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FIGURE 3.26: Photo showing stand of dead lodgepoles in former beaver dam impoundment. USFS biologist Mollie Hurd (Personal Communication, 2003) indicates that these dead stands are important bird habitat.

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FIGURE 3.27: Photo showing regolith exposed below soil pedestals in area affected by historic grazing. This area was apparently a trail access to Elbert Lake. (July, 2003)

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FIGURE 3.28: View of Upper Truckee River, upper southwest watershed divide showing Tertiary Volcanic (Tv) rocks overlying granitic rocks.

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FIGURE 3.29: The upper photo shows recent sediment generated on hillslopes of tertiary volcaniclastic (Tv) rocks. Photo taken south of Round Lake in Upper UTR watershed (10/03). The lower photo shows debris flow chute emanating from Tv terrace near Round Lake in the Upper Watershed.

forest vegetation cover. However, the incorporation of fine sediments derived from Tv into runoff and into the UTR is readily apparent. While the rate of volcanic sediments generated appears to be close to natural background rates (given a lack of disturbance), once entrained in the streamflow there is little chance of settlement or deposition until flow overtops banks in the large meadows downstream, in the study area and below. Given the fact that all of the meadows have been disrupted and now have deeply incised channels that rarely flow overbank (through Christmas Valley, the LTGC, Sunset Ranch and Lake Tahoe Airport, Mosher Meadow and Barton Meadow), the natural mechanism for removing fine sediments has been removed. This function was especially important at the mouth of the UTR in the Barton Meadow, where the UTR was channelized away from its historic path during the Comstock Era and thus away from its historic delta. The historic delta would have allowed the UTR to discharge directly into the lagoon formed behind the barrier beach and would have been the best opportunity to deposit fine sediments over the full range of discharges before flowing into Lake Tahoe. The historic trend of channel incision is thus a double negative: it increased channel instability and chronic fine sediment sources from eroding banks, and it significantly reduced the overbank flow onto meadows where hydraulic residence times are the longest (especially in the Barton Meadow delta).

Another factor presented by Tertiary volcanics is the natural presence of phosphorous. Although a specific chemical analysis of eroded sediments and clays was not conducted, indirect evidence suggests that the Tv do produce abundant phosphorous. Observation of Round Lake, both in 2003 and earlier in the 1970s by hydrologist Toby Hanes (personal communication 2003), found decreased water clarity compared to other lakes in the Upper Watershed. The difference appears to be watershed sources of sediment and phosphorous, as Round Lake has a contributing watershed of Tv versus others that are predominately granitic and without significant phosphorous. The greenish tint of Round Lake observed in 2003 was evidently far more intense (described as "pea green") in the 1970s when observed by Toby Hanes. The best explanation is that there was still extensive cattle grazing of the Upper Watershed in the 1970s, which would have introduced greater nitrogen levels (likely the limiting factor for algae production in Round Lake).

An analysis of the mapped geologic units and the drainage network of the Upper Watershed reveals 4.72 square miles of Tv. Of this 2.92 square miles (62%) flow into one of the ten lakes in the Upper Watershed, leaving 1.8 square miles (38%) contributing directly to the UTR and available for discharge downstream.

III.1.D Opportunities and Constraints

The following opportunities and constraints were identified for geomorphology, hydrology and water quality.

Opportunities

- There are opportunities to stabilize and restore geomorphic functions to the UTR mainstem through channel reconstruction and/or bioengineered stabilization projects. These must be carefully designed in order to gain hydraulic and sediment transport continuity. There must be consideration of the acceptable risks involved in attempting to "stabilize" the unstable reaches.
- Projects that restore channel function would also benefit native riparian vegetation communities and wildlife habitat. Restoration of groundwater conditions and riparian plant communities along channel banks would help increase channel stability and reduce sediment supply.
- There is a significant opportunity to implement channel reconstruction and/or stabilization projects in Reaches 1 through 4, where nearly all of the land is under public ownership.
- A significant improvement in the environmental quality of the UTR could be attained in Christmas Valley, Reaches 5 through 11, by implementing low-tech bioengineering and revegetation projects.

Constraints

- Any effort to restore the UTR requires land already in use. Different objectives by private landowners could be a constraint to restoration activities. However, cooperative projects and incentives could be developed by public agencies and private sources. Public land is subject to policies of a number of agencies and is focused on developing the best possible use of the land given the many constraints involved. Current public land use can be changed, but not without the proper processes.
- Any effort to restore and/or stabilize the UTR will involve construction activities in the SEZ, which could lead to short term water quality and wildlife impacts. The projects will have to be carefully designed and implemented to avoid significant impacts and to gain regulatory permits and requirements.
- Infrastructure may require modification to allow for restoration of UTR.
- Construction access to most of the UTR in Christmas Valley is difficult.

III.1.E References Cited

Chang, C.Y.Y., J.S. Kuwabara and S.P. Pasilis. 1992. Phosphate and iron limitation of phytoplankton biomass in Lake Tahoe. *Can. J. Fish. Aquat. Sci.* 49:1206-1215.

Goldman, C.R. 1988. Primary productivity, nutrients, and transparency during the early onset of eutrophication in ultra-oligotrophic Lake Tahoe, California-Nevada. *Limnology Oceanography*. 33(6, part 1): 1321-1333.

Hanes, T. 2003. Personal communication. Registered Professional Hydrologist, HydroScience, Vacaville, CA.

Hanes, T. and M.S. Swanson. 1997. Upper Truckee River Bankfull Discharge Monitoring Survey. Prepared for The California Tahoe Conservancy. October 27, 1997.

Hurd, M. 2003. Personal communication. USFS biologist. Fall 2003.

Natural Resource Conservation Service. 2000. NRCS Field Office Technical Guide. Prepared by the South Lake Tahoe Branch Office of the NRCS.

Reuter, J.E. and W.W. Miller. 2000. Aquatic resources, water quality and limnology of Lake Tahoe and its upland watershed. The Lake Tahoe Watershed Assessment: Volume I. Prepared for USDA-Forest Service, Tahoe Regional Planning Agency, UC-Davis, University of Nevada-Reno, and Desert Research Institute.

Rosgen, D.L. 1996. Applied River Morphology. Wildland Hydrology.

Rowe, T.G., D.K. Saleh, S.A. Watkins, and C.R. Kratzer. 2002. Streamflow and water quality data for selected watersheds in the Lake Tahoe Basin, California and Nevada, through September 1998. U.S. Geological Survey Water-Resources Investigations Report 02-4030.

Simon, A., W. Dickerson, and A. Heins. 2003. Suspended-sediment transport rates at the 1.5-year recurrence interval for ecoregions of the United States: Transport conditions at the bankfull and effective discharges? Geomorphology. In press.

Swanson Hydrology and Geomorphology. 2003. Assessment of seasonal pollutant loading and removal efficiency of detention basins. Prepared for Tahoe Regional Planning Agency and United States Environmental Protection Agency. February, 2003.

Swanson Hydrology and Geomorphology. 2003. UTR – Middle Reach

Tappe, D.T. 1942. The status of beavers in California. State of California, Department of Natural Resources, Division of Fish and Game. Game Bulletin No. 3.

III.2 VEGETATION AND WETLANDS

III.2.A Purpose

The study of vegetation carried out for this project had the following partially overlapping objectives:

- To provide a map of existing vegetation communities and a description of the ecological conditions of those communities, against which the predicted consequences of different restoration options could be compared, and which can be used as a baseline map for monitoring of restoration effects;
- To help elucidate the ecological processes that maintain, enhance, or are altering the existing communities under the present hydrologic regime;
- To propose and explain reasonable hypotheses about the pre-settlement vegetation and ecological processes, which is the only available reference basis for the restoration objectives of some of the community types; and
- To identify feasible and appropriate restoration actions that can be applied to the various communities.

III.2.B Methods

Existing vegetation of the Upper Reach Study Area was examined on foot throughout most of the Study Area, with the exception of small areas where private ownership closely adjoins the river. Field work was carried out by Adrian Juncosa and Julie Etra between July and September, 2003. Observed plant communities were noted on prints of the Ikonos data set, to the extent feasible from the highly pixellated image. The mapped vegetation boundaries were based primarily upon the field observations and, to a lesser extent, on the color signatures of known community types. The nature of the Ikonos imagery limits the accuracy of the vegetation mapping that was produced. The NAPP aerial photograph and 2003 aerial photographs for the Study Area were not available for the purposes of the vegetation study and draft mapping, therefore the accuracy of discrimination, especially between some vegetation types, was limited.

A series of historic aerial photographs (1940 through 1997) were examined to discern vegetation conditions over time. Although it is generally not possible to assign areas precisely to the various community types described here, we could usually discriminate among coniferous forest, deciduous riparian forest, woody riparian scrub, and herbaceous communities. The timeline for recolonization of disturbed areas is also easily determined. However, aerial photographs crucially fail to reveal pre-settlement (pre-1860) ecological conditions. Thus, despite the value of historic aerial photographs, much of our understanding of ecological changes and trends comes from knowledge of the ecology of dominant species and from clues derived from field work, rather than from aerial photograph comparisons.

III.2.C Areas and Features Not Mapped

Some polygons within the Study Area were areas which have been substantially developed or modified from native vegetation. These areas are designated Developed (see below) and include the Lake Tahoe Golf Course and small patches of native vegetation within it, playing fields and parking areas in the park in Reaches 3 and 4, and lawns or other heavily modified portions of residential lots in reaches upstream of Highway 50.

Old channels that were once either the main Upper Truckee River channel or subsidiary channels were found in many places throughout the Study Area, but were concentrated in certain reaches. These features were noted on field maps, but not transferred to the vegetation maps because they are linear features rather than polygons.

Finally, one of the most interesting areas in the study region lies a short distance outside the limits of the Study Area and is therefore not mapped. This feature is a spring that has developed within approximately the last 10 years and now supports a sizable and rich wetland community. It is of importance because it exemplifies the potentially dynamic nature of groundwater removed from the existing channel.

III.2.D Vegetation Classification for the Study Area

No single available reference accommodates the observed community types accurately and comprehensively. Sawyer and Keeler-Wolf (1995), which is often preferred for vegetation mapping in California project sites, does not provide sufficient discrimination among the types of vegetation that are found within the Study Area to be used for the present project. To the extent feasible (only a few communities), the community types described are drawn from the two most applicable references (Manning and Padgett, 1995; CDFG, 2002). However, both of these references subdivide some vegetation complexes too finely for practical application to the present project site. For example, CDFG (2002) recognizes separate willow scrub communities for the various willow species (Lemmon's Willow Scrub; Geyer's Willow Scrub). It was our observation that most of the willow communities in the Upper Reach Study Area were not monospecific, but instead were mixtures of two or three species. Similarly, large areas of meadow habitat that were ecologically cohesive (that is, for the purposes of the present project, they constituted one continuous community type) included numerous small patches that would conform to one or another graminoid-dominated community type described by the sources cited above.

