At the same time,

vegetation treatments may improve scenic conditions by opening views of Lake Tahoe and views of the Sierras.

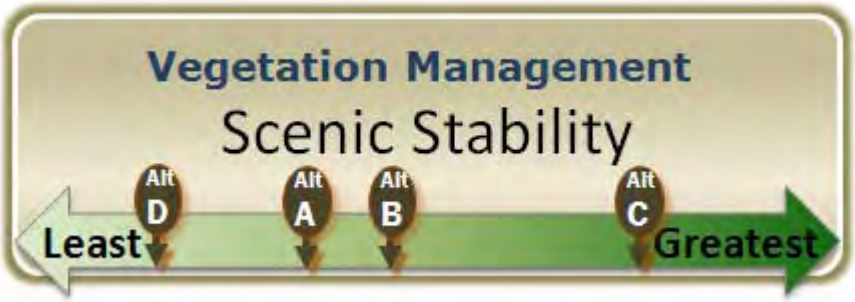
Most of the planned activity for the next decade would occur in the WUI defense zone. The defense zone is about a quarter mile from most residences and coincides with the SMS foreground zone. Management activities in the foreground aremost visible and have the greatest potential effect. The potential for scenic consequences is much higher in the WUI defense than in more remote areas. Since the initial WUI treatment strategy (thinning and fuel reduction) is the same across all alternatives, there is no difference in effects between the alternatives in the first decade. Adherence to design criteria at the project level for foreground thinning (such as low stump cutting) would minimize short-term impacts to scenery.

The recovery rate of thinning projects for scenic resources is assumed to be 2-10 years. Given the rate of treatment and recovery approximately 10,000 acres would have visible effects at any one time but should meet scenic class 3 conditions.

DEIS Alternatives -Alternative C would propose to treat slightly more acres through forest structure restoration, forest type conversion and stand resiliency than would the other alternatives; therefore, it would result in more short term impacts to scenic integrity than Alternatives A or B. Impacts would be lowest under Alternative D, which proposes the least amount of forest vegetation treatment.

Forest vegetation and WUI fuels-reduction activities may result in a more stable forest condition, which may then better resist catastrophic wildfires. Without fuels-reduction treatments, wildfires may be more likely to increase in size or severity.

Natural disturbance factors, such as low-intensity wildfire, have the potential to alter the appearance of the planning area. Periodic low-intensity wildfire is a natural disturbance factor that may change scenic conditions; however it may improve scenic stability. Generally, low intensity fire (wild or prescribed) may result in long term beneficial consequences to scenic stability by increasing forest resilience.

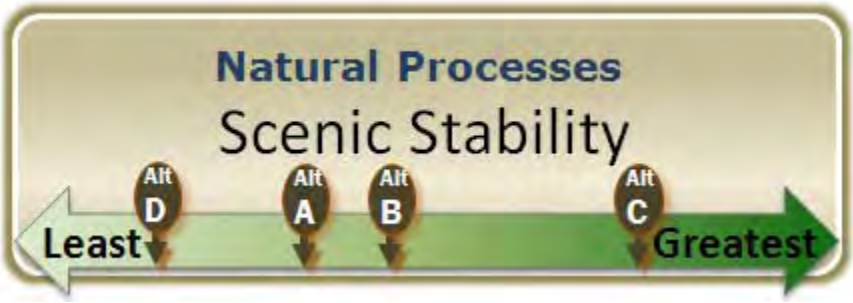


Compared to alternative A, Alternative B is the same, Alternative C would propose to treat slightly more acres more aggressively than would the other alternatives; therefore it would result in a faster rate of restoration of desired open stand characteristics among alternatives. Aspen stand and meadow restoration is the same across alternatives A, B, and C. Alternative D proposes the least amount of active vegetation restoration and may lower scenic stability relative to Alt A.

Natural Processes

Natural processes can also affect scenery, such as wildland fires, insect and disease infestations, and the spread of non-native invasive vegetation. The size and intensity of just a few recent fires, Angora, Gondola, and Showers, have had the most impact to the scenic resource in the last 25 years. If the trend to larger fires continues, then the expected impacts to scenic resources will continue. Increasing forest resiliency and lessening fire severity risk should improve scenic stability for all alternatives.

DEIS Alternatives – Wildfire risk predictions vary between the alternatives but it is assumed that treating fuels more aggressively will reduce wildfire risk. Compared to Alternative A, Alternative B is very similar, Alternative C would propose more fuels treatment, more aggressively than would the other alternatives; therefore it would result in a lower wildfire risk. Alternative D proposes the least amount of active fuel reduction and may lower scenic stability relative to alternative A based on wildfire risk.



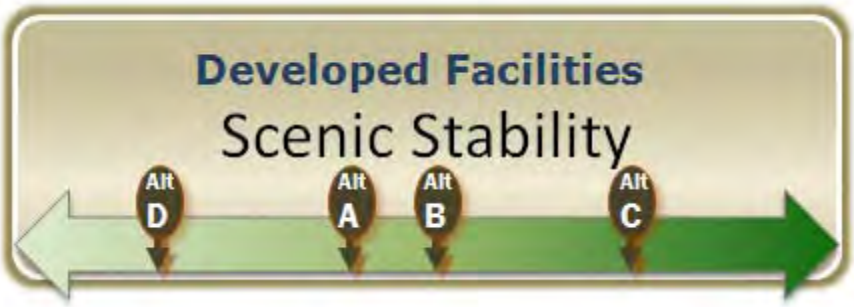
Scenic integrity would be negatively affected by natural processes such as wildfire events that reduce the presence of valued scenic attributes. Forest fuels treatments described above would affect scenic integrity such that Alternative D would have the least negative effect on integrity. Alternatives A and B are similar to each other, and Alternative C would have the greatest impact on scenic integrity.

Developed Recreation

Developed recreation affects scenic integrity through degrees of contrast from the natural environment and through application of design standards consistent with the mountain setting and environmental objectives. Addressing the backlog of deferred maintenance is common to all alternatives. As facilities are brought up to current codes for design, accessibility, water quality BMPs, over time most facilities should meet scenic quality guidelines. The alternatives vary by the amount of developed recreation allowed, however new construction, maintenance and restoration of old facilities, are budget driven. Projecting future budgets is speculative. Experience since the 1988 plan was adopted suggests that most recreation development management activity was retrofits of existing facilities rather than expanding capacity or creating new facilities.

Modeling assumptions for the alternatives seek to satisfy different demand scenarios for developed recreation. In general, the forest plan alternatives address developed recreation areas programmatically, allowing for generalized expansion or contraction to respond to demographic projections, demand scenarios and the range of issues driving the alternatives. (Alt A. +10%, Alt B. +5%, Alt C + 15%, Alt. D -15%)

DEIS Alternatives - Based on the modeled growth scenarios scenic integrity would follow the relative pattern displayed below. More growth and development would equal greater effect to scenic resources in terms of degree of contrast from the natural environment. Compared to alternative A, Alternative B would allow less expansion, Alternative C more expansion and Alternative D the least amount of expansion. Alternative D would be the best for scenic integrity.



Ski Areas

The LTBMU manages the Heavenly Mountain Resort under a special use permit and Master Development Plan. A small portion of Homewood Ski Area, Alpine Meadows and Diamond Peak have incidental ski runs on NFS lands and are also managed under special use permt. The impacts to scenic integrity are documented in the SMS inventory update. Generally speaking, the existing vegetation cuts for ski runs and lifts are highly visible throughout the basin and impact scenic resources. The site specific direct effects are analyzed and mitigated at the project level. In general the forest plan alternatives seek to address developed recreation and ski areas programmatically, allowing for generalized expansion or contraction to respond to demographic projections, demand scenarios and the range of issues driving the alternatives. (Alt A. +10%, Alt B. +5%, Alt C + 15%, Alt. D -15%)

Alternative A reflects the current conditions for allowable development following the most recent Master Plan(s) for ski areas. The consequences related to existing ski area operations and development are expected to continue over the planning period allowing for some modest growth and expansion. The effects on scenic integrity are expected to continue. The visible scars from lifts and runs will continue along with efforts to mitigate these effects.

DEIS Alternatives -Compared to alternative A, Alternative B would allow less expansion, Alternative C more expansion and Alternative D less. Alternative D would be the best for scenic integrity overall.

Ski areas are generally managed for developed recreation. The impacts from concentrated use and development on the stability of the vegetation component may lead to unstable forest conditions, making these areas more susceptible to insect, disease and fire outbreaks. As ski resorts move to more all season operations the effects are felt year round. More development pressure and increased human caused fire ignitions does increase fire risk and vegetation loss. The presence of roads, trails, and water reservoirs may improve fire response times.

Compared to alternative A, Alternative B would allow less expansion, Alternative C more expansion and Alternative D would allow the least amount of expansion. Alternative D would be the best for scenic stability overall.

Other management activities

Other management activities that generally have short term effects to the scenic resource are stream channel and aquatic habitat restoration, species recovery and habitat restoration. The long term effect of restoring stream systems and habitats is assumed to benefit scenery.

Land exchange, urban storm water treatment projects, and administrative site facility construction may cause more lasting contrast with naturally appearing scenic conditions, but are assumed to be of a size and scale to be barely measureable at the regional level.

No new road construction is planned with any of the alternatives. Temporary roads may be constructed to implement vegetation management activities. Temporary road construction must

follow required BMP's and design criteria but may result in minor long term impacts to scenic integrity, associated with vegetation management.

Reclassification of existing Forest Service System roads to allow different vehicle classes to access more of the existing road networks does differ between alternatives. However the scenic effects are minor, such as few additional gates and signs, and assumed to be of a size and scale to barely be measureable at the regional scale.

Many activities are ongoing and common to all alternatives or are not expected to differ significantly between the alternatives. These include:

Utility corridors and communication sites

Of the current conditions and ongoing activities, utility corridors and communication sites impact scenic resources the most. The existing scenic integrity inventory takes into account the effect of these facilities. However, the main variables that influence the number of new utility corridors and communication sites are growth related. As population increases, technology changes and infrastructure ages, it is assumed that additional pressure will continue for new and replacement services. Since these variables are expected to be the same under all of the alternatives, the related impact to scenic integrity of managing existing facilities and developing new facilities is expected to be site-specific and similar under all of the alternatives and cannot be predicted.

Vehicle parking strategies

Vehicle parking strategies do change between the alternatives. All alternatives would employ BMP's for parking areas. Alternatives A and B have the same strategies for vehicle parking. Compared to Alt A and B, Alternative C would eliminate roadside parking which would benefit scenic integrity and increase parking capacity which would impact scenic integrity. Alternative D would eliminate roadside parking and not increase parking capacity, which would benefit scenic integrity.

Trail construction

Trail construction affects scenic quality in two primary ways. First, sensitivity level 1 trails, such as the Pacific Crest Trail or the Tahoe Rim Trail, draw users into the foreground of areas that may have previously been unseen thus increasing the sensitivity of those landscapes. Secondly, there are some direct effects of trail construction. Recently updated SMS inventories have shown an increase in sensitivity to scenic resources due to trail building activities over the past 20 years. However, trail building does not vary a measurable amount between the alternatives (see table 2.1) so effects to scenic resources from trail construction are so similar that they do not vary between the alternatives.

Aquatic and terrestrial ecosystem restoration, and invasive species management

Potential impacts would be the same under Alternatives A, B and C. Alternative D would have the least amount of active restoration and would therefore have the least amount of impact to scenic resources. Indirect effects may include site-specific construction of structures necessary for project implementation. The impacts related to these elements would be local. Site-specific planning and design would be undertaken in order to limit adverse impacts to scenery while, at

the same time, taking every opportunity to enhance scenery. As a result, these features may be installed so that they are noticeable to the casual observer, but do not dominate the view.

3.4.18.4. Analytical Conclusions

Comparison of Consequences by Alternative

Table 3-55. Comparison of Consequences to Scenic Resources by Alternative

Management Activities	Unit of Measure	Scenic Indicator	Existing Condition	Alt A	Alt B	Alt C	Alt D
Vegetation Management in WUI	Acres of Treatment See Table 2-1	Integrity	High/Moderate	Decreased Integrity	Decreased Integrity	Decreased Integrity	Decreased Integrity
		Stability	Low/very low/no stability	Increased Stability	Increased Stability	Increased Stability	Increased Stability
Vegetation Management Outside WUI	Acres of Treatment See Table 2-1	Integrity	High/Moderate	Decreased Integrity	Decreased Integrity	Decreased Integrity	Decreased Integrity
		Stability	Low/very low/no stability	Increased Stability	Increased Stability	Increased Stability	Increased Stability
Aspen Stands, Meadows & Wetlands Restored	Acres	Integrity	High/Moderate	Increased Integrity	Increased Integrity	Increased Integrity	Increased Integrity
Aspen Stands, Meadows & Wetlands Restored	Acres	Stability	Low/very low/no stability	Increased Stability	Increased Stability	Increased Stability	Increased Stability
Vehicle Parking Capacity	Acres	Integrity	Low	Low	Low	Low	Mod

Management Activities	Unit of Measure	Scenic Indicator	Existing Condition	Alt A	Alt B	Alt C	Alt D
Vehicle Parking Capacity	Acres	Stability	Low	Low	Low	Low	Mod
Developed Recreation Area Expansion	Modeled Growth Scenarios	Integrity	Low	Low	Low	Low	Mod
Developed Recreation Area Expansion	Modeled Growth Scenarios	Stability	Low	Low	Low	Low	Mod
Special Areas **Protected**	Wilderness Acres	Integrity	Very High	Very High	Very High	Very High	Very High
Special Areas **Protected**	Wilderness Acres	Stability	High	High	High	High	High
N/A	Recommended Wilderness Acres	Integrity	Very High	Very High	Very High	Very High	Very High
	Recommended Wilderness Acres	Stability	High	High	High	Mod	Mod
Management Area	Backcountry Acres	Integrity	High 48,813	High 48,813	High 48,813	High 27,861	High 25,151
Management Area	Backcountry Acres	Stability	High	High	High	High	High

How the Alternatives Maintain or Achieve the Desired Conditions

Scenic Integrity Desired Condition

Scenery viewed from Lake Tahoe and the Basin's major roadways, public recreation areas, trails and urban centers predominantly display natural-appearing forest, meadows, mountains, and the shoreline of Lake Tahoe. Development, where visible, appears subordinate to and harmonious with the surrounding setting.

Existing conditions for scenic quality in 2011 are very similar to existing condition measured in 1982 (see ESI acres). Scenic Integrity Objectives (SIOs) represent a minimum threshold for scenery management rather than a management goal. Scenic conditions, as measured by existing scenic integrity, far exceed scenic integrity objectives set for each alternative. That trend is expected to continue under all alternatives over the next 10-15 years. Some programmatic strategic differences do exist between the alternatives that may affect scenic integrity. These include vegetation management, developed recreation, and proposed wilderness designation. The effects of these strategies, activities and land use allocations, when combined produces the following Scenic Integrity Objectives by alternative.

Table 3-56. Scenic Integrity, by Alternative

Scenic Class	Existing condition 2011	Alt. A Current AVQO	Alt. B Proposed SIO	Alt C Proposed SIO	Alt D Proposed SIO
Very High (VH)	20,847	24,973	24,674	38,925	53,827
High (H)	115,510	28,902	41,813	27,862	25,151
Moderate (M)	4,067	100,770	88,357	88,043	75,852
Low (L)	2,903	Restoration Objectives for Lands Below Moderate (M)			
Very Low (VL)	406				
No Integrity	1,474				

- Alternative A – Existing wilderness allocation protections. Allows recreation expansion to extent of prescription combined with vegetation management may achieve Moderate scenic integrity on those acres. Restores L, VL and No integrity landscapes.
- Alternative B - Existing wilderness allocation protections. Focuses on restoring existing developed recreation footprint. Only small increase in growth coupled with vegetation management strategy may achieve Moderate scenic integrity on those acres. Moves more acres to High scenic integrity than A. Restores L, VL and No integrity landscapes.
- Alternative C – Increases protection with additional wilderness allocation. Allows expansion of existing developed recreation, achieving Moderate scenic integrity on those acres. Vegetation management strategy achieves Moderate scenic integrity. Restores L, VL and No integrity landscapes.
- Alternative D – Increases protections with most wilderness allocation. Allows reduction of existing developed recreation achieving Moderate scenic integrity. Vegetation management achieves Moderate scenic integrity. Restores L, VL and No integrity landscapes.

Scenic Stability Desired Condition

The desired scenic attributes are ecologically stable and display minimal visual disruption resulting from disturbance events. Landscape alterations complement and blend with the characteristic landscape of the Lake Tahoe Basin. Vegetation treatments designed using the latest environmental design arts skills produce natural-appearing diverse forest structure.

Those alternatives that restore or protect desired scenic attributes will have the greatest chance of improving stability. Desired scenic attributes that can be measured and differ between the alternatives are age class diversity (age class diversity of Jeffrey Pine Mixed Conifer, White Fir Mixed Conifer and Red Fir vegetation types), and acres of aspen stands, riparian areas and meadows restored.

- Alternative A – current age class diversity, disease risk and restoration objectives
- Alternative B – more diversity, less disease risk than A. Same restoration objectives as A
- Alternative C – more diversity, less disease risk than A or B. Same restoration objectives as A
- Alternative D – less diversity more disease risk than A. Less opportunity for restoration objectives due to land allocation and passive management

Natural processes can also affect scenery, such as wildland fires, insect and disease infestations, and the spread of terrestrial invasive plant species. The size and intensity of just a few recent fires, Angora, Gondola, and Showers, have had the most impact to the scenic resource in the last 25 years. If the trend to larger fires continues, then the expected impacts to scenic resources will continue. Wildfire risk predictions vary between the alternatives. Those alternatives lowering wildfire risk will have the greatest chance of maintaining or improving scenic stability.

- Alternative A – current FRCC, disease risk and terrestrial invasive plant species.
- Alternative B – less risk than A
- Alternative C – less risk than A or B
- Alternative D – greater risk than A

3.4.19 Social and Economic Conditions

3.4.19.1. Introduction

This is a summary of some of the key factors describing the social and economic condition of the Lake Tahoe Basin. See Appendix F: Social and Economic Assessment for a more detailed report.

The Lake Tahoe Basin Management Unit (LTBMU) is an integral part of the economy and social life of Lake Tahoe Basin communities. Visitors from around the country and the world are attracted to Lake Tahoe to enjoy a variety of recreational activities. The scenic quality of Lake Tahoe and its surrounding landscape make visiting the Lake Tahoe Basin a one-of-a-kind experience. The LTBMU contributes to the Lake Tahoe Basin's scenic quality through the conservation and management of vegetation, waterways, infrastructure, and recreation.

The Lake Tahoe Basin's economy is driven largely by recreation and tourism. The LTBMU plays an important role in providing outdoor recreation opportunities and preserving the scenic quality of the Tahoe Basin's lands and waterways.

Two geographic areas were studied: the Lake Tahoe Region (LTR) is defined by the watershed boundaries around the lake itself using Census County Divisions (CCD's), which is compared to the larger Greater Lake Tahoe Area (GLTA) which is defined by the surrounding counties in California and Nevada (see Appendix F – Social and Economic Assessment for a map and detailed explanation). This provides a comparison of the area immediately in the vicinity of the lake within the context of the larger surrounding area which includes the large communities of Placerville, CA and Reno, NV.

The GLTA is representative of the region's functional economy, meaning this is where Lake Tahoe Region residents and businesses are likely to purchase a significant amount of their goods, services, and housing. Counties within the GLTA are influenced by spending patterns of residents, visitors and businesses within the LTR, and have a direct influence on visitor rates and use patterns on the LTBMU.

3.4.19.2. Affected Environment

Social Conditions and Trends

Population

The Lake Tahoe Region (LTR), with a population of 55,665 represents a small fraction of the Greater Lake Tahoe Area (GLTA) population of 1,053,168 people in 2010. Within the LTR, more than half of the population resided in the South Lake Tahoe CCD. Between 2000 and 2010, Nevada's population grew by 35%, while California's population grew at a much slower rate increasing by 10%. The GLTA grew in population by over 25%. In contrast, the LTR lost 11.5% of its population. An article in the Sierra Sun (March 9, 2011) attributed this loss in population to a worsening economy. Also, the gaming industry declined over 50% since 1990 so

there are fewer jobs in the LTR to hold people there. There is also a trend toward increasing second home ownership by people who do not live year-round in the Lake Tahoe Basin area. These are used as vacation homes and do not contribute toward such things as kids in schools, year-round shopping in the local community, etc.

The rise in populations of the states of California and Nevada translate into higher demand being placed on recreation opportunities in the Lake Tahoe Basin. The 25% rise in population in the surrounding GLTA results in greater day-use demand for recreation in the Basin.

Race and Ethnicity

Compared to California and Nevada, the GLTA and the LTR are not as racially and ethnically diverse. In the GLTA, 82% of the population is white, while in the LTR, 84% of the population is white. Within the LTR, South Lake Tahoe CCD is the most racially diverse of the four CCDs, followed by Lake Tahoe CCD.

Poverty

Poverty estimates of the LTR and GLTA were compared with averages across California and Nevada by ethnic groups. In general, the poverty rates in the GLTA and LTR are less than the state-wide averages.

Education Attainment

Educational Attainment in the GLTA and LTR compared favorably against state percentages. Both the GLTA and LTR had a higher percentage of high school graduates than Nevada and California. When considering the percentage of population with a bachelor's degree or higher, the LTR outranked all other regions; however, GLTA was consistent with California and exceeded Nevada's rate.

Housing

When considering housing occupancy status, the LTR differs greatly from all other regions with a 45% vacancy rate, outstripped the next highest rate, which was for the GLTA at 34%. Of the vacant housing units, the LTR and the GLTA were used primarily for seasonal, recreational, or occasional use. Only 8% of the vacant homes in the LTR were rental units compared to 34% for California and 37% for Nevada. When looking at homeownerships rates the GLTA exceeded all other regions, and the LTR was on par with California and Nevada.

Economic Condition and Trends

Employment

At the time this was written, employment data was not available for the 2010 Census data at the local CCD level. Appendix E presents an overview based on the 2000 Census data (as updated to 2003). So the unemployment figures presented in Appendix E are out-of-date at the CCD or LTR level. In general the LTR employment is dominated by the Accommodation and Food Service sector at 25%, followed by the Government sector at about 20%, and Arts, Entertainment and Recreation; Real Estate and Rental Leasing; and Retail Trade sectors each providing about

10% each. The LTBMU contributes to these tourism based employment sources and through direct input of wages and contracts to the Government sector.

Income

The Lake Tahoe Region (LTR) income follows the employment data. In 2006 the accommodation and food services industry provided the most income, followed by government. Income in the LTR is dominated by the wage or salary income sector with about 62%, as compared to much lower income being derived from self-employment income (about 12%), Interest-dividends-net rental income (about 16%), or person current transfer receipts (about 10%) (see Figure F30 in Appendix F – Social and Economic Assessment).

LTBMU Economic Contributions

An economic contribution analysis depicts the Forest Service's contribution to the local and regional economy. IMPLAN is the economic modeling tool created by the Forest Service in cooperation with the Federal Emergency Management Agency and the Bureau of Land Management that was used to estimate the Forest's contribution to the local economy. IMPLAN models the economic stimulus, i.e., the labor and income generated among 509 economic sectors identified in the North American Industrial Classification System (NAICS) within the study area. The economic sectors were aggregated by the first two digits of their classification number for report purposes to produce twenty aggregate sectors.

The model built for the LTBMU is based on zip codes which concentrate on the physical boundary of the Basin. This determination is driven by the issues raised by the public and resource managers. The Lake Tahoe region is well defined by the mountain ridges around the lake.

Table 3-55 describes the LTBMU's contribution to the Lake Tahoe Basin area as measured by jobs and labor income by industry sector. Note that "Jobs" refers to average annual employment and includes a combination of full and part time, temporary, and seasonal workers. "Labor Income" is the sum of employee compensation (the value of wages and benefits) and proprietor's income. The numbers in the "LTBMU-related" columns are Total Effects – direct effects plus the ripple (secondary) effects in the local economy.

Table 3-57. LTBMU Economic Contribution to Lake Tahoe Region (2008)

Industry	Employment (jobs)		Labor Income (Thousands of 2010 dollars)	
	Area Totals	FS-Related	Area Totals	FS-Related
Agriculture	54	55	$2,070	$1,751
Mining	51	6	$2,261	$277
Utilities	199	4	$23,685	$620
Construction	3,287	27	$200,103	$1,588
Manufacturing	242	69	$14,983	$1,979
Wholesale Trade	329	81	$24,169	$6,236
Transportation & Warehousing	654	66	$27,195	$2,842
Retail Trade	3,563	385	$115,344	$14,799
Information	411	32	$26,545	$2,044
Finance & Insurance	2,382	50	$74,893	$2,281
Real Estate & Rental & Leasing	7,594	89	$107,985	$1,592
Prof, Scientific, & Tech Services	3,316	160	$178,494	$7,437
Mngt of Companies	156	16	$18,573	$1,881
Admin, Waste Mngt & Rem Serv	2,189	82	$78,082	$2,717
Educational Services	681	20	$15,962	$726
Health Care & Social Assistance	3,748	95	$239,840	$10,931

Industry	Employment (jobs)		Labor Income (Thousands of 2010 dollars)	
	Area Totals	FS-Related	Area Totals	FS-Related
Arts, Entertainment, and Rec	2,816	320	$88,447	$10,649
Accommodation & Food Services	10,167	1,784	$316,644	$54,786
Other Services	3,150	77	$125,385	$4,244
Government	7,623	175	$498,144	$14,343
Total	**52,612**	**3,593**	**$2,178,808**	**$143,722**
FS as Percent of Total	**---**	**6.83%**	**---**	**6.60%**

The LTBMU's contribution to employment in the LTR by program area by alternative is shown in Table 3-58. Of the Forest Service programs, the greatest economic stimulus to the GLTA and LTA's economy is due to the recreation program. Note: The row titled "Forest Service Expenditures" is the only place government employment for program planning and administration is counted. Employment in all other rows counts only private sector jobs.

Table 3-58. Employment by Program Area for the Lake Tahoe Region

Resource	Total Number of Jobs Contributed			
	Alternative A (Current)	Alternative B	Alternative C	Alternative D
Recreation: non-local only	3,166	3,324	3,641	2,691
Wildlife and Fish: non-local only	87	92	100	74
Grazing	0	0	0	0
Timber	0	0	0	0
Minerals	0	0	0	0
Ecosystem Restoration	50	50	50	50
Payments to States/Counties	31	31	31	31
Forest Service Expenditures	258	258	258	258
Total Forest Management	3,593	3,755	4,081	3,105
Percent Change from Current	---	4.5%	13.6%	-13.6%

An economic contribution to the area of analysis of close to 7% is a large contribution in comparison with other National Forests. The typical contribution is 1 - 2%. This contribution is relatively large because the study area is limited to the Lake Tahoe Basin and the LTBMU makes up around 75% of the area. Also, the LTBMU is one of the smallest forests in the country and has the highest per acre visitor rate. The dominant industries in the LTR are related to recreation and tourism. The LTBMU also contributes to relatively high wage positions in its administrative capacity related to the Southern Nevada Public Land Management Act. In addition, the LTBMU receives and administers, on average, $37.5 million in federal funding annually to support environmental improvement projects, which contributes to a large share of the employment and income being related to the government sector.

3.4.19.3. Environmental Consequences

Unit Budget

The general program of work and levels of goods and services provided is expected to remain fairly constant over the next 4 years, but is expected to decrease after that. Appropriated funding is expected to decrease from 2012 levels by 5-7% in 2013 and again in 2014; and remain flat after that. Funding from the Southern Nevada Public Lands Act (SNPLMA) will be largely expended by 2016, and is expected to be totally expended by 2020.

Presidential commitments from 1998-2003 are congressional earmarks funding the Lake Tahoe Environmental Improvement Program (EIP) and the Lake Tahoe Restoration Act (LTRA). Presidential commitments from 2004-2011 are SNPLMA funds (Table 3-59 and Figure 3-78). SNPLMA funds shown in Table 3-58 are funds expended; more funds may have been available for a given year.

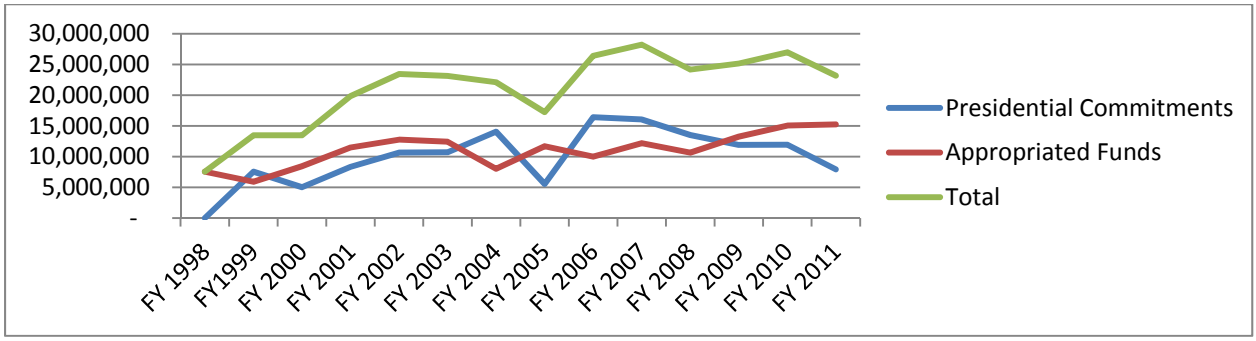
Table 3-59. LTBMU Environmental Improvement Program (EIP) and the Lake Tahoe Restoration Act (LTRA Program Funding by Fiscal Year

($1000)	EIP and LTRA					
	FY 1998	FY1999	FY 2000	FY 2001	FY 2002	FY 2003
Presidential Commitments	-	7,547	5,025	8,350	10,664	10,699
Appropriated Funds	7,560	5,919	8,436	11,494	12,769	12,435
Total	**$7,560**	**$13,466**	**$13,461**	**$19,844**	**$23,433**	**$23,134**

3-60. LTBMUProgram Funding Provided by the Southern Nevada Public Lands Management Act (SNPLMA)

SNPLMA								
FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	Average
14,080,000	5,545	16,412	16,049	13,521	11,900	11,930	7,932	$9,975
8,033,000	11,702	10,006	12,181	10,654	13,269	15,054	15,237	$11,053
$22,113,000	$17,247	$26,417	$28,230	$24,174	$25,169	$26,985	$23,170	$21,029

Figure 3-78. LTBMU Program Funding by Fiscal Year



Economics

Alternative C has the most recreation use projected which results in the highest labor income and employment projections, followed by B, A and then D. Payments to counties are expected to be about the same across alternatives (Table 3-61). The LTBMU does not contribute any jobs and income from grazing or minerals (Table 3-62). There is no timber program, however some trees are sold as part of the ecosystem restoration activities and are assumed to be about the same contribution towards jobs and income across the alternatives.

3.4.19.4. Analytical Conclusions

Table 3-61. Summary of Alternatives by Economic Alternaive

Indicator	Unit of Measure	Alt. A	Alt. B	Alt. C	Alt. D
		Current Plan (No action)	Proposed Plan		
Labor Income	$1,000	$143,722	$149,473	$160,974	$126,471
Employment	# Jobs	3,593	3,755	4,081	3,105
Payments to Counties/States	$1,000	$2,313	$2,313	$2,313	$2,313

Table 3-62. Employment (for the Lake Tahoe Region as defined by zip codes) – total number of jobs contributed

Resource	Alt. A (Current)	Alt. B	Alt. C	Alt. D
Recreation: non-local only	3,166	3,324	3,641	2,691
Wildlife and Fish Recreation: non-local only	87	92	100	74
Grazing	0	0	0	0
Timber	0	0	0	0
Minerals	0	0	0	0
Ecosystem Restoration	50	50	50	50
Payments to States/Counties	31	31	31	31
Forest Service Expenditures	258	258	258	258
Total Forest Management	3,593	3,755	4,081	3,105
Percent Change from Current	---	4.5%	13.6%	-13.6%

3.4.20 Soils Resource

3.4.20.1. Introduction

In addition to supporting native vegetation and wildlife, soils play a critical role in supporting watershed and ecosystem health through their functions of accepting, storing, and releasing water. The soils analysis analyzes the effects of the alternatives in terms of their effects on soil quality and soil productivity. Discussion of water quality impacts can be found in the water quality section (Section 3.4.22 of this chapter) and the Water Quality specialist report (project record PR#5). Information in the soils analysis is not intended to predict water quality impacts and should not be used for that purpose.

The spatial scope of the analysis is limited to National Forest System (NFS) lands within the Lake Tahoe Basin administrative boundary. The analysis is further limited to lands dedicated to growing vegetation. Roads, trails and some parts of developed facilities such as resorts and campgrounds are not dedicated to growing vegetation. Soil productivity is a site-specific attribute of the land; soil productivity of one area is not dependent on the productivity of an adjacent area. For this reason, only soils on NFS lands are analyzed; effects to soil productivity on NFS lands generally do not affect productivity on adjacent lands under other ownership.

The temporal scope for assessment of soil resource environmental effects includes short term (1-10 years following activities) and long term (10-20+ years following activities) for this analysis.

Methodology

Consequences of activities and uses to the soil resource are discussed in terms of the magnitude, duration, and extent of the effect. Magnitude describes the degree of positive or negative impact on the resource. Consequences may be short term (less than 10 years) or long term (> than 10 years) in duration. Extent is a measure of the area of the effect.

The environmental consequences of the following major categories of activities and uses to the soil resource are discussed as follows:

- Stream channel restoration (Section 3.4.22 – Water Quality and Soil Erosion)
- Vegetation and fuels management
    - Prescribed fire – underburning and pile burning (Section 3.4.10 – Fire and Fuels)
    - Hand and mechanical thinning (Section 3.4.10 – Fire and Fuels)
    - Temporary road construction and rehabilitation (Section 3.4.1 – Access and Travel Management)
- Terrestrial invasive species management (Section 3.4.5 – Botanical Terrestrial Invasive Species)
- Developed recreation sites – sustainable use and expansion (Section 3.4.17 - Recreation)

- Road and trail use and maintenance (Section 3.4.1 – Access and Travel Management)
    - Non-system trail uses and creation
    - encroachment uses by residents (Section 3.4.13 – Lands Program)
- Other Activities and Uses (Summarized in Table 3-1)
- Wildfire (Section 3.4.10 – Fire and Fuels)

Some activities are not specified because they are a combination of activities from the above list. For example, aspen enhancement and meadow restoration may include hand and mechanical thinning and prescribed fire. Other activities are not discussed because they do not involve ground disturbance or other actions that could affect soil productivity.

Forest management activities and uses that cause soil disturbance have the potential to impact productivity. The following indicators form the basis for this analysis and are defined and discussed below:

1. Soil Porosity and Soil Hydrologic Function
2. Effective Soil Cover
3. Surface and Subsurface Soil Organic Matter
4. Severe Burning

These are the primary indicators of soil productivity that may be affected by forest management activities and uses. The indicators are described briefly below; additional information is available in the Soils Specialist Report.

Soil Porosity and Soil Hydrologic Function

Porosity is the space between individual soil particles. Maintenance of natural soil porosity is important for maintaining healthy native plant communities and for maintaining the hydrologic function of the soil. Soil hydrologic function is the ability of water to move into and through soils. Infiltration is the movement of water into soils, while hydraulic conductivity (sometimes called permeability) is the movement of water through soils. Compaction can alter soil porosity and soil hydrologic function, often in ways that are detrimental to plant growth.

Effective Soil Cover

The presence of effective soil cover generally indicates that the soil surface is adequately protected from accelerated (human-caused) erosion. Effective soil cover is defined as live vegetative plant canopies, plant litter and duff, and rock fragments at least ½ inch in diameter.

The topsoil (A horizon) is the most fertile and biologically active part of the soil profile due to its enrichment by organic matter in varying stages of decomposition. Loss of all or part of this horizon through erosion impairs the ability of the soil to support natural vegetation communities and often imparts a competitive advantage to terrestrial invasive plant species (weeds).

The Water Quality section discusses erosion as it relates to water quality.

Surface and Subsurface Soil Organic Matter

Surface organic matter includes plant litter and duff and is sometimes referred to as the forest floor. It protects the soil surface from erosion and moderates changes in soil temperature and moisture through its mulching effects.

Subsurface organic matter exists in various stages of decomposition; humus is the well-decomposed, relatively stable, dark-colored portion. Decomposed subsurface organic matter provides plant-available nutrients, increases soil pollutant filtering capacity, increases water-holding capacity, and promotes the transfer of air and water through soils through its role in aggregate formation.

Organic matter also serves as a major reservoir for terrestrial carbon. The effects of forest management activities and uses on carbon storage are of concern due to climate change. This is a relatively new area of investigation and much remains unknown (Trumbore and Czimczik 2008, Rasmussen et al 2008).

Severe Burning

Severely burned soil is a condition where most woody debris and the entire forest floor are consumed down to bare mineral soil. Soil may have turned red due to extreme heat; in wildfires in the Sierra Nevada, about 1-2% of the area may have severely burned soil (Ulery and Graham 1993). Fine roots and organic matter are charred in the upper one-half inch of mineral soil. Severely burned soils are identified by ratings of fire severity and the effects to the soil. A range of soil impacts may result: soil humus losses, structural changes, hydrophobic characteristics (water repellency) and temporary reductions in soil organism populations due to lethal temperatures.

Assumptions

In the analysis for this resource, the following assumptions have been made:

- All activities and uses would comply with Forest Plan Standards and Guidelines.
- All activities and uses would employ Forest Service Best Management Practices and these practices would be effective at controlling erosion.
- Additional project-specific resource protection measures or mitigations would be prescribed and implemented as needed to maintain soil productivity.
- All activities and uses would be consistent with Forest Service policy as expressed in FS Manuals and Handbooks and other documents.
- The desired conditions for maintaining, enhancing, and restoring soil productivity apply to areas that are dedicated to growing vegetation. There is no requirement to maintain soil productivity on system roads and trails or on some portions of developed sites (e.g. corrals, parking areas).

Winter recreation would not affect the soil resource because activities and uses would be conducted in accordance with law, regulation, policy, Forest Plan Standards and guidelines, and project-specific resource protection measures. While incidental soil damage is expected, it would not be significant, is not predictable, and is not expected to vary by alternative.

3.4.20.2. Overview of the Affected Environment

Soils of the Tahoe Basin are predominantly derived from igneous rock, with minor contributions from metamorphic rocks. The volcanic (extrusive) rocks are mainly andesitic lahars and the granitic (intrusive) rocks are mostly granodiorite. Soils are generally coarse-textured (sandy), and relatively young, with low clay contents. These characteristics make them susceptible to erosion when disturbed. Depths range from very shallow on steep mountains to very deep in some meadows and glacial deposits. Meadow soils generally have higher silt contents than most other basin soils, along with thicker surface layers of partially decomposed organic material. Organic soils, including peat, are limited in extent. General soil types and their associated management concerns are summarized in the Soil Specialist Report. The Soil Survey of the Lake Tahoe Basin Area provides more detailed information on soil properties and management (USDA NRCS 2007).

Soil productivity is at or near natural levels throughout most of the planning area in areas dedicated to growing vegetation. During the 19th and early 20th century, soil impacts from logging and grazing were widespread, and forest floor and topsoil loss along with compaction, likely decreased productivity (Murphy and Knopp 2000a). These impacts are only apparent today in isolated areas.

Fire suppression during the 20th century resulted in forest floor buildup that is greater than what would be expected under a normal fire return interval regime. The current overly dense condition of most forest stands in the Lake Tahoe Basin may have produced thicker surface organic horizons than were present before the Comstock logging era, with higher levels of carbon, nitrogen, phosphorous, and other nutrients than under more natural conditions (Miller 2007).

Monitoring suggests that current vegetation management practices are not significantly impacting soil productivity or causing extensive accelerated erosion. (USDA Forest Service 2010b and c). Erosion in the Heavenly Ski Area was a significant concern discussed in the EIS for the 1988 Forest Plan. Since then, management practices have been adjusted such that this is no longer a major concern (Cardno ENTRIX 2010).

A combination of past and current land use has resulted in a slightly elevated erosion risk in four 6th field watersheds. Trout Creek watershed receives heavy recreational use and is still recovering from road and railroad networks and flumes associated with Comstock logging. Angora Creek and Fallen Leaf watersheds receive heavy recreational use, including many non-system trails and relic roadbeds. Ward Creek watershed is still recovering from past logging and grazing impacts.

Erosion in the Gondola, Showers, and Angora fire areas has largely returned to background levels. Post-fire erosion was severe enough to impair productivity in limited areas only.

3.4.20.3. Environmental Consequences

Geomorphic Stream Channel and Habitat Restoration

Stream channel and habitat restoration activities would result in short term impacts of limited extent and net long term soil productivity increases.

Short term compaction results from heavy equipment use during construction; these impacts are of limited extent and are generally mitigated at the close of the project. Riparian restoration projects are often on Tahoe soils, which have a higher risk of compaction than most Tahoe basin soils due to higher silt and moisture contents in surface layers. This risk is countered by root growth over time, which ameliorates compaction or restores soil porosity; the greater amount of available water in riparian zones and vegetative growth probably means recovery proceeds faster in those areas than in upland settings.

Over the long term, surface organic matter would increase as a result of the enhancement of native vegetation communities; riparian vegetation would benefit from increased soil moisture content for a longer portion of the growing season due to increases in overbank flows.

Similarly, erosion potential would decrease over the long term as effective ground cover and the root mass of native vegetation increases.

The extent, magnitude, and duration of consequences would be similar for Alternatives A, B, and C. Under Alternative D, there would be a potential for fewer resource benefits after currently planned projects are completed.

Forest Vegetation and Fuels Management

Prescribed fire – underburning and pile burning

Underburning results in minor to negligible short term effects to soil productivity. Pile burning results in minor short term impacts over most of the activity areas, and severe impacts of limited extent which may be long term in duration.

Soil temperatures under burning piles vary with soil moisture, pile size, and the diameter of the material in the piles, creating a range of impacts. Impacts are greatest when burning larger diameter material under dry soil conditions. In underburns, these effects would be limited in area to soils under the occasional log or stump that burns for an extended period of time.

Underburning and slash pile burning generally have negligible effects on soil porosity. Potential impacts would be loss of surface soil aggregate structure and clogging of soil pores by ash. These effects are limited to the pile footprints.

Effective soil cover losses are a short term impact; cover is replaced by needle cast and regrowth of vegetation. Depending on the amount of fuels removed, piles may cover between 1% and 34% of the ground surface (Busse et al. *in press*). Burn pile footprints often have a concave surface that retains water, providing an advantage to emerging vegetation.

During underburning, detrimental soil heating can be limited by burning when soils are moist to wet, which also may result in patchy duff consumption, thus reducing erosion potential (Knapp et al 2009, Busse et al 2010). Underburning may improve microbial response to wildfire. When a moderate intensity wildfire burned ponderosa pine forest, the microbial biomass in soils was nearly twice as great in soils subjected to prescribed fire three months before the wildfire than in soils without prescribed fire (Choromanska and DeLuca 2001). Prescribed fire can also result in short term nutrient releases that provide a burst of vegetative growth.

The consequences to the soil resource would be similar in duration for all alternatives. The extent of consequences from underburning would be similar for Alternatives A and B. Under Alternative C the extent would be less than Alternative A, for the first round of treatments, but would increase after that because stand density would be low enough to permit underburning as a maintenance tool. Under Alternative D the extent of effects would be greater than Alternative A because Alternative D has the greatest emphasis on use of fire as a management tool. However, Alternative D would also carry a greater risk of wildfire than the other alternatives because underburning would be prescribed in stands with higher tree densities than in Alternatives A, B, and C. Increased wildfire risk means an increased risk of severe burning and erosion.

The extent of consequences from pile burning would be similar in Alternatives A and B. Under Alternative C, the short term consequences would be greater than Alternatives A and B because treatment prescriptions would be more intensive, resulting in a greater amount of material to be piled and burned. After the first round of intensive treatments is complete, effects would diminish because a greater number of stands could be maintained through underburning. Effects from pile burning would be greatest under Alternative D. The reduced diameter limits for mechanized thinning would necessitate a greater acreage of pile burning as well as a greater volume of larger diameter material in the piles than in other alternatives, which in turn would increase the magnitude of the effects on soils because larger diameter material results in higher soil temperatures (Busse et al. *in press*).

Hand and mechanical thinning

The consequences of hand thinning to the soil resource are negligible as this activity results in very little soil disturbance. Most of the effects are from burning the piles created during thinning; effects of pile burning are discussed above, in the section on Prescribed Fire.

Mechanical thinning results in areas of compacted soil; the degree of compaction varies with the number of passes, the soil type, and soil moisture at the time of equipment operation. The extent of compacted areas varies with the kind of logging system. In past projects in the Lake Tahoe basin, severely compacted areas have been limited to less than 12% of the area treated when cut-to length (CTL) systems were used. Whole tree (WT) systems tend to impact more of the treated area than CTL (Han et al. Unpublished). In addition, soil compaction is often more severe in WT units than in CTL units (McNeil and Ballard 1992; Lanford and Stokes 1995). Where slash is available, the forwarder used in the CTL system drives on a slash mat, which cushions the soil, absorbing some of the ground pressure and vibration from the equipment. The effectiveness of the slash mat depends on its thickness and the number of times it is driven over (breakage reduces effectiveness).

Compaction can be minimized by operating on relatively dry soils and limiting the extent of equipment traffic through designating skid trails and limiting the size of landings. Operating on less sensitive or low risk sites is also very effective. Soils with low risk characteristics can tolerate greater variety of equipment and operating conditions (moisture) than high risk soils (Miller et al 2004). Most of the Tahoe basin soils have a low compaction risk due to their coarse textures. Compaction is inhibited on rocky soils because compaction is limited when subsurface rocks are pushed against each other.

Surface soils tend to recover relatively quickly from compaction, but subsoil compaction may persist for decades, so loss of porosity is generally considered a long term impact (Sands et a 1979; Froehlich et al 1985; Tiarks and Haywood 1996). Slight recovery may occur after 5-10 years (Page-Dumroese et al 2006; Powers et al 2005). Recovery rates may vary with repeated disturbance, soil moisture during equipment operation, soil texture, and rock fragment content (Miller et al 2004; Williamson and Neilsen 2000; Liechty et al 2002).

Short term impacts to the forest floor result as surface organic matter is displaced and crushed by equipment traffic, making it more susceptible to erosion. Post-treatment replacement of ground cover begins with needle cast in the fall. When chipping or mastication is used for slash disposal, ground cover is replaced more quickly, but is higher in carbon and lignin and lower in nitrogen and other plant nutrients than material that accumulates naturally.

Removal of vegetation would result in a temporary loss of potential surface and subsurface organic matter. As the trees in the stand grow, additional surface and subsurface organic matter would be produced through decomposition of litter and fine roots. Additionally, thinning is proposed in order to reduce stand density to conditions more appropriate to the ecosystem, so this temporary loss would not be a significant detriment to soil quality. The current overstocked condition of forest stands have likely resulted in forest floor accumulations that are greater than the norm for the ecotypes in the project area.

Soil loss from erosion is a risk of mechanized thinning, but has been successfully controlled on NFS lands in the Tahoe Basin through project design and use of BMPs (USDA Forest Service 2010b and c). Water quality impacts from erosion are usually evident before soil productivity is affected. This means that when monitoring results show that erosion has not impacted water quality, one can assume that soil productivity has not been affected.

Consequences to soil productivity would be roughly equal under Alternatives A and B, which would result in minor short and long term impacts of limited extent.

The magnitude and extent of impacts would be slightly greater under Alternative C than under Alternatives A and B, but this difference would be balanced by the lower frequency of disturbances due to thinning. Alternative C might be the most favorable for the soil resource due to the longer recovery time between mechanized treatments; porosity losses that require long term recovery would be less frequent. Although surface disturbance would be slightly greater because more trees would be removed at one time, surface disturbances recover relatively quickly. Based on modeling, Alternative C would result in up to 20% more shrub growth than Alternatives A and B; nitrogen-fixing shrubs such as whitethorn (*Ceanothus leucodermis*) and

snowbrush (*Ceanothus velutinus*) would provide additional nutrient inputs, slightly increasing potential productivity.

The extent and magnitude of effects from mechanized thinning would be least under Alternative D because there would be fewer acres of mechanized thinning.

Temporary road construction and rehabilitation

Temporary roads are often constructed as a part of vegetation management projects to access areas not accessible from the permanent road system. Over the past 10 years, the LTBMU has constructed or plans to construct roughly 19 miles of temporary road. Of these, 13 miles were on existing road alignments of closed or decommissioned roads, and 6 miles were new construction. Vegetation management projects have required roughly 5 feet of temporary road construction per acre treated.

Overall, consequences of temporary road construction are minor due to their limited extent and are long term in duration.

Soil compaction is primarily a concern with new temporary road construction; existing alignments have soil that is already compacted. For new construction, the degree of compaction at project completion depends on whether the road is ripped or recontoured at project close. Compaction, with the associated loss of porosity and hydrologic conductivity, is a long term effect of limited extent.

Organic matter loss is also a long term effect of limited extent. Road construction removes the forest floor and some or all of the organically-enriched topsoil is removed and displaced. When well designed temporary roads with adequate BMPs generally present a low risk of erosion.

Consequences would be similar under Alternatives A, B, and C. The extent of the consequences would be less under Alternative D because there would be less mechanized thinning.

Terrestrial Invasive Plant Species Management

The extent and magnitude of effects to the soil resource from weed management would be minor to negligible. Effects are described in detail in the Terrestrial Invasive Plant Species Treatment Project EA (USDA Forest Service 2010d). Short term impacts would result from physical and chemical treatments. Long term effects would be positive, as native vegetation would be enhanced. This would benefit the soil resource because many weed species do not provide as much ground cover and soil protection (plant canopy and litter) as native species. In addition, some invasive species alter soil microbial communities or secrete chemicals into the soil to the detriment of native plant species.

Consequences would be similar in Alternatives A, B, and C. Under Alternative D, treatment would be limited to selected priority species. This would reduce the extent of treatment impacts, and would also reduce the extent and magnitude of positive benefits.

Developed Recreation Sites – Use and Expansion

Use of developed recreation sites such as campgrounds, resorts, and scenic overlooks is largely dependent on site design and maintenance. Soil impacts are limited on newer sites and sites which have received BMP upgrades, while older sites that have not been redesigned or upgraded may have more severe impacts.

Site design is critical for maintaining soil productivity which supports the native vegetation and associated scenic values in developed recreation sites. Site design which limits intensive use to hardened areas protects the soils, resulting in reduced areas of compaction and loss of surface organic matter, and consequently, lower erosion potential. Accelerated erosion is adequately controlled on most developed sites (USDA Forest Service 2010b and c, Cardno ENTRIX 2011). The hardened areas of these sites, such as pathways, are not areas dedicated to growing vegetation, so there is no expectation for soil productivity to be maintained.

Expanding the area of developed recreation sites would increase the area of compacted soils, but the extent of this effect could be controlled through design. Expanding the season of use into spring and fall increases the risk of compaction because use while soils are wet would increase. This could be controlled to some extent through design, but is not always a priority in current practice. The extent of the area where the forest floor is diminished or missing would likely also increase, along with compaction. Effective cover and erosion risk could be controlled under extended season use, but there is always more risk during seasons with more rain (spring and fall).

Effects of Alternatives A and B would be similar. There is a potential for effects over a slightly greater extent under Alternative C and a slightly lesser extent under Alternative D.

Dispersed Recreation

Effects of dispersed recreation are largely captured under the discussion for developed recreation and trail use. The effects of dispersed recreation are concentrated in popularly used areas, which are hardened as needed to limit resource damage. Off-trail recreation by hikers, cyclists, and equestrians is limited and would result in negligible effects in most instances. A notable exception is the creation of unauthorized trails by cyclists and OHV riders which results in compacted surfaces that are highly susceptible to erosion because they are not designed to control runoff.

Outside of effects associated with road and trail use, effects of dispersed recreation on the soil resource would not vary significantly by alternative.

Road and Trail Use and Maintenance

The permanent transportation system is not land dedicated to growing vegetation and so there is no mandate to maintain soil productivity on this land. Consequences to the soil resource from the use and maintenance of the transportation system are therefore limited to areas where use and maintenance impact areas outside the road or trail alignment. These are generally minor effects of limited extent on porosity and surface organic matter. Erosion on slopes below roads and trails may impact productivity in limited areas where runoff velocity is not well controlled. Monitoring has found such erosion to be uncommon (USDA Forest Service 2010b and c).

Based on the current condition, most effects would be minor for Alternatives A and B. Under Alternative C, effects would be slightly greater than for A and B due to the work needed to increase the maintenance level of selected routes. Effects of Alternative D would be slightly greater than Alternative C in the long term due to reduced maintenance levels.

The creation and use of unauthorized roads and trails results in compaction, loss of the forest floor and surface organic matter. Erosion of topsoil is often a problem because these routes are not engineered and have no provisions for drainage or runoff control. Existing unauthorized roads or trails would be added to the system or closed and ecologically restored. Some unauthorized roads provide needed access such as utility easements that are included under special use permits; these would be added to the managed road system in the future.

Unauthorized use is not expected to vary by alternative.

Wildfire

Potential impacts to soils in the event of wildfire include severe erosion, loss of nutrients and organic matter, reduced infiltration, and destruction of soil macro- and microorganisms. The 2002 Gondola Fire resulted in significant soil loss from erosion. Short term effects also included significant increases in soil solution concentrations and/or leaching of mineral forms of nitrogen, sulfur, and phosphorous. The most significant long term effect was the loss of ecosystem nitrogen from the forest floor and the fire (Murphy et al. 2006). Post-fire erosion often stabilizes within a few years (Berg and Azuma 2010, Robichaud et al 2000, Benavides-Solorio and MacDonald 2005).

Although wildfire cannot be predicted, the alternatives do affect the risk and potential intensity and severity of wildfire. Hazardous fuel reduction treatments in the Lake Tahoe Basin have been shown to reduce fire behavior from a crown fire to a surface fire, thus reducing potential soil impacts because less heat is generated in a surface fire than in a crown fire (Murphy et al 2006). Similarly, reducing crown fuels was found to moderate extreme fire behavior in four different ecosystem types across the United States. An important feature these sites had in common was historical short fire return intervals, a feature also shared by the Tahoe Basin (Omi and Martinson 2002).

The risk of a significant loss of soil productivity due to wildfire would be roughly equal under Alternatives A and B. Risk would decrease more rapidly under Alternative C, though the decrease would be modest. Risk would be slightly greater under Alternative D than under A, B, or C because desired conditions for hazardous fuels would be only partially met outside the defense zone. The rationale for the differences among alternatives is described in more detail in the Fire and Fuels section.

Climate Change

Predictions of warmer temperatures, an increase in the proportion of precipitation falling as rain, and earlier peak snowmelt time could result in long-term indirect effects to soils.

Rain-on-snow events have the potential to cause significant erosion. These events may become more frequent as temperatures warm, but are not always associated with climate change – one of

the largest was documented in 1862, when resultant flooding destroyed much of Sacramento and other areas.

Soils may be dry for longer periods during the summer due to warmer temperatures combined with earlier peak snowmelt, but these effects are not likely to be observable or measurable during the planning period.

Other Activities and Uses

A number of other ongoing and intermittent activities and uses have minor effects on soils in limited areas, including

- Water, sewer, and power line maintenance and reconstruction
- Cell phone tower/water tower construction/reconstruction
- Other permitted non-recreation special uses
- Recreation residence use and maintenance
- Grazing

None of these activities and uses would vary by alternative, and it is not likely that they would significantly alter the existing condition in the future.

Water, sewer, and power line rights of way are accessed regularly for inspection and maintenance, including periodic tree removal under power lines. Inspection and maintenance activities result in compacted areas where surface organic matter is decreased or absent due to vehicle traffic and occasional ground disturbance when digging is necessary. Erosion control is mandated and monitored through compliance with permits issued for these activities. New construction or reconstruction of water, sewer, or power lines is infrequent, but can require larger disturbed areas. Recovery is generally long term.

Cell phone tower and water tower construction or reconstruction involve ground disturbance over a limited area and new sites may also require limited road construction. Limited areas of compacted soil and areas with decreased or absent surface organic matter are generally present. Erosion control is mandated and monitored through the permit system.

Other permitted uses include activities such as research projects, film- making, weddings and special events, and removal of forest products such as Christmas trees. Resource protection is controlled through the permit system and effects are generally negligible to minor and very limited in extent.

Limited areas of compaction and forest floor depletion are associated with foot traffic around recreation residences. These are small enough that soil productivity impacts are negligible, as evidenced by the surrounding native vegetation.

Grazing is primarily an incidental use on the LTBMU. There are no active grazing allotments and none are projected to become active in the future under any alternative. Grazing is primarily associated with outfitter-guide activities and other equestrian recreation. Impacts to soils are negligible, and would not vary by alternative.

3.4.20.4. Analytical Conclusions

Comparison of Consequences by Alternative

Overall, the consequences to the soil resource would be relatively similar under all alternatives. Qualitative ranking results are displayed in Table 3-63. Net positive benefits to the soil resource are displayed as positive numbers and net negative effects are displayed as negative numbers. This ranking does not account for differences in wildfire risk among the alternatives; those differences are discussed below.

Table 3-63. Comparison of Consequences to the Soil Resource.

Indicator	Unit of Measure	Alternative A	Alternative B	Alternative C	Alternative D
Compaction **Erosion** **Soil organic matter and forest floor** **Severe burning**	Acres	Soil quality maintained at sustainable level. Alternatives A and B would have similar risk of impacts due to wildfire	Soil quality slightly improved over Alternative A. Alternatives A and B would have similar risk of impacts due to wildfire.	Soil quality slightly decreased as compared to Alternative A, but still at sustainable level. Alternative C would have the least risk of impacts due to wildfire.	Soil quality slightly increased as compared to Alternatives A and B. Alternative D would have the greatest potential for soil impacts due to wildfire.

Stream channel and habitat restoration would result in minor very short term impacts and a net positive benefit over the long term for all alternatives. Consequences would be similar for Alternatives A, B, and C in the long term, but there would be fewer long term benefits under Alternative D.

Terrestrial invasive species management would result in negligible short term impacts and minor long term net positive consequences for all alternatives. Long term positive benefits could be somewhat less in Alternative D because fewer species would be treated. These findings assume the infested acres would be within the range analyzed in the TIPS EA.

Developed recreation site use and expansion would have minor negative consequences under all alternatives. From least to greatest impacts, the alternatives rank D, B, A, C.

Road and trail use and maintenance would result in minor negative consequences under all alternatives. Alternatives A and B would have similar consequences, consequences of

Alternative C would be slightly greater than A and B, and consequences of Alternative D would be slightly greater than Alternative C.

Vegetation and fuels management are most likely to have the greatest impacts on soil productivity because of the nature of their effects and because they impact the largest area of ground. The differences in consequences by alternative from forest vegetation and fuels management activities are thus considerably greater than the differences from other activities and uses. The potential for wildfire is also an important consideration because wildfire can significantly impair soil productivity. The consequences of vegetation and fuels management and wildfire would overshadow the consequences to the soil resource from other activities and uses.

Consequences of Alternatives A and B would be similar; the risk of significant damage due to wildfire would be slightly less in Alternative B. Impaired productivity would be slightly greater in the short term in Alternative C than Alternative A, due to more intensive silvicultural treatments and to a lesser extent by increased developed recreation. Impacts from vegetation and fuels management would be balanced in the long term by the need for fewer mechanized entries and the ability to use prescribed fire more safely over more acres. Potential impacts from wildfire would be similar in Alternatives B and C, but reduction in risk would be achieved slightly more quickly in Alternative C. Alternative D would result in the least impacts to soils overall, but carries the greatest risk for impacts from wildfire.

How the Alternatives Maintain or Achieve the Desired Conditions

Since soils are currently at or near natural levels of productivity throughout most of the planning area in areas dedicated to growing vegetation, the goal is to *maintain* the desired conditions. The desired conditions for soils would be maintained throughout most of the planning area in all alternatives; maintenance of desired conditions would differ slightly by alternative as described above. The desired condition related to impervious coverage is discussed under cumulative effects.

3.4.21 Terrestrial Wildlife Habitat and Species

3.4.21.1. Introduction

The purpose of this analysis is to evaluate and disclose the potential direct and indirect effects of the management activities proposed under the four Forest Plan revision alternatives on special status terrestrial wildlife species and habitat. Cumulative effects are described in Section 3.5. The four alternatives under consideration (Alternatives A, B, C, D) are described in Chapter 2.

Methodology

This analysis evaluates the potential direct and indirect effects of management activities under the four alternatives within the following program areas: (1) Watershed and Aquatic Habitat Restoration, (2) Biological Resource Protection, (3) Forest Vegetation Management, (4) Recreation, and (5) Access to NFS Roads and Trails. The program areas represent the suite of management activities that comprise the focal elements for management planning and activities on the LTBMU. The program areas are generally described in the descriptions of the alternatives in Chapter 2.

Indicators of effects in this analysis include special-status terrestrial wildlife species/species groups and terrestrial wildlife habitats. The following special-status species are evaluated:

- Threatened, endangered, candidate, and proposed species under the Endangered Species Act of 1973 (as amended)
- Region 5 Forest Service Sensitive Species
- Tahoe Regional Planning Agency (TRPA) Special Interest Species

Table 3-64 lists all other special-status species for the LTBMU, their listing status, habitat, and occurrence status. In addition to these individual species, effects to migratory birds are addressed as a group. Effects on Management Indicator Species (MIS) are described separately in section 3.4.13 of this chapter.

On June 16, 2010 coordination began between the LTBMU and the U.S. Fish and Wildlife Service (USFWS), Reno, Nevada and Sacramento, California field offices for species protected under the ESA (threatened, endangered, and candidate species) on the revision of the Forest Plan. Discussions on the process for formal consultation, including requesting technical assistance for candidate species and incorporation of migratory bird act considerations were determined as well as the method of interaction and how information exchange would be completed during the revision process. With the changes in Forest Planning rules in late 2010, the consultation process with USFWS was placed on hold until the new Draft EIS and Revised Draft Forest Plan would be made available for review (including the draft Biological Assessment and other biological support documents) to the USFWS (both Reno and Sacramento field offices). At that time (anticipated as January 2012) a formal request for consultation and technical assistance will be reinitiated with the new revised Draft EIS and Draft Forest Plan. Consultation will be completed prior to the Responsible Official issuing a Record of Decision on the Final EIS and Final Forest Plan (sometime in late 2012 or early 2013).

Table 3-64. Special-status species for the LTBMU, listing status, habitat, and potential for occurrence in the LTBMU during the life of the Plan

Species **Common Name** ***Scientific Name***	**Status[1]**	**Habitat[2]**	**Occurrence Status[2]**
Birds			
Waterfowl	SI	Lacustrine, riverine, wetlands, and marsh areas	Known to occur; waterfowl found throughout Basin.
Northern goshawk ***Accipiter gentiles***	S, SI	Forested areas associated with riparian systems, high canopy closure, high density of large and mature trees and snags, and open understories	Known to occur; detections at 28 of 32 Protected Activity Centers on LTBMU from 2001-2010
Golden Eagle ***Aquila chrysaetos***	SI	Early successional forests and shrub communities for foraging and cliffs and large trees for nesting	Known to occur; incidental detections in Round Lake area and Desolation Wilderness in 2011
Bald eagle ***Haliaeetus leucocephalus***	D, S, SI[3]	Open water with juxtaposed mature live and dead (snags) trees or steep cliffs	Known to occur; recorded in LTBMU since 1874; one known nest on LTBMU
Osprey ***Pandion haliaetus***	SI	Large snags and open trees in mixed conifer forests near large bodies of water	Known to occur; recorded as recently in 2011 at shore and inland sites
Peregrine falcon ***Falco peregrinus***	SI	Open areas; breeding near rivers, wetlands, lakes, or other aquatic features; nests on cliffs, banks, dunes, mounds, and human-made structures.	Known to occur; recorded as recently as 2011 at various locations in LTBMU
Great gray owl ***Strix nebulosa***	S	Meadows and early seral-stage habitats that support sufficient prey and have adjacent conifer forests with moderate to high canopy cover	Not expected to occur; last detected near LTBMU in 1979

Species Common Name *Scientific Name*	Status[1]	Habitat[2]	Occurrence Status[2]
California spotted owl ***Strix occidentalis occidentalis***	S	Late seral closed canopy forest; mature coniferous forests with high tree canopy cover, multilayered canopies, and an abundance of large and mature trees and snags; possible use of younger stands for foraging	Known to occur; detections at 15 of 21 Protected Activity Centers on LTBMU (2001-2010)
Willow flycatcher ***Empidonax traillii adastus***	S	Meadows that have high water tables in the late spring and early summer, and abundant shrubby, deciduous vegetation (especially *Salix* spp.); especially meadows with standing water or saturated soils	Known to occur; recorded in LTBMU since 1992
Mammals			
Townsend's big-eared bat ***Corynorhinus townsendii***	S	Coniferous forests and riparian habitat for foraging; cave and cave surrogate habitat (e.g., mines) and buildings for roosting	Known to occur; recorded in LTBMU in 2007 and 2009 (Borgmann and Morrison 2008)
Sierra Nevada red fox ***Vulpes vulpes necator***	S	High elevation barren, conifer and shrub habitats; montane meadows; subalpine woodlands and fell-fields	Occurrence possible; no detections in last 10 years in LTBMU but contemporary range poorly understood and recently identified on adjacent NFS lands (Humboldt-Toiyabe)
American marten ***Martes Americana***	S	High elevation mature and old growth conifer forests with complex understory structure, large snags and live trees and logs, and minimal human disturbance	Known to occur; recorded in LTBMU since 1980's; one known den
Pacific fisher ***Martes pennanti***	C	Late successional forests with high canopy cover, large live trees, and snags and logs	Not expected to occur; no detections in last 10 years in LTBMU, outside geographic and

Species Common Name *Scientific Name*	Status[1]	Habitat[2]	Occurrence Status[2]
			elevation range of species
California wolverine ***Gulo gulo luteus***	S	Diverse, coniferous forest types and non-forested alpine habitats with minimal human disturbance and cover	Occurrence possible; last detected 2 miles from LTBMU in 1994; recent wolverine detection in Truckee in 2008/09 was genetically related to Rocky mountain population (Moriarty et al. 2009)
Mule deer **(*Odocoileus hemionus*)**	S	Riparian areas, meadows, and early to mid-successional habitats	Known to occur; species was detected throughout LTBMU during 2007 Basin-wide surveys

1. **Status**
   C: Candidate, D: Delisted under Endangered Species Act of 1973 (as amended)
   S: Region 5 Forest Service Sensitive Species
   SI: Special Interest Species (TRPA)
2. More detailed habitat associations and occurrence descriptions provided in species accounts below.
3. Both winter and nesting bald eagles are considered TRPA Special Interest Species.

Terrestrial wildlife habitat indicators evaluated in this analysis include: wet meadows, montane riparian (e.g., stream and creek habitat), lakeside marsh and shore habitat, aspen, Jeffrey pine, white fir-mixed conifer, red fir, lodgepole pine, subalpine forest, montane chaparral, cliff and cave habitat, and species-designated habitat (Protected Activity Centers).

Potential direct and indirect effects on special-status terrestrial wildlife species and terrestrial wildlife habitat are measured by the anticipated trend in species productivity (i.e., reproductive success) and habitat condition. The analysis involved identifying: (1) the management activities associated with each program area by alternative, (2) potential effects from these management activities, and (3) the proposed magnitude of change in these actions by alternative.

Sources of information used in the analysis include a search of the USFWS database of special-status species for the LTBMU (USFWS 2012; accessed on April 20, 2012; http://www.fws.gov/sacramento/ES_Species/Lists/es_species_lists_NF-action-page.cfm) and a review of the peer-reviewed literature, Forest Service general technical reports, TRPA Code of Ordinances (1987), and reports of studies conducted in the LTBMU.

The Spectrum model was the primary model used by analysts to predict future outcomes of planned vegetation treatments in the LTBMU. The timeframe for implementation of the revised Plan is 15 years but the full perspective of management implications are best understood further out in time. Therefore, projected trends in modeled habitat types are presented for 30 years out in time. For more detailed information on the Spectrum model please refer to the *Forest Vegetation Resources* section.

Geographic information system (GIS) information for California Wildlife Habitat Relationship (CDFG 2005) habitats were used to calculate the amount of high and moderate capability habitat for terrestrial wildlife species in the LTBMU.

The analysis area for direct and indirect potential effects is defined as all NFS lands within the LTBMU administrative boundary. All measures of effect are evaluated at a basin-wide scale and based on the assumption that the future revised LTBMU Forest Plan will be programmatic in nature and not area-specific and/or project-specific. All effects are evaluated on a 15-year basis for the anticipated life of the Plan; short terms effects will be addressed in project-specific NEPA analysis as projects under the revised Forest Plan come online.

Assumptions

In addition to universal assumptions, the following assumptions have been made:

- Increased recreation capacity would be correlated with increased use.
- Increased access to Forest System lands would be correlated with increased use of access and increased dispersed recreation activities.
- Alternative A represents the 1988 LTBMU Forest Plan (as amended) as written and as currently implemented.
- Creation of new developed recreation sites (e.g., facilities, campgrounds) would be compatible with natural resource objectives.

Expansion of ski resort operational boundaries under Alternatives A, B, and C means additional ski runs, facilities, lifts and all other infrastructure and activities that occur in current operational boundaries could occur in the newly expanded boundary.

3.4.21.2. Overview of the Affected Environment

Major coniferous forest types in the Lake Tahoe Basin include Jeffrey pine, white fir -mixed conifer, and red fir and there are old growth examples in each type. Forested habitat in the LTBMU has been influenced by major historic land uses and practices such as Comstock era logging (1860-1920), cattle and sheep grazing (1850’s-1950’s), rapid human development (1960-1980), and fire suppression throughout urbanization of the basin (1911-present). The result is a landscape with altered tree species composition, reduced vegetation complexity, decreased extent of old-growth forests, degraded biological diversity, increased risk of high-intensity wildfires, and altered ecosystems functions, such as water uptake, fuels, tree longevity, and decay characteristics (Manley 2004). Contemporary old-growth forests are fewer in the basin than prior

to the mid 1800s and have denser understories, a shift in species composition towards more white fir and incense cedar and less Jeffrey pine, and there is a higher incidence of tree disease and mortality (Manley et al. 2000 and Barbour et al. 2002 as cited in Manley 2004). In the montane zone, tree species composition and diameter have changed such that there are more small-diameter and shade tolerant trees in the understory, particularly white fir, and fewer large-diameter trees (Barbour et al. 2002 as cited in Manley et al. 2010). In general, fire suppression and logging have contributed to current forest conditions that have higher tree densities in the smaller size classes, a shift to firs over pines, and a greater amount of fuels in the understory (Barbour et al. 2002 and Taylor 2004 as cited in Manley et al. 2010). The dense, homogenous and simplified structure of forests in the Lake Tahoe Basin lend towards a reduced potential to support diverse species assemblages.

Non-coniferous habitats in the Basin have also changed as a result of major historic land uses and practices. Aspen stands in the Sierra Nevada, including the LTBMU, are being replaced (shaded out) by conifers due to changes in historic fire regime. Montane chaparral on the landscape has diminished, having been converted to forest (Nagel and Taylor 2005 as cited in Manley et al. 2010). Limited management activities in proximity to stream riparian zones have resulted in the invasion of shade-tolerant conifers into many riparian areas (Manley et al. 2010) that compete with existing riparian vegetation (Haugo and Halpern 2007, Jones et al. 2005, Lang and Halpern 2007, Stam et al. 2008 all cited in Manley et al. 2010). Approximately half of the Basin's meadows have been permanently lost, fragmented, or altered (Cobourn 2006 and Elliot-Fisk et al. 1997 as cited in Manley et al. 2010). Grazing is no longer prevalent in meadows in the Lake Tahoe Basin, but there may be substantial legacies of this former major land use (particularly altered plant and animal species composition), similar to circumstances elsewhere in the Sierra Nevada (Dull 1999 as cited in Manley et al. 2010).

The LTBMU is recognized as one of the nation's most popular recreation areas and receives approximately 4.6 million visits per year. The high concentration of recreation activities and type of recreation activities (e.g., motorized, non-motorized, developed, dispersed) affect the occurrence and abundance of wildlife, structure of wildlife communities, as well as condition of habitat. The LTBMU manages campgrounds, resorts and lodges, day use sites, recreation residences, and ski areas, and also provides special use permits for management of developed recreation facilities, outfitter and guide activities and organized events. The LTBMU also manages many trails and roads that provide access to dispersed and developed recreation activities. Examples of summer dispersed recreation activities include, but are not limited to camping, mountain biking, rock climbing, hunting, hiking, Off Highway Vehicle (OHV) travel, and dirt bike riding. Examples of winter dispersed recreation activities include, but are not limited to back-country skiing, cross country skiing, sledding, snow play, snowshoeing, and Over Snow Vehicle (OSV) travel (i.e., snowmobiling). Recreation activities occur throughout the Basin but many highly concentrated activities occur along the lake shore where there tend to also be a variety of sensitive habitat types (e.g., meadows, marshes, etc.) and species. This is particularly true of the south shore, an area that has particularly high recreation use and also a high concentration of sensitive wildlife species and habitats.

In general, hunting is not considered a major recreational activity in the Lake Tahoe basin. The large patchwork of campgrounds and communities throughout the basin as well as the pockets of land under non-federal ownership likely limits hunting opportunities. Still, hunting is a

permissible activity on NFS lands in the LTBMU but is regulated by the California Department of Fish and Game (CDFG) and Nevada Department of Wildlife (NDOW). The state agencies issue permits/licenses for hunting of common species, including big game (e.g., deer bear), upland/small game (e.g., quail, grouse), and waterfowl. These agencies also impose a limit on the number of individuals of each species that can be hunted.

Changes in temperature, precipitation, and fire behavior have been occurring in the Lake Tahoe Basin and throughout the Sierra Nevada and are likely influencing terrestrial wildlife species. Mean annual temperature has risen by about two degrees Fahrenheit and precipitation has increased during the last century in the Lake Tahoe Basin (Safford 2010). Overall there appears to be a strong upward trend in air and Lake temperature, rainfall intensity, a shift from snow to rain, earlier seasonal snowmelt events, and increased inter-annual variability in the Lake Tahoe Basin (Coats 2010). The Sierra Nevada has experienced an increased frequency of fires since the 1980's (Westerling et al. 2006) and an increase in the mean and maximum fire size, total burned area, and fire severity between the early 1980's and 2007 (Miller et al. 2009); increases are attributed to the interaction between climate change and increasing forest fuels.

Changing climate conditions are likely influencing terrestrial wildlife species in the Lake Tahoe Basin but our understanding of the effects are not well understood and predictions are limited. Climate change has been correlated with latitudinal and altitudinal range boundary shifts (Parmesan 2006, Moritz et al. 2008, Crimmins et al. 2011) as well as phenological (timing) shifts (e.g., migration and blooming) (Parmesan & Yohe 2003, Root et al. 2003) in a variety of plants and animals. Uphill and higher elevation range shifts in response to historical warming have been well documented (Lawlor et al. 2009). For example, in Yosemite National Park, Moritz et al. (2008) found substantial upward shifts in elevation limits of 50% of small mammal species sampled as well as an expansion of ranges in low elevation species, contraction of ranges in high elevation species, and changes in the community composition at mid- and high-elevations. Forister et al. (2010) found a similar upward shift in elevation range of butterfly species in the Sierra Nevada. In contrast, recent research on range shifts of 73 vascular plant species in various California mountain ranges over the last century showed that about half of them had shifted the center of their range slightly downhill, in response to increasing water balance due to rising precipitation, which has slightly outpaced increasing evapotranspiration due to increasing temperatures (Crimmins et al. 2011). Based on their results, the authors suggest that cooler and wetter sites at higher elevations have potential to be more sensitive to changes in precipitation than warmer and drier sites at lower elevation sites which would be more sensitive to temperature changes. The authors also suggest that downhill shifts in species' ranges are expected to be more likely at these higher elevation wetter sites (Crimmins et al. 2011). Although these results are not specific to terrestrial wildlife species, which have been found to have experienced uphill and higher elevation shifts in the Sierra Nevada (e.g., Mortiz et al. 2008, Forister et al. 2010), some terrestrial wildlife species could shift ranges in response to precipitation changes. For example, repeated bird surveys along Grinnell transects in the entire Sierra Nevada has provided evidence that bird species may be tracking both precipitation and temperature or either over time (Tingley et al. 2009). It can be expected that range shifts in terrestrial wildlife species will occur although the type (up or down) and pace of shifts are not well understood at this time.

It can also be expected that community composition will change with range shifts; related species and species in the same community may respond differently to changing environmental variables and these disparate responses may result in the breaking up of existing communities and formation of novel communities (Root et al. 2003, Mortiz et al. 2008). Novel communities that are formed will present new challenges in terms of predator/prey relationships, parasitism, change in foraging resources, among other things.

Terrestrial Wildlife Habitat

Below are the descriptions of the various habitat type values in the LTBMU to terrestrial wildlife species.

Wet Meadow

Wet meadow habitat can provide nesting, burrowing, cover, and/or foraging habitat for a variety of terrestrial wildlife species including fossorial mammals (e.g., gophers, moles, and marmots), meadow nesting birds (e.g., willow flycatcher and mountain bluebird [*Sialia currucoides*]), herbivores (e.g., mule deer and bears), insectivorous bats, and mammalian carnivores and raptors. Wet meadows are important nesting, breeding, and foraging habitat for willow flycatcher, a region 5 Forest Service Sensitive Species, and yellow warbler (*Dendroica petechia*). Meadows also support a number of nest predators such as chipmunks (*Tamias spp.*), Douglas squirrel (*Tamiascriurus douglasii),* and long-tailed weasels (*Mustela frenata*) (Cain et al. 2006). Wet meadows support a variety of insects and are important foraging habitat for insectivorous bats. At least five bat species, including Townsend's big-eared bat, a region 5 Forest Service Sensitive Species, have been recorded in meadows in the LTBMU (Borgman and Morrison 2008). Meadows can serve as potential foraging locations for a variety of carnivorous mammals and raptors that feed on small mammals, and ungulates such as mule deer.

Lakeside Marsh and Shore Habitat

Marshes are wetlands where standing water exists year-round, except in shallower areas during late summer or unusually dry years and may support the growth of emergent plants, such as cattails, bulrushes, reeds, and sedges, as well as many floating and submergent plants (Caduto 1990 as cited in Manley et al. 2000). Marshes can provide valuable nesting, foraging, and cover opportunities for a variety of waterbirds, including ducks, shorebirds, and rails (Manley et al. 2000). Beaches are numerous and shoreline extensive in the Lake Tahoe Basin. Both marshes and shoreline habitat can provide essential nesting and foraging opportunities for a number of raptors including bald eagle, osprey, and peregrine falcon.