Commonly, shrub-dominated and herbaceous communities occurred in mosaics that appeared to be either dynamic or comprised of sufficiently small patches that it was neither practical nor useful to map the constituent communities separately. For example, Willow Scrub often occurred mixed with mesic or wet meadow types, and the mixed nature of these communities has ecological values that are not reflected in either one or the other. Such areas were mapped as, for example, Willow/Wet Meadow.

III.2.E Floristics and Nomenclature

A list of the plant species that were observed in the Study Area is included as Appendix E. The vast majority of species were identified on the basis of sight identification, but fragments were obtained from some, especially graminoids, for microscopic examination. Taxonomy and nomenclature follows the Jepson Manual (Hickman, 1993). Plants that form the majority of the structure of a given community are referred to mostly by common names; others are usually referred to by scientific binomials to avoid confusion that results from multiple or unfamiliar common names.

III.2.F Plant Species Ecology

Statements regarding dominance and occurrence are based on subjective observation; no quantitative vegetation sampling was carried out for the present phase of study. Terms such as abundant, common, rare, and so on are used according to common usage. For example, a ubiquitous or common species would be within sight from nearly any point within a particular map unit; occasional or scarce plants would not be. Rare or scarce species might not be encountered at all during a casual reconnaissance of a community. Locally common species are abundant only within specialized microsites.

Ecological status of plant species is sometimes discussed in terms of the U. S. Fish and Wildlife Service wetland indicator statuses (USFWS, 1996). Despite imperfections, this system and the statuses of many common riparian plant species are widely known (if not universally agreed to be accurate), thus it is an extremely useful communications tool. The status definitions are as follows, with comments on the soil moisture regime that is often found along with plants in each category:

- **OBL** Species found in wetlands >99 percent of the time; occurrence of vegetation dominated by plants in this category is usually strongly correlated with soils subject to annual prolonged near-surface saturation.
- **FACW** Species found in wetlands 67 to 99 percent of the time; usually correlated with moderately prolonged near-surface saturation in nearly all years.
- **FAC** Species found in wetlands 34 to 66 percent of the time; species in this category are frequently found in a wide range of soil moisture conditions, from short-duration saturation during most years to almost never saturated during the growing season.
- **FACU** Species found in wetlands 1 to 33 percent of the time; correlates with soil that is almost never saturated, or is only saturated very briefly during the early part of the growing season.
- **Upl** Species found in wetlands <1 percent of the time (also notated NI or "--" in the USFWS lists); correlates with soils that are never subject to prolonged saturation during the growing season.

The indicator statuses are defined for particular geographic regions; they are not necessarily the same for the California and Intermountain Regions (including Nevada). The project site lies almost exactly on the boundary between these two regions. Also, it is not known to what degree these experts tried to consider the range-wide ecology of particular species (that is, whether a species with a wide altitudinal range might be more or less closely associated with wetlands in the mountains versus the foothills).

To the best of our knowledge, the assignment of species to indicator status categories was not based upon any quantitative sampling, but upon the subjective impressions of contributing experts. It is our observation that, for some or many species, the indicator status that would be assigned based upon quantitative sampling would be different than that provided by the USFWS list. Also, many common wetland-associated species (FACW or OBL) become established only under a wetland hydrologic regime, but are able to persist for long periods of time even if the soil moisture regime becomes much drier. This can be misleading in making wetland determinations, but is extremely useful to an experienced field botanist in interpreting ecological history and trend. Finally, some species that are closely associated with wetland soil saturation regimes may nevertheless require more dissolved oxygen than other wetland species and are consequently tend to be found in wet areas where the water is flowing rather than stagnant.

Notwithstanding all of these considerations, the familiar USFWS wetland indicator status list does provide a useful relative categorization of the soil moisture regime with which the listed species are associated. Also, most areas that are dominated by species that are regarded as hydrophytic by the federal wetland identification manual (FAC, FACW, and/or OBL species) are likely to delineate as wetlands, so the community mapping provides a useful initial guide to permitting requirements. However, some areas that are defined as Stream Environment Zones (SEZs) by the Tahoe Regional Planning Agency lie outside the federal wetland definition.

III.2.G Community Types

The following community types occur within the Study Area, roughly arranged from upland forests to perennial wetlands, and are shown in Figures 3.30A-E. Some vegetation types occurred characteristically (not merely occasionally) as mosaics with one another. The poor resolution of the Ikonos imagery made it impossible to circumscribe the separate types of vegetation in these areas; such detailed mapping would be of questionable ecological and planning value anyway. Accordingly, some areas appear on the map as mixed communities, for example, Willow mixed with Wet Meadow (WWM). On the other hand, where scattered elements of one community (e.g., individual lodgepole pines) occurred within another community type (e.g., Dry Meadow), the entire area was mapped according to the predominant ecological character for wildlife habitat and planning purposes. Only where the mixture of community elements was more even was a mixed community mapped.

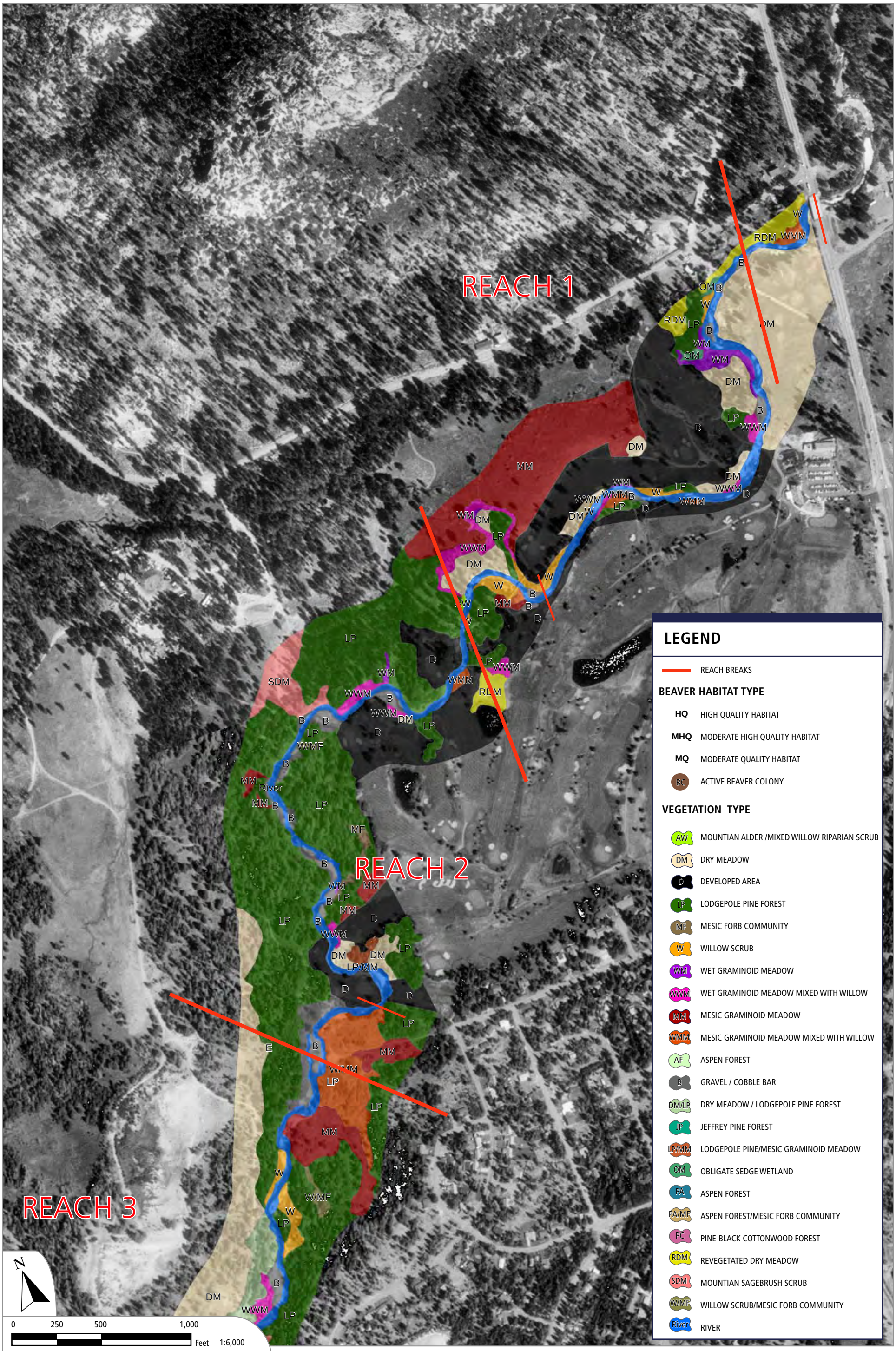

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FIGURE 3.30A: Map describing beaver habitats and vegetation communities within the project area (Reaches 1-3).

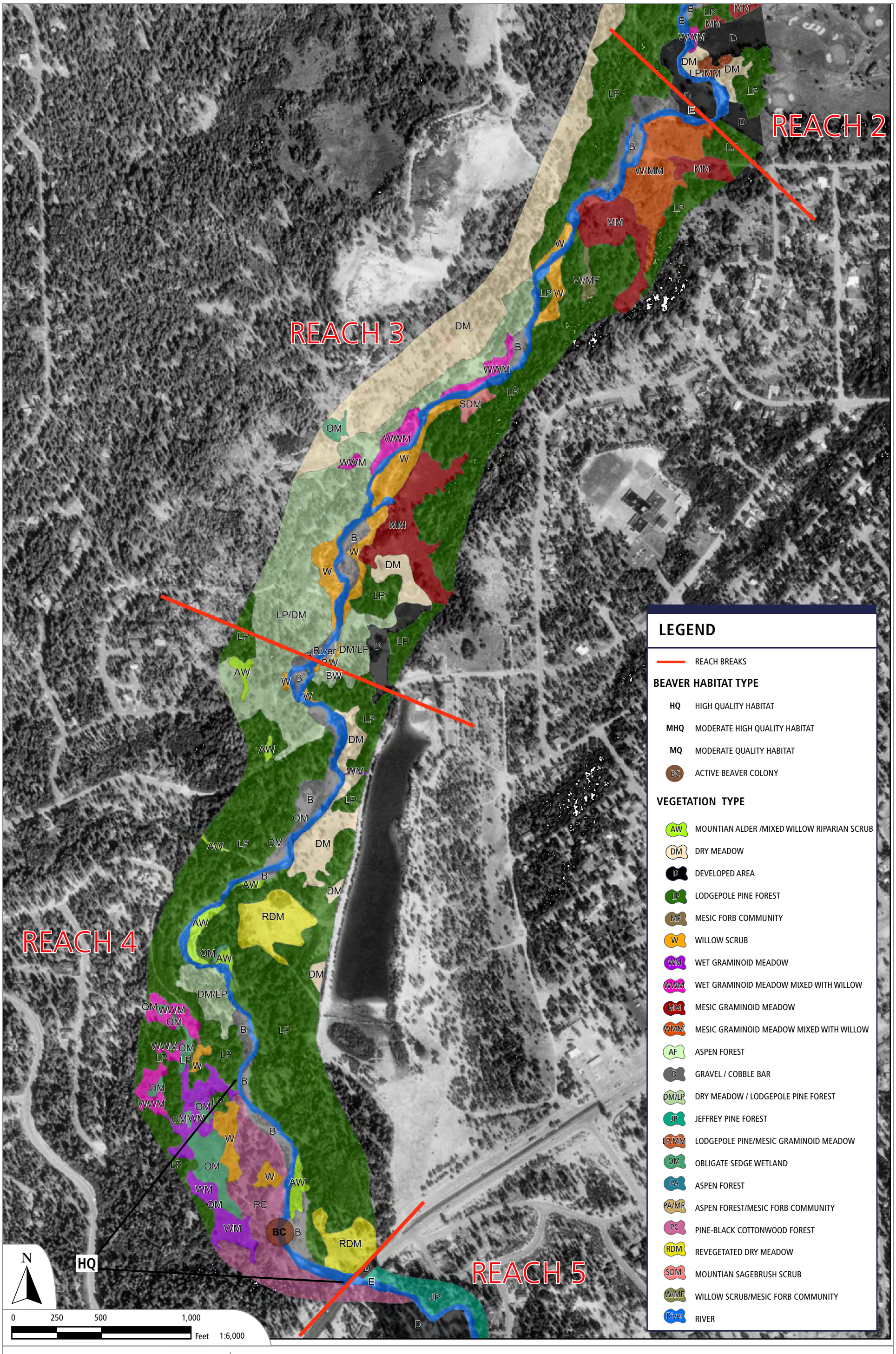

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FIGURE 3.30B: Map describing beaver habitats and vegetation communities within the project area (Reaches 2-5).

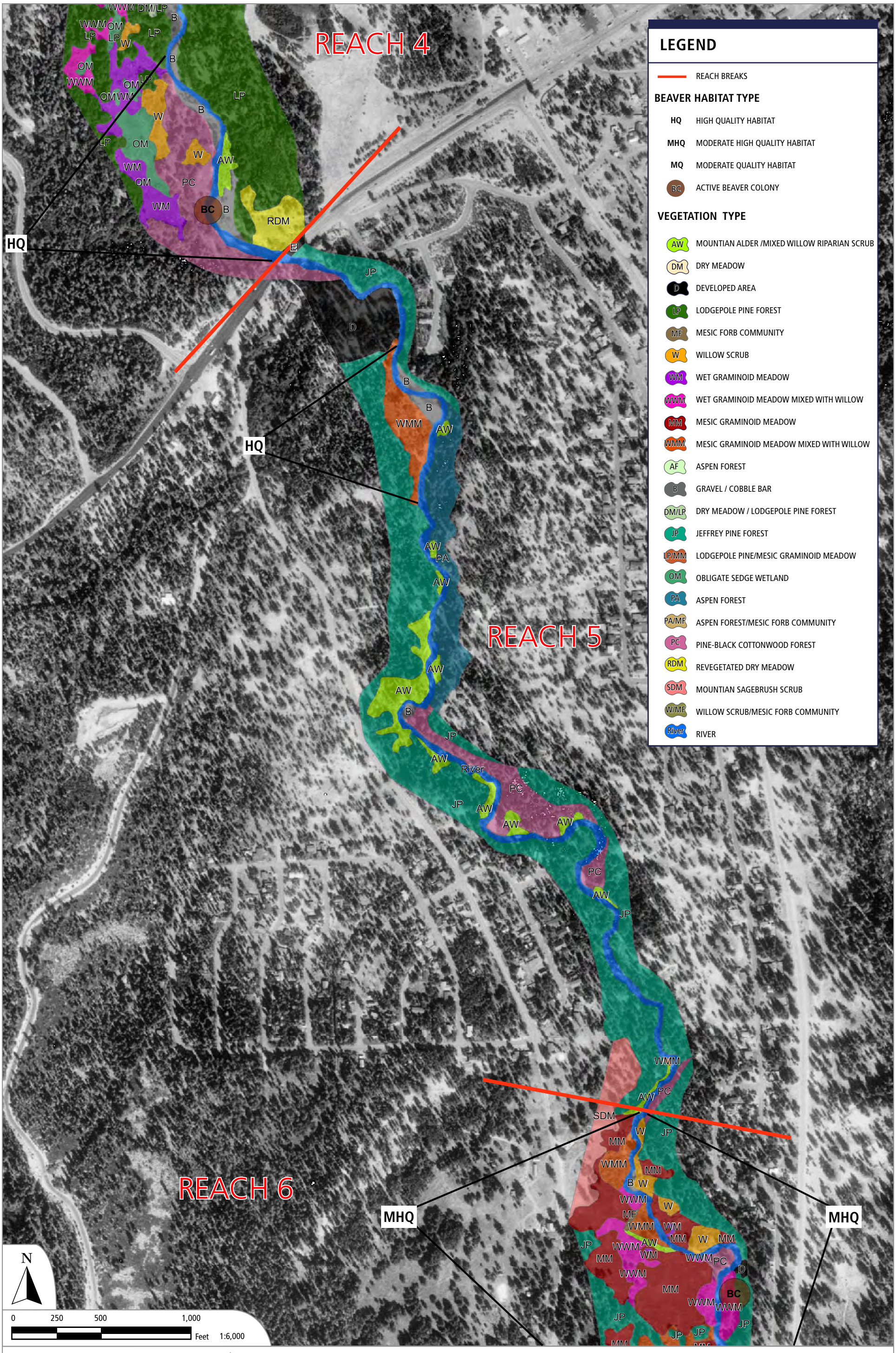

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FIGURE 3.30C: Map describing beaver habitats and vegetation communities within the project area (Reeches 4-6).

REACH 6

REACH 7

MHQ

MHQ

LEGEND

REACH BREAKS

BEAVER HABITAT TYPE

- HQ — HIGH QUALITY HABITAT
- MHQ — MODERATE HIGH QUALITY HABITAT
- MQ — MODERATE QUALITY HABITAT
- BC — ACTIVE BEAVER COLONY

VEGETATION TYPE

- AW — MOUNTIAN ALDER /MIXED WILLOW RIPARIAN SCRUB
- DM — DRY MEADOW
- D — DEVELOPED AREA
- LP — LODGEPOLE PINE FOREST
- MF — MESIC FORB COMMUNITY
- W — WILLOW SCRUB
- WM — WET GRAMINOID MEADOW
- WMM — WET GRAMINOID MEADOW MIXED WITH WILLOW
- MM — MESIC GRAMINOID MEADOW
- WMM — MESIC GRAMINOID MEADOW MIXED WITH WILLOW
- AF — ASPEN FOREST
- B — GRAVEL / COBBLE BAR
- DM/LP — DRY MEADOW / LODGEPOLE PINE FOREST
- JP — JEFFREY PINE FOREST
- LP/MM — LODGEPOLE PINE/MESIC GRAMINOID MEADOW
- OM — OBLIGATE SEDGE WETLAND
- PA — ASPEN FOREST
- PA/MF — ASPEN FOREST/MESIC FORB COMMUNITY
- PC — PINE-BLACK COTTONWOOD FOREST
- RDM — REVEGETATED DRY MEADOW
- SDM — MOUNTIAN SAGEBRUSH SCRUB
- W/MF — WILLOW SCRUB/MESIC FORB COMMUNITY
- River — RIVER

N

0 250 500 1,000 Feet 1:6,000

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FIGURE 3.30D: Map describing beaver habitats and vegetation communities within the project area (Reaches 6-7).

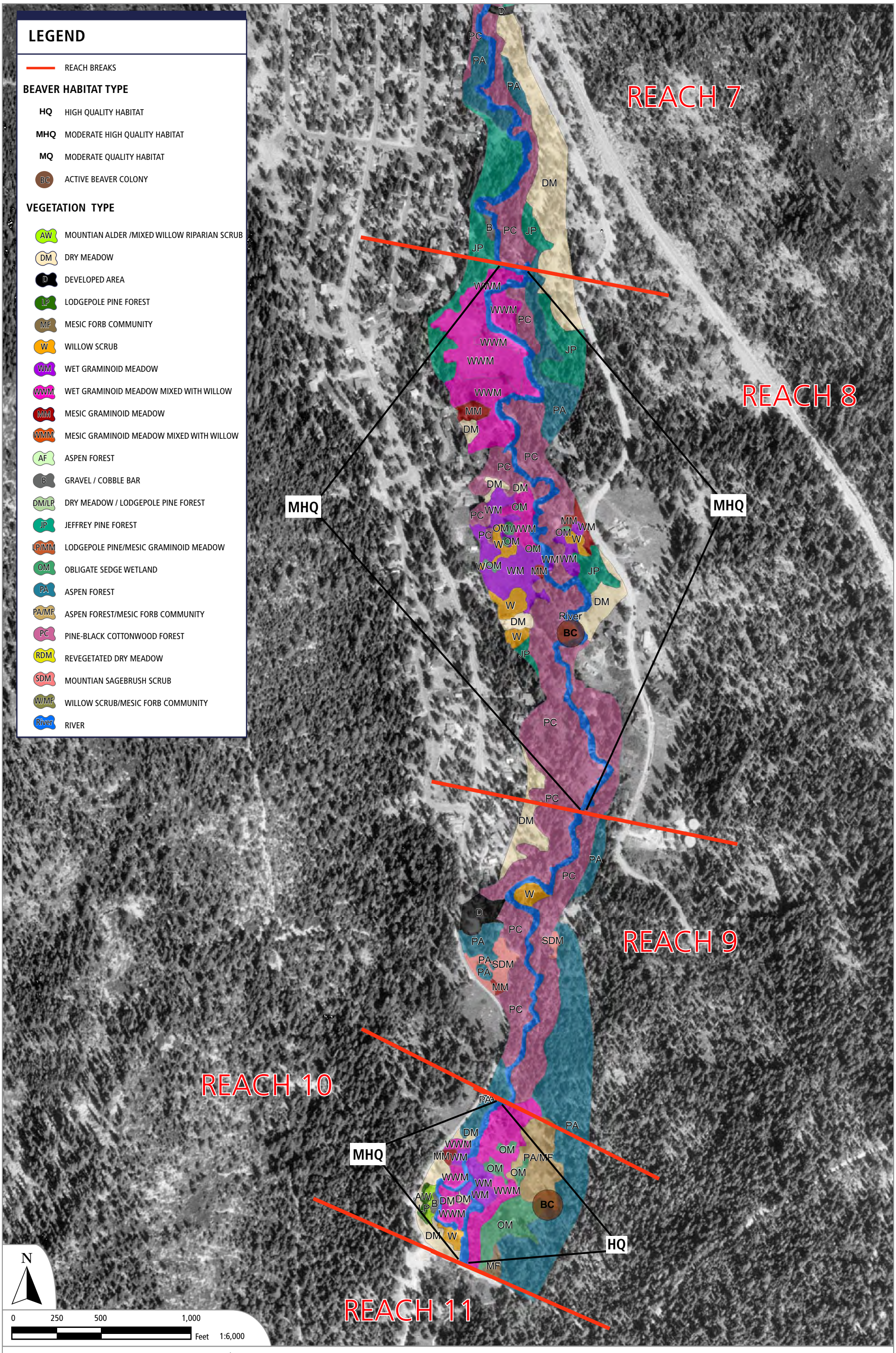

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FIGURE 3.30E: Map describing beaver habitats and vegetation communities within the project area (Reaches 7-11).