Montane riparian

Riparian areas consist of vegetation commonly associated with lentic (standing) or lotic (running) water, such as willows, alders, aspen, and meadows (Manley et al. 2000). Riparian areas occur throughout the Lake Tahoe Basin and have an exceptionally high value for many wildlife species. However, many of the montane riparian communities in the LTBMU are currently overstocked with conifers. Riparian areas provide water, thermal cover, migration and movement corridors and diverse nesting and feeding opportunities (Grenfell Jr. 1988). The shape

of many riparian zones, particularly the linear nature of streams, maximizes the development of a natural edge which is used by a variety of mammals as movement corridors, such as Sierra Nevada red fox a region 5 Forest Service Sensitive Species. Montane riparian habitats also serve as important nesting, foraging, and cover habitat for a variety of birds. These habitats are also especially important for bats as they follow the stream course foraging for insects; other bats (i.e., western red bat [*Lasiurus blossevillii*]) prefer to nest in riparian vegetation.

Aspen

Intact aspen communities are valuable nesting, foraging, and cover habitat for passerine and other bird species, rodents, large native ungulates, and raptors. The Lake Tahoe Watershed Assessment declared aspen groves as an Ecologically Significant Area (ESA) because they have an exceptionally diverse array of associated species and are uncommon in the Lake Tahoe Basin (covering less than 0.5 percent of the basin's land area) (Manley et al. 2000). Aspen stands in the Sierra Nevada, including the LTBMU, are being replaced (shaded out) by conifers due to changes in historic fire regime. In response to the Watershed Assessment the LTBMU has been implementing a multi-year restoration project focused on restoring aspen stands throughout the basin that are at risk of loss from the landscape. Aspen stands typically support a high diversity, richness, and abundance of birds as compared to adjacent habitats (Richardson and Heath 2004), and several bird species have been shown to have a strong affinity for aspen, including northern goshawk, red-breasted sapsuckers (*Sphyrapicus ruber*), dusky flycatcher (*Empidonax gentilis*), warbling vireo (*Vireo gilvus*), Swainson's thrush (*Catharus ustulatus*), and MacGillivray's warbler (*Oporornis tolmiei*) (Richardson and Heath 2004). Willow flycatcher, although more strongly associated with montane meadows, has been detected in meadow habitat with aspen in the LTBMU (Bombay et al. 2003b). Aspen stands are also habitats favored by a variety of cavity nesters such as bluebirds, sapsuckers, downy woodpeckers, and chickadees (Verner and Purcell 1988). Several mammal species are also associated with aspen and include ungulates such as mule deer (*Odocoileus hemionus*), rodents such as pocket gophers (*Thomomys*), voles (*Microtus*), shrews (*Sorex*), and mountain beaver (*Aplodontia rufa*) (Beier 1989, Coggins and Conovers 2005 and Loft et al. 1991 as cited in Manley et al. 2010).

Jeffrey pine

A number of terrestrial wildlife species use Jeffrey pine habitats by seeking cover in the herbaceous vegetation layer or downed logs, nesting or denning in snags and live trees, and/or foraging on pine seeds. Currently in the LTBMU, much of the Jeffrey pine habitat is represented by mid seral open and closed canopy stages. Generally, there is a paucity of late and early seral stages compared to reference conditions (Lake Tahoe Basin Existing Vegetation Map, Version 4.1, updated for the 2007 Angora Fire). The understory herbaceous vegetation layer that is generally associated with early seral stages and open canopy stands, including grass and forb species as well as montane chaparral shrubs, sagebrush, and bitterbrush can provide cover for a variety of terrestrial wildlife species especially small mammals and ground nesting birds. More closed canopy stands can preclude the growth of understory vegetation and consequently reduce wildlife species richness associated with this feature. The Jeffrey pine type is composed predominantly of vigorous trees, but dead and declining trees are a component and provide for snags and downed logs which can provide for rich nesting, denning, and cover habitat for

terrestrial wildlife. A number of cavity-nesting bird species (e.g., bluebirds, woodpeckers, nuthatches, chickadees) often use Jeffrey pine habitat for nesting (especially in snags) and foraging (Gucker 2007). California spotted owls use Jeffrey pine habitat for foraging and for nesting when large-diameter trees are present (Gucker 2007) and while there are large diameter Jeffrey pine trees present, overall there is an underrepresentation of late seral Jeffrey pine habitat in the LTBMU compared to reference conditions (Lake Tahoe Basin Existing Vegetation Map, Version 4.1, updated for the 2007 Angora Fire). The value of the Jeffrey pine forest type as a habitat for wildlife is also due to the food value of the Jeffrey pine seeds and seedlings. Pine seeds are included in the diet of more wildlife species than any other genus except oak (McBride 1988). American black bears, a variety of small mammals, and many bird species use Jeffrey pine habitats and/or feed on Jeffrey pine seedlings or seeds (Gucker 2007). Small mammals such as chipmunks and squirrels often cache and feed on Jeffrey pine seeds. Jeffrey pine seeds are an important food resource for Clark's nutcracker (Gucker 2007). The bark and foliage also serve as important food sources for squirrels and mule deer (McBride 1988).

White fir-mixed conifer

In the Lake Tahoe Basin, the white fir-mixed conifer forest type is dominated by white fir, with Jeffrey pine, sugar pine, red fir and incense cedar as important associates. In the LTBMU, white fir-mixed conifer is proportionally greater in the late seral conditions as opposed to earlier seral stages (Lake Tahoe Basin Existing Vegetation Map, Version 4.1, updated for the 2007 Angora Fire). Snags and downed logs in this habitat type, as with Jeffrey pine, can provide nesting, cover, and denning habitat for a variety of wildlife species, including cavity dependent species. White fir is the preferred tree species for insect-gleaning yellow-rumped warblers and western tanagers, and is also commonly used by other insect-gleaning birds, such as mountain chickadee, chestnut-backed chickadee, golden-crowned kinglet, and blackheaded grosbeak (Shimamoto 1988). The extent of white fir-mixed conifer in the LTBMU and across the Sierra Nevada is increasing steadily under fire suppression. Shade tolerant white fir trees are filling in stands previously comprised of Jeffrey pine. Fire-suppressed white fir-mixed conifer forest stands tend to have high tree densities in the smaller size classes, few shade intolerant pine associates, and a large amount of fuels in the understory. Generally, the high density of trees prevents sunlight from reaching the forest floor and limits the shrub cover. A reduced shrub cover limits potential cover and foraging locations for a variety of terrestrial wildlife species, especially small mammals and birds and their predators (e.g., spotted owls). In addition, a high density of small trees can also potentially limit the ability of California spotted owl and northern goshawk to navigate through forest stands. In areas where the canopy is more heterogeneous and shrub cover is high, this habitat feature can provide cover and foraging opportunities for a variety of terrestrial wildlife species.

Red fir

As with Jeffrey pine and white fir-mixed conifer habitat types, red fir forests can provide habitat for a number of terrestrial wildlife species. Marten prefer large snags, stumps, and logs in closed canopies of these forests for den sites (Cope 1993a). Other animals that use California red fir forests include fisher, wolverine, black bear, squirrels, chickadee, pileated woodpecker, great gray owl, Williamson's sapsucker, and pocket gopher (Cope 1993a). The cones are cut and

cached by squirrels. Deer browse new growth in the spring (Cope 1993a). Infrequent, low to mixed severity fires are characteristic in this type, including throughout spotted owl and goshawk PACs and HRCAs. Late and mid seral open canopy forest dominates the LTBMU (Lake Tahoe Basin Existing Vegetation Map, Version 4.1, updated for the 2007 Angora Fire). Where the canopy is open, a higher shrub layer exists in the understory (generally in higher elevations but patchy) and provides cover and foraging opportunities for a variety of small mammals and birds.

Lodgepole pine

Mammals and bird species use lodgepole pine forests for food, cover, and nesting/denning habitat. Dead or dying trees provide nesting sites for cavity-nesting birds (Cope 1993b). The fallen branches from these trees provide sites for ground-nesting birds and mammals. Although dead trees may be hazardous to elk and deer that are traveling quickly, dense stands of Sierra lodgepole pine provide excellent escape and resting cover (Cope 1993b). The seeds are a food source for squirrels, chipmunks, birds, and mice (Cope 1993b). Riparian lodgepole stands in the LTBMU are often very dense and comprised of many thin-stemmed individuals and high densities of snags and down timber. Understory diversity can range from very low to very high, depending on the availability of sunlight at the ground surface. Where stands are dense and sunlight to the forest floor is limited, understory shrub layer may be low or absent, limiting the opportunities for cover and foraging. Stands at meadow and lake edges are often much more open, and may support high levels of shrub and herb cover, and possible greater diversity of species. In drier stands, which also form part of the subalpine forest, the tree canopy is usually open (<50% cover) and characterized by trees of large diameter that can be used for nesting.

Subalpine forest

Major tree species in subalpine forest include mountain hemlock, whitebark pine, red fir, lodgepole pine, western white pine, and sierra juniper. Subalpine forest occurs on ground that is frozen for much of the year. Coniferous forests at high elevations in California typically support fewer species of birds and mammals than any other major forest type in the State (Verner and Purcell 1988). The reasons, though, not clearly established, probably involve some combination of climate, short growing season, lower primary productivity, moisture stress, and lower production of insects and other invertebrates that provide food resources for many vertebrates (Verner and Purcell 1988). Great gray owl, pileated woodpecker, marten, and wolverine are known to occur in these habitat types (Verner and Purcell 1988). Small mammals and birds (e.g., Clark's nutcracker) cache and disperse seeds in these habitat types.

Montane chaparral

The growth form of montane chaparral species can vary from treelike to prostrate. Its structure is affected by site quality, history of disturbance (e.g., fire, erosion, logging) and the influence of browsing animals (Risser and Fry 1988). For example, on shallow granitic soils in the Sierra Nevada, low dense growths of pinemat manzanita and huckleberry oak characterize an edaphic climax community, associated with scattered conifers and much exposed granite. Montane chaparral is characterized by evergreen species; however, deciduous or partially deciduous species may also be present. Understory vegetation in the mature chaparral is largely absent.

Conifer and oak trees may occur in sparse stands or as scattered individuals within the chaparral type. Montane chaparral can provide habitat for a wide variety of wildlife. Numerous rodents inhabit chaparral. Deer and other herbivores often make extensive use of chaparral (Risser and Fry 1988) Montane chaparral provides critical summer range foraging areas, escape cover and fawning habitat. In the Sierra, fawning areas are frequently found where the chaparral lies adjacent to or contains an interspersion of perennial grass or meadow-riparian habitat (Risser and Fry 1988). However when chaparral is mature, the structure may be impenetrable to large mammals (Risser and Fry 1988). Some small herbivores use chaparral species in fall and winter when grasses are not in abundance (Risser and Fry 1988). Many birds find a variety of habitat needs in the montane chaparral. It provides seeds, fruits, insects, protection from predators and climate, as well as singing, roosting and nesting sites (Risser and Fry 1988).

Cliffs, Caves, and Cave-Surrogates

Large cliffs may provide habitat for a variety of raptors in the LTBMU including peregrine falcon, osprey, bald eagle, and golden eagle. Peregrine falcons currently nest in cliff habitat in the LTBMU; some of these cliffs are also used for dispersed recreation activities such as rock climbing. Caves and cave surrogates (e.g., mines, adits, and vacant buildings) can provide habitat for many bat species, including Townsend's big-eared bat. At least three large, abandoned mine shafts and adits exist on the LTBMU and may provide cave-like habitats. No natural caverns are yet known on the LTBMU, although natural caverns have been discovered on National Forest System lands located immediately adjacent to the LTBMU administrative boundary.

Protected Activity Centers and Home Range Core Areas

In addition to the individual habitat types described above, the LTBMU manages 21 California spotted owl and 32 northern goshawk Protected Activity Centers (PACs), for a total of 6,040 acres and 6,383 acres respectively. California spotted owl PACs include the best available 300 acres of habitat on NFS lands in as compact a unit as possible surrounding a territorial owl's activity center. Northern goshawk PACs include the best available 200 acres of forested habitat on NFS lands in the largest contiguous patches possible and surrounding all known and newly discovered breeding territories detected on NFS lands. PACs are managed to meet the life history requirements of spotted owls and goshawks. As a result, management activities that would modify the habitat so that it trends away from desired conditions are prohibited.

The LTBMU also manages 21 California spotted owl Home Range Core Areas (HRCAs) for a total of 20,365 acres. HRCAs on the LTBMU include 1,000 acres of the best available and contiguous California spotted owl habitat in the closest proximity to the owl activity center. The acreage in the 300-acre PAC counts toward the total HRCA acreage. As with PACs, HRCAs are also managed to meet the life history requirements of spotted owls.

Terrestrial Wildlife Species

The following species accounts provide information for special-status species in the LTBMU, including habitat associations, threats, management direction under the 1988 LTBMU Forest Plan (as amended) and other applicable directives, as well as historical and contemporary

occurrence in the Lake Tahoe Basin. For additional information on species please refer to the Biological Assessment/Biological Evaluation. MIS are described separately in Section 3.4.14 of this chapter.

Pacific Fisher – Species Protected under ESA

The Pacific fisher (*Martes pennanti*) is currently a U.S. Fish and Wildlife Service (USFWS) candidate (C) species under the Endangered Species Act (ESA) of 1973, as amended. Fisher is typically associated with contiguous late successional forested habitat with relatively dense canopy cover and the presence of large live trees and snags and logs, although second-growth and non-forested habitat use has been detected (Lofroth et al. 2011). In California, habitat loss and modification in the 1800s may have contributed to range contractions but there are few documented records to verify this (Lofroth et al. 2010).

The 1988 LTBMU Forest Plan (as amended) provides designation criteria, desired conditions, and standards and guidelines for the protection of fisher den sites in the Sierra Nevada, including limited operating periods (LOPs), restrictions on fuels treatments, and the requirement to mitigate impacts where a den site has been disturbed.

The current North American distribution is substantially reduced from the historic distribution (Gibilisco 1994). The historic range in California and Oregon included the southern Cascade Ranges, northern Coastal Ranges, and Sierra Nevada Ranges (Zielinski et al. 1995, 2005) including the Lake Tahoe basin. Within California, the range of the fisher has since contracted and now appears to consist of two isolated native populations: one in the northwestern portion of the state that extends into southwestern Oregon, and the other in the southern Sierra Nevada (Zielinksi et al. 1995, Zielinski et al. 2005, Slauson et al. 2007, Lofroth et al. 2010). Few fisher detections have been made in or adjacent to the LTBMU, these include: (1) the south shore of Lake Tahoe south of the South Upper Truckee bridge in Christmas Valley in 1967, (2) just outside the western Lake Tahoe basin to the west of Barker Pass on the Tahoe National Forest in 1972; and (3) the west shore of Lake Tahoe in Sugar Pine State Park near the mouth of General Creek in 1984 (CDFG 2008).Therefore, due to the lack of detections in the LTBMU within the last 10 years and recent data regarding the geographic range of the species in California, it is assumed that the LTBMU is outside the contemporary range of the species and will continue to be outside the range during the life of the Plan.

The geographic range of the fisher is changing due to reintroduction efforts in the northern Sierra Nevada and is predicted to continue changing with climate change. Nevertheless, the range is not expected to include the LTBMU within the life of the Plan. Since 2009, California Department of Fish and Game (DFG) has been re-introducing fishers into Sierra Pacific Industry's Stirling Management Area which includes portions of Tehama, Butte, and Plumas counties and is approximately 80 miles northeast of the Lake Tahoe Basin. In a study of climate change effects on species in the genus Martes, Lawlor et al. (2011) concluded that macroclimate conditions closely correlated with fisher presence in California are likely to change greatly over the next century, resulting in a possibly pronounced loss of suitable habitat with the largest climate impacts occurring at the southernmost latitudes of their range (i.e. in the southern Sierra Nevada). It is within the realm of possibilities that the range of the species may shift up in altitude and north. Although Lawlor et al. (2011) noted that fisher habitat is driven to a great

extent by mesotopographic and local vegetation features that could not be incorporated into their climatic models, fire occurrence and behavior have substantial effects on local vegetation and these factors are driven to a large extent by climate/weather, so they also looked at stand-level implications of fire under a series of future fire scenarios. Based on this analysis, Lawlor et al. (2011) recommended protecting fisher habitat through targeted forest-fuel treatment, and applying more liberal fire-management policies to naturally ignited fires during moderate weather conditions.

Region 5 Forest Service Sensitive Species

Forest Service Sensitive species are those plant and animal species identified by a Regional Forester for which population viability is a concern, as evidenced by (FSM 2670.5):

(a) significant current or predicted downward trends in population numbers or density.

(b) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

Northern Goshawk – Region 5 Forest Service Sensitive Species

The northern goshawk (*Accipiter gentilis*) is a Region 5 Forest Service Sensitive Species and a TRPA Special Interest Species. Goshawks use areas with high canopy closure, a high density of large trees, and open understories (Keane 1999, USDA 2001). Some of the threats facing goshawk include habitat loss and fragmentation (e.g., loss of large diameter trees), forest structure changes and changes in prey populations due to fire suppression and climate change, risk of habitat loss due to stand-replacing fires, and disturbance from human activity in and near territories.

TRPA Code of Ordinances includes the designation of a 0.5 mile radius buffer around a goshawk nest or perching site that shall remain free from disturbance. The 1988 LTBMU Forest Plan (as amended) also provides designation criteria, desired conditions, management objectives, and standards and guidelines for the protection of northern goshawk nests and activity centers, delineated as Protected Activity Centers (PAC). Goshawk PACs include the best available 200 acres (more or less depending on availability of suitable vegetation) of the highest quality nesting habitat, and the most recent nest site and alternate nests within a goshawk breeding territory as described in management direction for the forest (USDA 2004).

There are currently 32 northern goshawk PACs on the LTBMU, following a re-mapping effort in 2008 to incorporate the most up-to-date detection, nest location, and land boundary information available. Goshawks have been detected in 27 (84%) of the 32 PACs between 2001 and 2010. Data for northern goshawk in the LTBMU are stored on the USDA Natural Resource Manager Natural resource Information System (NRM NRIS) (http://fsweb.nris.fs.fed.us/products/Wildlife/index.shtml).

Bald Eagle – Region 5 Forest Service Sensitive Species

The bald eagle (*Haliaeetus leucocephalus*) was federally delisted as threatened under ESA in 2007 and was selected as a Region 5 Forest Service Sensitive Species. This species is protected under the Bald and Golden Eagle Protection Act of 1940, and the winter and nesting population in the LTBMU is designated as a TRPA Special Interest Species. Bald eagles require open water with juxtaposed mature trees or steep cliffs for nesting, perching, foraging, and roosting (Bent 1961 in Murphy and Knopp 2000). This species typically perches in "large, robustly limbed trees, on snags, on broken topped trees, or on rocks near water" (Peterson 1986 and Laves and Romsos 2000). Habitat (unpubl.USFS data 1994) and perch sites (Laves and Romsos 2000) identified in the Lake Tahoe Basin indicate that local bald eagles prefer late successional stands (particularly Jeffrey pine) and trees that are larger in diameter and taller than the dominant tree canopy (particularly trees greater than 40 inches dbh, greater than 98 feet tall, and dead topped trees with robust, open branch structures).

The Recovery Plan for the Pacific Bald Eagle (USFWS 1986) states that the main threats to this species in Zone 28 (Sierra Nevada Mountains) are disturbance at wintering grounds and loss of potential nest habitat to logging or development. TRPA Code of Ordinances includes the designation of a 0.5 mile radius buffer around a bald eagle nest that shall remain free from disturbance and have also designated bald eagle winter disturbance free zones in the LTBMU. The 1988 LTBMU Forest Plan (as amended) was developed prior to the delisting and also provides standards and guidelines to identify potential bald eagle nesting sites and manage them to encourage the reestablishment of four pairs. In May 2000, also prior to the delisting, the LTBMU Bald Eagle Management Plan was prepared in an effort to recommend actions that will encourage the recovery of the species in the Basin.

Bald eagles have been recorded in the Lake Tahoe basin since 1874 and occur year-round. The LTBMU conducts annual bald eagle nesting surveys in conjunction with osprey nesting surveys and in cooperation with California Department of Parks and Recreation and Nevada Department of Wildlife. This species has been known to breed at Marlette Lake on the east side of Lake Tahoe and at Emerald Bay on the south shore. One bald eagle nest has been identified in the LTBMU since 1997 (active 1997, 2002-2003, 2005-2010). Two additional bald eagle nests occur in the Lake Tahoe Basin but are not located on Forest System Lands. Bald eagle numbers peak during the fall and winter, corresponding with kokanee salmon spawning activity (Murphy and Knopp 2000). The LTBMU hosts annual mid-winter bald eagle counts in coordination with partner agencies and the University of Santa Cruz, Predatory Bird Research Group (PBRG). A minimum of 7 and maximum of 18 bald eagle individuals (mean and median = 12) have been identified during the mid-winter surveys between 1999 and 2011. The number of individuals detected fluctuates annually; nearly twice as many individuals were detected in 2011 (N=17) as in 2010 (N=9). The LTBMU currently manages approximately 370 acres of the Taylor Creek and Tallac Creek wetlands and meadows north of Highway 89 in the south shore region as bald eagle wintering habitat from October 15 through March 15 annually.

Great Gray Owl– Region 5 Forest Service Sensitive Species

The great gray owl (*Strix nebulosa*) is a Region 5 Forest Service Sensitive species. Great gray owls typically forage in meadows and early seral-stage habitats that support sufficient prey, primarily *Microtus* and *Thomomys* spp. (USDA 2004, Sears 2006). Nesting and roosting occur in

adjacent conifer forests, generally in areas where canopy cover averages greater than 40 percent (USDA 2004). Some of the potential threats to this species in the high elevation range include timber harvest, fire suppression, post-fire salvage harvest, grazing, and alteration of hydrological regimes that has reduced the number of large conifers and oak trees used for nesting, as well as the quality of meadows and forest stands used for foraging (Dull 1999, Hutto and Gallo 2006, Saab et al. 2009). Additional threats include West Nile virus, direct and indirect human disturbance from recreational activities, and climate change (Gancz et al. 2004, Rauscher et al. 2008, Miller et al. 2009, Hull et al. 2010). The 1988 LTBMU Forest Plan (as amended) provides designation criteria, desired conditions, management objectives, and standards and guidelines for the protection great gray owl activity centers, delineated as Protected Activity Centers (PAC).

There are no PACs for great gray owls on the LTBMU and it is presumed that this species does not occur in the LTBMU and will not occur during the life of the Plan. Surveys for great gray owl have not been conducted on the LTBMU and this species has not been detected during large-scale surveys conducted on the Basin for other owls. Nearby, surveys have detected great gray owls on the Eldorado, Stanislaus, Sierra, and Tahoe National Forests but not on the Plumas or Sequoia National Forests. The nearest detection of this species to the Lake Tahoe basin occurred near Carson Pass in 1971 approximately 1.1 miles south of the LTBMU. A second great gray owl detection was reported near Grover Hot Springs State Park, approximately 7.9 miles southeast of the LTBMU in 1979. Based on the lack of detections on the Forest and the presumption that this species likely would have been detected during surveys for other owls if it were present, the great gray owl is not expected to occur in the Lake Tahoe basin.

California Spotted Owl – Region 5 Forest Service Sensitive Species

The California spotted owl (*Strix occidentalis occidentalis*) is a Region 5 Forest Service Sensitive Species and a Management Indicator Species (MIS) for the late seral, closed canopy coniferous forest habitat on the LTBMU. Additional information for the California spotted owl as an MIS is provided in the following section entitled *Management Indicator Species*.

Spotted owl home ranges and nest locations are highly associated with mature coniferous forests with high tree canopy cover, multilayered canopies, and an abundance of large trees (Forsman et al. 1984, Bias and Guitierrez 1992, Call et al. 1992, Verner et al. 1992, Bond et al. 2004, Chatfield 2005). Spotted owl foraging areas are also associated with late seral forests but may also include other, younger vegetation classes (e.g., pole-sized conifer stands) interspersed among mature and old growth forest patches (Williams et al. 2011). It has been suggested that landscape heterogeneity may be an important consideration for spotted owl management (Williams et al. 2011).

Potential threats to this species include loss of mature forest and large diameter trees, habitat fragmentation, forest structural changes and prey population changes as a result of fire suppression and climate change, risk of stand replacing fires, and expansion of barred owls (*Strix varia*) into the range of spotted owls. The 1988 LTBMU Forest Plan (as amended) provides designation criteria, desired conditions, management objectives, and standards and guidelines for the protection of California spotted owl Protected Activity Centers (PAC) and home range core areas (HRCA). PACs include 300 acres of the highest quality nesting habitat available and the most recent nest site or activity center within a spotted owl breeding territory as described in

management direction for the forest (USDA 2004). An HRCA includes is 1,000 acres, includes its associated PAC, and is comprised of the best available contiguous habitat.

There are currently 21 California spotted owl PACs (and associated HRCAs) on the LTBMU, following a re-mapping effort in 2008 to incorporate the most up-to-date detection, nest location, and land boundary information available. Spotted owls have been detected in 16 (76%) of the 21 PACs between 2001 and 2010. There are 15 identified nests in the Lake Tahoe Basin, 11 of the nests are located on Forest System lands. Nest occupancy fluctuates annually. Data for California spotted owl found in the LTBMU are stored on the USDA Natural Resource Manager Natural resource Information System (NRM NRIS) (http://fsweb.nris.fs.fed.us/products/Wildlife/index.shtml).

Willow Flycatcher – Region 5 Forest Service Sensitive Species

The willow flycatcher (*Empidonax trailii*) is a Region 5 Forest Service Sensitive species. Willow flycatchers are closely associated with meadows that have high water tables in the late spring and early summer, and abundant shrubby, deciduous vegetation (especially *Salix* spp.). Furthermore, this species prefers and is significantly more likely to occupy and defend territories that have standing water or saturated soils during the breeding season, often selecting the wettest portions within meadows (summarized in USDA 2001).

Degradation and alteration of willow flycatcher habitat (i.e., montane meadows) is a primary factor contributing to population declines (Green et al. 2003). Degradation could include, but is not limited to: (1) alterations to the hydrological patterns leading to meadow drying, (2) destruction of shrub vegetation resulting in loss of nesting sites and cover for predator avoidance, (3) increased predator access to meadow interior, (4) loss of foraging substrate and decreased insect abundance, and (5) potentially increased contact with brown-headed cowbirds (Green et al. 2003). The 1998 LTBMU Forest Plan (as amended) provides standards and guidelines for the protection of willow flycatcher sites, including guidance to develop restoration actions to restore historically occupied sites.

Since 2001 several large-scale meadow and riparian restoration projects (e.g. Cookhouse Meadow, Big Meadow, Washoe State Park, Upper Truckee River, Taylor-Tallac, High Meadows, Meeks Bay, Blackwood, and Antone Meadows) have or will soon be restoring willow flycatcher habitats. Livestock grazing has been essentially eliminated in the Lake Tahoe basin, assisting in the restoration of primary habitat for the species.

Willow flycatcher surveys have occurred in the LTBMU since 1992. Surveys since 2001 have used the USFS, Region 5, “Willow Flycatcher Survey Protocol for California” (Bombay et al. 2003a). The LTBMU also participates in the central Sierra Nevada willow flycatcher demography study led by the Tahoe National Forest. Information regarding population, territory, and nest monitoring for willow flycatchers in the Lake Tahoe basin is derived from this collaborative effort (Mathewson et al. 2007). The long-term demographic research is conducted from Highway 88 in Alpine County north to Lassen Volcanic National Park and includes the LTBMU. Sites north of the Feather River, in Plumas County are considered north sites; central sites extend south to the mid-latitude of Lake Tahoe; and the south sites are comprised of the

remainder. The number of territories in the central region remained relatively stable from 2002 to 2007; the number of territories in the south declined over the previous 11 years; and the number of territories in the north fluctuated. Nest success was 45.5%; of all failed nests, predation was the primary cause of 71% of failed nests in the central region (Mathewson et al. 2007). Other causes of failure involved brown-headed cowbird (*Molothrus ater*) parasitism and partial predation of 29% of nests; cowbirds parasitized 10% of nests (Mathewson et al. 2007). Overall, Mathewson et al. (2007) estimated that the rate of population change represented a 14.4% annual decline.

Townsend's big-eared bat – Region 5 Forest Service Sensitive Species

Townsend's big-eared bat (*Corynorhinus townsendii*) is a Region 5 Forest Service Sensitive species. This species has been found in a variety of habitats including coniferous forests and riparian areas and is highly associated with cave and cave surrogate structure (e.g., mines, buildings) for roosting (Graham 1966, Barbour and Davis 1969, Kunz and Martin 1982). The distribution of the species appears to be significantly constrained by the availability of suitable roosting sites and the degree of human disturbance at roosts. The primary threats facing this species throughout its range are disturbance and destruction of roost sites, timber harvest practices, and loss of riparian habitat (Piaggio 2005). Currently, there are no standards and guidelines in the 1988 LTBMU Forest Plan (as amended) to protect this species. Measures to protect the species in the LTBMU have been developed on a project-specific basis.

Townsend's big-eared bat was first detected on the LTBMU in 2007 in Blackwood Creek and Big Meadow Creek watersheds. This species was identified again in 2009 at two adits and a vacant building in the LTBMU. This species was not positively identified at survey locations in the LTBMU in 2010 and 2011.

Sierra Nevada Red Fox – Region 5 Forest Service Sensitive Species

The Sierra Nevada red fox (*Vulpes vulpes necator*) is a subspecies of the red fox (*Vulpes vulpes*) and is a Region 5 Forest Service Sensitive species. This species is associated with high elevation barren, conifer and shrub habitats; montane meadows; and subalpine woodlands and fell-fields (Perrine et al. 2010). Some of the potential threats facing the Sierra Nevada red fox include development and recreation which can result in increased exposure to humans, vehicles and pets, as well as the potential for increased use by non-native red foxes, coyotes, and other competitors (Perrine et al. 2010). Climate change, resulting in a loss or restriction of their boreal environment and reduced snowfall may also threaten this species (Perrine et al. 2010). The 1988 LTBMU Forest Plan (as amended) provides designation criteria, desired conditions, and standards and guidelines for the detections of Sierra Nevada red fox including detection and verification procedures, the use of LOPs, and follow up surveys.

The contemporary geographic range of this species is not well-defined. It was previously believed that the current range of the Sierra Nevada red fox was limited primarily to the southern Cascades; the Sierra Nevada population appeared to be either extirpated or occurring at extremely low densities (Perrine 2005, Zielinski et al. 2005). However, a population of red foxes in the Cascades near Lassen Peak was identified as the native Sierra Nevada red fox through

analysis of mtDNA samples (Perrine 2005). In addition, biologists on the Humboldt-Toiyabe National Forest detected a red fox in August 2010 near Sonora Pass along the border of Tuolumne and Mono Counties, south of the southern Cascades and approximately 50 miles south of the Lake Tahoe Basin. Preliminary genetic analyses indicated that the fox was a Sierra Nevada red fox (Perrine et al. 2010). Follow up research conducted in the Sonora Pass area since 2010 has so far identified 9 Sierra Nevada red fox individuals (Rich pers. comm. 2012). The most recent record of this species in the immediate vicinity of the LTBMU occurred in 1973 approximately 4.4 miles southeast of the Lake Tahoe basin in Charity Valley, near Markleeville Peak (CDFG 2008). Detections of Sierra Nevada red fox or their den sites have not occurred within the Lake Tahoe Basin within the past 10 years. However, because the contemporary range of this species is not well understood and it has been recently found in the Sonora Pass area, it is possible that this species could occur in limited portions of the LTBMU within the life of the Plan. An estimated 2,583 acres of high and moderate capability denning and resting habitat and 5,817 acres of high and moderate capability foraging habitat currently exist for Sierra Nevada red fox within the LTBMU.

American Marten – Region 5 Forest Service Sensitive Species

The American marten (*Martes americana*) is a Region 5 Forest Service Sensitive species and a Management Indicator Species (MIS) for the late seral, closed canopy coniferous forest habitat component on the LTBMU. Additional information for the American marten as an MIS is provided in the following section entitled *Management Indicator Species*.

This species is known to inhabit high elevation (5,000-10,000 feet) late-successional conifer forests with complex physical structure near the ground (Buskirk and Powell 1994 *in* Buskirk and Ruggiero 1994). Rest structures typically include cavities or platforms in live trees or snags, cavities in logs, and, to a lesser extent, rock piles, slash piles, and subterranean cavities (e.g., those created by rotting root wads) (Raphael and Jones 1997, Gilbert et al. 1997, Ruggiero et al. 1998, Bull and Heater 2000). Den structures typically include arboreal cavities in live trees, snags (Gilbert et al. 1997, Raphael and Jones 1997, Bull and Heater 2000) and logs, rock crevices and red squirrel middens (Ruggiero et al. 1998). Resting and denning sites are most commonly located in woody structures (live trees, snags, logs) that tend to be in the largest available size classes and are used disproportionate to their availability (Wilbert 1992, Gilbert et al. 1997, Raphael and Jones 1997, Ruggiero et al. 1998).

Some of the threats facing martens are ski area expansion and use, habitat loss and fragmentation, and recreation activities. While martens do occupy portions of many ski areas in the LTBMU, female martens appear to exhibit a higher sensitivity to forest fragmentation from ski-run creation than males, avoiding areas highly fragmented by ski runs (K. Slauson unpubl. data). Furthermore, while males occupy more highly fragmented portions of ski areas than females, male survivorship appears to be lower in sites with higher fragmentation (K. Slauson unpubl. data). Data for one study conducted in the LTBMU found that OHV/OSV use did not affect marten occupancy or probability of detection and that overall OHV/OSV use in the study areas was low (1 OHV/OSV pass every 2 hours) and exposure occurred in <20% of a typical home range (Zielinski et al. 2007).

The 1988 LTBMU Forest Plan (as amended) provides designation criteria, desired conditions, and standards and guidelines for the protection of marten den sites in the Sierra Nevada, including limited operating periods (LOPs), restrictions on vegetation treatments, and the requirement to mitigate impacts where a den site has been disturbed.

Marten appear to be well distributed in the western and southern portions of the LTBMU but are comparatively rare in the northern and eastern portions (Slauson et al. 2008). Slauson et al. (2008) analyzed data from several marten surveys that were conducted in the LTBMU between 1993 and 2005 and found that marten were detected at 36% of all sample units that were surveyed. The majority of detections were made in the western (50% of sites) and southern (31% of sites) regions of the LTBMU. Detections in the northern and eastern portions of the basin were scarce despite 30% of the total survey effort occurring in these two areas, and the authors suggested that these areas may have supported less suitable habitat conditions (e.g., open canopy) due to drier conditions. One marten den has been identified in the Lake Tahoe basin although there are likely greater than 30 breeding females in the LTBMU in any given year, each using many dens for kit rearing (Slauson, pers. comm. 2011). The single known den was discovered opportunistically in 2009 and is located on the west shore.

In a larger context, marten occupancy and geographic range is predicted to be influenced by climate change such that the species will be highly sensitive to climate change, and would probably experience the largest climate impacts at the southernmost latitudes (i.e. in the southern Sierra Nevada) (Lawlor et al. 2011).

California Wolverine – Region 5 Forest Service Sensitive Species

The California wolverine (*Gulo gulo luteus*) is a Region 5 Forest Service Sensitive species. Wolverine use diverse coniferous forest types (Copeland 1996, Hornocker and Hash 1981) and unlike fisher and marten, this species also uses non-forested alpine habitats (Banci 1994 and Copeland 1996). This habitat generalist appears to select areas that are free of significant human disturbance and requires den sites associated with structural cover (e.g., boulders and persistent snow cover) in cirque basins or avalanche chutes at high elevations (summarized in USDA 2001). Potential threats to this species include habitat loss and fragmentation, loss and alteration of alpine habitat from climate change, and increasing human presence. The 1988 LTBMU Forest Plan (as amended) provides designation criteria, desired conditions, and standards and guidelines for the detections of wolverines including detection and verification procedures, the use of LOPs, and follow up surveys.

Extensive carnivore surveys have occurred on the LTBMU over the past 10 years and wolverines have not been detected. An estimated 198 acres of high and moderate capability denning habitat, 32,609 acres of high and moderate capability resting habitat, and 34,153 acres of high and moderate capability foraging habitat currently exist for wolverine within the LTBMU. Wolverines have been detected on or adjacent to the LTBMU since 1971 but none of the following detections were associated with a den site: (1) on Echo Summit at Highway 50 in 1941 (2) approximately one mile northwest of the LTBMU near the Lower Truckee River at the east end of Squaw Valley in 1953, (3) approximately 5.5 miles west of the LTBMU near Strawberry, CA in 1971, (4) approximately one mile northwest of the analysis area in Emerald Bay between Highway 50 and Eagle Lake in 1990, and (5) approximately 2 miles west of the LTBMU near

Island Lake on the Eldorado National Forest in 1994 (CDFG 2008). During February and March 2008, and late winter and spring 2009, a male wolverine was detected approximately 14-19 miles northwest of the LTBMU near Truckee, California. Agency biologists and researchers determined that the wolverine is most closely related to, and most likely came from, a population on the western edge of the Rocky Mountains rather than either the historic California population or contemporary northern Cascades (Washington) population (Moriarty et al. 2009).

TRPA Special Interest Species

The TRPA has designated Special Interest Species that are locally important because they are public interest species or are rare, sensitive, threatened, or endangered species designated under state or federal species protection acts. The northern goshawk and bald eagle are considered Special Interest Species and have been described in the previous section entitled *Forest Service Sensitive Species*; all other Special Interest Species are described below.

Waterfowl – TRPA Special Interest Species

Waterfowl Special Interest Species include species of ducks, geese, shorebirds, loons, grebes, mergansers, rails, gulls, terns, and herons. For these species groups, undisturbed marsh and riparian vegetation is critical habitat for nesting and feeding (TRPA 2004a). Successful nesting, breeding, and feeding in these species is challenged by human presence in suitable habitats that can cause disturbance of individuals and result in displacement, nest abandonment, increased energy expenditure, reduced energy intake (i.e., lower feeding rates), among other consequences (Belanger and Bedard 1990 and Rogers and Smith 1997 as cited in TRPA 2004a).

TRPA Code of Ordinances includes a measure that calls for the protection of wetlands for nesting and resting sites for waterfowl as well as waterfowl management areas in the Lake Tahoe Basin. The current LRMP (as amended) includes provisions to manage suitable wetlands for low levels of human disturbance between March 1 and June 30 for waterfowl (except Pope Beach recreation site which may be opened beginning Memorial Day weekend); harassment by dogs must be controlled.

Golden Eagle – TRPA Special Interest Species

Golden eagle (*Aquila chrysaetos)* is associated with early successional forests and shrub communities for foraging and cliffs and large trees for nesting. Threats to this species include disturbance by human as a result of recreation activities, particularly rock climbing, as well as loss of habitat.

The TRPA Code of Ordinances includes a zone within a 0.25 mile radius of golden eagle nest sites that is to be protected from habitat manipulation while occupied by golden eagles.

Golden eagle surveys have been conducted during the past several years in the LTBMU. The species was detected in 2009 at Angora Peak. Golden eagle was not positively identified during 2010 or 2011 surveys but incidental detections of golden eagles were made by LTBMU staff in 2011 at Meiss Meadow and Desolation Wilderness.

Osprey – TRPA Special Interest Species

Osprey (*Pandion haliaetus*) is associated with open forests with large snags for nest sites that are typically located near open water. Nest sites include large coniferous and deciduous trees, cliffs, and poletops located near or over water. Primary threats to osprey in the LTBMU include disturbance from recreation activities (e.g., boating, camping, etc.) and loss or degradation of habitat due to conflicts with recreation needs. Osprey are migratory and arrive in the Tahoe Region from South and Central American wintering grounds in March and April when the snow begins to melt and fish return to shallower waters. Osprey is threatened by disturbance from humans as a result of recreational activities as well as by loss of nesting and perching habitat along the shorezone.