Lodgepole Pine Forest (LP)
Jeffrey Pine Forest (JP)
Jeffrey Pine - Aspen Forest (JPA)
Pine-Black Cottonwood Forest (PC)
Black Cottonwood Forest (CF)
Quaking Aspen Forest (A)
Mountain Alder-Mixed Willow Riparian Scrub (AW)
Willow Scrub (W)
Dry Meadow (DM)
Revegetation Dry Meadow (RDM)
Mountain Sagebrush Scrub (SDM)
Mesic Graminoid Meadow (MM)
Mesic Forb Community (MF)
Wet Graminoid Meadow (WM)
Obligate Sedge Wetland (OM)
Gravel/Cobble Bar (B)
Developed Areas (D)
Historic Channels (not a map polygon)

III.2.H Community Type Descriptions

Lodgepole Pine Forest (LP)

Occurrence and Structure
This community type includes extensive areas of forest with variable canopy structure, ranging from open woodland with canopy closure of 30 percent or less, to densely forested areas with 100 percent canopy cover. It occurs primarily in Reaches 1-4, and along portions of upstream reaches, on the left bank. Where the canopy is more open, scattered shrubs are present, but do not form a nearly continuous shrubby understory. A herbaceous stratum is present only where canopy cover is low; generally, this stratum resembles Dry Meadow, described below.

Trees larger than 24 inches diameter at breast height (dbh) are very scarce in this community type. Over very large areas where the pre-existing forest community was disturbed by logging and/or mass grading, the forest is composed of an extremely high density (individuals per unit area) of small trees (almost all less than 12 inches dbh).

Species Composition
The woody canopy is comprised almost entirely of lodgepole pine (*Pinus contorta* ssp. *murrayana*). In some areas, occasional trees of white fir (*Abies concolor*) and/or Jeffrey pine (*Pinus jeffreyi*) are present, but almost never form an ecologically significant portion of the canopy.

The shrub stratum, where it exists at all, varies from remnants or stringers of riparian (FACW or OBL) species that persist along abandoned small channels to strictly upland species such as wax currant (*Ribes cereum*) or *Ceanothus cordulatus*.

The herbaceous stratum similarly varies from mesic species typical of the meadow communities (for example, *Elymus glaucus* and *Poa pratensis*) to dry site species such as *Elymus elymoides*, *Gayophytum sp*., or *Achnatherum lettermanii*.

Ecological History and Trend
Based upon examination of the historic aerial photographs and considering the small diameter of the overwhelming majority of the lodgepole pines in the Study Area, it is clear that most of the area mapped as Lodgepole Pine Forest constitutes an early-seral-stage (early successional), colonizing forest. In 1940, a large proportion of what is now mapped as Lodgepole Pine Forest appears to have been a very open pine savannah, probably maintained in that condition by livestock grazing. Under pre-settlement conditions, it is unlikely that Lodgepole Pine Forest was an ecologically stable community as it presently occurs in the project region. The present extremely densely stocked conifer stands in this community would, if ignited by lightning or humans, burn at a very high temperature, and the entire stand and canopy would most likely be consumed; that is, a stand-replacing fire would occur. Due to its thin bark, lodgepole pine is relatively sensitive even to low-intensity fires, such as the ground fires that burn through and maintain meadow communities at higher elevations. Also, lodgepole pine is a relatively short-lived conifer among the species that occur on the project site. Thus, in the absence of fire for an extremely long period of time (much longer than the known natural fire return interval for the Lake Tahoe region), lodgepole pines would very gradually be replaced as the dominant canopy component by other species, such as white fir and Jeffrey pine.

In sites where lodgepole pines colonize exposed soil very densely, such as much of the mapped Lodgepole Pine Forest, it is likely that the natural pre-settlement community was either dry to mesic meadow that was maintained in meadow condition by frequent low-intensity fires, or a community that functioned somewhat like a chaparral community: dense shrubby (pine) vegetation would establish itself directly after the fire, only to be consumed in a subsequent fire a few decades later.

Thus, Lodgepole Pine Forest that is mapped in the Study Area should be regarded as a transitional community, not a "climax" community type whose character can be maintained while enhancing habitat values incrementally. From an overall habitat value standpoint, the short life span of

lodgepole pine itself indirectly provides some habitat value by virtue of the occurrence of standing dead trees and snags, which are essential to many insectivorous birds and to cavity nesters. However, such resources are not absent from other coniferous forest types, where occasional to many trees are killed by bark beetles.

With few exceptions (some notable ones occur in close proximity to the river), the lodgepole pines in the Study Area are of relatively small stature and are therefore of less value in contributing large woody debris to the channel/floodplain system than other species and communities. Drastic thinning of the Lodgepole Pine Forest would result in growth rate release of the remaining trees, and therefore would improve the production of large woody debris by the community. Data derived from another site within the Lake Tahoe Basin showed that the maximum growth rate of any native tree, slightly over 1 inch in diameter in a single year, was achieved by open-grown lodgepole pine, exceeding the fastest rate observed in black cottonwood by some 10-20 percent (Swanson, 2002).

Restoration Notes

From the perspectives of erosion control, wildlife and plant diversity habitat values, and community stability, the most desirable restoration actions for Lodgepole Pine Forest would include a drastic reduction in the amount of standing live and dead fuel by removal of nearly all of the smaller trees (at a minimum, all lodgepole pine and white fir trees less than 12 inches dbh). Ideally, the drier portions of the community would be converted to eastside pine - sagebrush/bitterbrush habitat, and the more mesic portions would be converted to meadow and maintained in that condition by low-intensity natural and/or prescribed fire. However, many of the desired restoration actions are the same and, in any case, require removal of large amounts of small caliber (<12 inch) trees and fuel prior to any other action.

An important riparian restoration objective that is highlighted by the behavior of the recent human-caused fire near Heavenly Ski Area, but rarely considered in large-scale riparian restoration, is fire protection. Where high fuel loads occur in close proximity to woody riparian communities, major damage to these communities and consequent water quality impacts, often occur when the inevitable high intensity wildland fires occur. Accordingly, it is preferable to reduce the load of small sized woody fuel (trees less than 12 inches, slash, and small-caliber ground fuels) throughout all coniferous forest communities that adjoin riparian habitat.

JEFFREY PINE FOREST (JP)

Occurrence and Structure

This community type presently occurs along Reaches 5-11, especially on the eastern (right bank) side of the valley, where the landforms slope relatively steeply upward from the river corridor. The forest canopy is composed primarily of very variable aged pine trees, some of them emergent individuals of extremely large size for the Lake Tahoe region (exceeding 72 inches dbh). The subcanopy and understory are patchy but generally sparse, without any areas of the typically solid

shrub layer that is seen in many mixed coniferous forest communities in the Basin. Herbaceous vegetation is also very sparse. Recruitment of new pines is ongoing at a relatively slow rate, compared with the Lodgepole Pine Forest, where many hundreds of small sized trees are present per acre.

Species Composition

The majority of the canopy, and all of the largest trees, are Jeffrey pines; a small portion of the canopy is lodgepole pine and white fir. In some areas in Reaches 5 through 10, a much more substantial lodgepole component is present, but the larger trees are almost all Jeffrey pines, showing that this is the real community type and that the lodgepole pines represent a flush of new establishment during the recent decades of more vigorous fire suppression. Species composition of the shrubby and herbaceous understory strata is similar to that of the Lodgepole Pine Forest and Dry Meadow communities (typical shrubs include *Ribes cereum* and *Ceanothus cordulatus*; herbs include *Monardella odoratissima, Aster sp., Eriogonum nudum, Elymus elymoides, Achnatherum lettermanii, Bromus carinatus,* and *Wyethia mollis*).

Ecological History and Trends

Based upon stand data from approximately 100 years ago for pre-logging conifer forests in various parts of the Sierra Nevada, the present vegetation conditions in the Jeffrey Pine Forest within the Upper Reach Study Area conform more closely to the conditions believed to have occurred in pre-settlement conifer forests than any other stand of upland forest we have observed directly in the region. The largest trees are at least several feet in diameter and occur at spacings of only a few emergent trees per acre, a variety of age classes are represented, and the trees in the youngest cohorts (less than 50 years old) do not occur at excessively high densities. Although no increment coring was carried out for the present project, information from an 84-inch Jeffrey pine tree in Truckee indicated an age in the range of approximately 450 years. That tree is growing in a much drier setting, a Jeffrey pine - bitterbrush community, and therefore could be older than an equivalent sized tree in the Upper Reach Study Area. However, it is safe to conclude that the many trees in the 72-inch size class within the Study Area are at least 300 years old. Since these trees are in superb condition, with perfectly straight and unflawed boles, it is certain that the area was not logged during the Comstock era. This makes it the probably the most easily accessible old growth Jeffrey pine forest community in the Basin and provides a perfect model for restoration of upland coniferous forest in the immediate vicinity of the riparian zone.

Restoration Notes

As noted above, this community provides a good ideal for restoration of upland forests at the lower elevations within the Lake Tahoe Basin. Although additional thinning of smaller diameter trees may still be beneficial, the only useful restoration action would be the application of prescribed fire, which, however, is unadvisable in any site with in-filled residential development. Absent low-intensity fire, we advise that residents be permitted, even encouraged, to remove the majority of the existing small-diameter trees (especially white fir) from their property. Felled trees and other ground fuel should be removed from the site entirely, or can be chipped and spread

thinly as an aid to erosion control. These actions are both ecologically beneficial and increase the defensibility of the houses from wildfire.

JEFFREY PINE - QUAKING ASPEN FOREST (JPA)

The Jeffrey Pine - Quaking Aspen Forest community type is almost identical to the preceding one, except that aspens are present either in moderately dense stands or as isolated stems scattered throughout the understory and subcanopy. This community occurs primarily on the lower slope above the right (east) bank of the river in Reaches 5-11, and in small patches in the floodplain on the west side. Despite the usual (not universal) association of aspen with moist sites, within the Upper Reach Study Area, Jeffrey Pine - Quaking Aspen Forest is neither a wetland nor even a riparian plant community.

Structure

Canopy and subcanopy structure are similar to Jeffrey Pine Forest: scattered very large trees, proportional representation of most age classes of trees, and moderate density of trees that are less than 50 years old. Quaking aspen (*Populus tremuloides*) occurs as occasional to common stems, almost never as clumps or groves. Some of the aspen trees are fairly large for the species (exceeding 12 inches dbh), which likely places them in the 60 to 80 year old age range. (Quaking aspen trees in our region rarely survive past 100-120 years old.)

Species Composition

Species composition of this community is essentially identical to that of Jeffrey Pine Forest except for the addition of quaking aspen. The lower fringe of the community (upper non-wetland riparian zone) also supports abundant plants of *Lonicera conjugialis*, which is uncommon anywhere else within the Study Area, and other mesic riparian species. This fringe definitely constitutes a riparian Jeffrey pine community subtype that is not recognized in the literature. However, the occurrence of this vegetation type was narrow and discontinuous, and it was therefore not mapped as a separate community.

Ecological History and Trends

Quaking aspen does not naturally reproduce by seed under the climatic conditions that presently prevail in the West, but instead regenerates solely by sprouting from roots. Thus, all occurrences of quaking aspen in our region are believed to have been present, in those locations, since the post-glacial period 10,000 years ago. A few occurrences may represent whole plant communities that moved downslope in massive landslides, but this is an extreme exception. Although most aspen groves on slopes occur as stringers along spring-supported, steep-gradient creeks with long-seasonal or perennial flow, the Jeffrey Pine - Quaking Aspen community is one recognized by the CDFG vegetation classification system, so it is not at all unique to the present study site.

As a consequence of its regeneration exclusively from root sprouting, aspen occurrences are clonal, typically with all of the stems of a particular occurrence either physically connected via the roots or genetically nearly identical. Stems sprout densely when a tree dies or is badly damaged, or when low-intensity fire creates high light levels and hormonal release of the root-sprouting behavior.

In light of our knowledge of the ecological history of aspen in the arid West, it seems certain that the Jeffrey Pine – Quaking Aspen community described and mapped here occurred, with its present structure and composition, prior to 1860. Although regeneration in the Upper Truckee River occurrence of this community is relatively sparse, the aspen does not yet appear to be in danger of becoming completely extinguished by competition with the coniferous component of the forest.

Restoration Notes

As for Jeffrey Pine Forest, some thinning of the smaller diameter conifers in this community would be beneficial. If this were focused in the immediate vicinity of existing aspens, regeneration of the aspen clone would be expected to be more robust, with benefits to wildlife habitat values.

PINE-BLACK COTTONWOOD FOREST (PC)

Occurrence and Structure

This community is present extensively at the outer fringe of the floodplain, and even on the lower portions of the valley slopes, in Reaches 5 through 11. It corresponds to Jeffrey Pine - Black Cottonwood as recognized in the CDFG vegetation classification system (2002), except that lodgepole pine is present as well as Jeffrey pine. Within the Upper Reach Study Area, Pine - Black Cottonwood is present only in patches of limited lateral extent. The community is composed of a tree canopy of variable density. Generally, there is relatively little regeneration of the canopy species underneath, but an understory of willow and/or alder may be present in portions of Pine - Black Cottonwood forest close to the channel.

Species Composition

This community is characterized by the dominance of large black cottonwood (*Populus trichocarpa*) trees, mixed with Jeffrey pine and/or lodgepole pine. Few other species are present within the mapped patches of Pine - Black Cottonwood Forest, although divergent upland and wetland species are present in the adjacent communities.

Ecological History and Trends

This community is one that results from establishment of cottonwood trees at the edge of the floodplain during major flood events. Once established, the deeply rooted cottonwoods continue to grow vigorously on the basis of groundwater that is present through the years within the subsoil of the floodplain. As best as can be determined from the 1940 and 1952 aerial photographs, and

from the sizes of the trees observed in the field, the Pine - Black Cottonwood Forest occurrences in the Upper Reach Study Area were present at least 60 years ago, and most likely occurred in the same or analogous locations under pre-settlement conditions. However, it is possible that watershed alterations during the late 19th century resulted in high sediment loads and consequent major deviations of the course of the channel during high flow events. Such planform deviations and large-scale sediment deposition are known to be associated with the establishment of mixed cottonwood - coniferous forest communities in other sites in the Lake Tahoe Basin, both under pre-1860 and more recent (human-altered) conditions.

Within the Upper Reach Study Area, not all size (age) classes of cottonwood trees are well represented, although there are some individuals present of every size from <5-year old saplings to trees larger than two feet in diameter. The very large (>4 foot dbh) individuals that are present in some other Lake Tahoe Basin watersheds are essentially absent from the present Study Area, and relatively few individuals in the 6-12 inch size class are present. Recruitment of new saplings is more limited than in some other watersheds. Thus, although the existing trees nearly all appear to be in very robust condition and the community does not appear to be in danger of declining, it is appropriate to note that the younger size classes are less well represented than would generally be expected in a plant community that is perpetuating itself by establishment of new individuals of all of its major structural components.

Clues to the pattern of establishment are found in the historical aerial photographs and in a small tributary in Reach 4, where several cottonwood trees have become established, apparently within the last five to ten years. We conclude that this community results from establishment of cottonwoods within riparian conifer vegetation (see below), rather than from simultaneous establishment of both components of the canopy or from invasion of cottonwood groves by conifers. (The latter would be highly unlikely because lodgepole and Jeffrey pines generally establish poorly or not at all under a pre-existing dense canopy.)

In the context of this community description, it is appropriate to include an ecological note regarding Jeffrey pine. The typical and widely familiar ecological role of this tree is as the sole or a codominant canopy tree in very dry eastside Sierra Nevada habitats. In settings that are not adjoined by pinyon-juniper woodland, Jeffrey pine is often the last remaining tree species present when Sierran coniferous vegetation gives way to sagebrush-bitterbrush scrub vegetation. However, another setting where Jeffrey pine paradoxically is very successful is as a large tree on riparian floodplains; hence the recognition of a Jeffrey pine - Black Cottonwood community by CDFG (2002). We have observed sizeable (>12 inch dbh) trees growing vigorously in a wetland setting with shallow, slowly flowing surface water surrounding the trunk, and it is often the largest (albeit not most numerous) tree present in white fir - lodgepole pine - Jeffrey pine floodplain forest. The relative sizes of trees in these sites indicates that the Jeffrey pines persist from a time when the floodplain was the wettest, followed in establishment by the lodgepole pine and white fir that now comprise the majority of the canopy.

In summary, it is useful to recognize that one of the diverse ecological roles of the Jeffrey pine is as a large floodplain tree, not merely as a dry-site dominant.

Restoration Notes

From a restoration planning standpoint, any riparian communities including black cottonwood are regarded as desirable, both from a wildlife habitat standpoint and as a source of large woody debris in the system. However, since the community becomes established only under occasional very high flow events, the only restoration actions that enhance the likelihood of establishment of Pine - Black Cottonwood Forest are the maintenance of sufficiently open conditions in the understory of the floodplain/terrace coniferous forest (e.g., by thinning of the subcanopy as recommended above). The high light levels that prevail are favorable for the establishment of cottonwood under 10-20 year flood events.

Black Cottonwood Forest (CF)

Occurrence, Structure and Species Composition

This community occurs in narrow patches immediately adjacent to the present or a past channel in Reaches 5 through 7. Although occasional individuals of cottonwood are present downstream of the Meyers Highway 50 crossing, for reasons which we do not fully understand, no cottonwood groves are present. In its mature form, Black Cottonwood Forest is a dense monospecific stand (essentially 100 percent canopy closure) of black cottonwood. Other broad-leaved riparian species such as mountain alder and willows may adjoin it closely, but are not present as a significant understory under the dense canopy. In very early successional stages, the community may be a mixture of all three components, but the shrubby species are outcompeted and ultimately disappear as the cottonwoods overtop them.

Ecological History and Trends

As for Pine - Black Cottonwood, the Black Cottonwood Forest community becomes established in the mixed and coarse sediments that are deposited thickly under high flow events. Observations of other cottonwood species in the Platte River (USFWS 1981) show that establishment of new seedlings does not occur on sites that remain inundated for a prolonged period of time after seed dispersal, although seedlings that do attain a sufficient size are then able to survive the extended inundation that occurs subsequently. Also, the seedlings only survive if the groundwater level drops moderately slowly (less than an inch per day, but may vary depending upon the texture of the soil). Even when such events occur at a time that does not coincide with the dispersal of cottonwood seeds (as was the case in the January 1997 event), the soil moisture regime in freshly deposited bars during the dispersal period may be conducive to cottonwood establishment.

Species of the genus *Populus*, with the notable exception of *P. tremuloides* (quaking aspen), characteristically have a phreatophytic root system, which extends deeply into the soil profile and accesses groundwater far from the surface. Once established and grown to reach the canopy, that

is, no longer subject to suppression by competition for light, cottonwood trees typically survive to their maximum life span (100-150 years) regardless of changes in soil and hydrology.

To the extent we can see in the 1940 and 1952 aerial photographs, the present patches of Black Cottonwood Forest became established during the mid-20th century. It is reasonable to expect that cottonwood groves established themselves in the adjoining or analogous locations under pre-settlement conditions as well.

Restoration Notes
Optionally, cottonwoods can be planted in areas where suitable sediments were deposited by the 1997 event, such as gravel bars in Reaches 3 and 4. Obviously, such revegetation would be undesirable within play areas of the golf course. Natural fluvial geomorphic processes can reasonably be expected to ensure the periodic establishment of new cottonwood groves throughout any portion of the system where the floodplain is not constrained by adjacent slopes or filled areas.

QUAKING ASPEN FOREST (A)

Occurrence and Structure
Quaking Aspen Forest typically occurs as a nearly pure stand only on floodplains or low terraces, specifically in Reach 7. Generally, in the Study Area, aspen occurs only as scattered individuals and groups of stems within Jeffrey Pine-Aspen forest. However, the one major aspen grove in Reach 7 was so notable that it merited separate recognition. Structure of this community is essentially identical to that of Black Cottonwood Forest (dense canopy, little understory), although the stature of the trees is somewhat smaller.

Species Composition
The community is dominated by quaking aspen, but with minimal occurrence of black cottonwood, one or another willow species, and/or mountain alder.

Ecological History and Trends
Discussion of the ecology of quaking aspen is provided above under Jeffrey Pine - Quaking Aspen Forest. As for that community type, Quaking Aspen Forest must have occurred in essentially its present location and character since the immediate post-glacial period.

Restoration Notes
No restoration actions are needed or appropriate within this community type, unless encroaching vegetation of other types (e.g., pines) begin to create sufficient competition for (primarily) light. Under normal conditions, vigorously growing aspen tree shoots will synthesize hormones to inhibit the initiation of new shoots. When the aspen is cut, or as it gets very old, not as much of

the suppression hormone is produced and recruitment of new root sprouts begins. If these new sprouts are competing for light with other vegetation (pines) their health and survival will be in jeopardy and in this instance, the competing vegetation should be cleared.