The TRPA Code of Ordinances includes a zone within a 0.25 mile radius of osprey nest sites that is to be protected from habitat manipulation while occupied by osprey.

Detections of active osprey nests in the LTBMU have fluctuated since 1997. The number of active nests detected decreased between 2003 and 2005, and 2007 and 2008 but there has been an overall increase in the number of active nests detected since 1997 with approximately 11 active nests detected in 1997 and 27 in 2011. Since 2008, the number of active nests detected has been steadily increasing with 22, 24, 26, and 27 active nests detected in 2008, 2009, 2010, and 2011, respectively.

Peregrine Falcon – TRPA Special Interest Species

The peregrine falcon (*Falco peregrinus*) is associated with rivers, wetlands, lakes, or other aquatic features for breeding and cliffs, banks, dunes, mounds, and human-made structures for nesting. Nests are usually situated on open ledges or potholes and a preference for southern facing slopes increases with latitude (USFWS 1984). Peregrine falcons are threatened by human disturbance from recreation activities, including rock climbing.

The TRPA Code of Ordinances includes a zone within a 0.25 mile radius of peregrine nest sites that is to be protected from habitat manipulation while occupied by the falcons. The current LRMP (as amended) includes a standard prohibits rock climbing on nesting cliffs between April 1 and July 31.

Three birds were introduced to the Lake Tahoe Basin in each of 1985, 1986, and 1987. From 1987 to 2007 there had been no official record of peregrine falcon in the basin other than a handful of incidental detections. In 2007 there were three reported incidental detections. Surveys for peregrine falcons began in 2008 and a pair was detected but successful nesting was not confirmed. From 2009 through 2011, successful nesting has been confirmed in the Lake Tahoe Basin. As of 2011, two locations in the LTBMU had confirmed successful peregrine falcon nests.

Mule deer – TRPA Special Interest Species

Mule deer are associated with riparian areas, meadows, and early to mid-successional habitats. Threats to mule deer include habitat fragmentation and loss.

The TRPA Code of Ordinances includes measures to protect mule deer fawning habitat as well as migration and movement corridors.

Results from the Multi-species Inventory Monitoring (MSIM) in the LTBMU indicate that the mule deer may have declined slightly since early/mid 1900s, as it was described as a common resident historically, whereas now it appears to be less common but still present. During MSIM surveys in 2007, the mule deer was found to be broadly distributed across the Lake Tahoe Basin having been identified at 13 (22%) of sampled sites.

Migratory Birds

Migratory birds have become a focus of conservation concern due to evidence of declining population trends for many species. Under the National Forest Management Act (NFMA), the Forest Service is directed to "provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives" (P.L. 94-588, Sec 6 (g) (3) (B)). The January 2000 USDA Forest Service (FS) Landbird Conservation Strategic Plan, followed by Executive Order 13186 in 2001, in addition to the Partners in Flight (PIF) specific habitat Conservation Plans for birds and the January 2004 PIF North American Landbird Conservation Plan, references goals and objectives for integrating bird conservation into forest management and planning.

In late 2008, a *Memorandum of Understanding between the USDA Forest Service and the USDI Fish and Wildlife Service to Promote the Conservation of Migratory Birds* was signed. The intent of the MOU is to strengthen migratory bird conservation through enhanced collaboration and cooperation between the Forest Service and the Fish and Wildlife Service as well as other federal, state, tribal and local governments. Within the National Forests, conservation of migratory birds focuses on providing a diversity of habitat conditions at multiple spatial scales and ensuring that bird conservation is addressed when planning for land management activities.

To facilitate a regional approach to bird conservation, regional geographic units called bird conservation regions (BCRs) were developed under the North America Bird Conservation Initiative (http://www.nabci-us.org/bcrs.html). BCRs encompass landscapes with similar bird communities, habitats, and resource issues. In *Birds of Conservation Concern 2008*, the U.S. Fish and Wildlife Service (FWS) (2008) identified the species in each BCR in greatest need of conservation action and proactive management to prevent the need for listing them as endangered or threatened. These species are termed Birds of Conservation Concern (BCC), and a list is given for each BCR. A BCC may be present in a BCR but not included in that BCR's list because its population numbers are not a concern in that region.

In addition, Audubon California (2009) has designated 145 important bird areas in the state. See http://www.ca.audubon.org/iba for additional information about these areas.

3.4.21.3. Environmental Consequences

This section describes the potential direct and indirect environmental consequences of the activities proposed by each program area under the four Forest Plan alternatives on terrestrial wildlife habitat condition and terrestrial wildlife species productivity. Cumulative effects are described in Section 3.5 of this chapter. MIS are described separately in Section 3.4.14 of this chapter.

Watershed and Aquatic Habitat Restoration

Direct/Indirect Effects

It is anticipated that restoration of aquatic habitat and watershed condition under all alternatives would have long-term benefits to terrestrial wildlife habitat and special-status terrestrial wildlife species in the LTBMU. This expectation is based on the assumption that restoration projects under all alternatives would not only improve physical habitat elements such as vegetation diversity and structural complexity but also achieve restoration of natural processes that help ecosystem functions and maintain wildlife habitat over the long-term. In other words, planting riparian vegetation alone may not achieve restoration of wildlife habitat over the long-term but planting vegetation that facilitates recruitment, and fulfills major functions of riparian habitats such as physical filtering of water, stabilization of banks and floodplains, water storage, can benefit wildlife species (George and Zack 2001).

The most pronounced positive trend in habitat condition and species productivity is expected to occur under alternatives B and C. These alternatives function similarly to A, which is also expected to show a positive trend similar to B and C, but Alternatives B and C provide clear, written strategies and objectives that are lacking in Alternative A. The most pronounced positive trend in habitat condition is expected to be experienced in wet meadow, aspen, montane riparian, and marsh and lake shore habitat types as these habitat types are specifically targeted during restoration of watershed condition and aquatic habitat. The most pronounced positive trend in productivity is expected to be experienced by willow flycatcher, bald eagle, northern goshawk, Townsend's big-eared bat, peregrine falcon, osprey, waterfowl, and mule deer as these species are either reliant on the aforementioned habitat types (i.e., willow flycatcher with meadows; bald eagle with marsh and lakeshore habitat; waterfowl with marsh, wetland, and riparian habitats) or associated to some degree with these habitat types (i.e., northern goshawk with aspen; Townsend's big-eared bat and meadows, marsh, and montane riparian; peregrine falcon with rivers, wetlands, and lakes; osprey with lakeshore and marsh habitat; mule deer with riparian corridors and meadows). Those species that are reliant on riparian habitat for nesting, cover, and/or foraging are expected to have the most pronounced positive trend. In addition, limited research in the Lake Tahoe region indicates that the population trend of willow flycatchers is declining (Mathewson et al. 2007); restoration efforts that improve meadow conditions (i.e., water table, shrub cover, etc.) may help reverse this trend.

Because migratory birds are so ubiquitous and diverse, maintenance and restoration of many types of habitats, include aquatic habitat under this program area, is relevant to migratory birds.

As a result, provisions for these species are integrated into numerous desired conditions, objectives, and standards and guidelines that would target restoration of habitat under Alternatives B and C. Such considerations are already in place under Alternative A. Alternative D includes protection measures but does not include restoration following the completion of currently planned projects.

In the absence of restoration under Alternative D, following the completion of currently planned projects, it can be expected that the condition of various habitat types normally targeted by watershed and aquatic restoration (i.e., wet meadow, montane riparian, aspen, marsh and Lake shore) would remain stable with the potential to diminish, and the productivity of associated special status species would also remain stable but with the potential to decline. Many of the aforementioned habitat types in the Lake Tahoe Basin are being overcrowded and encroached upon by conifers and degraded by urbanization and recreation, essentially changing the structure, function, and value of these habitat types for wildlife (Manley et al. 2010). For example, without restoration and in the absence of disturbance such as fire, it is likely that conifers will continue to encroach and shade out aspen trees in the understory (Shepperd et al. 2006); the result would include a loss of aspen as well as negative impacts on herbaceous cover and stand moisture that are essential habitat components for many mammal and bird species (Manley et al. 2010). Indeed, limited studies in the Lake Tahoe Basin have demonstrated that healthy herbaceous communities and limited conifer intrusion in aspen may be optimal habitat conditions for aspen-associated breeding birds (Richardson 2007, Richardson and Heath 2004).

Without restoration of meadows and associated water sources that maintain meadow wetness, willow flycatchers, a species with a seemingly declining population in the LTBMU, could be at an increased risk of predation and could experience a loss in insect prey based on the results of willow flycatcher demographic studies in the LTBMU (Mathewson et al. 2009). The effects of habitat loss, degradation and alteration are anticipated to be the most pronounced for wet meadow, marsh and lake shore habitat, montane riparian, and aspen habitat types as well as willow flycatcher, bald eagle, and northern goshawk. Effects may be the most pronounced for willow flycatcher, a species that is dependent upon wet meadows where riparian shrub cover, water table, and soil saturation in meadows is sufficient (Mathewson et al. 2009) and bald eagle, a species that relies on marsh and lakeshore habitat for foraging and nesting opportunities. Northern goshawk has been associated with aspen stands and a decline in productivity for this species can be expected where previously occupied aspen stands are no longer functioning as suitable habitat. Townsend's big-eared bats forage in a variety of habitats but it can be expected that a decline in productivity could occur in those habitats where water tables are diminished and the habitat no longer supports sufficient insect prey.

In terms of climate change, the restoration strategies associated with Alternatives A, B, and C all provide opportunities to maintain or improve biodiversity of the landscape and also improve resilience of watershed systems and their associated habitats to better enable these habitats and their communities to adapt to changing climate conditions. Alternatives B and C go one step further than Alternative A and recognize the importance of improving aquatic habitat components for associated species in addition to reducing stream sedimentation. Without the opportunity to actively restore or maintain habitats under Alternative D, vulnerable habitats may

be more at risk for degradation or loss as conditions change.

Biological Resource Protection

Direct/Indirect Effects

The most pronounced long-term positive trend in habitat condition and special-status species productivity is expected to occur under Alternatives B and C because these alternatives include desired conditions, objectives, and standards and guidelines that: (1) reflect the contemporary needs of special-status species and associated habitat in the LTBMU, (2) incorporate restoration objectives to meet desired conditions, and (3) emphasize critical habitat features and movement corridors that could support community assemblages and maintain future applicability. The species- and location-specific approach emphasized by Alternative A has value for the protection of den and nest sites, wet meadows for willow flycatchers, cliffs for peregrine falcons, among others. However, this more narrow approach may be unable to maintain or enhance habitat elements important to all special-status species and their associated species assemblages across the landscape. Alternatives B and C have been developed in such a way that they focus on critical habitat elements (e.g., snag retention, cliff and cave accessibility, meadow restoration, habitat connectivity) rather than specific requirements of each species. An added benefit of this approach is that the habitat features identified may also support other species that use these features, inhabit this habitat type, and/or are part of the species assemblage that supports these special-status species. Although Alternative D includes the same desired conditions and standards and guidelines as B and C for this program area, any objective related to restoration would not be implemented under this alternative after currently planned projects and are therefore this alternative is not anticipated to have the same potential for positive effects as Alternatives B and C.

The condition of terrestrial wildlife habitat is expected to be maintained under Alternatives A, B, and C with a potential for improvement in condition under Alternatives B and C. These latter alternatives include objectives for the restoration of at least one cliff, cave, and cave-surrogate habitat as well as habitat within six California spotted owl PACs and seven northern goshawk PACs. Maintenance and improvement of movement corridors, restoration and maintained connectivity of stream and terrestrial habitat, maintenance and improvement of wet meadow complexes, and restoration of fens are also emphasized under Alternatives B and C. These measures to protect habitat components (e.g., movement corridors, cliff habitat) and restoration objectives under Alternatives B and C, and Alternative A to a lesser extent, can assist the habitats and wildlife communities of the LTBMU in being better able to adapt to the stresses of changing climate conditions. Without the positive synergistic effects of habitat protection and restoration, Alternative D could fall short of enabling terrestrial wildlife species and associated habitat components to be better adapted to climate change.

The potential for the most pronounced positive trend in species productivity is expected to occur under Alternatives B and C for willow flycatcher, Townsend's big-eared bat, California spotted owl, Northern goshawk, peregrine falcon, waterfowl, osprey, golden eagle, mule deer, American marten, and migratory birds. With the emphasis under these alternatives on restoration of willow flycatcher historic and occupied habitat, it is expected that these activities could assist in

reversing the declining trend in this species in the LTBMU. Restoration of meadow systems as well as riparian habitats as proposed under these alternatives is also expected to benefit mule deer. These alternatives officially recognize the importance of cave and cave-surrogate habitat in the LTBMU for Townsend's big-eared bat and include measures to protect this habitat and protect the species through implementation of a Limited Operating Period (LOP). Peregrine falcon and golden eagle are expected to benefit from the more all-encompassing protection measures provided to cliff habitat under these alternatives. Bald eagles, waterfowl, and osprey are expected to benefit from the restoration efforts proposed for aquatic habitat under this program area. Bald eagle and osprey are also expected to benefit from the measures to protect and retain large and complex snags. In addition to the LOP for protection of American marten den sites, objectives to maintain and restore complex structural stand features (i.e., down woody debris, snags, etc.) and connectivity of habitat are expected to benefit productivity of American marten.

Provisions to protect migratory bird habitat were considered when developing the desired conditions, objectives, and standards and guidelines for the Biological Resources Protection Program Area under Alternatives B, C, and D. All Alternatives contain provisions to maintain and protect habitat for migratory bird species.

Under the current direction (Alternative A), PAC habitat is protected for spotted owls and northern goshawk but there is limited ability to maintain or improve habitat condition through restoration efforts. PACs in the LTBMU have a combination of both high and moderate capability nesting, roosting, and foraging habitat but almost all spotted owl PACs contain no or very few acres of high capability habitat; most of the PACs are comprised of moderate capability habitat. In contrast, a large proportion of goshawk PACs contain more high capability than moderate capability habitat. Restoration of habitat could help improve moderate capability habitat or maintain the existing high capability habitat that could be compromised by continued fire suppression.

Restoration in PACs under Alternatives B and C is expected to maintain or enhance nesting, foraging, and resting habitat for the northern goshawk and spotted owl. At the stand scale, both the northern goshawk and spotted owl are associated with multilayered canopy, high canopy cover, large trees, and a high density of large snags (Forsman et al. 1984, Bias and Guitierrez 1992, Call et al. 1992, Verner et al. 1992, Keane 1999, USDA 2001, Bond et al. 2004, Chatfield 2005). Furthermore, nest site areas of both species are not associated with high densities of small and medium sized live trees (Keane 1999, Blakesley et al. 2005). In fact, spotted owl site occupancy of nest sites has been shown to be negatively associated with stands dominated by dense medium sized trees, despite high canopy cover (Blakesley et al. 2005). Roberts et al. (2011) suggest that a range of tree sizes influences site occupancy by spotted owls but suggested that "thickets of young trees could interfere with owl foraging". Indeed, Irwin et al. (2007) found that owls in their study foraged in areas with a lower density of trees than that found in roost areas, and Williams et al. (2011) also found that although spotted owl home ranges contained a high proportion of mature and old-growth forests, owls used younger stands as foraging habitat. The authors concluded that landscape heterogeneity with respect to cover types may be an important consideration for spotted owl habitat management as it may better meet the life history requirements of the species.

Restoration of PAC habitat, within the standards and guidelines proposed as part of Alternatives B and C, could increase heterogeneity of the landscape for improved spotted owl habitat. At the landscape scale, heterogeneity of cover types may be an important resource for the life history needs of spotted owls, especially for the maintenance of foraging habitat (Lohmus 2005, Williams et al. 2011). Improving habitat within a minimum of six California spotted owl PACs over the life of the Plan could improve the heterogeneity of cover types across the landscape and improve foraging habitat for spotted owls.

Restoration of habitat within a PAC can also protect important roosting and nesting habitat from stand-replacing fires. An overall build-up of live and dead materials in the understory of fire suppressed forests increases the probability of stand-replacing fire (Agee 1993, Sugihara et al. 2006), and recent assessments of wildfire trends in the Sierra Nevada and other similar climate and vegetation zones in the southwestern US show increases over the last 20-30 years in the area of fires burning at stand-replacing severity (Miller et al. 2009, Dillon et al. 2011). Furthermore, current empirical data, patterns in the paleo-record during similar warming periods, and future modeling all suggest these tendencies toward increasing fire activity and impact will continue and perhaps accelerate, as both temperatures and fuel loads continue to increase (e.g., Whitlock et al. 2003, Lenihan et al. 2003, Westerling et al. 2006, Westerling and Bryant 2008, Miller et al. 2009, National Research Council 2011). Both field studies and model simulations on spotted owls suggest that low- to moderate-severity burns can help maintain suitable spotted owl habitat (Roberts et al. 2011) and that high-severity fires can have a pronounced negative effect on spotted owl populations (Lee and Irwin 2005). The results of one recent study support the idea that within a burned landscape, spotted owls prefer to roost in low intensity burned forest during the breeding season, and avoid nesting in high intensity burned stands, but do forage in high intensity burned stands (Bond et al. 2009). Therefore, although areas that have had high intensity burns may provide foraging habitat for spotted owls, these areas may fail to provide suitable roosting and nesting habitat.

PAC restoration is also not anticipated to reduce snag density and the potential for snag recruitment in future years because of the goals and techniques that would be used for PAC restoration. Restoration goals in PACs would be to maintain or improve habitat for spotted owls and northern goshawks. Towards this end, thinning to retain the largest trees, both live and snags, would be emphasized and is expected to retain a sufficient number of snags to provide nesting and roosting habitat and to reduce the risk for high intensity crown fire. In addition, restoration efforts would follow snag retention standards and guidelines for PACs and position restoration efforts to target the creation and retention of suitable snags where necessary. Most of the vegetation management techniques in the LTBMU involve hand thinning which is limited in the size of trees that can be removed as well as by the amount to which the density of a stand can be reduced. Mortality of live trees (snag creation) can occur during prescribed burning and when slash piles are burned following hand thinning treatments. Indeed, in the northern Sierra Nevada, Stephens and Moghaddas (2005) found that post-treatment density of snags greater than 15 cm diameter-at-breast-height (dbh) in decay class 1 (sound, intact, no rot) actually increased in stands with prescribed fire treatment and with mechanical treatment followed by prescribed fire when compared with mechanical treatment only or no treatment at all. It should be noted that the density of small snags (1-15cm dbh) in fairly intact decay classes also increased in fire only and mechanical treatment plus fire when compared with no treatment; such accumulation of small snags can increase fire hazard and the authors recommended additional prescribed fires in

areas with high amounts of small tree mortality to reduce additional surface fuel accumulation (Stephens and Moghaddas 2005). Because many of the treatment techniques in the LTBMU use hand thin methods followed by prescribed fire, it is not anticipated that treatments would have the ability to reduce the density of snags of a size or decay class suitable for wildlife or reduce the potential for recruitment of snags in future years.

Forest Vegetation Management and Fire

Direct/Indirect Effects

For the most part, forest vegetation management would be conducted in conjunction with wildlife habitat objectives. However, each alternative includes varying degrees of flexibility in the size of trees that can be removed from a stand, the extent to which the canopy can be opened, and the size of openings that can be created, and any of these approaches could conflict with wildlife habitat objectives. For example, in Alternatives B and C trees greater than 30 inches in diameter could be removed under certain limited circumstances. While canopy closure limits would only be retained for PACs and HRCAs, emphasis would be placed on maintaining and improving late seral habitats. The protection measures in place for biological resources under these alternatives would limit implementation in highly suitable habitat for special-status species or in areas that would disrupt connectivity of suitable habitat for special-status species. Furthermore, early seral openings are targeted in mid seral stands throughout the LTBMU; late seral stands would not be targeted for early seral creation.

Creation of early seral stages and converting forest types in red fir, Jeffrey pine, and white fir-mixed conifer forests can increase habitat heterogeneity on the landscape, promote early seral associated species (e.g., small mammals), and increase foraging habitat condition and productivity in predators of early seral associated species (e.g., spotted owls, golden eagle, goshawks, marten, wolverine). Species such as spotted owl are believed to benefit from habitat heterogeneity on the landscape because they roost in mature forest conditions but have been found to forage in younger, open stands or stands that have been opened by fire (Williams et al. 2011, Bond et al. 2009). In addition, there are a number of small mammal species (e.g., woodrats, voles) that are more abundant in early than late seral conditions and the creation of such conditions could facilitate increased abundance in small mammal prey. For example, although marten tend to avoid open areas that lack canopy cover and ground-level structural complexity, they often forage at the edges of openings where prey species (i.e., snowshoe hare, voles, etc.) tend to be abundant. Early seral conditions would increase under Alternatives B and C over the next 30 years. The dbh and canopy closure limits imposed by Alternatives A and D would restrict the ability for early seral creation under these alternatives. Increasing habitat heterogeneity on the landscape can also effectively improve habitat condition and adaptability in the face of changing climate conditions.

The limitations on treatment intensities under Alternatives A and D would not only restrict early seral stage creation but facilitate an increasing trend in the acres of late seral forested habitat in the LTBMU. Currently, late seral open and closed canopy forests represent approximately 47% of all seral stages (early, mid, and late) on the LTBMU. However, much of this percentage is comprised of white fir-mixed conifer forests and Jeffrey pine is severely underrepresented when compared to reference conditions, especially in the late seral open canopy forest stage (*see* Table

1 in the Draft Forest Plan). It should be noted that late seral in this analysis does not necessarily refer to old growth forest but could mean younger trees that are very large and increasing the quadratic mean diameter of a stand, pushing the stand it into a late seral classification. Late seral conditions would increase in the LTBMU by approximately 19% and 22% in 30 years under Alternative A and D, respectively. The positive trend towards more late seral closed canopy forest in both alternatives can mean more available habitat for late seral associated species such as spotted owls, goshawk, marten, and wolverine. However, the increasingly high density of late seral forests on the landscape would mean a declining trend in condition of this habitat such that the stands could experience increased vulnerability to beetle outbreak, drought stress, the effects of climate change, and the increased potential for high severity wild fires, although none of these risks were modeled. Please refer to the *Forest Vegetation Resources* section for detailed information on projected trends and outcomes by different forest types, definitions of forest types, and Spectrum model parameters.

Under Alternatives B and C, late seral closed canopy habitat decreases by 16% and 14% over 30 years, respectively. Much of this change is the result of strategically thinning select late seral closed canopy stands to open canopy conditions which increases under both alternatives. The loss of closed canopy habitat conditions outside of PACs and HRCAs would reduce the amount of roosting, nesting, and foraging habitat available for spotted owls and northern goshawk (roosting and nesting only) as well as denning, resting, and foraging habitat for marten and wolverine. Although wolverine may use non-forested alpine habitats, marten are very closely associated with dense canopy conditions, especially in the understory. Both species rely on a diverse prey base that inhabits various seral stages so increasing landscape heterogeneity could increase foraging opportunities but the effects of increased heterogeneity on habitat use and foraging success are unknown. Although the declining trend in late seral closed conditions could be interpreted as a negative environmental consequence of Alternatives B and C, the condition of overall habitat on the landscape can be improved for wildlife with these management activities. The increasing trend in open conditions of late seral habitat could result in improved foraging habitat for northern goshawk (CDFG 2005). Spotted owl may also benefit from the increased hetereogeneity on the landscape. In a study of the effects of comparative forest management practices on fisher habitat in the Sierra Nevada, Thompson et al. (2011) found that without management activities forest succession resulted in a loss of landscape heterogeneity over a 45-year period due to the gradual domination of older forests. The authors stated that this change in forest condition didn't infer a loss of suitability in fisher habitat but did represent a deviation from the characteristics found in currently occupied fisher home ranges (Thompson et al. 2011). Without management, simulated fire on the landscape was catastrophic and resulted in the greatest loss of fisher habitat (Thompson et al. 2011). Similarly, Lee and Irwin (2005) found that lethal fire scenarios in spotted owl habitat were slow to recover to suitable conditions for owl use. The authors also suggest that modest fuels treatments in the Sierra Nevada would not be expected to reduce canopy cover sufficiently to have measureable effects on owl reproduction (Lee and Irwin 2005).

Vegetation treatments are expected to have a long term positive influence on habitats such as meadows, montane riparian, and aspen and species such as willow flycatcher, northern goshawk, and mule deer where they occur in these habitat types in the LTBMU. These positive effects are expected to be greatest under Alternatives B and C because of the ability to remove larger diameter conifers than Alternatives A and D; conifers in these communities in the LTBMU are

currently outcompeting aspen and other native riparian vegetation where they coexist and encroaching on meadows and montane riparian communities. These alternatives would also allow for a greater scope of prescribed burning and managed wildfire than Alternative A which could more naturally mimic natural disturbance regime and allow for greater regeneration of vegetation. Meadows could respond positively where encroaching conifers have been removed from perimeters and where underburns are utilized to regenerate native meadow vegetation. Vegetation treatments to remove conifers from the overstory of aspen stands and use fire as a tool to disturb soil in the understory can improve aspen condition (Shepperd et al. 2006). Similarly, thinning montane riparian communities from encroaching conifers may reduce competition with riparian species such as willow, alder, among others.

Creation of early seral stages and improvements of late seral forested conditions are important for associated migratory bird species that use these habitat types.

Although grazing is not anticipated to be used as a primary or secondary form of vegetation management, grazing can have negative effects on wet meadows and montane riparian habitat and associated species such as willow flycatcher. Grazing can directly cause structural alterations to willow flycatcher habitat that could "expose nests, reduce substrate for insects, and diminish foliage cover that protects nests" (Mathewson et al. 2007).

All alternatives include protection measures for biological resources that would avoid or minimize potential disturbance events during the implementation of forest vegetation treatments. These protection measures include LOPs, PAC and HRCA stand structure guidelines, habitat connectivity guidelines, down woody material and snag retention guidelines, and others as described in Chapter 2 and the Draft Forest Plan Revision. However, for all alternatives, where vegetation treatments require the creation of temporary or permanent roads to access treatment sites, these actions can lead to habitat fragmentation, loss and degradation that can have persisting negative consequences for habitat condition as well as species associated with these habitat types.

Project-level effects of the methods used for treatments and the locations of treatments would be evaluated when projects come online. Overall, taking into account the program-level actions of these alternatives, it would appear that Alternatives B and C have restoration strategies that would achieve landscape-level desired conditions by increasing heterogeneity and improving resilience for many wildlife habitats. In contrast, the strategies proposed under Alternatives A and D may not be as effective at improving habitat conditions and reducing the potential for severe consequences of beetle outbreaks, climate change, drought conditions, and wildfire.

Recreation

Direct/Indirect Effects

It is expected that habitat condition and species productivity have the potential to trend negatively under Alternatives A, B, and C, depending on specific sites that would be expanded and /or have new facilities created. However, the most pronounced negative trend in habitat condition and species productivity is expected to occur under Alternative C because this alternative allows for the greatest amount of expansion at each recreation facility and permit area

(operational areas for ski resorts). However, effects of Alternative A may parallel those of Alternative C because of the ability of Alternative A to create the new facilities as described in the 1988 LTBMU Forest Plan (as amended); apparent inapplicability of LOPs and vegetation management standards and guidelines in recreation areas under the current direction; and potential expansion of ski resort areas. In addition, Alternative A does not recommend any area for wilderness designation. Although Alternative C includes the recommended designation of Dardanelles as a wilderness area, which can be viewed as beneficial for protecting natural resources as they currently exist, the total amount of potential expansion and creation of developed recreation facilities could counteract the potential benefit of the wilderness designation when viewed from a Basin-wide perspective.

Many of the recreational facilities currently found in the LTBMU (excluding ski facilities) are located around the Lake Tahoe perimeter and adjacent to sensitive habitat types like lake marsh and shore, meadows, and riparian communities (i.e., streams, creeks and rivers). These habitat types have the potential to experience the most pronounced negative trend in habitat condition under Alternatives C and A which could affect bald eagle, willow flycatcher, waterfowl, mule deer, migratory birds and osprey. These species and groups are sensitive to both human disturbance and habitat degradation, loss, and fragmentation that could result from facility expansion and/or creation. There is potential for permanent displacement of these species in these areas with increased developed recreation.

Habitat types such as Jeffrey pine, white fir-mixed conifer, and lodgepole pine are also expected to experience a negative trend where they exist within and adjacent to developed recreation areas, especially campgrounds and ski areas, and species such as spotted owl, northern goshawk, marten, and wolverine are expected to be adversely affected where expansion and creation occur in or adjacent to occupied forested habitat.

Overall, Alternative D is expected to result in stability or have the potential for a positive trend in habitat condition and species productivity because this alternative would reduce recreation facilities and would include the recommended designation of two wilderness areas. Although Alternative D is expected to have a positive trend because of the reduction of developed recreation facilities, it is possible that a negative trend could be experienced if recreation capacity under this alternative fails to meet demand and recreation use shifts spatially towards previously less used areas or shifts by type and includes more dispersed recreation activities in areas that previously experienced low levels of use.

Recreation can have varying degrees of adverse impacts on terrestrial wildlife resources such as habitat loss, degradation, and fragmentation; disruption of behavior (e.g., foraging, reproduction, etc.); reduction or alteration in supply and availability of food and cover; direct physical harm to individuals and/or offspring (e.g., eggs, young, etc.); and increased refuse, anthropogenic food sources, noise, and pet presence. Although it remains unclear which species are most affected by recreation and how the growing number of visitors may amplify those effects (Manley et al. 2010), examples from some studies can improve our limited understanding of recreation impacts on various species found in the LTBMU. For example, a study conducted by Morrison et al. (2011) in the Lake Tahoe Basin indicated that northern goshawks are susceptible to human disturbance; human activity was twice as high within infrequently occupied territories as compared to frequently occupied territories. Bald eagles in Washington have also been found to

be adversely affected by recreation that involves both pedestrian traffic and boat use by adversely affected feeding activity (Stalmaster and Kaiser 1998). Many kinds of human activities have been documented to affect raptors by altering habitats; physically harming or killing eggs, young, or adults; and by disrupting normal behavior (Postovit and Postivit 1987, Delany et al. 1999 as cited in Morrison et al. 2011).

Additional recreation facilities and consequential increased human use (see assumptions above) can not only lead to harassment and disturbance of species that tend to be more secretive but also attract other species to developed sites because of additional anthropogenic sources (e.g., food, denning and resting sites, etc.). Habitat enrichment (i.e., supplemental food) occurs in developed areas of the Lake Tahoe Basin and can lead to population growth and/or shifts in species distributions towards more developed sites (Manley et al. 2010). In the Lake Tahoe Basin, bear encounters in campgrounds, resorts, and recreation residences are frequent and a number of conflicts have been recorded, sometimes resulting in euthanization of individual bears. These types of conflicts are expected to increase with expanded and/or new facilities that support an increased capacity of visitors. Campgrounds can also attract a variety of small mammals and birds that respond to an increased food supply. Martens appear to be benefiting from anthropogenic resources in some ski areas in the Lake Tahoe Basin. In these ski areas, martens have been reported using anthropogenic food sources (e.g., dumpsters), using resort structures (e.g., chalets, buildings) as rest sites, and their tracks in snow are occasionally detected beneath lift lines. Food available at ski areas, from humans, may also attract small mammals which, in turn, may provide food for martens.

Although downhill ski resorts in the LTBMU may provide wildlife (e.g., marten) with anthropogenic food and resting resources, these resorts have several potential adverse effects on wildlife species. As described by Manley et al. (2010), potential adverse effects of ski resorts on wildlife include: “(1) forest losses and fragmentation (only shrub and grass layers remain on ski slopes), which affect late seral associated species, such as American marten, northern goshawk, California spotted owl, and spotted skunk; (2) high human disturbance during daytime on ski slopes may create barriers to habitat use and between-habitat patch movement for diurnal species; (3) changes in forest cover and human disturbance may create “sink” habitat for American marten; (4) night lighting and grooming on ski slopes may interfere with the behavior of nocturnal species; and (5) losses of snags in forested areas between ski runs owing to hazard tree removal can locally reduce wildlife habitat quality”. While martens do occupy portions of many ski areas in the LTBMU, female martens appear to exhibit a higher sensitivity to forest fragmentation from ski-run creation than males, avoiding areas highly fragmented by ski runs (K. Slauson unpubl. data). Furthermore, while males occupy more highly fragmented portions of ski areas than females, male survivorship appears to be lower in sites with higher fragmentation (K. Slauson unpubl. data). Snow compaction from grooming alters surface consistency making it easier for larger-bodied carnivores (e.g., coyotes [*Canis latrans*]) which, unlike martens are not adapted for deep, soft snow, to expand their winter ranges and compete with or prey on martens. Skiers and staff are active during the majority of the day at high densities and during the night conducting grooming activities, creating a higher likelihood for marten-human encounters and their associated disturbances (e.g., decreased frequency of prey captures due to interruptions while hunting). Finally, ski resort effects are not limited to winter,

as permanent effects (e.g., fragmentation) are present year-round, and because many resorts are developing summer recreation (e.g., hiking, mountain biking).

The additional of Dardanelles and Freel Peak as Wilderness designations can contribute to long-term positive trends in habitat conditions and species productivity. However, there is also a possibility for long term negative trends. The Freel Peak area includes old-growth forest stands as well as a variety of ecological important streams and montane riparian areas. Designation as a wilderness can benefit species by precluding management activities (i.e., timber harvest) and limiting potentially adverse human activities such as mountain biking and OHV use. This conservation approach has long been employed to help protect natural resources from degradation associated with human actions. However, climate change has been associated with and will continue to influence shifts in ecological processes and patterns, and species ranges, movements, and phenologies (Bradley et al. 1999, Cole and Yung 2010, Safford et al. 2012) among other newly emerging patterns. Biotic communities may shift but not shift together and newly formed communities may be comprised of new and different species assemblages with potential for new predatory and/or competitive interactions (Stralberg et al. 2009). Furthermore, the concept of ecosystem management represents a shift in conservation ecology in that it takes on a view of "nature in flux, rather than balance" and aims to protect ecosystem structure and function through adaptive management to maintain both biodiversity as well as adaptive capacity (Kalamandeen and Gillson 2007, Grumbine 1994, 1997 as cited in Kalamandeen and Gillson 2007). Therefore, while wilderness designation can benefit terrestrial wildlife species in these areas, protection of species and community assemblages may be limited to a snapshot in time and may not be protective in the future if natural processes aren't sufficient to maintain habitat conditions due to factors such as climate change, non-native species invasions (e.g., barred owl), insect outbreaks and other pathogens, among others.

Access to NFS Roads and Trails

Direct/Indirect Effects

Although the miles of OHV trails would increase under Alternative D more than any other alternative, and half of the miles of previously closed roads would be open under Alternative B, the most pronounced negative effect on habitat condition and species productivity is expected to occur under Alternative C because of the combined increase in mechanized, OHV, and motorized trails under this alternative and the types of dispersed recreation activities that can occur on these trails. All species have the potential to be affected under Alternative C although species such as willow flycatcher, bald eagle, spotted owl, osprey, peregrine falcon, northern goshawk, and marten are expected to experience the most pronounced negative effect.

Roads and trails in the LTBMU traverse various upland and riparian habitats and have the potential to adversely affect wildlife habitat and species. Newly created trails and roads lead to permanent habitat fragmentation, degradation, and loss. Special status species known or with potential to occur in the LTBMU that are particularly sensitive to habitat fragmentation, either directly or indirectly, include marten, spotted owl, northern goshawk, California wolverine, and Sierra Nevada red fox. For example, nest predation in willow flycatchers has been shown to increase with habitat fragmentation and disturbance (Wilcove and Robinson 1990 as cited in

Mathewson et al. 2009), and increased habitat edge provides favorable habitat for brown-headed cowbirds that parasitize willow flycatcher nests. "Trails or other paths created through meadows may expose willow flycatcher nest sites, reduce substrate for insects, diminish foliage cover that provides protection for adults and fledglings from predators and could potentially encourage adults to abandon nests or relocate" (Mathewson et al. 2007). Fragmentation can also lead to isolation of individuals and populations that can cause a reduced carrying capacity of the habitat, inability of individuals to find mates, and/or lead to the habitat becoming a sink habitat in which the reproduction rate does not offset the rate of population decline (i.e., emigration, death, low reproductive rates). Associated infrastructure such as culverts can disrupt or alter hydrology and contribute to desiccation of meadow systems (Mathewson et al. 2007), alteration of stream and creek flow, and consequently alter vegetation condition and the wildlife associated with these systems. Upgrades and maintenance of existing roads and trails have the potential to temporarily displace individuals and or alter normal behavior during implementation of these ground disturbing activities.

In addition to the roads and trails themselves and associated infrastructure, human use of the trails and roads for dispersed recreation activities (e.g., driving, hiking, mountain biking, OHV and OSV use) can lead to direct mortality and injury in the form of vehicle strikes; temporary and permanent displacement of wildlife; alteration of normal behavior and activities by wildlife species (e.g., foraging, nesting, denning, etc.); and spread of noxious weeds. Prolonged or consistent use of trails and roads can lead to permanent displacement of individuals from territories, nest or den abandonment, and/or alteration of foraging behavior and species-specific effects can lead community-wide effects. "Higher trophic level species such as northern goshawk, California spotted owl, American marten" may be particularly vulnerable to disturbances from dispersed recreation activities (Manley et al. 2010) and impacts to these species could result in a cascading effect through lower trophic levels.

The type of dispersed recreation activities can vary by season and have varying degrees of impacts on terrestrial wildlife species although the variation in some of these effects is not well understood. Rock climbing can disturb cliff-nesting birds and crevice-roosting bats. Limited research has shown that the effect of hiking versus bicycling did not induce a different disturbance response (i.e., flushing) by bison, mule deer, and pronghorn antelope in Utah (Taylor and Knight 2003). However, hikers move more slowly on trails than bicyclists and it has been suggested that this longer residence time may pose a greater disturbance to sensitive species (Manley et al. 2010). Conversely, bikes move quickly through habitat but may pose a greater risk of physical impacts (Manley et al. 2010). Although OHV use is restricted to designated trails in the LTBMU, this activity can damage vegetation, disturb wildlife, impact nesting success of breeding birds, alter movement patterns of mammals, and cause a reduction in wildlife populations (Luckenbach and Bury 1983, Lovich and Bainbridge 1999). In a study of OHV trail use and songbirds in northern California, Barton and Holmes (2007) found that 2 of 18 species studied were less abundant at sites on OHV trails than at sites 250 meters from trails, and no species were more abundant on trails. In the winter, OSV (i.e., snowmobile) use compacts snow and creates noise. Some small mammals (i.e., voles) may have difficulty navigating through compact snow layers but some predators may use compacted snow for travel, changing the spatial pattern of their movements and predation (Manley et al. 2010). Activities such as backcountry snowshoeing and cross country skiing are not expected to adversely affect wildlife

because they are limited in spatial and temporal extent. Data for one study conducted in the LTBMU found that OHV/OSV use did not affect marten occupancy or probability of detection and that overall OHV/OSV use in the study areas was low (1 OHV/OSV pass every 2 hours) and exposure occurred in <20% of a typical home range (Zielinski et al. 2007).