MOUNTAIN ALDER-MIXED WILLOW RIPARIAN SCRUB (AW)

Occurrence and Structure

Alder and willow scrub occurs throughout the Study Area, but riparian thickets that include mountain alder as a codominant species are much more common upstream of Meyers Highway 50 crossing (that is, in Reaches 5 through 11) than they are in Reaches 1 through 4. This community is a shrub-dominated community approximately 10-15(-20) feet tall, generally with 100 percent canopy cover. Where the canopy is closed, there is usually no actual understory. However, the fringe of the community and, at rare times, the interior when the canopy is partially open, is vegetated by FACW and OBL species of forbs (broad-leaved herbaceous plants, as distinguished from graminoid, or grasslike, species).

Species Composition

This community is characterized by having a canopy that is rarely purely comprised of, but always codominated by, mountain alder (*Alnus incana* ssp. *tenuifolia*). Usually, all three willow species that we found within the Study Area are present in significant numbers: Lemmon's willow (*Salix lemmonii*), Geyer's willow (*S. geyeriana*), and Pacific willow (*S. lucida var. lasiandra*). In some sites, other riparian shrubs, such as *Cornus sericea* and *Sorbus sp*., are also present but almost never codominant.

The understory may include a diverse assemblage of FACW and sometimes OBL forbs, such as *Heracleum lanatum*, *Thalictrum fendleri*, *Lupinus polyphyllus*, *Epilobium angustifolium*, and *Veratrum californicum*, and less commonly also FACW graminoids. Where the canopy is thin or absent, the alder-willow community intergrades with Mesic Forb Community Type, thus, mapping of a mosaic of these two types is often appropriate.

Ecological History and Trends

Examination of the historic aerial photographs suggests that riparian shrub and herbaceous communities (specifically ones dominated by hydrophytic species and lacking any coniferous component) were much more extensive prior to the last few decades. The area of riparian wetlands, both shrubby and herbaceous dominated types, has been substantially reduced by both direct fills in portions of the lower reaches (1-4) and by what seems to be invasion of wetland communities by lodgepole pine and mesic/dry meadow vegetation. Areas that appear to be mixed Mountain Alder - Willow Scrub and Mesic Forb communities, occurring on cut-off meanders in the 1940 and 1952 photographs, are presently much narrower due to encroachment of lodgepole pine. Only the center of the old channel remains dominated by the original FACW and OBL species. These observations clearly indicate a drying trend in most portions of the floodplains in Reaches 1-4. They also emphasize the closer association between alder and flowing water (channel

banks) than is the case for our willow species. Within the Upper Reach Study Area, the latter occur extensively throughout wet meadow sites, far from the channel banks.

The history of one patch of alder-willow habitat in particular is revealing. This thicket occurs on a very large gravel/cobble bar in Reach 5, possibly the result of more than one event. Regardless of its fluvial history, in 1940, the riparian scrub community occurred as scattered solid patches with significant expanses of substrate that were either unvegetated or thinly vegetated. This indicates that the community did not arise from one establishment event, as we normally implement in riparian revegetation, but instead was colonized by scattered patches of shrubs first, followed by gradual in-fill by others. A plausible hypothesis to account for this pattern is that whole shrubs with their root systems were dislodged from riverbank sites upstream and deposited along with the bar materials during the flood event. This demonstrates, on the basis of natural process alone, the utility of using salvaged willow and alder clumps for stabilization and large-scale revegetation of areas of newly established low floodplain. Mountain alder, in particular, seems not to colonize coarse substrates especially vigorously; close examination of bars that were deposited in 1997 shows that the vast majority of riparian shrub seedlings are willows.

Restoration Notes

In order to become established and persist, Mountain Alder - Mixed Willow Scrub habitat is closely dependent on precise hydrologic conditions, with a long period of near-surface saturation, normally in a setting where the water is flowing at or nearby the community edge. Accordingly, maintenance of existing alder-willow habitat and establishment of new areas is primarily a matter of channel-floodplain connectivity and deposition of appropriately sized sediment (finer than those that seem to be most conducive to the establishment of cottonwoods, for example).

Willow Scrub (W)

Occurrence and Structure

Willow Scrub community types occur throughout the Study Area, generally in combination with mesic and wet meadow vegetation, but also on depositional bars. The structure of this community is essentially identical to that of Mountain Alder - Mixed Willow Riparian Scrub.

Species Composition

There appear to be two intergrading, but still slightly ecologically divergent, types of willow communities within the Study Area. Time and analytical constraints posed by the reliance on Ikonos prints limited our ability to discriminate between these in the maps. Consequently, they are mapped as one vegetation type for the present baseline purposes.

One of the communities, which seemed to be more common in newly colonized settings (1997 bars) and in meadow settings that are more remote from the channel (thus, in slightly drier settings), was comprised of Lemmon's and Geyer's willows and usually, but not always, dominated

by Lemmon's willow. In the Upper Reach Study Area, it is ecologically misleading and impractical to discriminate between community types dominated by these respective species, as is done by both Manning and Padgett (1995) and CDFG (2002). Coyote or sandbar willow (*S. exigua*) occurs very uncommonly and only on recently deposited bars.

The other willow scrub community is characterized by codominance of Lemmon's, Geyer's, and Pacific willow. It was our impression that this mixed willow community was more closely associated with sites having a longer period of saturated soil, but groundwater monitoring would be required to confirm this hypothesis.

Ecological History and Trends

Mixed willow scrub habitat areas appear to have occurred generally in their present locations from pre-settlement times through the period for which we have aerial photographs. It is likely that willow/meadow mosaics were the existing condition even before livestock grazing was introduced. Fires, which we know were commonly set by native Americans, would tend to maintain a patchy scrub/meadow landscape very similar to that which we have today. Based upon the series of aerial photographs and on comparison with many other study sites, it appears that the occurrences of these community types in the Upper Reach Study Area have benefited from relatively enlightened grazing management throughout the recent decades.

From 1940 to the present day, some areas of willow scrub have shrunk in area, others have been lost to erosion, and still others (specifically in Reaches 3 and 4) have evidently become slightly drier than they were previously. Evidence for drier conditions include a gradual and slight change in the composition of the meadow vegetation with which the willow scrub are associated and the invasion of some willow/meadow mosaic areas by lodgepole pines over the last few decades.

Restoration Notes

In most portions of the Study Area, the present willow scrub communities exhibit relatively vigorous conditions, with few moribund plants and abundant colonization of new substrate. The most appropriate restoration actions pertain to maintenance of sufficiently wet conditions in the floodplains. As is discussed more fully elsewhere in this report, willows are the most suitable woody plants for bank stabilization and can be used to rapidly revegetate large expanses of newly disturbed soil within the reach of seasonal inundation or near-surface saturation.

DRY MEADOW (DM)

Structure

Dry Meadow is a herbaceous plant community dominated by upland (including FACU and some FAC) plant species. Scattered trees, primarily lodgepole pine, are present in most areas mapped as Dry Meadow, however, for the purposes of understanding of habitat values and planning restoration efforts, the character of these areas is primarily meadow rather than woodland.

Dry Meadow habitat is structurally very different from other meadow types discussed below, as they have much lower aerial and basal vegetative cover. Consequently, this community type is highly susceptible to erosion, both the small-scale surface erosion resulting from intense precipitation and the large-scale erosion that results when channels become reoriented through previously unflooded areas.

Species Composition
The species composition of this community is somewhat variable depending upon its ecological history. Typical dominant species include *Bromus carinatus, Carex filifolia, Carex subfusca, Lupinus lepidus, Gayophytum sp.,* and *Achnatherum lettermanii*.

Ecological History and Trends
In pre-settlement times, much of the area now mapped as Dry Meadow probably supported Mountain Sagebrush Scrub, or scrub mixed with meadow (as described below). However, it is equally possible that these areas were maintained in a purely herbaceous condition by frequent fire. It is not possible to discriminate between meadow and sagebrush scrub/meadow in the 1940 and 1952 aerial photographs, and is even somewhat speculative in any others as well.

Restoration Notes
This community is not important from a restoration planning standpoint, except to avoid creating concentrated flow patterns that impinge directly on dry meadow sites by anticipating flow regimes and patterns.

Revegetation Dry Meadow (RDM)

Occurrence and Structure
This community is ecologically similar to native Dry Meadow, but occurs in areas of surface disturbance that were revegetated using species not native to the area. Primary areas where it occurs are along the east side of Reaches 3 and 4, in the large-scale surface disturbance associated with the construction of Highway 50, and in various locations in Reaches 1 and 2. The structure of this community is similar to that of Dry Meadow.

Species Composition
Due to the long time period that has elapsed since these areas were revegetated, they have been colonized by many of the native Dry Meadow species. However, Revegetation Dry Meadow is characterized by the frequent to dominant presence of soil stabilization species such as *Dactylis glomerata, Bromus inermis, Festuca trachyphylla,* and *Elytrigia intermedia* ('Luna').

Ecological History and Trends
This community has existed in the Study Area only in recent decades, and in the absence of new surface disturbance, would be expected to persist long term because of their tendency to reseed in place. They generally seem not to spread to other habitats, however.

Mountain Sagebrush Scrub (SDM)

Occurrence and Structure
This community is a mixed scrub and meadow vegetation type, with somewhat lower shrub cover than is usually the case for Mountain Sagebrush Scrub. As for Dry Meadow, some scattered trees are present, but the predominant characteristics and habitat values of the community type are of scrub and meadow rather than woodland.

Species Composition
The dominant species composition of Mountain Sagebrush Scrub is essentially the same as that of Dry Meadow, described above, except for the addition of mountain sagebrush (*Artemisia tridentata ssp. vaseyana*). Also, FACU species such as *Poa pratensis* and *Elymus glaucus* are rare to absent in Mountain Sagebrush Scrub.

Ecological History and Trends
Prior to 1860, this community type probably prevailed, or occurred as a Jeffrey/lodgepole pine savannah, over most of the drier upland portions of the Study Area. Through that time, this condition may have been maintained, entirely or in part, by frequent low-intensity natural or human-caused fires and more recently by livestock grazing.

Restoration Notes
No special considerations of this community need to be made when planning restoration projects in the Upper Reach Study Area.

Mesic Forb Community (MF)

Structure
Mesic Forb Community is a dense herbaceous wetland community, typically with 90 to 100 percent canopy cover. Due to the different subterranean growth forms of forbs and graminoids (the latter having much more rhizome and root biomass at and near the soil surface), Mesic Forb community type is much more susceptible to erosion than are graminoid-dominated meadows.

Species Composition
Typical examples of Mesic Forb Community type include a relatively diverse assemblage of plants that are codominant or at least common in one or another microsite within the habitat patch.