3.4.21.4. Analytical Conclusions

Comparison of Consequences by Alternative

Overall, Alternatives A and C could have the greatest potential for adverse direct impacts on terrestrial wildlife species productivity and habitat condition, and Alternative D could have the greatest overall potential for adverse indirect impacts. Alternative B is expected to have the fewest consequences. Alternatives A and C propose creation (Alternative A only) and expansion of recreation sites and Alternative A also proposes the greatest increase in road and trail access as well as the most intensive vegetation treatments to meet forest health and fuel reduction objectives. Compared to Alternatives B and C, Alternative D and to a lesser extent Alternative A fall short of facilitating long-term improvements to forest stand conditions over the next 30 years and the result could include increasingly dense stands and a more homogeneous landscape that is vulnerable to insect outbreak, drought, climate change effects, or high severity wildfires. Alternative D also doesn't continue the active restoration program proposed under the other alternatives following the completion of currently planned projects. Without restoration, habitats could deteriorate and no longer meet the life history requirements of associated species. These habitats could also be less able to adapt to changing climate conditions.

Although some of the management actions proposed as part of these alternatives could impose challenges on special-status species productivity and habitat conditions, each alternative includes a variety of design criteria that are intended to avoid or minimize such effects in both the short and long term. Furthermore, each alternative proposes various actions that are intended to benefit terrestrial wildlife species and their habitat and could offset these potential consequences.

How the Alternatives Maintain or Achieve the Desired Conditions

The restoration objectives and biological resource protection measures proposed under Alternatives B and C address contemporary desired conditions tied to species life history, habitat needs, and overall community-level management in the LTBMU. The biological resources protection measures provide clear and proactive management direction for special-status species protection and habitat restoration and enhancement as well as management standards for certain hot spot areas in the LTBMU. The desired conditions are based on Lake Tahoe and Sierra Nevada specific current state of knowledge from various watershed, ecological and species-centric assessments and research. The goal of the restoration program desired conditions is to refine management intent by defining proactive elements which sustain terrestrial wildlife habitat and communities of special status species. In addition, approaches to achieve such watershed and aquatic restoration, and biological resource protection desired conditions (strategies, objectives

and standards and guidelines) are scientifically credible and outcomes measurable. In contrast, desired conditions under the current direction (Alternative A) are founded in a more reactive management intent with goals of preventing terrestrial habitat and species degradation from land management actions. Under Alternative A the opportunity to design site-specific land management projects to restore multiple ecosystem functions becomes more of a challenge. Alternative D includes the same desired conditions as Alternatives B and C for biological resources protection and watershed and aquatic habitat condition but fails to follow the same restoration objectives to achieve these desired conditions. Therefore, Alternatives A and D may fall short of reaching desired conditions because of the lack of the proactive biological resource protection measures in Alternative A and lack of continued restoration under Alternative D.

Overall, Alternatives A, B, and C include management options that would maintain and/or improve terrestrial wildlife habitat and better enable the habitats to respond to changing climate conditions, thereby assisting species dependent on features of these habitats. Alternative D does not provide for these opportunities. Alternatives B and C also provide for maintenance and improvement of movement corridors that would improve habitat connectivity and assist species as changing climate conditions may influence species ranges or habitat needs.

Table 3-65. Comparison of Alternatives by Habitat Type and Special-status Species

Terrestrial Wildlife Resource Type	Alternative A	Alternative B	Alternative C	Alternative D
Terrestrial Wildlife Habitats				
Riparian Habitats (Wet meadows, Montane riparian, Lakeside marsh and shore habitat, Aspen)	Stable condition expected with potential for improved condition from watershed and aquatic habitat restoration activities; challenges to condition by conifer encroachment, expansion and creation of developed recreation sites, and trail upgrades.	Stable condition expected with potential for improved condition from watershed, aquatic, and forest vegetation restoration activities; challenges to condition from expansion of recreation sites and road openings.	Stable condition expected with potential for improved condition from watershed, aquatic, and forest vegetation restoration activities; challenges to condition by the potential for greatest expansion of recreation sites and roads and trails.	Stable condition expected with potential for improved condition from watershed and aquatic habitat restoration and reduction in roads, trails, and recreation infrastructure; degraded condition possible because lack of restoration in future, increased dispersed recreation, and increased OHV trails.

Terrestrial Wildlife Resource Type	Alternative A	Alternative B	Alternative C	Alternative D
Coniferous Forests (Jeffrey pine, white fir-mixed conifer, red fir, lodgepole pine, subalpine conifer)	Continued stability expected with potential for degraded condition where vegetation management is limited in ability to improve stand resiliency, reduce potential for high severity fire, and reduce continued homogenization of the landscape.; challenges where developed recreation expands into this habitat.	Stability expected with potential for improved representation of multiple seral stages and forest types with conversion and structure restoration; potential for improved condition where vegetation treatments improve stand resiliency, habitat heterogeneity, and stand structural diversity; challenges where developed recreation expands into this habitat.	Stability expected with potential for improved representation of seral stages and forest types with conversion and structure restoration; potential for improved condition where vegetation treatments improve stand resiliency, habitat heterogeneity, and stand structural diversity; challenges where developed recreation expands into this habitat.	Continued stability expected with potential for degraded condition where vegetation management is limited in ability to improve stand resiliency, reduce potential for high severity fire, and reduce continued homogenization of the landscape.
Montane chaparral	Potential for degraded condition because of fire suppression facilitating conversion to forest; and where recreation sites are expanded/created within this habitat.	Potential for improved condition where forest health treatments prioritize improving habitat heterogeneity; potential for degraded condition where fire suppression continues to facilitate conversion to forest and where recreation, roads, and trails are expanded within this habitat.	Potential for improved condition where forest health treatments prioritize improving habitat heterogeneity; potential for degraded condition where fire suppression continues to facilitate conversion to forest and where recreation, roads, and trails are expanded within this habitat at a level more than any other alternative.	Potential for degraded condition because of fire suppression facilitating conversion to forest; potential for improved condition where fire is used as a management tool and is able to create/maintain this habitat.
Cliff,Cave, and Cave-Surrogate Habitat	Protection measures for caves and cave-surrogate habitat, and for cliffs not occupied	Potential for improved condition is assured because of protection of cave	Potential for improved condition is assured because of protection of cave and cave-	Potential for improved conditionis assured because of protection of cave

Terrestrial Wildlife Resource Type	Alternative A	Alternative B	Alternative C	Alternative D
	by nesting peregrine falcons is mitigated on a project-specific basis, though not mandated by Forest Plan..	and cave-surrogate habitat, and cliff habitat for multiple sensitive species, and objective to remove anthropogenic damage from one site.	surrogate habitat, and cliff habitat for multiple sensitive species, and objective to remove anthropogenic damage from one site.	and cave-surrogate habitat, and cliff habitat for multiple sensitive species.
PACs and HRCAs	Stable condition expected and continued protection proposed; potential for degraded condition where habitat needs maintenance or improvement but restoration not permissible.	Stable condition expected and continued protection proposed; potential for improved condition where several PACs are restored.	Stable condition expected and continued protection proposed; potential for improved condition where several PACs are restored.	Stable condition expected and continued protection proposed; potential for degraded condition where habitat needs maintenance or improvement but restoration not permissible.
Wildlife Species Protected Under ESA				
Pacific fisher	Species not expected to occur.	Species not expected to occur.	Species not expected to occur.	Species not expected to occur.
Forest Service Sensitive Species				
Bald eagle	Stable productivity expected; potential for improved productivity with restoration; challenges from potential for expansion of developed recreation sites and trail adoption/upgrades.	Stable productivity expected; potential for improved productivity with restoration; challenges from potential for expanded developed recreation sites and road openings.	Same as Alternative B but with challenges from greatest potential expansion of developed recreation sites, and road and trail access of all alternatives.	Stable productivity expected; potential for improved productivity with restoration and reduction in developed recreation sites; challenges from discontinued restoration; increasingly dense stand conditions and potential for

Terrestrial Wildlife Resource Type	Alternative A	Alternative B	Alternative C	Alternative D
				increased dispersed recreation (shifting recreation use).
Great gray owl	Species not expected to occur.	Species not expected to occur.	Species not expected to occur.	Species not expected to occur.
California spotted owl	Stable productivity expected; potential for diminished productivity without PAC restoration; challenges from increasingly dense stand conditions and landscape homogenization; challenges due to increased developed recreation sites and trail upgrades.	Stable productivity expected; potential for improved productivity with PAC restoration and overall improved condition of forested habitat and heterogeneity; challenges from developed recreation expansion and road openings.	Stable productivity expected; potential for improved productivity with PAC restoration and overall improved condition of forested habitat and heterogeneity; challenges from greatest expansion of developed recreation sites and trail/road access to NFS lands.	Stable productivity expected with potential improvements from reduced developed recreation sites and challenges without PAC restoration opportunities, from diminished habitat conditions from increasingly dense stand conditions, and potential for increased dispersed recreation (shifting recreation use).
Northern Goshawk	Stable productivity expected with potential improvements from aspen restoration and PAC protection measures; challenges without PAC restoration opportunities, from diminished habitat conditions, and from developed recreation expansion and opened/upgraded trails.	Stable productivity expected; potential for improved productivity with aspen and coniferous forest health restoration activities, PAC protection measures, and PAC restoration objectives; challenges from potential to expand developed recreation sites and road openings.	Same as Alternative B but with challenges from greatest potential expansion of developed recreation sites and road and trail access of all alternatives.	Stable productivity expected with potential improvements from reduced developed recreation sites and challenges without PAC restoration opportunities, from diminished habitat conditions, and potential for increased dispersed recreation (shifting recreation use).

Terrestrial Wildlife Resource Type	Alternative A	Alternative B	Alternative C	Alternative D
Willow flycatcher	Potential for stable trend with meadow restoration but challenges to habitat from potential for increased developed recreation, and opened/upgraded trails.	Potential for stable trend with meadow restoration and objective to restore select willow flycatcher historic and occupied habitat; challenges to habitat from potential for increased developed recreation and road openings.	Potential for stable trend with meadow restoration and objective to restore select willow flycatcher historic and occupied habitat; challenges to habitat from the greatest potential for increased developed recreation and road and trail access of all alternatives.	Potential for stable trend in productivity from reduction in developed recreation sites; challenges where restoration no longer implemented and habitat deteriorates, and from potential shifting recreation use because of inability to meet demand.
Townsend's big-eared bat	Improved foraging habitat condition from restoration; challenges to roosting habitat by recreation expansion.	Improved foraging habitat condition from restoration; roosting habitat remains stable or improves because of cave and cave-surrogate protection measures and objective to remove anthropogenic disturbance from one cave (or cliff) site; challenges from recreation expansion.	Same as Alt B but with added pressures from largest potential for developed recreation expansion.	Foraging opportunities remain stable or decline without continued restoration of aquatic habitat. Roosting habitat remains stable or improves because of cave and cave-surrogate protection measures.
Sierra Nevada Red Fox	If species present, potential for improved habitat from meadow restoration; challenges from trend towards dense, late seral forested conditions of diminished quality and from potential expansion of	If species present, potential for improved habitat from meadow restoration and vegetation treatments; challenges from potential expansion of developed	Same as Alternative B but with challenges from greatest potential expansion of developed recreation sites, and road and trail access of all alternatives.	If species present; potential for improved foraging habitat from meadow restoration; challenges from treand towards dense late seral forested conditions of diminished quality;

Terrestrial Wildlife Resource Type	Alternative A	Alternative B	Alternative C	Alternative D
	developed recreation sites, and roads and trail upgrades.	recreation sites and road openings.		potential for positive trend from reduction in developed recreation sites but potential challenges from increased dispersed recreation.
American marten	Stable productivity expected; increased amount of habitat but potential for diminished condition; challenges from developed recreation (ski resorts) expansion and trail upgrades.	Stable productivity expected; increased amount of habitat and potential for improved habitat condition; challenges from developed recreation (ski resorts) expansion and enhanced road access.	Same as Alternative B but with challenges from potential expansion of developed recreation (ski resorts) and road and trail access of all alternatives.	Stable productivity expected; increased amount of habitat but potential for diminished condition; potential for improved productivity from reduction of developed recreation (ski resorts); challenges due to increased potential for dispersed recreation activities (including OHV use).
California wolverine	If species present, potential challenges from expanded developed recreation sites and trail upgrades.	If species present, potential challenges from expanded developed recreation sites and vehicle access but at a level less than Alts A and C.	If species present, potential challenges from expanded developed recreation sites, and road and trail upgrades.	If species present, potential challenges from increased OHV trails.
TRPA Special Interest Species				
Waterfowl	Potential for stable or improved productivity with restoration of aquatic habitat; challenges from increased developed and dispersed	Potential for stable or improved productivity with restoration of aquatic habitat; challenges from increased	Same as Alt A	Same as Alt A but with potential for declining trend where habitat restoration not implemented.

Terrestrial Wildlife Resource Type	Alternative A	Alternative B	Alternative C	Alternative D
	recreation.	developed and dispersed recreation but at level less than Alts A and C.		
Golden eagle	Potential for stable or improved productivity with restoration of foraging habitat and protection of nesting habitat.	Same as Alt A	Same as Alt A	Same as Alt A but with potential for declining trend where habitat restoration not implemented.
Osprey	Potential for stable or improved productivity with restoration of meadow and riparian habitat; challenges due to disturbance from increased developed and dispersed recreation.	Potential for stable or improved productivity with restoration of meadow and riparian habitat; challenges due to disturbance from increased developed and dispersed recreation but at a level less than Alts A and C.	Potential for stable or improved productivity with restoration of meadow and riparian habitat; challenges due to disturbance from increased developed and dispersed recreation.	Potential for stable or improved productivity with restoration; potential for diminished productivity without restoration; challenges due to increased dispersed recreation (e.g., OHV).
Peregrine falcon	Potential for stable or improved productivity from restoration of foraging habitat and protection of nesting cliffs from rock climbing.	Potential for stable or improved productivity from restoration of foraging habitat; protection of nesting cliffs; and objective to remove anthropogenic disturbance from a cliff (or cave) site.	Same as Alt B.	Potential for stable or improved productivity from cliff protection measures and restoration of foraging habitat; potential for diminished productivity where future restoration not implemented.
Mule deer	Potential for stable or improved productivity with restoration of meadow and riparian	Potential for stable or improved productivity with restoration of	Potential for stable or improved productivity with restoration of meadow and riparian	Potential for stable or improved productivity with restoration of meadow and riparian

Terrestrial Wildlife Resource Type	Alternative A	Alternative B	Alternative C	Alternative D
	habitat; challenges from increased developed and dispersed recreation.	meadow and riparian habitat; challenges from increased developed and dispersed recreation but at level less than Alts A and C.	habitat; challenges from increased developed and dispersed recreation.	habitat; challenges where restoration not implemented and habitat condition diminishes.
Migratory birds	Improved habitat conditions with watershed and aquatic restoration; challenges from increasingly dense forested conditions and increased developed and dispersed recreation.	Improved habitat conditions with watershed and aquatic restoration as well as forest restoration; challenges from increased developed and dispersed recreation.	Improved habitat conditions with watershed and aquatic restoration as well as forest restoration; challenges from increased developed and dispersed recreation.	Improved habitat conditions with watershed and aquatic restoration; challenges from lack of future habitat restoration; increasingly dense forested conditions and increased dispersed recreation.

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3.4.22 Water Quality and Soil Erosion

3.4.22.1. Introduction

Water quality is a key component and indicator of watershed condition. Degradation of other components of watershed condition (i.e. soil quality, SEZ and stream channel condition) are often reflected in water quality condition.

Fine sediment (<20 microns) transport to Lake Tahoe, and its effect on Lake Clarity is a primary water quality concern in the Lake Tahoe Basin. Nutrient inputs (nitrogen and phosphorus) are also a concern, particularly as it affects near shore clarity. Invasive species in the forms of both aquatic plants and mollusks, have also been recently identified as a major contributor to adverse impacts on near shore clarity.

Soil erosion is the primary process for fine sediment and associated nutrient transport to the Lake. Other aspects of soil quality (i.e. soil productivity) are addressed elsewhere in this chapter. Erosion processes includes sheet, rill, gully and channel erosion. The USFS has a variety of qualitative and quantitative techniques for assessing the scope and scale of management activity impacts on soil erosion and sediment transport at the project scale. Assessment of impacts at the programmatic scale presented in this Forest plan, relies primarily on qualitative assessment of past project scale analysis.

Methodology

The following indicators are utilized to describe current conditions and water quality impacts from forest management activities.

- Current Lake Tahoe Interagency Monitoring Program (LTIMP) Tributary Monitoring data for suspended sediment and nutrients.
- TMDL milestones for reduction of fine sediment and nutrient loading to Lake Tahoe from Upland and Stream Channel source areas.
    - BMPEP Implementation and Effectiveness scores
    - WEPP Analysis, utilizing measurements of soil attributes
    - Roads and Trails Water Quality Risk Assessment Scores
    - Stream Condition Inventory, Monitoring, and Assessment Data
- State Water Quality Standards

LTIMP Tributary water quality data is available on the USGS website, and is scheduled for presentation in the Tahoe Regional Planning Agency 2011 Lake Tahoe Threshold Evaluation Report. The methodology for assessing impacts of Forest management activities in achieving TMDL milestones is based on results from past Forest monitoring reports for the subset of indirect indicators identified above. This includes annual USFS Regional BMPEP evaluation reports, soil quality monitoring reports related to fuels reduction practices (including WEPP analysis), roads and trails BMP upgrades monitoring reports, stream channel/floodplain

restoration effectiveness monitoring reports, and existing Watershed Analysis and Ecosystem Assessment reports.

Assumptions

- Past water quality monitoring in the basin has proven to be largely inadequate to detect measurable adverse impacts to water quality specifically related to Forest Service management activities, such as roads and timber harvest. The Forest Service has developed other qualitative and quantitative methods that provide a better direct measurement of ecosystem impacts from Forest Management activities that have the potential to impact water quality
- Under all the alternatives, proposed changes in recreation infrastructure will consider impacts as they relate to the ecological values of riparian areas and wetlands (SEZs). Under all the alternatives, opportunities to protect and restore the ecological function of SEZs will be identified and considered, as part of future proposed actions related to increase recreational opportunity and capacity.

3.4.22.2. Overview of the Affected Environment

Water Quality

Past analysis of water quality monitoring data indicates that in general forested lands do meet the current state regulatory standards; however there are exceptions.

Watersheds that have experienced significant past disturbance, and have large sections of unstable stream channels frequently exceed state standards for sediment and nutrients (Blackwood, Trout Creek, and Upper Truckee River are a few examples). The total phosphorus standard is frequently exceeded in many more watersheds; however water quality analysis indicates this standard is frequently exceeded in undisturbed watersheds, and may need to be revised.

The only WQ monitoring the Forest has done related to human health impacts is limited fecal coliform monitoring at current grazing allotments, and a site investigation and remediation effort at the old Meyers Landfill site. This monitoring indicates that state standards for fecal coliform are frequently exceeded within and below grazing allotments, during the periods when livestock are present. The Meyers landfill investigation has detected a significant plume of vinyl chloride (VC). This VC contamination is not currently affecting drinking water sources, and remediation and cost recovery efforts are currently in progress.

Past water quality monitoring in the basin has proven to be largely inadequate to detect measurable adverse impacts to water quality specifically related to Forest Service management activities, such as roads and vegetation management. The interagency basin wide tributary monitoring program (LTIMP) was designed to collect data on overall watershed responses, but was not designed to separate out the impacts of individual land uses. Past water quality

monitoring performed by the Lake Tahoe Basin Management Unit related specifically to forest service management activities (such as roads and vegetation management) resulted in the eventual conclusion that in-stream water quality monitoring was a poor measure to detect impacts because when they occur, they tend to be episodic in nature, and difficult to capture through typical stream monitoring programs. (Norman, 2000; Norman, 1997; Norman, 1996; Norman, 1996).

The Forest Service has developed other qualitative and quantitative evaluations that is described in the soils section, that provide a better direct measurement of ecosystem impacts from Forest Management activities that have the potential to impact water quality. The discussion below described current conditions and trends related to water quality at the watershed scale, as measured through a Basin wide tributary monitoring program, as well as the results of past USFS initiated monitoring efforts.

The Lake Tahoe Basin has a long data record of tributary water quality data, provided through the LTIMP. This program is funded through TRPA and USGS, and recently has also been supported with funds through the USFS Erosion Control Grants program (for almost 1/3 of the cost of the program).

From this data, the State of California currently lists 8 tributary water bodies as impaired, and the State of Nevada lists seven tributary water bodies as impaired under Section 303(d) of the Clean Water Act (2010 List). These tributaries are located within the Lake Tahoe Basin boundary; therefore most of the tributaries mentioned include both USFS and private lands. The receiving water body, Lake Tahoe is listed by both states.

Two of the California streams currently have approved Total Maximum Daily Load (TMDL) targets related to sediment, (Heavenly Creek, 2002 and Blackwood Creek, 2008) and TMDLs are scheduled to be developed for the other water bodies and constituents. The Lake Tahoe TMDL approved by the EPA in 2011, is a joint effort between CA and NV. The Lake Tahoe TMDL requires the USFS to track and report on efforts to reduce loading from National Forest lands.

Most of the California streams (Table 3-66) and Lake Tahoe are listed because of sediment and nutrient loading to Lake Tahoe and subsequent impacts to Lake Tahoe clarity. However based on the TMDL analysis, upland sources (the forested non-urban portions of the watersheds) are estimated to contribute only 9% of the total fine sediment loading to the Lake, with atmospheric (15%) and urban sources (72%) the largest contributors. Forested non-urban sources are currently estimated to contribute 26% of the phosphorus and 15.5% of the nitrogen loading to the lake.

The six Nevada streams are listed (Table 3-66) because of zinc, iron, and in one instance pathogen violations. Two of the California streams are listed because of pathogens. The 303(d) listed waterbodies, other than Lake Tahoe, are listed below along with the pollutants causing listing.

Table 3-66. Listed 303(d) stream segments in the Lake Tahoe Basin (2010).

Segment	Measured Impact
California	
Blackwood Creek	phosphorus, nitrogen, sediment, iron
Cold Creek	nitrogen
General Creek	iron, phosphorus
Heavenly Valley Creek	phosphorus, chloride, sediment
Tallac Creek	pathogen
Trout Creek	phosphorus, nitrogen, pathogen , iron
Upper Truckee	iron, phosphorus
Ward Creek	phosphorus, nitrogen, sediment, iron
I	*Note* iron and chloride WQ stds may be revised*
Nevada	
Second Creek	zinc
Wood Creek	pathogen
Third Creek	zinc
Incline Creek	iron
Glenbrook Creek	iron
First Creek	zinc

Reporting of current water quality conditions and trends reported through Forest monitoring has been presented in the Forest Monitoring Program Annual Report for 2004/2005 through 2009/2010. The only analysis of water quality data that has been completed and presented in these reports during this time period is for Heavenly Ski Resort and the Marlette Creek, Blackwood Creek, and Cookhouse Meadow Restoration projects.

Water quality data indicates significantly improved conditions within the Heavenly Ski Area, with the water quality well below the TMDL standard for Heavenly Creek. There are still persistent exceedances of standards for iron (which appears to be natural causes) as well as chloride at all three Heavenly creek WQ sites, however these were also exceeded at the undisturbed reference site on Hidden Creek. State effluent standards for the California Lodge Parking lot, Edgewood Creek, and below the Boulder parking lot are also typically exceeded. Heavenly has recently completed new BMPs at both these facilities, and is continuing to investigate and improve the performance of these BMPs.

Monitoring at the dam removal and stream restoration project at Marlette Creek indicates that the new channel has been continuing to adjust after restoration, with evidence of continued bank erosion and channel scour and deposition. Water quality data has not proven to be a useful measure of project effectiveness, compared to instream channel measurements and photopoints. Therefore water quality monitoring has been discontinued, and future monitoring at this site will rely on channel measurements and photopoints, repeated at 3 year intervals to track channel adjustments and determine whether future restoration efforts are necessary. Based on this monitoring, deficiencies in the restoration design approach of this project have been identified, and have resulted in improved integration of geomorphic principles in later projects.

Water Quality monitoring was conducted at the Cookhouse Meadow/Big Meadow Creek and Blackwood creek restoration projects, during implementation only. This monitoring was required as part of State NPDES permitting, to determine whether state standards were

maintained during project implementation. This monitoring indicates that state standards for turbidity (no more than 10% exceedance over background levels) are frequently exceeded during implementation of in-channel stream restoration projects. However because background levels are typically very low (between 0.1 and 2 NTUs), the level of exceedances has usually stayed below 5 NTUs. There are exceptions when major precipitation events, and/or diversion failures have occurred during implementation, however these have been of relatively short duration and magnitude. The LTBMU is continuing to learn from past experience, to improve the timing, implementation, and maintenance of construction BMPs at these projects. Ongoing monitoring at both of these projects indicates there has already been substantial water quality benefits at both sites, as evidenced by measurements of more frequent and longer duration overbank flows, sediment deposition in the floodplain, and reduced channel erosion (Norman, 2009 and Oehrli, 2009)

Desired conditions and attributes for water quality as described in the 1988 Forest Plan have been refined through the Pathway 2007 process. The intent of the original desired condition statements has not been substantially changed through this refinement, but rather reflects an attempt to provide a better organized and uniform approach. The proposed attributes for pollutant load reduction related to lake clarity however do reflect a major change in how attainment of water quality desired conditions are measured through the development of the Lake Tahoe Basin Total Maximum Daily Load Model by the Lahontan Regional Water Quality Control Board. The TMDL model has assigned sediment and nutrient load reduction milestones for every watershed for each pollutant sources within that watershed, in order to meet the total load reductions needed to protect Lake Tahoe clarity. A crediting program is being developed to assign regulatory targets for achieving pollutant load reduction targets for urban sources.

There is no crediting program related to USFS sources, however the USFS will be required to report annually on actions taken to achieve TMDL milestones, and monitoring used to measure progress for upland and stream channel source categories on USFS managed lands.

These will be used in conjunction with current state water quality standards to measure attainment of desired conditions and regulation of management activities to protect the beneficial uses for waters within the Lake Tahoe Basin as identified in the Lahontan Basin Plan. (LRWQB, 2005)

All the management activities contained within the TMDL model are assigned disturbance coefficients that estimate their degree of impact on water quality. The Forest has been and will continue to adapt its monitoring program to provide better information to inform and validate the parameters used in the TMDL model related to Forest Management activities. The Forest monitoring program is anticipated to focus primarily on parameters related to soil quality, stream channel geomorphic condition, and BMP effectiveness.

Region 5 has developed guidance for management prescriptions and practices to protect water quality through the Region 5 Water Quality Management Program. This is described more fully in the Soil Erosion section presented below.

Groundwater Quality

In May 1975, leachate discharge was detected associated with the Meyers Landfill site. Volatile organic compounds (VOCs) and vinyl chloride were detected in the ground water beneath the landfill. These substances also reached nearby Saxon Creek. In the decades since, a plume of contaminated ground water has migrated thousands of feet offsite and poses a potential threat to domestic water supplies. An interim remedy is nearing completion which stabilizes the landfill and prevents rainwater from infiltrating into the landfill waste and thereby feeding more contaminated leachate to the ground water. The final remedy will determine the best means of controlling and removing the ground-water contamination.

Soil Erosion

Soil erosion is the primary process driving water quality impacts from forest management activities. Maintaining functional characteristics of soils such as hydrologic function, soil cover, and soil porosity, and soil productivity, are essential to maintaining overall watershed condition as it relates to erosion processes that effect water quality. The clarity of Lake Tahoe, the primary water quality concern in the Lake Tahoe Basin, is inextricably linked to controlling inputs of fine sediment to the lake, as well as nutrients bound to sediment particles. Therefore maintaining soil quality is a critical component of the Forests water quality protection program.

The Forest Service has developed a number of protocols to evaluate the potential for Forest management activities to adversely impact water quality, including evaluations of standard Forest Service Best Management Practices (BMPs). Forest Service BMPs have been systematically evaluated through the Region 5 Best Management Practices Evaluation Program (USDA Forest Service 2000) at randomly selected sites since 1992.

Monitoring through the Regional Best Management Practices Evaluation Program (BMPEP) has demonstrated an increase in implementation and effectiveness of BMPs employed for erosion control since the inception of the program. An extensive set of Forest Service Regional BMPs are prescribed for projects in all program areas, and additional project-specific BMPs are often prescribed. The annual BMPEP monitoring reports discuss monitoring results in detail, and are posted on the LTBMU external website. This data is presented in Table 3-67.

Table 3-67. Comparison of overall Best Management Practices Evaluation Program Ratings

Year of Evaluation	# eval	Implemented & Effective (%)	Not Implemented & Effective (%)	Implemented & Not Effective (%)	Not Implemented & Not Effective (%)
1992-2002	**194**	**72.2**	**11.3**	**11.3**	**5.2**
2003	45	80	0	13.3	6.7
2004	66	78.8	7.6	12.1	1.5
2005	39	94.9	2.6	2.6	0
2006	33	78.8	6.1	9.1	6.1
2007	32	78.1	6.25	9.4	6.25
2008	39	95	2.5	2.5	0
2009	30	90	7	3	0
2010	37	90	5	5	0
2003-2010	**321**	**85**	**5**	**7**	**3**

As can be seen in the table above, there has been a 13% improvement in overall BMP implementation and effectiveness ratings in for period between 1992 through 2002, and the period 2003 through 2019. Improvements can still be made. The current Regional and Forest target is 100% implementation and 90% effectiveness ratings.

Effectiveness deficiencies that historically seemed to recur persistently appear at roads crossings, recreation facilities and the Baldwin grazing allotment. As reported in Regional reporting of BMP implementation and effectiveness integrating results from all Region 5 forests, the most serious deficiencies occur when BMPs are not implemented as prescribed, or maintained, prior to significant storm events, as recently described in the 2009 LTBMU BMPEP report. Through regular reporting of the success of BMP implementation and effectiveness the Forest has become more responsive in correcting deficiencies.

TRPA BMPs are also prescribed and implemented where appropriate. The Special Uses Program required implementation of erosion control BMPs for owners of summer cabins on NFS land; and implementation of these BMPs was completed between 2005 and 2010.

Road and trail monitoring has been effective in identifying areas where runoff or off-road use has caused erosion. Inter-department communication of repair needs has improved, facilitating more timely repairs. In addition the LTBMU has also developed a water risk assessment for roads, which is utilized in conjunction with a watershed erosion prediction model to predict erosion potential (WEPP). The Forest completed a three-year evaluation of the Forest Roads Retrofit program in 2007, evaluating the effectiveness on retrofits implemented between 2003 and 2005 (USFS, 2007). Using a qualitative road risk assessment, this evaluation indicates that there has been a reduction in the number of high and medium risk road segments through the roads retrofit program. The water quality risk assessment estimates that 141 miles of the 152 mile Forest Service system road network present virtually no risk to water quality, because of the

location, grade, and proximity to stream channels of these roads. However there is approximately 11 miles of water quality risk road segments located adjacent to stream crossings, or exhibiting chronic erosion features, that will continue to have sediment loading potential. These water quality risk road segments will require more frequent maintenance and monitoring of BMPs, and may require more aggressive design measures to lower water quality risk. An addendum to this report was produced in 2009 that performed the same type of evaluation for the 4.2 miles of road that were retrofitted between 2006 and 2008.

An evaluation of a subset of these surveyed road segments (approximately 2/3) utilizing the WEPP runoff and erosion prediction model estimates a reduction in sediment yield from Forest Roads, from 23 tons per year, to 2 tons per year as a result of BMP upgrades. The WEPP model provides an estimate of annual erosion rates, and the model state that based on a comparison between measured and estimated results, WEPP has approximately 50% accuracy. Even with the limitations in the accuracies of WEPP modeling, it is clear that reducing the hydrologic connectivity of roads, has had a substantial impact on reducing the water quality impacts from Forest roads.

Design strategies include limiting unpaved parking areas, limiting foot traffic in sensitive areas, reducing the area where foot traffic occurs, and providing hard surfaces in intensively used areas. Systematic monitoring of campsites in Desolation Wilderness began in 2008, as a joint project with the Eldorado National Forest and is still ongoing. This program describes environmental impacts to campsites and identifies campsites where visitor use has decreased plant cover and vegetative litter, compacted soil, and resulted in the creation of multiple trails. The program also identifies other impacts not related to soils.

Prescribed fire has been largely successful in reducing fuels without significantly impairing soil productivity. There have been instances where fire has burned too hot and a reddening of the soil suggests a possible altering of soil physical and chemical properties, but these have been rare and their spatial extent has been small.

To minimize soil disturbance over the now logging was recommended in the 1988 plan, but weather patterns have severely limited the feasibility of this practice in the Lake Tahoe Basin. In recent years, low ground pressure equipment has been used in fuels reduction projects as a means to minimize soil disturbance. This equipment has been run on rubber tires instead of tracks, which limits soil displacement and compaction. There has been a large variety of research conducted in other parts of the nation, which indicates that this type of equipment can have minimal impacts on soil quality when operated under appropriate soil moisture conditions (Han et al 2007). Due to the high level of concern related to the potential for soil quality degradation in the Tahoe Basin, and resulting impacts to Lake Tahoe, the LTBMU decided to initiate a soil quality monitoring program to evaluate the impacts of this technology specifically on Tahoe Basin soils.

Between 2006 and 2009, the LTBMU collected data on soil quality parameters at three separate fuel reduction projects around the Basin, which utilized low ground pressure harvesting equipment. These projects represent a range of soils types around the Basin from west shore (Ward Unit 5, 2007) , south shore (Heavenly SEZ, 2008) and east shore (Roundhill, 2009). The Heavenly SEZ fuels reduction project was a pilot project to evaluate mechanical treatments on

soils classified as SEZ. The full monitoring reports for these three projects are posted on the LTBMU website.

Measured soil quality parameters include soil moisture, hydraulic conductivity (Ksat), bulk density, and soil cover. This data was then analyzed to determine pre and post project differences and whether regional soil quality guidelines were met. Measured soil quality data, as well as other specific site characteristics (i.e. slope, % canopy cover, and soil composition) were then input into the WEPP Hillslope model to determine to what degree measured changes in soil quality resulted in predicted changes to erosion response. The following conclusions can be drawn from these monitoring efforts.

- Regardless of where you are in the Tahoe Basin, soils consist primarily of coarse sandy loams with naturally high infiltration capacities. Therefore even though hydraulic conductivity was reduced by 27% to 62% as a result of management activity, median Ksat measurements between the three projects post-project were still 3.7 in/hr (Ward), 2.4 in/hr (Heavenly SEZ), and 2.08 in/hr (Roundhill). In one of the Roundhill units, post project Ksat measurements actually indicate an increase. We believe this result indicates that our sampling size (n=60) was not adequate to overcome the inherent variability that exists in this parameter in nature, and assume that this result means that there was no real change in Ksat in that particular unit.
- CTL harvester/forwarder equipment has not resulted in ecologically significant effects on the variety of Tahoe Basin soils evaluated, under the soil moisture conditions in which project operations occurred (5 to 11% soil moisture content). Soil cover after treatments averaged around 90% (regional guideline is maintain at least 50% cover), and soil porosity decreases were less than 5% (regional guideline is no more than 10% change in soil porosity). With the combination of robust soil cover, very small decreases in porosity and infiltration capacities still ranging from 2 to 3.7 in/hr post project; soil stability, soil hydrologic function, and soil productivity are not adversely impacted.
- WEPP modeling further indicates no ecologically adverse effects related to changes in runoff, erosion rates, or sediment transport as result of fuels reduction treatments. Among all three projects predicted sediment yield post project, using a 20 to 30 year climate simulation, ranged from 0.0 to 0.1 ton/acre/year.

Seasonal gate closures have been effective in limiting damage to roads and trails, which in turn limit off-road erosion (USDA Forest Service 2003, 2005a). LTBMU policy for timing gate closures favors resource protection through a conservative approach. Limiting off-highway vehicles to established routes and snowmobiles to designated areas has further prevented soil resource damage, but effectiveness is somewhat limited by law enforcement resources. As mentioned above, project design on developed recreation sites is being employed to limit disturbance from foot traffic to smaller areas and less sensitive areas. Hardened surfaces are provided on the most heavily used pathways and in parking areas.

Legacy compaction from logging activities in the 1950s and 1960s is still evident in many areas, but there are no visible or measurable effects on ecosystem condition as it relates to erosion and increased peak flows, or effects on vegetation).

Many stable disturbance features from the Comstock logging are now preserved for their historic value. Most of these roads, flumes, railroad grades, and other features have stabilized, so they no longer represent erosion sources.

Soil condition as it relates to soil erosion on NFS lands can generally be considered to be within desired ecological condition. The Forest has a relatively small and maintained roads and trails network, and BMPs have and are being implemented at all dispersed and developed recreation facilities. The Forest has only one remaining grazing allotment (trout creek), and this is very small. Restoration efforts have increased soil cover on ski slopes at the Heavenly Ski Area by an average of 20% between 1991 and 2003. However much of this cover is in the form of grass that requires ongoing irrigation and efforts are continuing at the resort to implement more sustainable soil restoration techniques, that does not require irrigation, at specific ski slope locations that have high connectively to water bodies.

The LTBMU anticipates having adequate funding to provide effective erosion control and soil restoration where new planned (and unplanned) soil disturbance is an issue, and to continue a program for monitoring impacts to soil condition as well as the Regional Best Management Practices Evaluation Program (BMPEP). Soil monitoring will continue to focus on impacts related to the use of mechanical equipment to treat vegetation as well as prescribed fire impacts. Regional Soil Quality Standards adopted in 1995, providing more detailed direction for assessing soil resource conditions than the Forest Plan, and were the starting point for developing the LTBMU soils monitoring program, as documented in the LTBMU soil monitoring plan, which is updated annually.

Ongoing monitoring of roads and trails will also continue, as the Basin continues to maintain its roads and trails network. Recent monitoring results from trails indicates that because of the low erosion and sediment delivery potential for these features, monitoring can be limited to routine visual surveys. Roads monitoring will continue to utilize a more intensive approach that relies on formal condition assessments, and WEPP modeling.

Stream Channel and Stream Environment Zone (SEZ) Condition as it effects Soil Erosion and Reduction of Fine sediments and nutrient loading.

The term stream environment zones (SEZ) was created by the Tahoe Regional Planning Agency, and is unique to the Lake Tahoe basin. It is a term used to attempt to define ecotypes that are heavily influenced by the presence of groundwater and/or surface water during at least part of the year, for the purposes of developing regulatory policies and standards related to these ecotypes. SEZs include ecotypes that lie adjacent to stream channels, and lakes, as well as those that are not directly connected to surface water bodies. SEZs include perennial, intermittent, and ephemeral stream channels, and lands typically termed as wetlands/fens/marshes (which have relatively high connectivity to water) as well as dryer ecotypes that have a lesser degree of connectivity to surface and groundwater (such as dry meadows and aspen stands). SEZs include a wide variety of wetland and riparian ecotypes which are addressed through numerous existing federal (USFS, EPA, FWS) and State planning and guidance documents and initiatives, even though the term SEZ is not used in these documents. SEZs should be considered to be a subset of ecotypes that lies within the zone described in the 2004 SNFPA ROD as Riparian

Conservation Areas (RCOs). There is tremendous overlap between these two concepts of defining this ecotype.

These ecotypes are considered to be high value as it relates to a variety of ecosystem functions including water quality. As such stream environment zones are a critical subcomponent of overall watershed condition as described above, and are the areas where degraded watershed function is most apparent. Maintaining functional characteristics of stream environment zones such as stream channel floodplain connectivity, vegetative cover, and soil hydrologic function are essential to maintaining overall watershed condition.

In the 1988 Forest Plan, goals and desired conditions for SEZs were included in the water quality desired conditions. These goals and desired conditions were expanded and given more of an ecosystem context by the Sierra Nevada Forest Plan Amendment (USDA Forest Service 2004a),

In 1996, the Sierra Nevada Ecosystem Project (SNEP) was completed. This document described and analyzed available knowledge, observations, and data with respect to riparian areas, wetlands, and stream channel conditions throughout the range. The results of SNEP suggested land use impacts in riparian areas, wetlands, and stream channels are greater than are seen in any other portion of the landscape. The study also enlightened management's view in that conditions in these ecotypes are often a reflection of watershed condition as a whole and suggested a more comprehensive approach to watershed management. The Sierra Nevada Forest Plan Amendment was, in part, a response to these findings. Proposed in 2001 and completed in 2004, the amendment has specific standards and guidelines for Riparian Conservation Area (RCA) management, and is directly applicable to ecotypes referred to as SEZs in the Lake Tahoe Basin. The SNFPA amendment directs Forests throughout the range to take actions and restore physical processes in RCAs that lead to healthy, self-sustaining ecosystems. Applicable direction from the SNFPA has been incorporated into all alternatives.

A presidential visit in 1997 led to the creation of the Lake Tahoe Restoration Act in the year 2000, which authorized funding for actions to restore and enhance the Lake's clarity, which includes efforts to restore SEZs. From 2005 through 2012, the Southern Nevada Public Lands Management Act has provided the funding for this work, and enabled the LTBMU to take a multi-disciplinary approach to the restoration of ecosystem processes at a watershed scale, to estimate how ecosystem conditions have deviated from natural trajectory, and then develop and implement projects to restore watersheds to a more natural trajectory. It is believed that this approach will lead to healthier functioning, self-sustaining ecosystems.

The LTBMU has initiated and completed several watershed-scale ecosystem analyses and has already begun to implement large-scale projects to meet LTBMU ecosystem restoration goals. Goals are largely defined by guidance provided in the SNFPA. Although SNFPA did not use or recognize the term SEZ, it did describe goals, objectives, strategies, and standards and guidelines for Riparian Conservation Areas. The definition and criteria for delineating RCAs is different than that for SEZs, however the management guidance is directly applicable to both.

Movement towards these desired conditions is accomplished through prevention and restoration of resource damage. Restoration is discussed below; prevention is largely accomplished through BMP implementation, and is discussed in the water quality and soils sections of this chapter.

In 1988, the Watershed Restoration program's primary goals were to reverse the downward trend in the quality of water flowing into Lake Tahoe from tributary streams on national forest lands,(as was demonstrated by data collected from the LTIMP tributary monitoring at the time), enhance and protect natural riparian function, and maintain and protect soil productivity and character.

The program completed a Watershed Improvement Needs (WIN) Inventory that identified many of the basin's erosion and potential water quality problems. Standards and Guidelines (S&Gs) focused on actions that included stream bank stabilization, controlling erosion at road crossings, and structural and non-structural habitat improvements for cold-water fish species. Floodplains have unique sediment filtering and nutrient recycling capabilities; therefore restricting disturbance and restoring floodplain connectivity to stream channels is a priority. Additionally, recommended restorative actions for existing disturbances in SEZs and riparian areas, identified in the WIN, is also a priority. The Plan also supports the conservation of soils as an underlying strategy for maintaining vegetation and preventing further degradation of water quality.

Over a 12-year period (1988-2000), approximately 500 acres of SEZ lands were treated.

Many treatments were small in scale and most were site specific i.e. stabilization of an excessively eroding stream bank. Most treatments have exhibited some degree of success with respect to meeting program goals.

Between 2000-2010 Watershed and SEZ restoration was planned and implemented at a larger scale. As described in the previous section under watershed condition, based on a variety of resource inventories the LTBMU contracted numerous watershed assessments between 2001 and 2004. These assessments reflect a fundamental shift in watershed management philosophy as reflected in the SNFPA, and identified restoration needs and opportunities for SEZs within those watersheds. The LTBMU also identified degraded conditions on a few discrete areas on the landscape that did not warrant a full-scale watershed analysis, but were addressed through smaller scale environmental assessments.

The following identifies the SEZ restoration projects implemented as a result of watershed assessments and environmental analysis conducted during this period:

2002 – Ward Creek fill removal and floodplain enhancement (3 acres)
2003 – Blackwood Phase I (Fish Ladder Removal) (2 acres)
2003 – Reconstruction on Lonely Gulch Creek (3 acres)
2003 – Dam removal on South Fork Marlette Creek (6 acres)
2005 through 2007 – Big Meadow Cookhouse channel construction (20 acres)
2006 – Blackwood Phase II (Barker Pass Bridge, culvert replacement) (4 acres)
2008 through 2009 -Blackwood Restoration IIIB, Reach 6 (40 acres)
2010 – Blackwood Phase IIIA, Reach 1 (Year 1 of 3)
2010- Cold Creek in High Meadows Restoration, Year 1 of 3
2011- Cold Creek in High Meadows Restoration, Year 2 of 3
2011- Blackwood Phase IIIA, Reach 1 (Year 2 of 3)

Monitoring conducted to date on these projects indicate that restoration efforts have been measurably successful in restoring ecosystem function in terms of reducing stream channel erosion and improving floodplain connectivity. Monitoring results and analysis are documented in numerous reports which are available on the LTBMU external website). These reports have also identified where restoration efforts have fallen short and the importance of incorporating sound principles of geomorphic function in restoration designs. Long term monitoring programs are in place to track effectiveness of existing and future efforts, and to inform adaptive management of the restoration program.

Current Forest Plan direction adopts TRPA and Lahontan RWQCB direction for SEZs, for all lands in the Lake Tahoe Basin. The USFS SNFPA added a wealth of guidance for Riparian Conservation Areas (RCAs), which are similar in definition to SEZs, but usually include much broader buffer zones. The guidance however is directly and appropriately applicable to both SEZs and RCAs.

Unlike current SEZ regulations, management activities are not prohibited in RCAs if analysis is conducted that shows that the project will meet the Riparian Conservation Objectives (RCOs) and the RCA standards and guidelines. The RCO analysis process is very sound and needs little change to meet the LTBMU's needs for Forest Plan revision. The RCA desired conditions and objectives were incorporated into the SEZ desired conditions in the Pathway 2007 process. At this time, the Forest Plan does not specifically reflect the changes in watershed resource management thinking since 1988.

The local State Water Resources Control Board has developed a Total Maximum Daily Load (TMDL) model for Lake Tahoe. This model estimates that 2% of total fine sediment to Lake Tahoe comes from stream channel erosion. Projects to stabilize degraded stream channels and restore floodplain connectivity will play a relatively small but important role in achieving TMDL load reduction targets for both stream channel erosion, as well as "treating" runoff from upland contributing source areas. The TMDL identified the Upper Truckee, Blackwood Creek, and Ward Creek as the three most significant contributors of stream channel erosion to Lake Tahoe. Along with the projects identified in the previous section, future projects planned on USFS lands in the Upper Truckee and Blackwood watersheds are expected to result in measurable improvements to sediment loading over time in these watersheds. A geomorphic based TMDL

was also established specific to the Blackwood watershed, which identifies TMDL targets based on geomorphic parameters (sinuosity, vegetation cover, and slope). Current TMDL targets also need to be incorporated into the new Forest Plan.

Most of the major stream channel floodplain restoration projects identified on National Forest lands are now in progress Many of these projects are also expected to provide substantial benefits to biological resources, as aquatic habitat is improved in stream channels, and riparian habitat in adjacent floodplains, and for some of these projects these biological benefits are the main driver for project prioritization.

Smaller scale stream channel restoration projects to restore stream channel function will continue to be tracked through the Watershed Improvement Program, described in the previous section under Watershed Condition.

Many future SEZ restoration projects on the LTBMU will focus more on the biological components of SEZ, such as meadow and aspen stand restoration through thinning and prescribed fire.

Additionally, restoration analysis identified that cessation of natural fire regimes in and adjacent to some SEZ's is a potential threat to ecosystem function. Similar to the vegetation and fuels management strategy in the rest of the LTBMU, natural disturbance processes in SEZs need to be mimicked by using vegetation manipulation and prescribed fire. The drought and subsequent bark beetle infestation in the late 1980s and early 1990s resulted in high rates of Lodgepole pine mortality in riparian areas. Many of the affected riparian areas are within the wildland-urban interface and constitute a fire hazard. Limited handwork has been done to reduce fuel accumulations, but until recently local regulations adopted by LTBMU prohibit the use of methods other than hand cutting and oversnow logging, so the vast majority of these areas remain untreated at present.

The LTBMU has recently implemented a pilot treatment project (Heavenly SEZ Fuels Reduction project) to test the effects of using low impact mechanical harvest equipment to treat fuels on SEZ soils. Monitoring results from this project are documented in the Heavenly SEZ Fuels Reduction Monitoring Report, 2008, and indicate that low PSI forwarder harvester equipment can be used in these areas under appropriate soil moisture regimes without causing adverse ecological impacts to soils, or hydrology. From these results an SEZ sensitivity rating protocol has been developed to identify SEZs within the boundaries of future projects that also indicate this level of resiliency. Wetter SEZ types, that do not exhibit dry moisture soil conditions, would still be limited to hand treatment or over the snow treatments.

Thinning and prescribed burn treatments are likely to be a desired management practice to utilize in SEZs well into the future to reduce fuel loads, and restore desirable riparian vegetation communities (and associated animal species) and subsurface/groundwater interactions within meadows and Aspen stands. Current restrictions on mechanical equipment used in SEZs needs to be removed and replaced with management standards and guidelines presented for RCA in the SNFPA in the new Forest Plan. The biological aspect of SEZ restoration is described further in the Biological Resources specialist report.

Climate Change

The affected environment for climate change would be the same in this section and the water quantity and watershed sections.

As described in Appendix C – for Climate Change Trend Assessment, the changes in temperatures and amounts and timing of precipitation due to climate change have led to earlier peak streamflows in most Sierra Nevada streams, with higher spring flows and lower summer flows. Streamflow data show that peak snowmelt in the LTB is occurring 2½ weeks earlier today than at the beginning of the 1960's. Spring flows may not necessarily be higher in the Tahoe Basin, but peak flows may occur more frequently, i.e. several peak flow spikes may occur throughout the winter and spring runoff due to rain on snow events, or extended periods of warm weather.

3.4.22.3. Environmental Consequences

Watershed Health and Aquatic Habitat Management

Under all the alternatives, the LTBMU would continue to implement to some degree the USFS Watershed Improvement Program (WIP), and soil and water BMP program, The BMPs provide protection from current and new activities, while watershed restoration actions under the WIP addresses adverse effects of past land uses.

A critical component of improving conditions in Lake Tahoe watersheds is implementation of stream channel restoration projects where under current conditions, stream channels exhibit unstable channel banks, and have eroded and incised to the point that they are no longer hydrologically connected to adjacent floodplains. Restroation projects currently in progress (defined as in planning phase currently and/or implementation has been funded and initiated) would be implemented under all of the alternatives. These currently planned projects address the bulk of the unstable channel reaches that have been identified on NFS lands in the Lake Tahoe Basin.

Under alternatives A, B, and C, the LTBMU would continue planning for implementation of both large and small scale restoration projects to restore degraded stream channels, beyond those projects for which planning and implementation has already been initiated. Under alternative D, future projects would not be planned to actively restore degraded stream channels. Some implementation of the National Watershed Improvement Program would occur, through removal of existing active stressors on these systems, (such as poorly designed stream channel crossings or hydrologic diversions). However systems that are out of equilibrium (as exhibited by headcuts, incision, accelerated bank erosion) as a result of past land use practices, climate change or other stressors not under the control of the USFS management, would be allowed to adjust through natural processes.

Under all the alternatives, currently planned USFS stream channel and watershed improvement restorations are expected to be achieved within the next 15 years, and the benefits of this work measured through assessments of watershed and stream channel condition, and contributions to achieving TMDL milestones. However under Alternative D, the achievement of longer term

TMDL stream channel milestones and geomorphic equilibrium from reaches on NFS lands, may take several decades longer than could be achieved through active restoration.

Vegetation Management

All the alternatives propose to utilize a variety of vegetation treatment options to reduce wildfire risk and improve forest health. Wildfire can result in significant impacts related to water quality and soil erosion, as documented in numerous studies across the country, which have been synthesized in the following document, Wildland fire in ecosystems; effects of fire on soils and water (Neary et al 2005).

Although the focus treatment types and vegetation prescriptions vary between the alternatives, all the potential treatment options proposed in the alternatives pose some level of short term risk of soil erosion and subsequent impacts to water quality. These risks will be managed by a variety of established best management practices (BMP), and the standards and guides presented in the Draft Forest Plan (Volume II). Therefore at the programmatic scale there are no differences between any of the alternatives as it affects water quality and soil erosion, in relationship to vegetation management activities. Vegetation management activities will not adversely affect current 303d listings, or impact the forests ability to achieve TMDL milestones for upland source areas.

However alternative D does create a greater risk to water quality with a reduction in vegetation management activities, because with limited active fuels management there is a subsequently greater risk of catastrophic wildfire. A synthesis of research on the impacts of wildfire on water quality was published by the Rocky Mountain Research Station of the US Forest Service (Neary et al 2005). The results from this synthesis conclude that the magnitude of effects on water quality is driven primarily by fire severity, which is a qualitative term describing the amount of fuel consumed. Wildfires are more severe than prescribed fire, and as a result are more likely to produce significant effects on water quality in terms of sediment and nutrients. Canopy-consuming wildfires are expected to be the greatest concern to managers because of the loss of canopy coupled with the destruction of soil aggregates. These losses present the worst-case scenario in terms of impacts to water quality, particularly if followed by heavy rains on recently burned lands.

The most significant risk to water quality as it relates to vegetation management practices are those associated with both permanent and temporary roads utilized as part of vegetation management projects. This is because roads can create linear conduits for concentrating flows and eroded sediments, if BMPS are not properly implemented and maintained. There will be somewhat less risk posed to water quality related to temporary roads used for vegetation management under alternatives in which additional areas of general forest are proposed for wilderness designation (Alternatives C and D).

Sustainable Recreation

The scale and nature of proposed activities related to management of recreation facilities and opportunity, including management area designations, also do not vary substantially in terms of

potential effects to water quality between alternatives. Once again established standards and guidelines and BMPs to protect soil and water quality will be part of any proposed changes in recreation infrastructure.

Under all the alternatives, proposed changes in recreation infrastructure will consider impacts as it relates to the ecological values of riparian areas and wetlands (SEZs). Under all the alternatives, opportunities to protect and restore the ecological function of SEZs will be identified and considered, as part of future proposed actions related to increased recreational opportunity and capacity.

The most significant difference that may exist between alternatives in this regard, may relate to the economic cost. For example, under alternative C it is proposed to expand developed and dispersed recreation capacity by increasing facility capacity. This may require more expensive design options to be able to achieve both an increase in recreational capacity, while at the same time mitigating or even restoring ecological function in areas where facilities exist within lands classified as SEZ

Under alternatives C and D the Dardanelles and/or Freel Peak Roadless areas are proposed for wilderness designation (See DEIS Map 10). This designation would result in limitations on any future watershed restoration activities that would involve the use of mechanical equipment. There currently is no known restoration needs in these proposed areas, and in the absence of the potential for human disturbance it is not anticipated there will be future needs identified in these areas. Future active restoration beyond currently planned projects is not allowed under alternative D.

Access and Travel Management (ATM)

Similar to recreation facilities as described in the section above, the scale and nature of proposed activities related to management of forest roads, trails and associated access facilities also do not vary substantially in terms of potential effects to soil erosion and water quality. Once again, established standards and guidelines and BMPs to protect soil and quality will be part of any proposed changes in these components of forest infrastructure. In addition, under each of the alternatives the LTBMU will continue to pursue opportunities to retrofit, relocate, or decommission roads and trails to reduce potential sediment and nutrient loading to Lake Tahoe, as part of the Uplands Forest TMDL management strategy.

As described in the affected environment section, a large volume of the potential opportunities in this regard has already been accomplished over the past decade. However there will continue to be improvements where opportunities still exist, such as the in areas of recent land purchases.

Climate Change

The stream channel and floodplain restoration efforts planned under all the alternatives will result in these systems being more resilient to any hydrologic adjustments that occur due to future climate change. Geomorphogically stable stream channels and floodplains that exist in a state of dynamic equilibrium are better able to adjust to climate change impacts to hydrology,

without resulting in adverse impacts to aquatic habitat, water quality, or water quantity. Hydrologic adjustments resulting from climate change occurs at a relatively slow rate as compared to hydrologic changes caused by human disturbance.

3.4.22.4. Analytical Conclusions

Comparison of Consequences by Alternative

Under all the alternatives, the LTBMU would continue to implement to some degree the USFS Watershed Improvement Program (WIP), and soil and water BMP program, The BMPs provide protection from current and new activities, while watershed restoration actions under the WIP addresses adverse effects of past land uses.

Under alternative A, B, and C, the LTBMU would continue planning for implementation of both large and small scale restoration projects to restore degraded stream channels, beyond those projects for which planning and implementation has already been initiated. Under alternative D, future projects would not be planned to actively restore degraded stream channels. Some implementation of the National WIP would occur, through removal of existing active stressors on these systems, (such as poorly designed stream channel crossings or hydrologic diversions). However systems that are out of equilibrium (as exhibited by headcuts, incision, accelerated bank erosion) as a result of past land use practices, climate change or other stressors not under the control of the USFS management, would be allowed to adjust through natural processes.

Under all the alternatives USFS stream channel and watershed improvement restorations are expected to be achieved within the next 15 years, and the benefits of this work measured through assessments of watershed and stream channel condition, and contributions to achieving TMDL milestones. However under Alternative D, the achievement of longer term TMDL stream channel milestones and geomorphic equilibrium from reaches on USFS lands, may take several decades longer than could be achieved through active restoration.

There is no substantial difference in consequences to water quality between all the alternatives based on planned Forest Management activities related to Vegetation Management, Recreation, or ATM

Because vegetation management treatments are primarily concentrated in a “ring” around lake Tahoe adjacent to urban areas (the WUI) , there is little to no potential for adverse consequences related to cumulative watershed affects under any of the alternatives, except as it relates to achieving overall reductions in pollutant loading affecting Lake Tahoe clarity as presented in the TMDL. Watersheds in Lake Tahoe are generally characterized by some level of urbanization in the lower third of the watersheds, with primarily stable forested uplands in the upper 2/3 of the watershed. Regardless of the specific type and scale of treatment options used as described under all the alternatives in the WUI, implementation of BMPs are expected to result in neutral environmental consequences as it relates to achievement of TMDL milestones, stream channel condition, or watershed hydrologic response.

All the strategies and objectives proposed under all the alternatives will not change the LTBMUs goal of doing its part to achieve the Lake Tahoe Basin TMDL milestones related to stream channels and forest uplands. The TMDL milestones for these two pollutant sources are a 12% reduction in fine sediment from Forest Uplands, and a 53% reduction of fine sediment from stream channels. As described in the TMDL water quality control plan, it is anticipated that these reductions will be achieved through past actions as well as through implementation of strategies as currently described under all the alternatives including implementation of BMPs, facilities roads and trails retrofits and decommissioning, implementation of currently planned restoration projects, and removal of existing stressors.

These efforts will be reported and tracked annually, as part of the LTBMUs contribution to the Lake Tahoe TMDL management strategy.

How the Alternatives Maintain or Achieve the Desired Conditions

Implementation of BMPs are expected to be successfully in protecting soil and water resources, and maintaining state water quality standards, as part of implementation of forest management actions proposed under all the alternatives.

Under all the alternatives, all planned USFS stream channel and watershed improvement restorations are expected to be achieved within the next 15 years, and the benefits of this work measured through assessments of watershed and stream channel condition, and contributions to achieving TMDL milestones. However under Alternative D, the achievement of longer term TMDL stream channel milestones and geomorphic equilibrium from reaches on USFS lands, may take decades longer than could be achieved through active restoration, as this is the time scale at which geomorphic equilibrium is re-established through natural processes after disturbance.

3.4.23 Water Quantity

3.4.23.1. Introduction

This section evaluates and discloses the potential environmental consequences on the surface and groundwater quantity resource that may result with the adoption of a revised land management plan. It examines, in detail, four different alternatives for revising the 1988 Land and Resources Management Plan (as amended) for the LTBMU (1988 Forest Plan).

Surface waters and ground waters are vital components of watersheds. Functional quantities of water flowing above ground in rivers, streams, springs, lakes, ponds, and marshes, and below ground in aquifers and underground rivers, must be maintained through management of water uses. Conjunctive-use management explicitly recognizes the interdependence of ground water and surface water within a watershed and is the framework within which water uses are best evaluated.

Methodology

Metrics

- Water quantity- General discussion of current water uses, consumptive and non-consumptive- including in stream flow requirement based on water rights and uses inventory and LTBMU Groundwater study.

Assumptions

- While groundwater demand is expected to continue increasing, at this time it appears that ground-water quality and quantities are sufficient to support use throughout the Lake Tahoe Basin by private, municipal, and commercial users within and adjacent to National Forest System lands.

At this time, it appears that surface water users in the Lake Tahoe Basin are not exceeding their allocated amounts and there are no potential illegal diversions or withdrawals

3.4.23.2. Overview of the Affected Environment

Groundwater

As the current Forest Plan predicted, there has been an increased demand for ground-water usage. While the demand is expected to continue increasing, at this time it appears that ground-water quality and quantities are sufficient to support use throughout the Lake Tahoe Basin by private, municipal, and commercial users within and adjacent to National Forest System lands. The US Geological Survey produced a report in 2007 which presents a compilation of existing hydrogeologic data and other information needed to determine the extent and characteristics of the aquifers in the Tahoe Basin (USGS, 2007).

The potential for overuse of ground water in the Basin is significant, however, as water demands generally mirror population increases and ground water is looked upon as a more stable supply than surface water. Ground-water levels appear to have stayed within historic ranges, with sufficient recharge rates to meet the demands of users; there have been no reports of wells drying up or of declining trends of water levels

The sufficiency of ground water to meet the natural resource needs of National Forest System lands in the Basin is presently not known (e.g., to maintain springs, stream baseflows, wet meadows, marshes, fens, bogs and other ground-water dependent ecosystems). However, it is important that sufficiency be determined to facilitate management of these natural resource needs. In the absence of such information, wise use of the resource requires that rather than using forest waters, the use of water sources located off NFS lands will be preferred when the water will actually be used off-forest (FSM 2542). Land use fees will be collected for ground water extraction, injection, or water pipeline operations authorized as special uses in accordance with FSM 2715 and FSH 2709.11, chapter 30.

Another important consideration is that water shortages may be created by contamination of ground water, both in direct loss of the purity of the affected ground water, and in consequent loss of purity of springs or streams replenished by the affected ground water. The largest volume of ground water affected by contamination in the Basin is associated with the Meyers Landfill, where a plume of ground-water contamination has migrated offsite several thousand feet over decades. Although there have been reports of several small ground-water contamination incidents associated with fueling locations and underground storage tanks in the Basin, no other large-scale contamination incidents have been discovered. In the past, it was assumed that the desired conditions of preventing ground-water shortages and water quality degradation were being met in NFS lands within Lake Tahoe Basin; that assumption will be tested through ongoing inventories of ground-water uses, localized studies associated with discoveries of ground-water contamination, and water needs assessments of ground-water dependent ecosystems.

Surface Water

At this time, it appears there are no potential illegal diversions or withdrawals, Adjudication of water rights within the Basin continues, however, and this underscores the need to thoroughly evaluate any proposal to withdraw water from surface waters to determine the potential

environmental impacts. The points of diversion (POD) and points of use (POU) have been verified for water rights held on NFS lands in the Basin. Water quantities will be verified as part of these ongoing water rights verification efforts in the Lake Tahoe Basin.

The LTBMU regulates runoff at Fallen Leaf Lake dam to prevent flooding along the lake and to delay peak runoff into Taylor Creek. Through the regulation of dam releases, channel degradation can be prevented and habitat integrity maintained.

Current Conditions and Trends

Management of Ground Water

Users of ground water on National Forest System lands include forest uses (e.g., administrative facilities, developed recreation sites, fire support, snow- and water-related recreational activities, and instream enhancement of fish and wildlife) and special use permits for ski resorts, concessionaires, and summer tract homes. Measurement and reporting of the quantity of water utilized is required for all ground water withdrawals from high-capacity wells located in NFS lands; however, withdrawals do not have to be measured or reported from wells equipped only with a hand or windmill pump. The details of most groundwater withdrawals (e.g., location, depth, flowrate) under special use permit have not yet been verified; these are being handled during special use permit renewals at this time. A comprehensive water rights verification and monitoring program for ground-water withdrawals is underway and will be ongoing, and that may increase the pace at which all forest uses of ground water are characterized.

In addition to water rights verification, ground-water resources and ground-water dependent ecosystems in the Lake Tahoe Basin will be inventoried and characterized. The LTBMU is in the process of developing a program for inventory and characterization of ground water and ground-water dependent ecosystems in the Lake Tahoe Basin.

Management of Surface Water

In the past, the USFS has measured streamflows to characterize water quantity at various locations in the Basin, in conjunction with water-quality monitoring efforts to evaluate management impacts. The USGS and TRPA fund a Basin-wide monitoring program (Lake Tahoe Interagency Monitoring Program, LTIMP) that continues to monitor water quantity and quality at numerous tributaries throughout the Basin.

The Engineering Department of the LTBMU operates a data logger that takes hourly stage measurements at Fallen Leaf Lake and a data logger on Taylor Creek downstream of the Fallen Leaf Lake dam that takes hourly flow measurements. In addition, the Engineering Department takes occasional flow measurements on Glen Alpine Creek above Fallen Leaf Lake. The LTBMU Engineering Department is also responsible for regulating flows at Fallen Leaf Lake dam. This is the only location in the Lake Tahoe Basin where the USFS is responsible for such duties.

The LTBMU maintains existing water rights and obtains new water rights with land acquisitions and when other opportunities arise to be put water to beneficial use for ecosystem conservation. Flow measurements are taken for water rights purposes as part of the Proof of Beneficial Use process of acquiring water rights in the State of Nevada. For the State of California, Statements of Diversion and Use are filed every three years concerning existing USFS water rights in California. The LTBMU is also preparing documentation to apply for conversion of existing consumptive water rights to riparian water rights, where previous consumptive uses of water have been discontinued. Existing reserve and riparian water rights are being maintained.

3.4.23.3. Environmental Consequences

Watershed Health and Aquatic Habitat Management

Under all the alternatives, the LTBMU will continue to follow national direction as it relates to management of surface water and groundwater quantity (and quality), to ensure beneficial uses for ecosystem conservation are maintained, while providing for essential consumptive use related to forest service administrative and recreation facilities.

In summer 2005, the importance of water rights on NFS lands was escalated to the regional level that resulted in high priority direction to all forests in Region 5. Forests of Region 5 were directed to make water rights a high priority by doing a more thorough job of managing water rights, verification of water use, and the purchasing and exchange of water rights. At this time the Points of Diversion and Points of Use of all of the water rights in NFS lands in the Lake Tahoe Basin have been verified.

Groundwater

The Forest will follow national direction regarding ground-water management issued July 2011.

Surface Water

There are numerous water right holders on NFS lands in the Lake Tahoe Basin. Nationally, increased focus on water rights has necessitated verification of water rights usage on NFS lands. Completion of a comprehensive water rights verification exercise on NFS lands in the Lake Tahoe Basin is planned during the life of this Forest Plan in all alternatives.

Vegetation Management

The scale and nature of proposed activities related to vegetation management do not vary substantially in terms of potential effects to water quantity between alternatives. Established standard and guides and best management practices to protect soil and quality will be part of any proposed changes in these components of forest infrastructure.

Sustainable Recreation

The scale and nature of proposed activities related to management of recreation facilities and opportunity, including management area designations, also do not vary substantially in terms of potential effects to ground and surface water quantity between alternatives. Established standard and guidelines and BMPs to protect soil and water quality will be part of any proposed changes in recreation infrastructure (see discussion in previous section).

Access and Travel Management (ATM)

Similar to recreation facilities as described in the section above, the scale and nature of proposed activities related to management of forest roads, trails and associated access facilities also do not vary substantially in terms of potential effects to water quantity between alternatives. Established standard and guidelines and BMPs to protect soil and water quality will be part of any proposed changes in these components of forest infrastructure.

Climate Change

The stream channel and floodplain restoration efforts planned under all the alternatives will result in these systems being more resilient to any hydrologic adjustments that occur due to future climate change. Geomorphogically stable stream channels and floodplains that exist in a state of dynamic equilibrium are better able to adjust to climate change impacts to hydrology, without resulting in adverse impacts to aquatic habitat, water quality, or water quantity. Hydrologic adjustments resulting from climate change occurs at a relatively slow rate as compared to hydrologic changes caused by human disturbance.

3.4.23.4. Analytical Conclusions

Comparison of Consequences by Alternative

The LTBMU would continue to follow national direction as it relates to management of surface water and groundwater quantity, to ensure beneficial uses for ecosystem conservation are maintained, while providing for essential consumptive use related to forest service administrative and recreation facilities in all alternatives.

How the Alternatives Maintain or Achieve the Desired Conditions

Same as above.

3.4.24 Watershed Condition

3.4.21.1. Introduction

This section evaluates and discloses the potential environmental consequences on Watershed Condition that may result from Alternatives A, B, C and D.

National protocols have recently been developed (USFS, 2011) for assessing and rating Watershed Condition. This protocol evaluates a wide array of attributes, including physical, aquatic, and terrestrial resource metrics, to develop an overall rating of Watershed condition. These attributes are listed below, and further detailed description of the environmental consequences related to these attributes are addressed throughout this chapter, organized by resource area. This narrative focuses on the overall impacts on Watershed Condition, and includes subsections that discuss the physical resource attributes such as water quality, water quantity, and natural hazards.

Methodology

Forest Service Watershed Condition Classification Technical Guide, July 2011.

Assumptions

None.

3.4.21.2. Overview of the Affected Environment

Lake Tahoe Basin Watershed Condition

An assessment of watershed conditions considers physical resource values such as water quality, water quantity, soil condition, and stream channel and stream environment zone geomorphic condition. However watershed condition also considers biotic values related to species and their habitats. In short watershed condition integrates the entire ecological function of a land area contained within a given hydrologic boundary. For the LTBMU, existing assessments describe watershed condition primarily as it relates to the upper watersheds in the Lake Tahoe Basin that are within Forest Service Management, and not lower watersheds and intervening areas that are largely not under Forest Service Management and are impacted by urban development.

The Forest Service Manual (FSM) uses three classes to describe watershed condition (USDA Forest Service 2004, FSM 2521.1):

Class 1 watersheds exhibit high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition.

Class 2 watersheds exhibit moderate geomorphic, hydrologic, and biotic integrity relative to their natural potential condition.

Class 3 watersheds exhibit low geomorphic, hydrologic, and biotic integrity relative to their natural potential condition.

The FSM classification defines watershed condition in terms of "geomorphic, hydrologic and biotic integrity" relative to "potential natural condition". In this context, integrity relates directly to functionality. Geomorphic functionality or integrity can be defined in terms of attributes such as slope stability, soil erosion, channel morphology and other upslope, riparian and aquatic habitat characteristics. Hydrologic functionality or integrity relates primarily to flow, sediment and water quality attributes. Biological functionality or integrity is defined by the characteristics that influence the diversity and abundance of aquatic species, vegetation, and soil productivity. In each case, integrity must be evaluated in the context of the natural disturbance regime, geoclimatic setting and other important factors within the context of a watershed. The definition encompasses both aquatic and terrestrial components because water quality and aquatic habitat are inseparably related to the integrity, and therefore the functionality, of upland and riparian areas within a watershed.

Within this context, the three watershed condition classes are directly related to the degree or level of watershed functionality or integrity: These three Classes relate directly to watershed functionality, and therefore watershed condition, as:

Class 1 = Functioning Properly;

Class 2 = Functioning at Risk; and

Class 3 = Impaired Function.

In March 2011, the Forest Service assessed the condition of all 6th field hydrologic units on all NFS lands using protocols recently developed by the Washington Office headquarters staff, at intervals of approximately 5 years (Forest Service Watershed Condition Classification Technical Guide, July 2011).

The watershed condition classification system described in this Technical Guide uses twelve (12) indicators comprised of attributes related to watershed processes. The indicators and their attributes are surrogate variables representing the underlying ecological functions and processes that affect soil and hydrologic function. For the majority of the indicators, the FS can take direct action, or cause actions to be taken by others that can contribute to maintaining or improving watershed condition (i.e. functionality). This provides for a direct linkage between the classification system and management or improvement activities the FS conducts on the ground. Because of this linkage, when a sufficient number of properly designed and implemented restoration and/or management actions occur within a watershed, the outcome can be expressed as a change in condition class and the information used for performance accountability purposes. Management activities that effect the watershed condition class are not limited to soil and water improvement activities, but include a broad array of resource program areas from hazardous fuel treatments, invasive species eradication, abandoned mine restoration, riparian area treatments,

aquatic organism passage improvement, road maintenance and obliteration, and others. To achieve a change in watershed condition class will in most cases require changes within a watershed that are significant in their scope and include treatments from multiple resource areas. Sound management or improvement to management practices can often be as effective as implementing restoration projects and must not be overlooked. In order to demonstrate improvement in condition class activities will need to be tracked at the smallest feasible watershed unit, the 6th level HUC (typically 10,000 to 40,000 acres in size).

The suite of watershed condition indicators includes:

1. Water Quality,
2. Water Quantity,
3. Aquatic Habitat,
4. Aquatic Biota,
5. Riparian/Wetland Vegetation,
6. Roads and Trails,
7. Soils,
8. Fire Regime or Wildfire,
9. Forest Cover,
10. Rangeland Vegetation,
11. Terrestrial Invasive Species, and
12. Forest Health.

The Lake Tahoe Basin HUC 6 watersheds contain several HUC 7 level watersheds that lie adjacent to each other. They all drain to Lake Tahoe, but are not hydrologically connected to each other. Therefore it is possible to have one or more HUC 7 watersheds within a HUC 6 watershed that exhibit poor ecological integrity, adjacent to highly functioning watersheds. For the purposes of this Forest Plan, watershed condition will be discussed as several scales, HUC 5, 6, and 7 levels.

The Lake Tahoe Basin constitutes one HUC 5 watershed and includes all the land that drains into Lake Tahoe. Condition of this HUC 5 watershed is best characterized by the TMDL evaluation report completed by the Lahonton Regional Water Quality Control Board, further described in the water quality section of this EIS (Lahontan, 2010). The Lake Tahoe Watershed is named on the EPA's 303d List as an impaired water body based on water quality.

The condition of HUC 6 watersheds on the LTBMU were assessed in March of 2011. The results of this assessment indicate that 2 watersheds were rated as Class 1, 8 watersheds as Class II, and no watersheds as Class 3.

Figure 3-79 displays a map of the nine HUC 6 watersheds defined in the Lake Tahoe Basin, and their current watershed conditions ratings. The rating and watershed names are also presented below.

1-Lake Tahoe-East Shore Frontal / North Half
1-Lake Tahoe-East Shore Frontal / South Half
2-Upper Truckee River –Angora
2-Upper Truckee River - Trout Creek
2-McKinney Creek-Bliss-Eagle Creek Frontal
2-Cascade Creek-Tallac Creek-Taylor Creek Frontal
2-Burton Creek-Watson Creek-Tahoe Vista Frontal
2-Ward Creek-Blackwood Creek-Eagle Rock Frontal
2-Stateline Point-Third Creek-Incline Creek Frontal

To describe watershed condition at the HUC 7 level we relied on existing survey and assessment information. This more informal assessment does rely on the same kind of data and analyses identified in the draft National protocol, but the qualitative assessment described below does not follow this specific protocol.

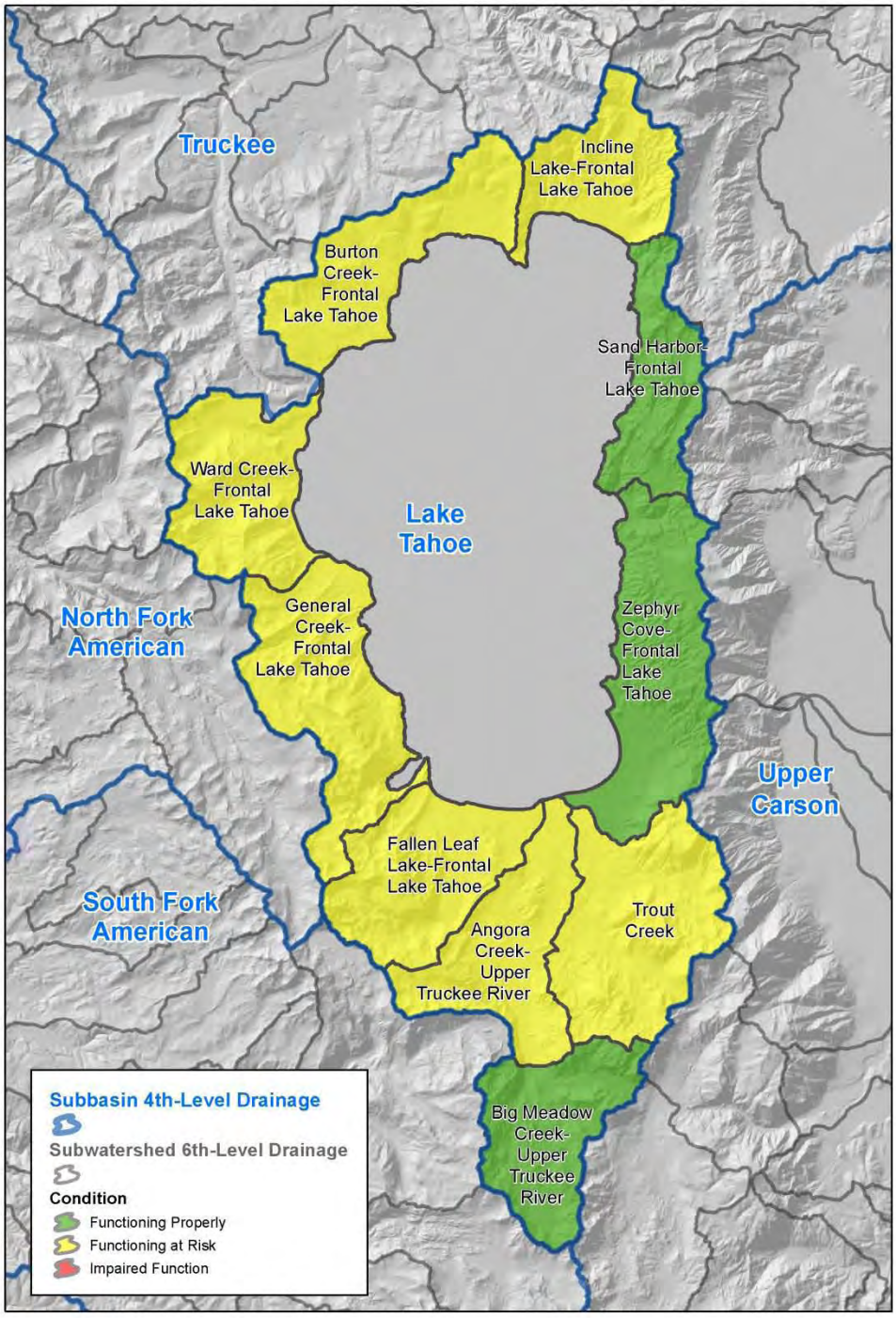

Figure 3-79. Map of HUC 6 Watersheds Defined in the Lake Tahoe Basin

Between 1993 and 2004 the LTBMU conducted watershed improvement needs (WIN) inventories throughout the Lake Tahoe Basin. During these inventories hydrologists visited every road, trail and stream channel to identify areas of accelerated erosion, and opportunities for restoration. During this time every stream in the Basin was also classified using the Rosgen Channel Typing protocol, as well as fish habitat typing. This information was used to identify stream reaches exhibiting unstable geomorphic channel characteristics and poor aquatic habitat quality.