These species include *Veratrum californicum, Lupinus polyphyllus, Thalictrum fendleri, Heracleum lanatum, Polemonium occidentale,* and *Senecio triangularis*. Numerous other species are common in one or another example of this community, such as *Dodecatheon jeffreyi, Geum macrophyllum, Smilacina stellata,* and *Platanthera leucostachys*. Graminoids may also be present, usually as a small component of the vegetative cover. Depending upon the soil moisture regime, the associated graminoids may vary from dry-site species such as Poa pratensis to OBL species such as Carex and Juncus species.

Ecological History and Trends

Mesic Forb Community occurs where there is long seasonal surface flow supported by channel flow or on hillside sites kept saturated by water originating from a spring. (Spring-supported sites with flat topography typically support graminoid wetlands; see below.) Mesic Forb sites typically have perennial or nearly perennial near-surface saturation. One notable example of the community occurs where a spring has recently begun to flow in the middle of an area previously dominated by dense Lodgepole Pine Forest with a dry to mesic meadow understory. The new spring flow has drowned the pines and given rise to a wetland community within the last 10-20 years.

As discussed earlier under Mountain Alder - Mixed Willow Scrub, Mesic Forb assemblages are frequently a good marker for abandoned meanders. Thus, as the sinuosity of the channel has decreased over time and the soil moisture regime in the floodplain in Reaches 1-4 has become drier, the extent of Mesic Forb vegetation has decreased substantially. Although the color signature of this community is not easily distinguished from Mesic and Wet Meadow types, some of the even dark green that characterizes all of them in the photographs from 1971 and more recently has been replaced by other vegetation types, primarily Lodgepole Pine Forest.

Restoration Notes

Due to the high plant species diversity of Mesic Forb communities, they can reasonably be presumed to contribute importantly to the base of a food chain and provide for a greater diversity of insect and vertebrate life than is the case for ecologically similar graminoid communities. Thus, to the extent that restoration opportunities and feasible actions permit the establishment of conditions favorable to patches of Mesic Forb habitat, this would be desirable from an overall habitat perspective.

MESIC GRAMINOID MEADOW (MM)

Occurrence and Structure

Mesic and Wet Graminoid Meadow communities are only slightly different, but are distinguished in this report and map in order to provide some indication of subtle differences and trends in soil moisture regime over wide areas of superficially similar vegetation. Ecologically, these meadow types have very similar topographic, edaphic, and hydrologic requirements to Willow Scrub; consequently the meadow and wetland scrub communities generally occur as mixed mosaics, as shown by the vegetation base map (Figures 3.30A-E). Mesic Graminoid Meadow usually has

moderately high basal and aerial vegetative cover, typically in the range of 70-80 percent. Due to the rhizomatous and fibrous-rooted nature of the dominant graminoid vegetation, areas of Mesic Graminoid Meadow with higher cover have relatively high resistance to erosion and also tend to exclude colonization by other species except lodgepole pine.

Species Composition
Species composition includes plants with a range of wetland indicator statuses. Dominants usually include both FACU species such as *Poa pratensis* and *Achillea millefolium*, FACW plants such as *Potentilla gracilis, Sidalcea oregana, Penstemon rydbergii var. oreocharis,* and *Juncus balticus* (this last usually not as a codominant), and species with upland affinities such as *Elymus trachycaulus* and *Lupinus lepidus*. Depending on hydrology, areas of Mesic Graminoid Meadow might delineate either as upland or as jurisdictional wetland.

Ecological History and Trends
It is not possible to confidently discriminate between Mesic and Wet Meadow habitat in the historical aerial photographs, therefore trends of change between them are not known with certainty. However, it seems likely that much of the Mesic Meadow actually represents former Wet Meadow (as indicated by the presence of Juncus balticus and other FACW species), which has become markedly drier due to lowering of the floodplain water table and was consequently invaded by species with Dry Meadow affinities.

As for all meadow types in the project region, it is also likely that their treeless condition was maintained at least in part by frequent low-intensity fires, both lightning-strike and human-caused.

Restoration Notes
Rewatering of Mesic Graminoid Meadow areas is desirable to maintain or enhance their value both for wildlife and for sediment/nutrient removal. However, these meadows are more susceptible to erosion than are Wet Graminoid Meadows and Willow Scrub. Therefore, care must be taken to ensure either that the likelihood of channel evulsions through Mesic Meadow is minimized and/or that sufficient floodplain flow obstacles, such as large woody debris or pre-established willow clump barriers, are installed to keep the flow velocities low.

In areas disturbed for restoration-related construction, Mesic Graminoid Meadow can be quickly and effectively re-established from seed and salvaged topsoil.

WET GRAMINOID MEADOW (WM)

Structure

Wet Graminoid Meadow is structurally distinguished from Mesic Graminoid Meadow by its higher basal and aerial cover, commonly 95-100 percent. Consequently, this community has the highest erosion resistance of any herbaceous dominated vegetation type within the Study Area.

Species Composition

Species composition of Wet Graminoid Meadow is dominated by FACW and OBL plants such as *Carex nebrascensis, Juncus balticus, Sidalcea oregana, Potentilla gracilis,* and *Penstemon rydbergii var. oreocharis*. Wet Graminoid Meadow sites near the river channel are also (or alternatively) dominated by a slightly different suite of FACW species such as *Poa trivialis* and *Juncus nevadensis*. Most Wet Graminoid Meadows also include some proportion of one or more FACU species such as P*hleum pratense, Poa pratensis, Achillea millefolium, Taraxacum officinale,* or *Perideridia lemmonii*.

Ecological History and Trends

Wet Graminoid Meadow probably represents the typical wetland meadow community type that has existed extensively throughout the floodplains of the Study Area since pre-settlement times. It is maintained by seasonal near-surface saturation in flat topography. Fire probably played an important role in maintaining the extent of wet meadow originally, followed by livestock grazing since 1860. Hypothetically, it seems ecologically likely that, absent these influences, Willow Scrub would gradually replace wet meadow, however, the historic aerial photographs do not provide unequivocal evidence that this is the case. In any case, interpretation of such a trend is confounded by the concurrent incision of the channel and resulting change in groundwater levels.

Restoration Notes

As noted above, Wet Graminoid Meadow constitutes the most erosion resistant herbaceous community in the Study Area. Strips of Wet Graminoid Meadow turf can be excavated from 'safe' areas (i.e. the middle of a meadow, far from a high energy channel) to provide superlative material for biotechnical erosion control, as discussed elsewhere in this report. The excavated areas can be easily backfilled, seeded and mulched and new meadow will quickly regenerate in its place.

OBLIGATE SEDGE WETLAND (OM)

Occurrence and Structure

Obligate Sedge Wetland occurs primarily in floodplain areas where springs supply perennial surface saturation. Specifically, major areas of this community type are found at the upstream extremity of the Study Area (Reach 11) and in a very large obligate/wet meadow complex west of the river in Reach 4. Small patches of Obligate Sedge Meadow also occur near the river. OM is structurally almost identical to Wet Graminoid Meadow, forming a sufficiently dense rhizome and root turf, as illustrated by the floating bog in Reach 4.

Species Composition
Floristically, Obligate Sedge Meadow is markedly distinct from Wet Graminoid Meadow, as it has much lower diversity (typically only two or three species are present), dominated or composed entirely of OBL sedges: *Carex utriculata, Carex nebrascensis, Carex aquatilis,* and *Scirpus microcarpus*.

Ecological History and Trends
This community has almost certainly existed in its present occurrences and conditions since the post-glacial era. Since the larger area occurrences are spring-supported, they are extremely robust to climatic changes and alteration attempts by humans (such as draining a site to favor other vegetation). The dam-building activity of beavers may expand or alter the configuration of Obligate Sedge Wetland occurrences, but probably does not create them where they were not already supported by springs.

Restoration Notes
The two main occurrences of this community are the two sites that are most conducive to the persistence of beaver. Thus, absent complete extirpation of this species from the region, restoration planning should incorporate the expectation that dam-building will be a continual feature of the landscape in these portions of the Study Area.

In other respects, Obligate Sedge Wetland can be expected to arise wherever restoration-related hydrologic changes result in prolonging the season of surface saturation beyond that tolerated by FACW and drier-affinity plants. However, it would not be a preferred restoration target from the perspective of ecosystem-wide habitat values, erosion control (Wet Graminoid Meadow is at least as erosion resistant), or nutrient scavenging.

GRAVEL/COBBLE BAR (B)

Occurrence and Structure
This community type occurs on recently deposited sediment bars, the surface of which is usually covered mostly by cobble-sized particles, with sand to gravel size material in the interior. The community has a highly variable structure, in keeping with its extremely patchy species composition. Typically there are patches of 100 percent shrub cover, patchy forb vegetation, and areas of low to 100 percent graminoid cover.

Species Composition
Species composition includes a very wide variety of plant species groups: Lemmon's and Geyer's willows, OBL sedges (see Obligate Sedge Wetland), Wet Graminoid Meadow species (*Poa trivialis* and *Juncus nevadensis* are particularly common), FAC herbs such as *Solidago canadensis*, and fully upland, colonist species such as *Lupinus lepidus* and *Lepidium densiflorum*.

Ecological History and Trends

It seems unlikely that the soil moisture regime within a particular Gravel Bar map unit varies as much as does the species composition of the vegetation. Notably, the FACW and OBL species tend to occur as relatively dense vegetation, whereas the FAC and upland species occur as scattered, clearly distinct individuals. This suggests a reasonable hypothesis that the willow and OBL/FACW sedge component of Gravel Bar vegetation might represent pre-existing wetland vegetation that was buried by the sediment deposition, then grew through the material to form the present above-ground wetland vegetation. The upland and FAC species clearly appear to have colonized the Gravel Bar communities since the material was deposited.

These patterns would certainly have occurred since prehistoric times, and, we believe, can be discerned on the historic aerial photographs as well.

Restoration Notes

A desirable and very cost-effective element of any restoration planning for the Upper Reach Study Area would be to enhance the revegetation of Gravel Bar sites by planting appropriate species, such as alder and willow species, in the more thinly vegetated areas.

DEVELOPED AREAS (D)

This map unit was used for areas within the Study Area that are highly modified by development. In Reaches 1 and 2, the Lake Tahoe Golf Course is a Developed Area, in Reaches 3 and 4 (east bank), recreational fields and parking areas within the park, in Reach 5 (west bank), the campground, and in Reaches 6-11, residences and associated landscaped yards.

HISTORIC CHANNELS

In many places in the Study Area, especially in Reaches 3 and 4, but also in Reach 2 and in the large meadow systems in Reaches 6 and 8, historic channels were discernible within communities that are now (variably) either upland forest (usually Lodgepole pine) or more mesic communities. Most of these channels appear to be too small to represent old oxbows of the main channel. These features are not large enough to be mapped as polygons, but are revealing of past fluvial history (most likely, the influence of beaver dams) and are ecologically significant because they support Alder-Willow and Mesic Forb vegetation within a dense forest context. They are therefore indicative of sufficient near-surface soil moisture for deciduous riparian communities or mesic/wet meadows to be supported with only moderate changes in channel grade and modification of the encroaching weedy lodgepole pine forest.