In addition, a comprehensive Road Condition Assessment was conducted in 1998 to further identify roads in need of BMP retrofits, as well as roads that should be obliterated. Other assessments that helped assess overall watershed condition, included site specific stream condition inventories (SCI) on 16 reaches between 1993 and 2008, both on reference streams, as well as those that were identified for future restoration. In addition, macroinvertebrate sampling has been conducted since 1993 as part of SCI and other selected project monitoring plans

From information gathered through these various efforts a large number of smaller stream channel restoration projects were implemented, as well as a comprehensive BMP retrofit of system roads (154 miles) and decommissioning of approximately 100 miles of road. System trails in the Basin are currently undergoing a similar assessment and retrofit program, but are not considered to present the same degree of water quality threat as the road network.

The Basin has completed a substantial amount of work associated with water rights verification, covering USFS water rights in the Basin. A number of relatively small issues including non-compliance have been identified, and are currently being resolved. However, currently no significant problems affecting water quantity and associated riparian beneficial uses have been identified.

From these past inventory and assessment efforts, and subsequent management response, many of the Forest legacy issues that may affect overall watershed condition, in terms of erosion, water quality, and water quantity have been addressed in the upper watersheds managed by the LTBMU in the Lake Tahoe Basin.

However, these efforts also identified a small number of HUC 7 watersheds (or subwatersheds) as needing a more intensive level of watershed assessment to characterize current geomorphic, erosion, and hydrologic processes, and assess the need for larger scale stream channel restoration efforts to address channel reaches that had lost optimal stream channel and floodplain geomorphic function. Detailed watershed assessments were conducted for these watersheds, which include the Upper Truckee River (TRCD, 2003; Swanson 2004), Cookhouse/Big Meadow, Blackwood Creek, Cold Creek (tributary of Trout Creek), Meeks Creek, Ward Creek, and Taylor/Tallac Creeks (see Figure 3-80).

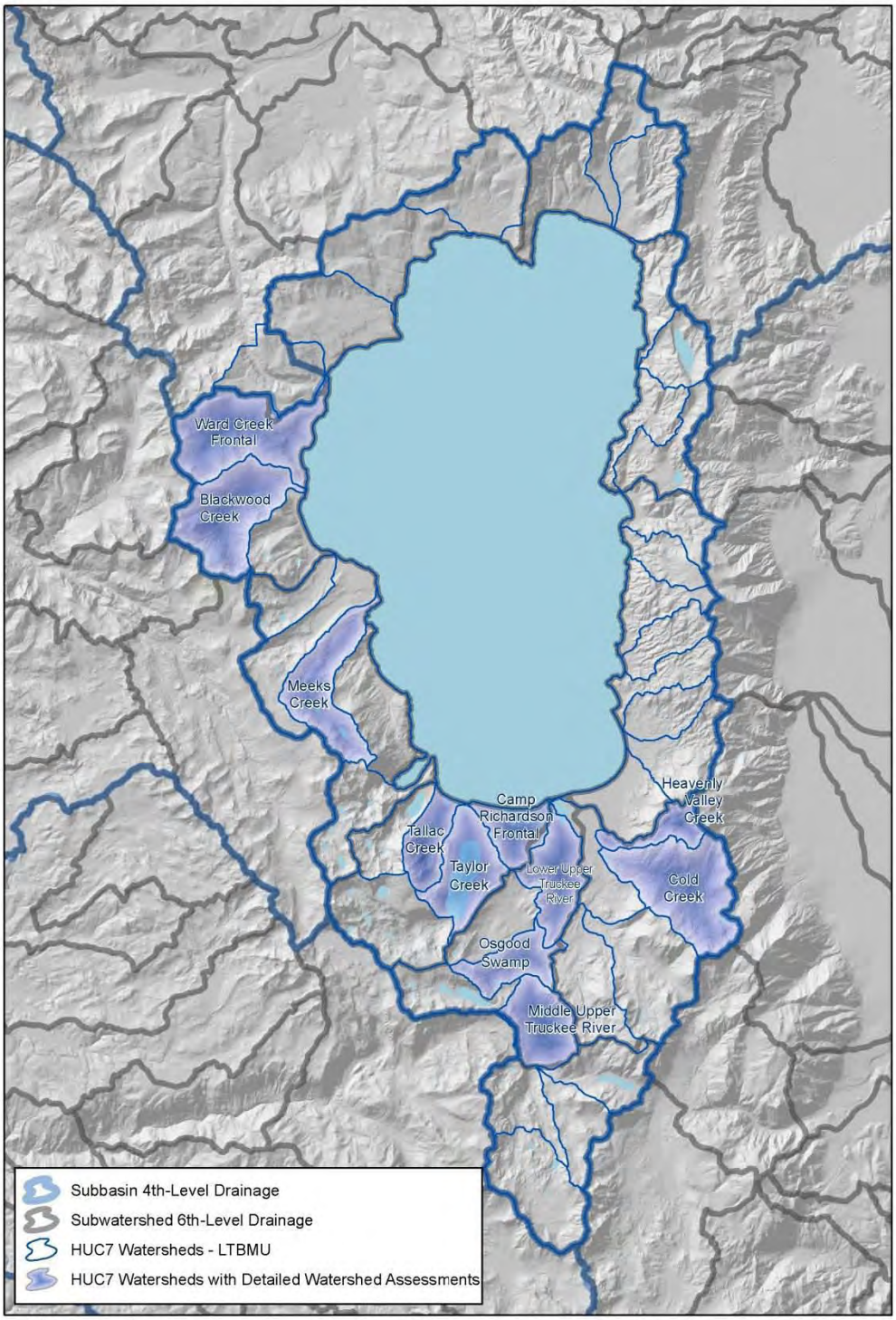

Figure 3-80. HUC 7 Watersheds and Subbasins Defined in the Lake Tahoe Basin

The condition of these watersheds that precipitated the need for a more intensive level of assessment effort included evidence of poor stream channel and floodplain function, indicated by incised and eroding channel reaches, the lack of "wetter type" riparian vegetation along stream channels and adjacent floodplains, and in some cases observations of significant disconnection of hydrology due to manmade diversions and structures. The more comprehensive ecosystem/watershed assessments completed for these watersheds documents the nature of historic disturbance, current management activities, and man-made structures and their effects on natural processes. Based on these assessments large scale stream channel, floodplain, and meadow restoration projects have been identified in these watersheds, and restoration projects have and are being implemented to restore impaired watershed functions. These are further described in the section below for stream environment zones and stream channels.

There are also a few other stream channels in the Basin that are considered to be in degraded condition as documented in the USFS watershed improvement tracking (WIT) database. While full scale watershed assessments have not been conducted, these creeks contain reaches of channel on NFS lands that are currently not in geomorphic equilibrium. This includes reaches within Incline Creek, Burke Creek, and Angora Creek.

There is one other watershed on LTBMU lands that has gone through extensive monitoring and evaluation. The Heavenly Valley Creek watershed, primarily affected by the Heavenly Ski resort, has been addressed through its own analysis, monitoring and planning efforts in conjunction with the Heavenly Mountain Resort Master Plan Amendment and the resort special use permit. While early data suggested that the watershed was impaired, the resort has implemented a substantial number of efforts to reduce sources of sedimentation and erosion. Comprehensive analysis of monitoring data from 1993-2004 (Norman and Greene 2004) indicates the resort has achieved substantial improvements in watershed condition, including water quality in Heavenly Creek.

Watershed Condition Assessments, using the National Protocol will be used to help identify and prioritize opportunities for restoration through an ongoing Watershed Improvement Program (WIP) at the broad scale. In addition the National Watershed Improvement Tracking Database (WIT), initiated in 2010, will be used to document current watershed needs, and track restoration efforts, and is expected to play a role in funding prioritization. The discussions below provide a more detailed description of specific ecosystem components that affect and are integrated into an evaluation of overall watershed condition.

3.4.21.3. Environmental Consequences

Watershed Health and Aquatic Habitat Management

Under all the alternatives, the LTBMU would continue to implement to some degree actions designed to improve the health of the physical resource and aquatic habitat attributes used to evaluate overall watershed condition. Therefore at the programmatic scale all the alternatives propose actions that would maintain or improve current watershed condition ratings.

The discussion of these actions related to specific attributes of watershed condition is presented in separate sections within this chapter as referenced below.

Vegetation Management

All the alternatives propose to utilize a variety of vegetation treatment options to reduce wildfire risk and improve forest health. Although the focus treatment types and vegetation prescriptions vary between the alternatives, all the potential treatment options proposed in the various alternatives pose some level of short term risk to soil, water, and air quality. These risks will be managed by a variety of established BMPs, and the standards and guidelines presented in the draft Forest Plan. Therefore at the programmatic scale all the alternatives propose actions that would maintain or improve current watershed condition ratings.

There is going to continue to be a risk of adverse resource effects associated with wildfire under each of the alternatives, which could result in degradation of overall watershed condition. The relative difference in wildfire risk between alternatives is described in Chapter 2. Because of the extreme unpredictability of either wildfire occurrence or level of effects, it is not useful to speculate regarding the level of effects on resources attributes that could occur under the various alternatives as a result of wildfire. However it can be assumed that there is a parallel level of risk of adverse effects on resources, associated with the level of risk of catastrophic wildfire.

Sustainable Recreation

The scale and nature of proposed activities related to management of recreation facilities and opportunity, including management area designations, also do not vary substantially in terms of potential effects to watershed condition between alternatives. Once again established standards and guidelines and BMPs to protect resources will be part of any proposed changes in recreation infrastructure.

The most significant difference that may exist between alternatives in this regard, may relate to the economic cost. For example, under alternative C it is proposed to expand developed and dispersed recreation capacity by increasing facility capacity. This may require more expensive design options to be able to achieve both an increase in recreational capacity, while at the same time mitigating or even restoring ecological function in areas where facilities exist within lands classified as SEZ.

Under alternatives C and D, an increase in wilderness area designations is proposed in Dardenelles and/or Freel Peak Roadless areas (see DEIS Map 10). This would result in limitations on any future watershed restoration activities that would involve the use of mechanical equipment. There currently is no planned stream channel and floodplain restoration using mechanical equipment in these proposed areas, and in the absence of the potential for human disturbance it is not anticipated there will be future needs. Future active restoration beyond currently planned projects is not allowed under Alternative D.

Access and Travel Management (ATM)

Similar to recreation facilities as described in the section above, the scale and nature of proposed activities related to management of forest roads, trails and associated access facilities also do not vary substantially in terms of potential effects to watershed condition resource attributes between alternatives. Once again established standards and guidelines and BMPs to protect soil and water quality will be part of any proposed changes in these components of forest infrastructure. In addition, under each of the alternatives the LTBMU will continue to pursue opportunities to either retrofit, relocate, or decommission roads and trails to reduce potential sediment and nutrient loading to Lake Tahoe, as part of the Uplands Forest TMDL management strategy, although the scale of this work is not likely to change existing watershed condition ratings for the road and trail metric.

As described in the affected environment section, a large volume of the potential opportunities in this regard has already been accomplished over the past decade. However there will continue to be improvements where opportunities still exist, such as in areas of recent land purchases.

Climate Change

The stream channel and floodplain restoration efforts planned under all the alternatives will result in these systems being more resilient to any hydrologic adjustments that occur due to future climate change. Geomorphogically stable stream channels and floodplains that exist in a state of dynamic equilibrium are better able to adjust to climate change impacts to hydrology, without resulting in adverse impacts to aquatic habitat, water quality, or water quantity. Hydrologic adjustments resulting from climate change occurs at a relatively slow rate as compared to hydrologic changes caused by human disturbance.

3.4.21.4. Analytical Conclusions

Comparison of Consequences by Alternative

Actions to improve conditions as it relates to various watershed condition attributes are planned under all the alternatives.

There is no method to provide a pre-implementation quantitative evaluation of when and to what degree these actions may improve current watershed condition ratings in watersheds currently rated as functioning at risk. Watershed Condition assessments are scheduled to be repeated every 3 to 5 years, according to the National protocol. Effects of management actions, as well as natural events (such as wildfire, extreme floods, climate change) will all determine the results of these assessments, as reflected by the current condition of the 12 watershed attributes during the assessment.

How the Alternatives Maintain or Achieve the Desired Conditions

Current watershed condition ratings are not expected to change under any of the alternatives, as rated through the National watershed condition assessment protocol, within the next 5 years. It is hopeful that through the implementation of currently planned work, that some of the watersheds that are rated as Class 2, functioning at risk, may improve to a Class I rating – Properly functioning, over longer time periods, Management actions to reduce forest fuels and fire risk, restore aquatic and terrestrial habitats, forest health, stream channel stability, disturbed soils, and manage invasive species are expected to result in improved desired conditions for the twelve attributes of watershed condition identified at the beginning of this section. The two priority watersheds for management actions are Blackwood and the Upper Truckee. There is no measurable difference between the alternatives in this regard.

3.4.25 Wilderness

3.4.25.1. Introduction

This report evaluates and discloses the potential environmental consequences on wilderness resources that may result with the adoption of a revised land management plan. It examines, in detail, the four alternatives described in Chapter 2.

Methodology

Effects will be assessed by how forest management activities influence the quality and quantity of wilderness resources as determined by the measurement indicators discussed below.

Issue and Indicators

Issue

Public participation and collaboration identified "the amount of land with wilderness designation" as a key issue as discussed in Chapter 1, Recreation Issues.

Amount of Wilderness

Indicators

Measurement indicators respond to the Issues and allow for an analysis of the Wilderness Resource. :

1. **Recommended Wilderness -** Acres of newly recommended Wilderness will be used to compare alternatives.
2. **Wilderness Access –** Miles of trails available to access recommended wilderness areas.

These recreation indicators are displayed in detail in Table 3-68.

Table 3-68. Wilderness Indicators - Recommended Wilderness Acres and Trails by Alternative

Wilderness Acres	**Unit of Measure**	**Existing Wilderness Acres**	**Alternative A**	**Alternative B**	**Alternative C** Dardanelles Roadless	**Alternative D**[2] Dardanelles and Freel Roadless
Recommended Acres	Acres	24,670	No Change	No Change	14,227	14,227 +15,341 = 29,568
Existing and Recommended Acres.		24,670	24,670	24,670	38,897	54,238
Wilderness Trails		**Existing Wilderness Trails**				
Existing and Recommended Miles of Wilderness Trails	Miles of Trail	55.85	No Change	No Change	20.4	*Dardanelles 20.4* *Freel* *+25.6* =46 miles
Wilderness and Recommended Wilderness Miles		55.85	55.85	55.85	+76.25	+101.85

Assumptions

Wilderness Acres – Current wilderness designations will remain constant for all alternatives.

Wilderness Managed to Primitive Standards – Recommended wilderness areas will be managed to primitive standards as described by the Recreation Opportunity Spectrum (ROS) notwithstanding their classification as Semi Primitive Non-Motorized in the ROS criteria.

3.4.25.2. Overview of the Affected Environment

The LTBMU shares management of three congressionally designated wilderness areas with three other National Forests (Table 3-67). Desolation Wilderness is co-managed with the Eldorado National Forest, Granite Chief with the Tahoe National Forest and Mt. Rose Wilderness with the Humboldt-Toiyabe National Forest. Both Granite Chief and the Mt. Rose Wilderness are managed primarily by the other forests. There are 55.85 miles of trails in the combined wildernesses.

As described by congress - "A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions, has outstanding opportunities for solitude or a primitive and unconfined type of recreation…"

The desired condition for managing wilderness areas within the basin is to protect and perpetuate the wilderness character and values of these areas as directed in the Wilderness Act and subsequent Wilderness designating legislation. This includes providing opportunities for solitude, education, physical and mental challenge, inspiration, scientific study and primitive recreation. Wilderness ecosystems are the result of natural succession and natural processes with as little human intervention as possible while retaining wilderness character. There should be little evidence of visitor use and low interaction among users. The few trails and associated facilities present are retained primarily to protect the wilderness resources. No motorized use is permitted. The Forest Plan provides specific standards for management of the various resources and activities that are or could potentially occur in the wildernesses including, recreation, fire, lands, minerals, fish and wildlife, insects and disease, research, search and rescue, special uses, and hydrology.

Table 3-69. Wilderness lands located within the Lake Tahoe Basin Management Unit

Name	Year Established	Total Acres	LTBMU Acres	LTBMU Trail Miles
Desolation Wilderness	1969	63,960	22,038	51
Granite Chief Wilderness	1984	25,680	46	0.5
Mount Rose Wilderness	1989	28,121	2,586	4.8
Total LTBMU			**24,670 Acres**	**55.85 Miles**

Desolation Wilderness – Though relatively small, the 63,960 acre Desolation Wilderness is one of the premier wilderness areas in the United States, both in terms of its qualities and its popularity. It is one of the most heavily used wilderness areas for its size in the nation due not only because of its inherent beauty, but also because its proximity to major population centers and its relative ease of access.

There are 22,038 acres that lie on the LTBMU with the remaining 41,922 on the El Dorado National Forest. Total use exceeds 120,000 visitors per year and includes both day use hiking and equestrian and overnight backpacking. Within the LTBMU portion of the wilderness, the average overnight use is estimated at 5,100 visitors and 82,500 day users per year. There are 51 miles of trails on the LTBMU side of the wilderness.

In managing the Desolation Wilderness, the LTBMU and the Eldorado National Forest have substantially achieved the Forest Plan goal of preserving its wilderness character, as intended by Congress. In 2006, the LTBMU and the El Dorado National Forest were awarded the Aldo Leopold Award for outstanding stewardship of the Desolation Wilderness.

In 1976 the Forest Service imposed restrictions on the numbers of overnight visitors, and currently there are area quotas for overnight camping that aim to distribute visitors and their impacts throughout the wilderness to protect popular areas from overuse.

In 1997, the Desolation Wilderness was added to a new national pilot program, the Fee Demonstration (Fee Demo) program. Both the LTBMU and the Eldorado NF collaborated to develop a Business Plan, conduct public meetings, and develop an Operations Plan for the assessment of user fees to manage and maintain the environmental integrity of Desolation.

In 2005, a revised fee act was passed by Congress, changing the initial program to reflect national concerns. The new fee legislation for the Desolation Wilderness is known as the

"Recreation Enhancement Act," or REA. The fee amount for Desolation has not been altered with the new act; however, the fee basis is different. The fees collected are co-managed with the Eldorado NF, and (except for a mandated 5% Agency Fee) all of the funds are returned to the Desolation. These funds are used to pay for maintaining trails, trailhead signing, conducting resource benefiting projects in the wilderness, and funding for wilderness rangers.

Granite Chief Wilderness– Located on the west shore of Lake Tahoe, the Granite Chief Wilderness is managed primarily by the Tahoe National Forest. With only 46 acres and 0.5 miles of trail in the Lake Tahoe Basin, the LTBMU does not play an active role in its management. This 25,680 acre wilderness offers valley meadows and spectacular 9,000 foot granite peaks. It was designated a Wilderness area in 1984 because of its pristine nature, natural beauty, and primitive, non-motorized recreational opportunities.

Mt. Rose Wilderness– The Mount Rose Wilderness encompasses a total of 28,121acres of which 2,586 acres lie on the northern rim of the LTBMU. There are only 4.8 miles of trail in the LTBMU portion. The Mount Rose Wilderness is managed primarily by the Humboldt Toiyabe National Forest but the LTBMU often plays an active role in management issues. The wilderness is part of the larger Carson Range which stretches from Luther Pass southeast of Lake Tahoe to the Truckee River northwest of Reno, Nevada. The highest mountain in the wilderness is Mount Rose at 10,776'. Mount Rose is the only mountain in the wilderness that can be considered "alpine" or "above tree line" but only by about 100 feet. The primary issues that the LTBMU manage involve degrading nonconforming uses (e.g. OSV/mountain bike intrusions), and unregulated visitation that diminishes the opportunities for solitude and a semi-primitive experience.

In 2009 an evaluation of areas for potential wilderness was conducted on the LTBMU. (Please see Appendix B “Evaluation of Areas for Potential Wilderness”, for more details on areas evaluated for wilderness characteristics). At the time the LTBMU did not administratively recommend any new areas for wilderness consideration, though the Dardanelles and the Freel Inventoried Roadless Areas (IRA) did have enough wilderness attributes to merit recommendations for wilderness status.

3.4.25.3. Environmental Consequences

Consequences Related to Wilderness

In this analysis, those management activities that may have the most effect on wilderness resources are:

- New Recommended Wilderness Designations
- Access - Dispersed Recreation
- Aquatic Invasive Species Management
- Species Recovery Habitat Restoration

Current wilderness designations will not be reduced or eliminated in any alternative. Two inventoried roadless areas, the Dardanelles and the Freel Peak, were identified in the 2009 Wilderness Evaluation (See Appendix B) as having enough wilderness attributes to merit recommendations for wilderness status in Alternative C and D of this report.

Dardanelles Inventoried Roadless Area - The Dardanelles Roadless Area (14,227 acres), commonly known as "Meiss Country," lies in the southernmost tip of the Lake Tahoe Basin and is the headwaters of the Upper Truckee River. The area sees prolific hiking, equestrian use, overnight backpacking, and in recent years increased mountain bike use. The area has long been closed to motorized summer and winter use. There are 20.4 miles of trail in the area that includes 8.1 miles of the Pacific Crest Trail which is closed to mountain biking. Popular trailheads include Echo Summit, Big Meadow, Carson Pass, Christmas Valley and Sayles Canyon.

Dardanelles is second only to Desolation Wilderness in popularity for non-motorized backcountry recreation that includes dispersed overnight backpacking. An estimated 15,000 visitors enjoy this area annually. The Dardanelles has been used as an alternative destination for the Desolation Wilderness area for years because of its easy accessibility and semi-primitive natural condition. The historic Meiss Cabin and Barn structures and historic dams are also present in the Meiss Meadow area.

A 7 mile stretch of the Upper Truckee River that flows through the center of the Dardanelles roadless area was determined to be eligible as a Wild and Scenic River in 1999 (USDA Forest Service 1999, ROD). Interim protection for that segment was provided as an amendment in the 1988 Forest Management plan to ensure that its eligibility is maintained. Interim protection requires that all projects proposed on NFS lands maintain the free-flowing status and that the Outstandingly Remarkable Values listed for this river is protected or enhanced. (See Appendix A, Wild and Scenic River Evaluation, for more information).

Freel Inventoried Roadless Area - The Freel IRA (15,341 acres) lies in the southern portion of the Lake Tahoe Basin. Freel Peak (10,881ft.) is the highest point in the Basin and is the dominant feature in the Carson Range rising over South Lake Tahoe and Meyers. With 25.6 miles of trails, summer use levels are steadily increasing with the area being more accessible to

mountain bikers, and hikers and backpackers due to completion of the Tahoe Rim Trail (TRT). An estimated 12,000 visitors access this area annually. Overnight camping is now only allowed within a 300 ft. corridor of the TRT and by Star Lake. Popular Mt. Bike trails include Saxon Creek and Armstrong Pass. The Saxon Creek trail is now one of the most popular mountain bike trails on the south shore and gained region-wide popularity among this user group. Winter use includes snowmobile and backcountry skiing. Currently snowmobiles are allowed on 9,084 acres of the Freel IRA that includes the Saxon Creek and Hell Hole drainages. The segment of roadless area north of Freel Peak including High Meadows and the south side of Heavenly ski area is currently closed to motorized use.

New Recommended Wilderness Designations

Alternatives A and B will maintain the existing 24,660 wilderness acres managed in the basin between the Desolation, Granite Chief and Mt. Rose Wildernesses.

Alternative C will add the Dardanelles Roadless Area (14,227 acres) for wilderness recommendation, and Alternative D will add both the Dardanelles and the Freel Roadless area (15,341 acres) for a total of 29,568 acres of new wilderness recommendation (see Table 3-68). Alternative C would increase the number of acres available in the basin for wilderness recreation by 60%. Alternative D would increase the number of acres available for wilderness recreation by 123%.

With wilderness designations, the Dardanelles and Freel areas would be managed to standards as prescribed in the 1964 Wilderness Act. Though it is not anticipated that the new wilderness areas will need the intensive management prescriptions now utilized to manage Desolation Wilderness, the additional acres of wilderness designation will increase administrative responsibilities. Though some additional visitor's users may be attracted to these areas because of the wilderness designations, the current use by mountain biking visitors will stop when that use is prohibited. Increasing wilderness acres will not increase the total miles of trails available for hiking and equestrian use, but it would provide an increase in opportunities for visitors who desire trails in a wilderness setting. The Freel Wilderness recommendation in Alternative D will also increase the acres in the Basin available for dispersed camping.

In Alternative C, there will be a total 38,897 acres of wilderness and recommended wilderness in the LTBMU to be managed to wilderness standards. The Dardanelles area will continue to be patrolled on a regular basis by rangers and volunteers who contact and educate the public on 'Leave No Trace' backcountry ethics and regulate user impacts such as user created trails, campfires, litter, and sanitation. Since this area is already classified as Semi Primitive Non-Motorized, there will be no change to the existing ROS classifications. A wilderness designation in Alternative C could also adversely affect the historic Meiss Cabin and Barn structures and historic dams unless enabling legislation is allowed for their preservation.

In Alternative D, there will be 54,238 total acres of wilderness and recommended wilderness in the LTBMU to be managed to wilderness standards. The level of administrative effort to manage to standard in this area is anticipated to increase since overnight backpacking will be allowed throughout the entire Freel Peak area rather than in the narrow corridor along the Tahoe

Rim Trail where it is currently permitted.

Access - Dispersed Recreation

Wilderness designations in Alternatives C and D will not increase the miles of trails in these areas, however because mechanized transportation (e.g. mountain biking) activities are prohibited in designated wilderness areas, the character of the recreation experience will change.

New wilderness designations may appeal to those backpackers, hikers, and equestrians who appreciate more primitive wilderness experiences and who have an aversion for meeting mountain bikes on the trails. Conversely, wilderness destinations will change the character of the experience for mountain bikers by prohibiting their use of some very popular riding trials. Satisfaction levels may increase for hikers and equestrians who desire a wilderness setting, but will be unsatisfactory for mountain bikers who will no longer have access to trails they are accustomed to using.

In Alternative C, the 14,227 acres of recommended wilderness would be managed to more primitive wilderness conditions. A wilderness recommendation will prohibit mechanized transport (bicycles) use on approximately 12.3 miles of popular trails in the Dardanelles Inventoried Roadless Area. This will include the trail from Big Meadow through Round Lake to the Pacific Crest Trail, the Dardanelles Trail, and the Christmas Valley Trail.

Alternative D will add 29,568 more acres of recommended wilderness which would be managed to more primitive wilderness conditions. A wilderness recommendation will prohibit mechanized use on 25.6 miles of trails in the Freel area including popular rides such as Saxon Creek, Armstrong, portions of Tahoe Rim Trail, Star Lake, and Monument trails. Adoption of Alternative D, along with those miles in Dardanelles, would exclude mountain biking from a total of 37.9 miles of trails in these two areas. (See Access Section for a more detailed discussion of mountain biking trails available per each Alternative).

Also in Alternative D; 9,084 acres of the Freel IRA will be prohibited for winterized OSV use. OSV users displaced by the area closure will have to find other areas to participate in this activity, most likely in the nearby Hope Valley in the Humboldt-Toiyabe National Forest. Users from nearby neighborhoods will have to trailer their machines to other open areas. There is a likelihood that users will not comply with new restriction and will continue to use the area for snowmobiling. This eventuality will increase enforcement needs in the future.

Aquatic Invasive Species Management

Environmental consequences to wilderness resources generated from aquatic invasive species management are the same for all alternatives. Impacts to recreation are generated by actions that either improve or modify existing recreation activities. Removing non-native fish from lakes, benefits the wilderness character by improving the recreation setting for those desiring a wilderness experience. In lakes where all fishing opportunities are eliminated for the protection of other species, displaced fisherman may move on to other lakes. Increased impacts may occur

at these new locations. Removal of non-native species is consistent with policy, although some sport fishing opportunities may be gone.

Species Recovery Habitat Restoration

Species management actions are the same in all alternatives as they all propose to maintain 1 Sierra Nevada Yellow Legged Frog sub-population and restore 9 sub-populations.

3.4.25.4. Analytical Conclusions

Wilderness

Wilderness lands are managed to preserve natural conditions and to provide outstanding opportunities for solitude and primitive unconfined type of recreation experience. No motorized or mechanized transportation modes are allowed in wilderness areas. Though it is not anticipated that the new wilderness areas will need the intensive management prescriptions now utilized to manage Desolation Wilderness, the additional acres of wilderness designations in Alternative C and D will increase administrative responsibilities needed to manage the wilderness areas to standards as prescribed in the Wilderness Act.

- Alternatives A and B are unchanged from existing conditions. Visitors will continue to enjoy the range of wilderness opportunities currently provided. Mountain Bikers will continue to have access to popular riding trails in the Dardanelles and Freel Roadless areas. Both areas will continue to be managed to Inventoried Roadless Standards.

- The 7 mile stretch of the Upper Truckee River that has been determined to be eligible for a Wild classification in the Wild and Scenic River inventory will continue to be managed to preserve its eligibility in all alternatives.

- Wilderness designation in Alternatives C and D will not increase the miles of trails available to backpackers, hikers, and equestrians, however it will enhance wilderness recreation and dispersed non-motorized camping for visitors that seek a wilderness experience with opportunities for solitude and primitive conditions that wilderness designations would provide. .

- Wilderness designation in Alternatives C and D change the character of the experience for mountain bikers by prohibiting their use of newly designated wilderness trails. Alternative C will prohibit mechanized use on approximately 12.3 miles of popular trails in the Dardanelles IRA. This will include the trail from Big Meadow to the Pacific Crest Trail and also the Dardanelles and Christmas Valley Trails. Alternative D will prohibit mechanized use on an additional 25.6 miles of trails in the Freel IRA including popular rides such as Saxon Creek portions of the Tahoe Rim Trail.

- A wilderness designation in Alternative C could also adversely affect the historic Meiss Cabin and Barn structures and historic dams unless enabling legislation is allowed for their preservation.

- In Alternative C, the 14,227 acre Dardanelles area will continue to be patrolled on a regular basis by rangers and volunteers who contact and educate the public on 'Leave No Trace' backcountry ethics and regulate user impacts such as user created trails, campfires, litter, and sanitation

- In Alternative D, the level of administrative effort is anticipated to increase since dispersed camping will be allowed throughout the entire Freel Peak area, rather than along the narrow corridor along the Tahoe Rim Trail that is currently permitted. User impacts such as those mentioned above will be extended to desirable areas such as stream sides and meadows.

- In Alternative D, OSV use of 9,084 acres of the Freel IRA will be prohibited. OSV users displaced by the area closure will have to find other areas to participate in this activity.

How the Alternatives Maintain or Achieve the Desired Conditions

A desired condition for Recreation is that "A spectrum of high quality recreational opportunities is provided, while Lake Tahoe Basin's natural setting as an outstanding recreation destination is maintained" *(Pathway*). Another desired condition states that "Access to public lands is provided when consistent with user and management expectations."

- Alternatives A and B will maintain or achieve desired conditions by continuing to provide the existing mix of wilderness/ recreation opportunities available in the Tahoe Basin. As reported in the Recreation section of this EIS, the recreation opportunities currently provided on the LTBMU have very high satisfaction ratings as reported by NVUM surveys. This supports the notion that the current mix of recreation opportunities is generally in balance with the public's expectations. Alternatives A and B will preserve some popular mountain biking opportunities by not recommending that the Dardanelles and Freel IRA's be changed to wilderness status. The Dardanelles and Freel areas will continue to be managed as Inventoried Roadless Areas and access to these areas will remain status quo. The 7 mile stretch of Upper Truckee River will continue to be managed to preserve its eligibility for Wild and Scenic River status.

- Alternatives C and D will still maintain and achieve the desired conditions, but by varying degrees and off-setting benefits. They will change the current spectrum of recreation opportunities in the Basin by increasing the amounts of recommended wilderness acres available for wilderness opportunities which will please some segments of our visiting population; however they will exclude mountain biking on total of 37.9 miles of popular riding trails. Wilderness designations in Alternative D will also displace OSV users from 9,084 acres in the Freel area to other areas to participate in this activity.

3.5. Cumulative Environmental Consequences

The Council on Environmental Quality (CEQ) regulations for implementing the procedural provisions of NEPA defines a cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to the past, present, and reasonably foreseeable future actions regardless of what Agency (Federal or non-federal) or person undertakes such other actions" (40CFR S 1508.7). CEQ has also provided guidance in the publication: Considering Cumulative Effects under the National Environmental Policy Act (1997). This publication can be found at http://ceq.hss.doe.gov/publications/cumulative_effects.html/.

For cumulative impacts to accrue there must first be an impact from the action under review that can be added to the impact of other past, present or reasonably foreseeable future actions that affect the same resource.

The boundary for analyzing cumulative effects includes the 207,420 acres within the watershed boundary of Lake Tahoe. The LTBMU manages 154,830 acres of this land (approximately 75% of the land in the Tahoe Basin). Attempting to describe the cumulative effects of each and every past, present and reasonably foreseeable Forest Service project for the entirety of these lands is neither possible nor informative at the programmatic level. As noted by CEQ's guidance memorandum of June 24, 2005, the effects of past actions can generally be captured by a description of the affected environment (Connaughton, 2005), which is detailed in each individual resource section of this chapter (detailed in Sections 3.5.2 and 3.5.3). Projects that are in the process of implementation and projects that have signed NEPA compliant decisions are enumerated in Appendix K – Previous Decisions That Remain In Place, and are accounted for in the environmental consequences for each resource.

The area of consideration for cumulative effects for most of the resources in this analysis includes the lands within the watershed boundary that defines the exterior boundary of the LTBMU. This includes the entire Lake Tahoe watershed. Some of the wildlife and plant resources have a boundary that extends beyond the watershed boundary of the Tahoe Basin and is defined further in those specific sections. At the programmatic level of planning the Lake Tahoe Basin is largely isolated from the surrounding National Forest's management activities. Where there are impacts that involve multiple out-of-basin jurisdictions they are managed by overarching documents (such as the Desolation Wilderness Plan) that are incorporated into the LTBMU Forest Plan. In resource areas such as air quality there is oversight over the effected larger landscape by another agency (e.g. California Air Resources Board). The timeframe for this cumulative effects analysis is 15-20 years from adoption of the new Forest Plan.

3.5.1. Non-Forest Service Lands

The LTBMU is uniquely situated in a highly regulated environment. Therefore since all actions on private, county, and state lands are guided by several layers of regulations, the assessment of the past, present, and foreseeable future has greater predictability than most National Forests, since every project or action of consequence on private, county, and state lands is regulated by

the Tahoe Regional Planning Agency in addition to other typical state and local regulatory agencies. After NFS lands, approximately 15% of the land in the Tahoe Basin is managed by the Washoe Tribe, states (i.e. State Parks) and other government entities (i.e. utility districts, counties, etc.). The remaining land, accounting for approximately 10% of the land in the Tahoe Basin, is privately owned and mostly comprised of dense residential communities with interspersed commercial locations.

The Tahoe Regional Planning Agency (TRPA) was created by Public Law 96-551 (the Revised Tahoe Regional Plan Planning Compact). Often referred to as the Bi-State Compact, it is an agreement between the States of Nevada and California and the Federal government on goals for the Lake Tahoe Basin. Directed by the Compact, the TRPA established Environmental Threshold Carrying Capacities (thresholds) for the basin. The thresholds are the standards against which all projects and activities are measured for the achievement of the goals and polies of the compact (TRPA, 1986). Since the thresholds have fundamentally been in place since 1982, they have guided the environmental landscape in the Lake Tahoe Basin for nearly 40 years. The TRPA Regional Plan as expressed by the Code of Ordinances, Goals and Policies, Planning Area Statements, Rules of Procedure and Community Plans guides the attainment of the thresholds.

At the state level, the Lahontan Regional Water Board (California) and the Nevada Department of Environmental Protection (Nevada) have responsibility for enforcement of the Clean Water Act. Recently, both agencies completed the Lake Tahoe TMDL Report (Lahontan and NDEP, 2010) and it was approved by the U.S. Environmental Protection Agency for each State within the Lake Tahoe Basin. The TMDL identifies a cohesive strategy that will lead to the attainment of the applicable water quality standards for Lake Tahoe in Nevada and California. This TMDL, in combination with the Water Quality Control Plan for the Lahontan Region (State of California 1995) and the Water Quality Management Plan for the Lake Tahoe Region (TRPA 1988b) ensure that activities that occur on any lands within the Lake Tahoe Basin will meet stringent water quality standards.

Also there are land management agencies within the Basin such as the California and Nevada State Parks, the Nevada Division of Lands and the California Tahoe Conservancy that manage land under their own set of laws, regulations and policies to protect the environment in addition to adhering to the regulations imposed by the TRPA. The same is true for the state transportation agencies, CalTrans and NDOT, who maintain the public road system in the Basin.

3.5.2. Cumulative Effects by Resource Area

Access & Travel Management

Roads

There are 110 miles of state and federal highways in the Tahoe region (Tahoe Metropolitan Planning Organization (TMPO), 2012). These routes, managed by Caltrans and NDOT, form the backbone of the region's transportation system. Three major roads that ring Lake Tahoe include: US Highway 50, Nevada State Route 28, and California State Route 89. These three roads connect community centers around Lake Tahoe to each other, and serve as the principal links to outside regions in both states. As mentioned above, in addition to their important role as regional connectors, these roads serve as the 'main streets' of the region's largest community areas. Intersecting and supplementing these regional roadways are 619 miles of local streets (TMPO, 2012). These local routes include a range of facility types from urban-style arterial streets and roadways in South Lake Tahoe, California and Stateline, Nevada with sidewalks and bicycle facilities, to rural county roads outside of urban centers.

Specific roadway projects include: US Hwy 50 South Shore Community Revitalization Project, State Route 89/Fanny Bridge Community Revitalization Project, Kings Beach Commercial Core Improvement Project, and the Incline Gateway Project, US 50 Corridor Project Phase II, Placer County State Route 89 Erosion Control, NDOT Water Quality Improvements.

Roads Conclusion

Under all alternatives, management of the forest road system would not add to the cumulative effects from these projects because forest roads are generally located off of the major roadways and local streets.

Trails

Currently, most of the region's larger communities have nearly completed networks of bicycle paths, lanes, and routes. Critical gaps in these more urban networks have been identified by local jurisdictions as high priority projects. At the regional level, there are major gaps in the bicycle network. The east shore has virtually no bicycle network, and while the west shore has an excellent, nearly continuous 10-mile separated path connecting parks and beaches to Tahoe City and beyond, the steep terrain near Emerald Bay has thus far been an obstacle in connecting the facility to the South Shore.

A wide range of pedestrian conditions currently exist in the Tahoe region. The major regional roadways, which were built as rural highways and designed to facilitate vehicle throughput, generally lack pedestrian facilities. Sidewalks and marked or signalized pedestrian crossings do exist on the regional roads to varying degrees in the region's largest communities (for example, along US 50 in Stateline; and along State Route 28 in Tahoe City and Incline Village).

Currently, most of the region's larger communities have nearly completed networks of bicycle paths, lanes, and routes. Critical gaps in these more urban networks have been identified by local jurisdictions as high priority projects. At the regional level, there are major gaps in the bicycle

network. The east shore has virtually no bicycle network, and while the west shore has an excellent, nearly continuous 10-mile separated path connecting parks and beaches to Tahoe City and beyond, the steep terrain near Emerald Bay has thus far been an obstacle in connecting the facility to the South Shore.

Specific trail projects include: Nevada Stateline to Stateline Bikeway, South Tahoe Greenway, Sawmill Bicycle Path and Lake Tahoe Boulevard Enhancement Project.

Trails Conclusion

Under all alternatives, NFS land will likely be considered for these types of regional trails. These proposed trails will link the forest system trail network to the urban areas and trailheads around the basin, overall providing a positive cumulative effect in all alternatives. Alternatives A and B would not change management of the current forest trail system, and when combined with effects from these trails, bicycle paths, lanes and routes would provide a positive cumulative effect to access. Alternative C would provide the most positive cumulative effects by increasing maintenance levels on trails which would provide access to more visitors. Alternative D would provide the least amount of positive cumulative effect because trail maintenance levels would be reduced and trails could be removed for ecological restoration.

Transit

Transit contributes to reducing pollution and roadway congestion. The Tahoe City Transit Center south of the intersection of California State Routes 28 and 89 is located on NFS lands and is anticipated to be completed in the of spring 2012. Covering about 2.5 acres on a tract of public land west of SR 89, the center will serve as a hub for Placer County's TART buses. The center is adjacent to hiking and bike paths and improves access to transit as well as pedestrian and bicycle mobility in and around Tahoe City. Parking is provided for commuters and visitors at the transit center.

The Tahoe region's major existing transit services include:

- The Tahoe Area Regional Transit (TART) bus system serves the North and West shores with service to Tahoma, Tahoe City, and Incline Village; and a shuttle between Truckee and Tahoe City.
- The BlueGO bus system serves the South Shore, including El Dorado County and Douglas County with fixed-route, door-to-door, and flex-route service, as well as seasonal ski shuttles and the "Nifty Fifty" Trolley.
- Squaw Creek Valley Shuttles serves skiers and employees at the Squaw Creek Valley Resort.

Transit Conclusion

Alternative A does not actively promote transit opportunities but would also not deny any transit opportunities so would not have any cumulative effects to transit in the Tahoe Basin. Transit would be promoted in alternatives B, C and D through the development of multi-modal transit stops where feasible which would provide positive cumulative effects to the existing transit system by linking transit modes such as bicycles, walking, and busses.

Air Quality

A programmatic planning effort, such as this one, considers a large area that encompasses a wide array of environmental interactions, a number of which affect air quality but do not occur on NFS lands. Many of these environmental interactions will be most accurately disclosed as cumulative effects in site-specific project environmental analyses. As described below, the nature of air quality impacts makes it extremely difficult to confidently predict their occurrence.

Factors that influence cumulative impacts on air quality include the following:

- Motor vehicle emissions: Both tailpipe exhaust and re-suspension of particles are the primary source of several pollutants of concern. Although off-road vehicles are important contributors to air pollution, the high volume of on-road vehicles has resulted in increased focus on these vehicles as well.
- Residential wood burning stoves and fireplaces and other uses, such as campfires can impact air quality.
- The topography and climate: Locally emitted pollutants can build up at the surface due to thermal inversions, which prohibit the dispersal of surface-level pollutants and therefore can result in localized areas of high pollution levels.
- Pollutant transportation: Emissions from surrounding sources and ozone precursors (NOx and VOCs) may enter the Basin from outside areas, such as the Sacramento Valley and Bay Area.
- Wildfires: Past, present, and reasonably foreseeable activities were reviewed to determine cumulative effects to air quality. Because impacts to air quality in regards to smoke from past wildfires and prescribed fire activities are short-lived, past activities do not contribute to cumulative effects. Past activities do influence the amount of live and dead woody material available for consumption in the event of a future wildfire.

Because the timing and locations of actions or events that could contribute to potentially significant air quality effects in the Lake Tahoe Basin are unknown, a quantitative cumulative effects analysis is not possible. However, if weather conditions, combined with the actions and events described above were conducive, potentially significant adverse cumulative air quality effects could occur for days or possibly weeks under all alternatives. California and Nevada Smoke Management Programs (SMPs) govern all project level activities. The burners must obtain a burn permit and an authorization. As PFIRS and BlueSky models are utilized, cumulative impacts injurious to public health from prescribed burns are expected to be mitigated.

One objective of the plan is to prevent the occurrence of large uncontrolled, high intensity wildfires. Wildfires present a risk to the public health and result in damage to both the environment and property. Vegetation management treatments leading to fire resilient forests provide the opportunity on a long-term basis to reduce the magnitude of wildfire air quality problems.

Air Quality Conclusion

There is a risk of cumulative effects to air quality from all of the alternatives as each one includes prescribed fire as an activity. However, as the states of California and Nevada each regulate burning the risk of significant cumulative effects would be low.

Aquatic Wildlife, Terrestrial Wildlife and Botanical Resources

For the following species, the cumulative effects analysis includes an area broader than the boundary of the Lake Tahoe Basin: California spotted owl, Northern goshawk, American marten, Sierra Nevada Yellow-legged frog, bald eagle, and Sierra Nevada red fox. These species have a broader area considered for cumulative effects because they are known to inhabit both the Lake Tahoe basin and have home ranges or populations that overlap adjacent lands.

All past and present actions on NFS lands have also been highly regulated by the suite of local and state agencies. Therefore, it is assumed that actions on land managed by state and other government agencies are compatible with the habitat protection measures on NFS lands. In addition to the strict regulatory environment, past and present management actions on NFS lands have been largely motivated by terrestrial and aquatic ecological restoration needs. For example, the LTBMU continues to implement a number of watershed restoration projects focused on improving hydrologic and stream habitat conditions. Other projects are focused on restoring aspen stands, meadow communities, and reducing fuel loads in both the WUI and general forest. The overall goals of these projects are to improve the condition of sensitive habitat throughout the LTBMU.

Outside of the Lake Tahoe basin, the majority of adjacent land is managed by other National Forests including the Tahoe National Forest, Humboldt-Toiyabe National Forest, and Eldorado National Forest. All of the Forest Service Region 5 sensitive species designated for the LTBMU are shared with the Eldorado and Tahoe National Forests, therefore, these forests have protection measures in place for these sensitive species including the California spotted owl, northern goshawk, American marten, and Sierra Nevada Yellow legged frog. The Humboldt-Toiyabe National Forest shares some of the sensitive species with the LTBMU including: Townsend's big eared bat, Northern goshawk, and bald eagle, and has protection measures in place for habitats where these species occur. Therefore, since all of these Forest's provide a consistent level of habitat protection in combination with the same National and regional direction. And, in the future each of their forest plans when amended will provide the ability to adapt and change over time if declining trends in habitat for sensitive species are observed.

Management by the Washoe Tribe and public agencies in the Tahoe Basin is guided by wildlife, conservation, and natural resource protection objectives. On private land, habitat is generally considered to be of low suitability for many terrestrial wildlife species because of the high level of human disturbance and extensive habitat degradation and fragmentation. However, some privately owned land along the Lake shore is valuable habitat for certain aquatic species such as Lahontan cutthroat trout and plant species such as Tahoe yellow cress and certain terrestrial wildlife lake-associated species such as bald eagle and osprey.

Regardless of ownership or habitat suitability, every project or action of consequence on private, county, and state lands is regulated by various state and local regulatory agencies as well as by the Tahoe Regional Planning Agency (TRPA). The TRPA established Environmental Threshold Carrying Capacities (thresholds) for the basin in 1982 (including terrestrial wildlife and fish/aquatic thresholds) that are the standards against which all projects and activities are measured for the achievement of the goals of the compact. The Goals and Policies (TRPA 1986) established two goals and five policy statements relative to maintaining terrestrial and aquatic habitat. The TRPA Code of Ordinances (TRPA 1987) also established provisions to protect and enhance terrestrial and aquatic habitats and protect special interest, threatened, endangered, and rare species. Because TRPA is involved in essentially all actions on private, county and state lands within the Lake Tahoe basin and have relatively stringent protection measures for terrestrial and aquatic habitat and species, there is a commonality of environmental protection that occurs on all lands in the Basin.

This evaluation assumes that all actions on non-NFS lands within the Lake Tahoe basin and NFS lands adjacent to the basin will not change across alternatives. Therefore, the only differences among foreseeable future actions across alternatives are those proposed by the LTBMU as part of the proposed Forest Plan revision. All alternatives will have varying degrees of pressures and benefits for special status terrestrial and aquatic wildlife species and habitat. The greatest short term pressures on terrestrial wildlife will come from forest health and fuel reduction approaches associated with Alternative C. Another impact will be from the expansion of recreation sites and access generally associated with Alternative C and to a lesser degree Alternative A. Alternative D has the greatest potential for degradation of late seral habitat and loss of early seral stages, and is least able to adapt to climate change. Similarly, both Alternatives C and D have the potential for the greatest consequences for aquatic species due to the potential increase in recreation permit areas (C only) and the potential expansion of aquatic invasive infestations. For a more detailed comparison of the evaluation of effects of alternatives on terrestrial and aquatic wildlife species, see the *Terrestrial Wildlife* and *Aquatic* sections in Chapter 3. Regardless of these potential pressures, each alternative has design criteria (standard operating procedures and standards and guidelines) intended to avoid or minimize potential adverse effects on terrestrial and aquatic wildlife species and their habitat. Finally, it is important to recognize that all site-specific future NFS projects would be evaluated under NEPA, NFMA, and Section 7 of ESA (where appropriate). These site-specific analyses would consider cumulative effects. In addition, updated monitoring information from either the regional or forest level would be available to show trends in cumulative effects.

Aquatic Wildlife, Terrestrial Wildlife and Botanical Resources Conclusion

The management direction proposed under all four Plan alternatives, when combined with past, present, and reasonably foreseeable future actions on all land ownerships within the Lake Tahoe basin is not expected to have an adverse cumulative effect on special status terrestrial and aquatic wildlife species or their habitat during the life of the Plan.

Management Indicator Species (MIS)

The Forest Service manages approximately 155,000 acres of land in the Lake Tahoe basin as the LTBMU. At the bioregional scale, the LTBMU is one of ten National Forests in the Sierra Nevada and represents fewer than 2% of the 11 million acres of Forest System lands in this region (Figure 1). Based on the relatively diminutive size of the LTBMU at the bioregional scale, potential adverse effects from management activities in the LTBMU would be functionally diluted at the bioregional scale and contribute minimally, if at all, to any cumulative consequences of activities in the Sierra Nevada on bioregional trends.

Not only would the potential for cumulative effects be minimized by the relatively small size of the LTBMU, but the management activities proposed as part of the Forest Plan revision are focused on protecting, enhancing, and restoring habitats and habitat components important to MIS. The LTBMU is unique among many National Forests in the Sierra Nevada in that a great deal of emphasis is placed on restoration of habitat and processes, as reflected in the revised Forest Plan objectives, and comparatively little to no emphasis is placed on mineral extraction, timber harvest, and grazing activities that often compromises the integrity of sensitive habitats and processes. Where recreation or forest vegetation management practices may affect MIS habitats or habitat components at the project-level, a number of standards and guidelines described in the revised Forest Plan are in place to avoid or minimize the potential for such effects.

All actions on private, county, and state lands within the Lake Tahoe basin are guided by several layers of regulations with the Tahoe Regional Planning Agency (TRPA) involved in essentially all actions. TRPA reviews all projects or actions on private, county, and state lands in the basin. The TRPA established Environmental Threshold Carrying Capacities (thresholds) for the basin; standards against which all projects and activities are measured for the achievement of the goals. These thresholds have fundamentally been in place since 1982 and have guided the environmental landscape in the Lake Tahoe Basin for nearly 40 years. In California, the Lahontan Regional Water Board and in Nevada, the Nevada Department of Environmental Protection also have responsibility for enforcement of the Clean Water Act. There are land management agencies within the basin such as the California and Nevada State Parks, the Nevada Division of Lands, and the California Tahoe Conservancy that manage land under their own set of laws, regulations and policies to protect the environment in addition to adhering to the regulations imposed by the TRPA. The same is true for the state transportation agencies, CalTrans and NDOT, who maintain the public road system in the Basin.

MIS Conclusion

Therefore, because the Lake Tahoe basin is in a highly regulated environment, is a relatively small portion of the Sierra Nevada, and proposes management activities focused on the protection, enhancement, and restoration of aquatic and terrestrial habitats, it is expected that the LTBMU Land and Resource Management Plan will not alter the existing bioregional trend in habitats or ecosystem components, nor will it lead to a change in the distribution of the MIS across the Sierra Nevada bioregion.

Built Environment

In the Lake Tahoe Basin, the built environment is highly regulated by TRPA. TRPA uses the Bailey system to prohibit new development on some sensitive lands, and restrict the amount of coverage (i.e., pavement and building footprint) that can be placed on others. TRPA has built into its Code of Ordinances a program for the transfer of development rights to other, less sensitive parcels. In this way, development can be moved away from the most sensitive areas and property owners can still realize value from their land. See the soil cumulative effects section below for an analysis of coverage on NFS lands.

A few of the larger development projects on non NFS lands which are in the foreseeable future include: Sierra Colina, Boulder Bay and Homewood developments.

Built Environment Conclusion

Alternative D would lead to a reduction in the built environment (by about 5%) and would not add to the cumulative effects from these other developments. Alternative C would allow for a fifteen percent increase in the built environment which would increase coverage by 0.05% and would not add significantly to cumulative effects. The same is true for Alternatives A and B, which would add 5% and 10% more coverage respectively.

Forest Vegetation, Fire and Fuels

Past and Future LTBMU Thinning, Fuel Reduction, and Prescribed Fire Treatments

Prior to the establishment of the Lake Tahoe Basin Multi-Jurisdictional Fuels Reduction and Wildfire Prevention Strategy (Strategy), the LTBMU had completed approximately 16,000 acres of fuels reduction and thinning treatments around the Basin. Under the Strategy the LTBMU has completed approximately 12,000 acres of thinning and fuel reduction.

Over the life of the Forest Plan, the LTBMU expects to treat approximately 25,000 acres using a combination of hand and mechanized thinning, followed in some cases by use of prescribed fire. These methods of treatment will continue to be used for reducing high tree densities and amounts of surface fuels within the Wildland Urban Interface (WUI).

The past and future acres to be treated on NFS lands within and around the communities represent about seventy-five percent of combined totals of acres to be treated in the WUI.

There are no differences between alternatives in the defense zone. However, there are diameter limits in two alternatives: alternative A the diameter limit is 30 inches throughout the WUI and in alternative D the diameter limit is 12 inches in the Threat Zone. Alternative D would not be consistent with the goals of the Strategy with the low diameter limit, since modeling has indicated that the fire type that would occur could carry an active crown fire, making wildfire adjacent to the communities difficult to safely suppress. Alternatives A, B and C would all permit accomplishment of the goals identified in the strategy.

Past and Future Non-Federal Thinning, Fuel Reduction, and Prescribed Fire Treatments

Prior to the strategy, State agencies had accomplished several thousand acres and local jurisdictions and fires protection districts had accomplished small acreages. With the Strategy and an influx of a variety of funding mechanisms and agreements, the amount of treatment acres has accelerated. The Tahoe Fire and Fuels Team, which collectively implements the non-federal portion of the strategy, had completed over 5,000 acres

Approximately 8,000 acres in the WUI will be accomplished by state agencies and local fire protection districts over the life of the plan.

The past and future acres to be treated on non-federal lands within and around the communities represent about twenty-five percent of the combined totals of acres to be treated in the WUI.

During implementation of the Forest Plan, the treatment of acres on non-federal lands would accomplish the goals identified in the strategy. Were these treatment acres subject to the limits of Alternative D, they would not be a factor as the number of acres of non-federal lands in the Threat Zone is miniscule.

Forest Vegetation, Fire and Fuels Conclusion

When the past and future thinning, fuel reduction and prescribed fire treatments that have been identified in the strategy are completed throughout the WUI, both on NFS and non-federal lands, a substantial step towards improved forest health and lower risk of catastrophic fire will have been achieved. This achievement will also provide benefits including, but not limited to: wildlife habitats, water quality, scenic integrity, public safety, and wildland fire fighter safety.

Heritage Resources

Heritage resources are managed through the California and Nevada State Historic Preservation Offices. Because every project on NFS land and non NFS land would need to be considered for heritage resources through these offices and project specific mitigation measures would be prescribed for each project; there would be no cumulative effects from any of the alternatives.

Interpretive Services & Conservation Education

There are no direct or indirect effects to Interpretive Services and Conservation Education from any of the alternatives so there would therefore be no cumulative effects.

Lands

There are no direct or indirect effects to lands from any of the alternatives so there would therefore be no cumulative effects.

Minerals

While the FS could approve plans of operations for mining, since TRPA would not permit the mining activity, the holders could not obtain the required state and county permits to actually start operations. Active mining is essentially precluded in the Lake Tahoe Basin; therefore, there would be no cumulative effects.

Natural Hazards

There are no direct or indirect effects from natural hazards from any of the alternatives so there would therefore be no cumulative effects.

Noise

All activities on the National Forest will contribute to expanded sound levels that will add to the Basins overall Cumulative Noise Event Level (CNEL), and the Single Noise Event Level (SNEL) thresholds adopted by the Tahoe Regional Planning Agency (TRPA). The Forest Service will work cooperatively under all alternatives to monitor and achieve the noise threshold standards, along with adhering to noise related enforcement of the Federal Code of Regulations (CFRs).

Alternatives B & C expand acres and mileage for motorized recreation access and that would contribute to expanded noise levels generated from motor vehicles, Conversely, Alternative D with a reduction in motorized access opportunities would generate less noise that the other alternatives, including alternative A. However, with TRPA enforcing the CNELs and SNELs thresholds, these alternatives would not add to the cumulative effects from noise.

Vegetation treatment activities would contribute noise from chainsaws and equipment operations. Under all alternatives, these types of operations would generally not start until after 7am and would end at 6pm (or as prescribed in specific projects) especially when taking place near residential areas. Therefore, both CNEL and SNEL noise levels would not be exceeded.

Under all alternatives, the LTBMU will adopt the best available technology to minimize noise exceedences along with applying management oversight over uses of and on the National Forest to ensure compliance with existing noise level standards and strive to ensure that noise levels are compatible with the primary use of the area. Also in all alternatives, prior to the issuance of a new use authorization or permit for an event or activity on National Forest lands, an analysis of compliance with existing noise standards should be completed.

Increased demand for access and use of the National Forest under all alternatives is expected, and although managed access (acres and development levels) varies among the alternatives, there will be a projected increase in concentration of use for the areas that are open as population levels increase and that will affect overall noise levels (both CNELs and SNELs) generated over the life the Forest Plan.

Recreation

Other entities in the Basin that manage and/or provide outdoor recreation opportunities includes the California and Nevada State Parks, the TRPA, various counties and municipalities, and other private recreation providers.

Due to Lake Tahoe's proximity to major population centers and their increased population projections, visits to the Basin are anticipated to increase over the 15 to 20 year life of the plan despite prevailing economic conditions. As is the situation now, there will continue to be unmet demand in some developed recreation sites during peak periods in all alternatives. In other words, when sites are full, visitors must look elsewhere for other recreation opportunities. The other recreation providers in the Basin also acknowledge the reality of being unable to meet demand during peak periods. Like the Forest Service they also operate with funding constraints that inhibit their ability to provide services or to expand to meet future demand.

The indicators in Forest Plan analysis used to address demand were the amount of Overnight Accommodations, Day use Parking and Acres of Permit Boundaries provided per alternative. Alternative C offers the best opportunity to meet demand by allowing up to a 15% increase for each amenity; however it is also the most costly. In all alternatives, the Forest Service will continue to manage recreation resources to the highest standards attainable within the limits of available funding to maintain visitor satisfaction.

California State Parks has projected a "status quo" condition for the outdoor recreation opportunities they will provide over the next 15 to 20 years (Bran Barton, California State Parks, Lake Tahoe Superintendent). Though they do not anticipate long-term closures or facility expansion opportunities within the Basin over the life of the Forest Plan, they acknowledge the challenge of remaining economically viable in the face of reduced overall funding. Since the expansion of facilities is not in the foreseeable future, they are considering offering a different suite of opportunities including special events and business retreats that would encourage more visits to Lake Tahoe during the shoulder seasons when visitation is generally low.

Lake Tahoe Nevada State Park Superintendent Jay Howard projects that Nevada State Park budgets will generally remain the same into the future which currently characterized as "bare bones". Though they do project a continued increase in demand, they do not project an increase in facility capacity over the life of the Forest Plan. Like California State Parks, Mr. Howard suggested that more services may be handled via concessionaire in the future but those services would still be available.

The TRPA currently manages for Recreation Thresholds that are found in the Recreation Element of the Goals and Polices Plan. The Recreation Element primarily recognizes three general types of recreational sub-elements between Developed, Dispersed, (both the same as the Forest Service) and Urban. Examples of Urban facilities in this case are athletic fields, ice skating rinks, swimming pools and neighborhood parks. There are two indicators used by the TRPA to determine if the Recreation Threshold is in attainment: R-1 High Quality Recreational Experience & Additional Access, and R-2 Capacity Available to the General Public. As stated in the 2006 Threshold Evaluation Executive Summary, both indicators are in attainment and are showing a positive trend.
Counties, municipalities and private entities account for a small percentage of the overall outdoor

recreation inventory in the Basin. Expansions or contractions of offerings within these sectors are not anticipated to largely impact overall Basin recreation opportunities over the life of the plan.

The amount of Wilderness acres available in the Basin would increase with the implementation of either Alternative C or Alternative D. As discussed in the analysis, the result of these designations would change the overall character of dispersed recreation opportunities in the Basin by increasing the acres available for hikers and equestrians who desire the outdoor experiences offered under wilderness protection. It would also decrease the miles of trail available to mountain bikers who value rides in those locations. This displaced use would most probably manifest itself elsewhere on the basin or in adjoining National Forests. Wilderness designations are not anticipated to effect the management of other national forests who would share boundaries. All areas would be managed to the standards required for specific land designations.

Infrastructure and Social Resources Conclusion

When considering the effects of the Forest Plan alternatives and those foreseeable actions projected by other non-Forest Service recreation providers, Alternative C would best be able to meet demand for recreation cumulatively since it would allow for the largest increase in recreation facilities on NFS lands.

Scenic Quality

Effects on scenic resources are analyzed in terms of Scenic Integrity and Scenic Stability (See Scenic Resources Environmental Consequences analysis for discussion of these indicators). Both scenic integrity and scenic stability are affected by the considered alternatives combined with the effects of projects that implement these alternatives. Each alternative would likely result in short term scenic impacts within foreground views. Implementation of Alternative A and foreseeable future Forest Service projects would result in the least scenic integrity. Implementation of Alternative D and its anticipated Forest Service projects would result in the greatest scenic Integrity. The effects of implementing Alternatives B and C fall between these two ranges with C representing a slight increase in scenic integrity compared to Alternative B.

Scenic stability would be greatest under Alternative C when considering the anticipated Forest Service project implementation. Alternative D would result in effects that produce the least scenic stability of the Alternatives considered. Alternatives A and B fall in between these ranges, with B slightly higher in scenic stability than Alternative A.

Past, present, and reasonably foreseeable project implementation on non-NFS lands within the project area are not anticipated to alter the general description of the environmental effects described above. NFS lands represent approximately 75% of lands within the Basin. The remaining 25% includes other public lands as well as private lands. Vegetation treatments on these lands are assumed to be consistent regardless of the Forest Plan alternative. Additional short term scenic impacts would be anticipated from these treatments which would be combined with anticipated short term impacts on NFS lands. Vegetation treatments on these lands have the greatest potential to alter the scenic character of the region; however the scale of reasonably

foreseeable treatments in these lands is not anticipated to result in impacts to regional scenic integrity. The cumulative impact of these combined short term disturbances to scenic integrity is anticipated to be less than significant because of the limited duration and the maintenance of the valued scenic attribute of views of conifer forest. Scenic stability would be positively affected by these treatments, and would only improve overall landscape scenic stability described for each Forest Plan alternative.

Development of the built environment on private and non-NFS lands also has the potential to negatively affect scenic stability. Development of these lands is regulated in the Tahoe Basin, primarily by the Tahoe Regional Planning Agency, which results in controls of development scale and visual character. The impact of this development on regional scenic integrity is not anticipated to be significant when combined with the impacts from any of the Forest Plan alternatives.

Scenic Quality Conclusion

When considering the effects of the Forest Plan alternatives and those of the projects that implement the alternatives with effects of non-Forest Service projects there are no impacts to scenic resource integrity or stability that would be considered a significant impact.

Soils Resource

Soil Productivity

Cumulative effects to soil productivity in the project area are reflected in the current conditions. Lingering effects from past actions are primarily compaction on closed roads and old landings and skid trails. Ongoing disturbance is primarily found on unauthorized recreation trails and access routes for sewer lines and other utilities. Small areas of ongoing disturbance are associated with some developed recreation sites, especially those which have not yet received BMP upgrades.

Soil productivity is a site-specific attribute of the land; the soil productivity of one area is not dependent on the productivity of an adjacent area. For this reason, cumulative impacts to soil productivity would be small under all alternatives, because cumulative impacts are only present when previously disturbed areas are subjected to new disturbance before they recover naturally or are restored.

Impervious Cover

In addition to soil productivity, cumulative effects to soils can also be analyzed in terms of impervious surface or impervious cover. The TRPA soil conservation threshold is based on the amount of impervious cover in the Lake Tahoe Basin. The TRPA regulates impervious cover, and has assigned allowable percentages of impervious cover to nine land capability classes (Bailey 1974). The soil conservation threshold is considered in attainment when impervious cover is within the allowable percentage for the land capability class.

Impervious cover totals for NFS lands and non-NFS lands are compared using 2004 IKONOS data (Table 3-70).

Table 3-70. Impervious cover by land ownership in the Lake Tahoe Basin

Ownership	Total land acres*	Existing impervious cover acres	Allowable impervious cover acres	Allowable impervious cover percentage	Existing impervious cover percentage
NFS lands	148,721	465	5,019	3.4%	0.3%
Non-NFS lands	53,395	6,373	5,343	10.0%	11.9%
All lands	**202,116**	**6,838**	**10,362**	**5.1%**	**3.3%**
* Water bodies and data gaps are excluded					

On NFS lands, all land capability classes are in attainment, ranging from 0.1% for class 1C to 4.2% for class 7 (Table 3-71). For all ownerships, impervious cover is in attainment in land capability classes 1A, 1C, 3, 4, 5, and 6. On Non-NFS lands, impervious cover is in attainment only in land capability classes 5 and 6. Differences between NFS and non-NFS lands are especially notable for land capability class 1B, most of which is SEZ, with 0.6% impervious cover on NFS 1B lands compared to 10.4% on non-NFS 1B lands.

Table 3-71. Impervious cover on National Forest System lands by Land Capability Class

Land Capability Class	Total NFS acres*	Existing impervious cover acres	Allowable impervious cover acres	Allowable impervious cover percentage	Existing impervious cover percentage
1A	59,723	126	597	1%	0.2%
1B	17,287	99	173	1%	0.6%
1C	48,587	38	486	1%	0.1%
2	3,281	21	33	1%	0.7%
3	6,161	17	308	5%	0.3%
4	3,407	26	681	20%	0.8%
5	6,842	99	1,710	25%	1.5%
6	2,875	13	863	30%	0.5%
7	558	24	168	30%	4.2%
Total NFS Lands	**148,721**	**465**	**5,019**	**3.4%**	**0.3%**
*** Water bodies and data gaps are excluded**					

The accuracy limitations of the IKONOS data include a "user accuracy " or reliability rating of 87%, which means that natural cover was found to be included as impervious cover only 13% of the time over the entire basin (Minor and Cablk, 2004). Conversely, impervious cover was included as natural cover 3% of the time. Nonetheless, it is clear that Forest Service lands are not a major contributor to impervious cover in the Lake Tahoe Basin, and this situation is not projected to change significantly under any alternative.

The transportation network (roads and trails) is the largest source of impervious cover on NFS lands. No alternatives project a large increase in roads and trails, so any increases in impervious cover would be small.

Vegetation management activities have the potential to increase impervious coverage in the form of soft cover through soil compaction. Cumulative watershed effects analysis (CWE) is used to predict increases in impervious surfaces due to soil compaction resulting from timber harvest

equipment and practices. The model currently used by the LTBMU predicts that using cut-to length harvester-forwarder operations, 7% of the harvest unit will be severely compacted such that the surface is effectively impervious to precipitation.

These predictions have not been confirmed by soil compaction monitoring, which found little or no decreases in soil porosity (increases in compaction) from pre-project or undisturbed conditions (USDA Forest Service 2008d, 2011, 2012). Post project conditions were far more similar to natural conditions than to an impervious condition. These results suggest a need to refine the CWE model to better reflect observed results.

The extent of compaction severe enough to be described as impervious cover is generally limited to landings that cannot be ripped due to high rock content and some main forwarder and skid trails, and comprise a very small portion of the areas treated. Thus, vegetation management projects on NFS lands are not expected to result in hydrologically meaningful increases in impervious cover in any alternative.

Impervious cover associated with other activities, including utilities and recreation, is not expected to increase significantly under any alternative.

Soils Resource Conclusion

Total increases in impervious cover on NFS lands are expected to be small to non-existent under all alternatives. All alternatives include strategies that seek to decrease impervious cover where feasible, and no activities are expected to result in large increases to impervious cover. On non-NFS lands, impervious cover would increase largely on the relatively small area of undeveloped lands that remain in the urban areas. Thus, changes to impervious cover resulting from the alternatives in this analysis would not be significant when added to those on non-NFS lands.

Water Quality and Soil Erosion; Water Quantity; Watershed Condition

The LTMBU largely relies on the efforts of other agencies in the Lake Tahoe Basin to track and analyze metrics that would serve as measures of cumulative effects relative to lake clarity and tributary water quality.

The Lake Tahoe Basin has a long data record of tributary water quality data, provided through the Lake Tahoe Interagency Tributary Monitoring Program (LTIMP). This program is funded through TRPA and USGS, and from 2005 through 2012, has also been supported with funds through the USFS Erosion Control Grants program (for almost 1/3 of the cost of the program).

From this data, the State of California currently lists 8 tributary water bodies as impaired, and the State of Nevada lists seven tributary water bodies as impaired under Section 303(d) of the Clean Water Act (2010 List). These tributaries are located within the Lake Tahoe Basin boundary; therefore most of the tributaries mentioned include both USFS and private lands. The receiving water body, Lake Tahoe is listed by both states.

The Tahoe Regional Planning Agency has established seven thresholds related to Lake Tahoe Basin water quality that address Lake Tahoe, tributaries, stormwater runoff, groundwater, and other lakes. Based on LTIMP and other data provided to and utilized by the TRPA, none of these thresholds are currently in attainment with the exception of near shore turbidity (TRPA, 2006). One of the other seven thresholds (tributary water quality) is noted as having a positive trend, even though that threshold is not in attainment. Two of the thresholds related to Lake Tahoe clarity are noted as continuing to show a negative trend, with groundwater, other lakes, and stormwater runoff water quality metrics considered to show neutral trends.

Two of the California streams currently have approved Total Maximum Daily Load (TMDL) targets related to sediment, (Heavenly Creek, 2002 and Blackwood Creek, 2008) and TMDLs are scheduled to be developed for the other water bodies and constituents. The Lake Tahoe TMDL is a joint effort between the Lahontan Regional Water Quality Control Board in CA and the Nevada Department of Environmental Protection in Nevada NV. The Lake Tahoe TMDL was approved by EPA in August of 2011. The Lake Tahoe TMDL requires the USFS to track and report on efforts to reduce loading from NFS lands.

Most of the California streams (Table 1) and Lake Tahoe are 303(d) listed because of sediment and nutrient loading to Lake Tahoe and subsequent impacts to Lake Tahoe clarity. However based on the TMDL analysis, upland sources (the forested non-urban portions of the watersheds) are estimated to contribute only 9% of the total fine sediment loading to the Lake, with atmospheric (15%) and urban sources (72%) the largest contributors. In addition stream channel erosion is estimated to contribute 4% of the total fine sediment loading.

Forested non-urban sources are currently estimated to contribute 32% of the phosphorus and 18% of the nitrogen loading to the lake. Of the forested non-urban lands, the LTBMU is the primary land use manager, responsible for managing 75 % of the forested non-urban lands in the Tahoe Basin.

The six Nevada streams are listed (Table 3-70) because of zinc, iron, and in one instance pathogen violations. Two of the California streams are listed because of pathogens. The 303(d) listed waterbodies, other than Lake Tahoe, are listed below along with the pollutants causing listing.

Table 3-72. Listed 303(d) stream segments in the Lake Tahoe Basin (2010).

Segment	Measured Impact
California	
Blackwood Creek	phosphorus, nitrogen, sediment, iron
Cold Creek	nitrogen
General Creek	iron, phosphorus
Heavenly Valley Creek	phosphorus, chloride, sediment
Tallac Creek	pathogen
Trout Creek	phosphorus, nitrogen, pathogen , iron
Upper Truckee	iron, phosphorus
Ward Creek	phosphorus, nitrogen, sediment, iron
I	*Note* iron and chloride WQ stds may be revised*
Nevada	
Second Creek	zinc
Wood Creek	pathogen
Third Creek	zinc
Incline Creek	iron
Glenbrook Creek	iron
First Creek	zinc

Cumulative Watershed Effects of Alternatives

All the strategies and objectives proposed under all the alternatives will continue to support the LTBMUs goal of doing its part to achieve state water quality standards, TRPA water quality thresholds, and the Lake Tahoe Basin TMDL milestones related to stream channels and forest uplands. The TMDL 15 year milestones for these two pollutant sources are a 12% reduction in fine sediment from Forest Uplands, and a 53% reduction of fine sediment from stream channels. As described in the TMDL water quality control plan amendments (TMDL Plan), it is anticipated that these reductions will be achieved through past actions as well as through implementation of future strategies, as currently described under all the alternatives, including implementation of BMPs; facilities, roads, and trails retrofits and decommissioning; and implementation of currently planned restoration projects including removal of existing stressors. The TMDL plan goes on to state that the LTBMU is responsible for implementing forest fuels reduction projects to reduce the threat of wildfire in the Lake Tahoe basin, and these projects must include best management practices and appropriate monitoring to ensure fuels reduction efforts do not cause this source to exceed load allocations.

Because vegetation management treatments are primarily concentrated in a “ring” around lake Tahoe adjacent to urban areas (the WUI) , there is little to no potential for adverse consequences related to cumulative watershed affects under any of the alternatives relative to these activities.

Watersheds in Lake Tahoe are generally characterized by some level of urbanization in the lower third of the watersheds, with primarily stable forested uplands in the upper two thirds of the watershed. Regardless of the specific type and scale of treatment options used, as described under all the alternatives in the WUI, implementation of BMPs are expected to result in neutral environmental consequences as it relates to achievement of TMDL milestones, TRPA thresholds stream channel condition, or watershed hydrologic response.

However alternative D does create a slightly greater risk to water quality with a reduction in vegetation management activities outside of the WUI. With limited active fuels management outside of the WUI, there is a subsequently greater risk of catastrophic wildfire in the upper watersheds which could have the effect of not achieving the TMDL milestones.

Soil- Naturally Functioning SEZ

SEZ Current Condition –

The TRPA has also established a threshold for the preservation and restoration of naturally functioning SEZ lands. Currently no established set of uniform metrics have been developed for determining whether the ecosystem function of SEZ lands has been preserved or restored to "naturally functioning levels". The Lake Tahoe Basin land management and regulatory agencies are currently working together to determine whether the California Rapid Assessment Methodology for Wetlands (CRAM) could be used in the Tahoe Basin for the purpose of evaluating attainment of this threshold.

In the meantime, TRPA has reported the number of acres in which restoration efforts have been implemented. Individual agencies rely on their own internal monitoring programs and protocols for determining the degree to which those efforts have been successful. The TRPA, 2006 threshold evaluation report documents that 378.9 acres have received restoration treatments within the urban boundary. Over a 12-year period (1988-2000), the LTBMU applied restoration treatments on approximately 500 acres of SEZ lands. Between 2000 and 2011 the LTBMU has completed an additional 78 acres of restoration on lands considered to be SEZ.

SEZ Cumulative Effects –

The LTBMU manages a large amount of land that would be considered SEZ (reference Stephanies table that displays the current acreage of riparian and wetlands habitat). The LTBMU restoration program has identified a number of stream channel reaches and meadows where ecosystem function in terms of geomorphic stability and habitat quality can be enhanced, and this currently planned restoration is proposed equally in all four alternatives (Table 3-72. This planned restoration will continue to contribute to the TRPA threshold for restoring or enhancing SEZs to naturally functioning levels.

The impact of less active future restoration proposed in alternative D may result in a lower rate of restoration through natural processes of degraded SEZs that are not currently identified. However all of the large scale opportunities for SEZ restoration on lands managed by the LTMBU are already identified and restoration of these identified opportunities is proposed at an equal level under all the alternatives,

3.5.3. Conclusion

Since essentially all actions on private, county and state lands must pass through the multiple layers of regulation with TRPA involved in essentially all actions, there is a commonality of environmental protection that occurs in the Basin. Consequently while it is impossible to know the array of individual projects that might occur in the foreseeable future, it is reasonable to assume they will all meet the appropriate stringent regulations and therefore respond to threshold attainment. There is a high degree of integration between all the agencies that has the result that none of the planning documents work at cross purposes to each other.

The equation for cumulative effect is reached by taking the environmental consequences of each of the four Forest Plan alternatives presented in this DEIS for NFS lands in combination with the highly regulated actions of all other land owners/managers as guided by the TRPA Regional Plan and other regulatory agencies. As a result there is a common intent of maintaining or improving the environment on all lands within the Basin. With this common goal constraining all actions in the basin, there are no significant negative cumulative effects at the programmatic level, and in fact, for some resources and alternatives there are positive cumulative effects.

3.6. Environmental Justice

As required by Executive Order (EO) 12898, all federal actions must consider potentially disproportionate effects on minority or low-income communities. Proposed Land Management Plans are strategic and programmatic in nature, providing guidance and direction to future site-specific projects and activities. These Plans do not create, authorize, or execute any ground-disturbing activity, although they do provide for the consideration of certain types of activities. Site-specific activities will consider potential disproportionate effects on minority or low-income communities during project planning.

The Lake Tahoe Basin Management Unit Social and Economic Assessment (Appendix F) did not identify any disproportionate impacts resulting from the proposed management of the LTBMU because there are a wide range of opportunities, activities and services offered. In addition, collaboration on the Plan with local agencies and members of the public did not identify any concerns regarding disproportionate impacts to low-income or minority populations.

3.7. Relationship of Short-Term Uses and Long-Term Productivity

NEPA requires consideration of “the relationship between short-term uses of man’s environment and the maintenance and enhancement of long-term productivity” (40 CFR 1502.16). As declared by Congress, this includes using all practicable means and measures, including financial

and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101).

Overall, with all alternatives, projects developed would be designed using standards and guidelines and standard operating procedures that would ensure the long term productivity of NFS lands in the Lake Tahoe Basin.

3.8. Unavoidable Adverse Impacts

The land management plan provides a programmatic framework that guides site-specific actions but does not authorize, fund, or carryout any project or activity. Before any ground-disturbing actions take place, they must be authorized in a subsequent site-specific environmental analysis. Therefore none of the alternatives cause unavoidable adverse impacts.

3.9. Irreversible and Irretrievable Commitment of Resources

The land management plan provides a programmatic framework that guides site-specific actions but does not authorize, fund, or carryout any project or activity. Because the land management plan does not authorize or mandate any site-specific project or activity (including ground-disturbing actions), none of the alternatives cause an irreversible or irretrievable commitment of resources.