III.2.I Opportunities and Constraints

OPPORTUNITIES

- Encourage property owners to remove small diameter trees (lodgepole pine, white fir, Jeffrey pine) from their property. The practice would be ecologically beneficial, as well as increase defensibility from wildfire. Thinned trees near existing quaking aspens allow for more robust regeneration of species and improved wildlife habitat. Thinning the subcanopy will also encourage the open conditions necessary for the recruitment of black cottonwood, a desirable species for wildlife habitat as well as a source of woody debris.
- Use the small trees to aid in erosion control by chipping and spreading thinly on property.
- Plant cottonwoods in suitable sediment depositional areas, such as the gravel bars in Reaches 3 and 4.
- Encourage the natural fluvial geomorphic process (that is, floodplain connectivity and deposition of appropriately sized sediment) and ensure cottonwood, mountain alder, mesic forb community, and mixed willow scrub habitat establishment.
- Revegetate areas disturbed by restoration-related construction with the quickly and effectively re-established Mesic Graminoid Meadow community.
- Use Wet Graminoid Meadow as a source for biotechnical erosion control, due to its high resistance to erosion.

CONSTRAINTS

- Infill residential development constrains the application of prescribed fire as a means of thinning trees.
- The play areas of the LTGC constrain the locations available for revegetation of cottonwoods, like the gravel bars in Reaches 3 and 4.
- The high erosional susceptibility of the Mesic Graminoid Meadow means that sufficient care must be taken to avoid channel avulsions through this habitat. Recommended steps to be taken include large woody debris or pre-established willow clump barriers.
- Beavers and their dam construction constrain the restoration efforts of the obligate sedge wetland communities in the Study Area. Any restoration planning will have to include for the persistence of flooding due to beaver activity.
- Obligate sedge wetland is not a preferred restoration target for habitat values, erosion control, or nutrient scavenging reasons. However, the community is expected to arise wherever restoration prolongs the surface saturation season beyond what is tolerated by FACW and drier-affinity plants.

III.2.J References Cited

California Department of Fish and Game (CDFG). 2002. List of California Terrestrial Natural Communities Recognized by the California Natural Diversity Data Base, May 2002 edition. California Department of Fish and Game, Wildlife and Habitat Data Analysis Branch, Sacramento, California.

Franklin, J. F., and J. A. Fites-Kaufman. 1996. Assessment of late-successional forests of the Sierra Nevada. Pp. 627-661 in Status of the Sierra Nevada, Volume II: Assessments and Scientific Basis for Management Options. Sierra Nevada Ecosystem Project Final Report to Congress. Wildland Resources Center Report No. 37, Centers for Water and Wildland Resources, University of California, Davis.

Franklin, J. F., and Skinner, C. N., and Chi-Ru Chang. 1996. Fire regimes, past and present. Pp. 1041-1069 in Status of the Sierra Nevada, Volume II: Assessments and Scientific Basis for Management Options. Sierra Nevada Ecosystem Project Final Report to Congress. Wildland Resources Center Report No. 37, Centers for Water and Wildland Resources, University of California, Davis.

Hickman, J. C. 1993. The Jepson Manual: Higher Plants of California. University of California Press, Berkeley, California.

Manley, P. N., J. A. Fites-Kaufman, M. G. Barbour, M. D. Schlesinger, and D. M. Rizzo. 2000. Biological integrity. Pp. 403-598 in D. D. Murphy and C. M. Knopp (eds.), Lake Tahoe Watershed Assessment: Volume 1. General Technical Report PSW-GTR-175. USDA Forest Service, Pacific Southwest Research Station, Albany, California.

Manning, M. E., and W. G. Padgett. 1995. Riparian Community Type Classification for Humboldt and Toiyabe National Forests, Nevada and Eastern California. USDA Forest Service, Intermountain Region. Technical report R4-Ecol-95-01.

McKelvey, K. S., and J. D. Johnston. 1992. Historical perspectives on forests of the Sierra Nevada and the Transverse Ranges of Southern California: Forest conditions at the turn of the century. Pp. 225-246 in The California Spotted Owl: A Technical Assessment of its Current Status. General Technical Report PSW-GTR-133. USDA Forest Service, Pacific Southwest Research Station, Albany, California.

Sawyer, J.O. and T. Keeler-Wolf. 1995. A manual of California vegetation. California Native Plant Society. Sacramento, California.

Swanson Hydrology and Geomorphology. 2003. Blackwood Creek stream restoration project – final design report. Prepared for USFS Lake Tahoe Basin Management Unit. April 29, 2003.

United States Fish and Wildlife Service. 1981. Platte River Ecology Study. Special Research Report.

United States Fish and Wildlife Service. 1996. National list of vascular plant species that occur in wetlands: 1996 National Summary.

III.3 TERRESTRIAL WILDLIFE

III.3.A Introduction

This report provides an evaluation of wildlife conditions in the Upper Reach Study Area. The report specifically addresses the following six issues:

- Identify the wildlife management policies of local resource agencies.
- Identify known or potential threatened and endangered wildlife species, as well as sensitive habitat sites within and near the Study Area.
- Develop a list of wildlife species with known and potential occurrences in the Study Area.
- Investigate the occurrence and behavior of beaver within the Study Area. Provide an initial approximation of population dynamics and trends. Discuss the conflicts and/or benefits to ecosystem function and land use.
- Assess opportunities and constraints for wildlife ecosystem restoration.
- Provide priorities for wildlife habitat restoration and management.

BEAVERS

In particular, this report focuses on the beavers (*Castor canadensis*) in the Study Area. Beavers are of interest because they can alter both landscape form and function, and this ability brings them into conflict with people. The effects of beavers are often described as either beneficial or detrimental. Beaver-altered environments are generally acknowledged to increase habitat suitability for waterfowl, furbearers, amphibians, upland game, and deer (Reed 1980; Muller-Schwarze and Sun 2003), but can affect fish in both beneficial and detrimental ways. Detrimental effects due to beavers include property damage from flooding, softening of road banks due to flooding, tree loss, and a potential increase in mosquitoes due to the availability of dammed water (Muller-Schwarze and Sun 2003). (It should be noted that mosquitoes can become less numerous in beaver ponds because mosquito species adapted to temporary-pool environments are unlikely to be able to develop in the permanent standing water impounded behind beaver dams (Butts 1992; Butts 2001)).

Beavers have been intentionally introduced into some areas for the purpose of restoring degraded watersheds. Dams constructed by beavers alter watersheds by trapping sediment, storing water, modifying flow regimes, expanding the extent and dynamic of riparian zones, and providing exposed sediment for willow establishment (Naiman et al. 1988). In some areas, cyclic beaver habitat occupancy and abandonment results in wetter environments with substantially more riparian habitat, even in areas located away from beaver ponds (Muller-Schwarze and Sun 2003).

Native to Tahoe?

The available evidence suggests that beavers did not occur in the Lake Tahoe Basin until some time in the early 1900s when they were formally and informally introduced. The beaver is absent from

traditional Washoe Indian heritage, as reported by the living elders who recollect memories of beavers only from the 1930s-1950s (Susan Lindström, project archeologist, September 17 and 23, 2003, personal communication).

Tappe (1942) provides the first documentation on the introduction of two pairs of beavers to Meiss Meadow by the California Department of Fish and Game (CDFG) in 1938. Federal agencies introduced beavers to uninhabited locations because of their value as a fur resource and as an aid in water conservation and control of soil erosion (Tappe 1942). Besides the introduction documented in Tappe's report, a long-time resident of the Basin cites an additional release of beavers into Lily Lake in the early 1940s by the USFS (Craven, personal communication). According to Craven, some earlier introductions might also have been attempted but were unsuccessful due to winter weather. These introductions were to establish a fur trade during the depression years (Craven, personal communication).

Informal introductions prior to agency introductions probably occurred by individuals who wanted to establish an additional income source from trapping (Peralt, retired California Department of Fish and Game warden, September 11, 2003, personal communication). Project archeologist Susan Lindström (email communication) notes beaver conflicts with irrigation systems for cattle grazing were a problem in the 1920s in North Canyon Creek (Spooner Summit Area).

Beavers were not included in Orr's (1949) book titled Mammals of Lake Tahoe, which included mammals currently occurring in the Basin or those recorded in the past. He might have been unaware of the introductions (perhaps due to poor research or scarcity of the population in areas he surveyed), or he chose to include only native species.

Reconstructing a timeline of when and where beavers colonized the Upper Truckee River would be useful to understanding some of their effects on the watershed. However, little information on this subject is available. A long-time resident of the Upper Truckee River Watershed stated that her family did not observe beavers in the Upper Truckee River, specifically Reach 6, until the early 1960s (Shirley Taylor, personal communication). Consultation with El Dorado County officials reveals that one colony site on the river has been active for at least seventeen years. A review of California Department of Fish and Game (CDFG) could provide more comprehensive information.

Study Area Beaver Habitat Suitability

A goal of this assessment is to develop an initial ranking of beaver habitat suitability within the Study Area. Because of the effects beavers produce through feeding and dam-building activities, ranking habitat suitability can assist in assessing beavers' potential effects on the river and restoration projects and can help to focus management activities related to nuisance beavers.

Delineation of habitat quality can help to differentiate where beaver colonies are likely to persist from locations where they are likely to be transitory. The assumption is that unmanaged beavers

will always occupy high quality habitat. Any vacant high-quality habitat will be re-occupied as soon as possible, and the emigrants would not need to construct a lodge or den, merely repair what is existing. Locating high quality habitat has management implications because these sites are least likely to be naturally vacated by beavers, and they serve as sources of young dispersing beavers. These sites are also least likely to experience potential adverse effects such as a decline in vegetation diversity and structure.

Numerous models to assess habitat suitability and quality for beavers and a site's associated carrying capacity have been developed (Slough and Sadler 1977; Willis 1978; Allen 1983; Howard and Larsen 1985; Beier and Barrett 1987; Robel et al 1993). These models typically incorporate quantitative measurements of key abiotic and biotic habitat variables that are thought to affect beaver populations.

Most models show that the most important factors related to beaver habitat use are physical factors, such as stream gradient (low), stream depth (deeper), and stream width (wider). Variables related to vegetation add little to the understanding of beaver occupancy (Beier and Barrett 1987). Reasons cited for the lack of a relationship include the opportunistic nature of food selection and that the observed plant species may have little relationship to the plant species that were present when the colony was established. The models have varying rates of effectiveness in predicting habitat quality/suitability in different habitat types and regions of the country, and some researchers suggest modification of models based on local conditions (Robel et al 1993).

While collecting data to implement a model is beyond the scope of this assessment, a method was developed to provide an initial ranking of habitat suitability.

III.3.B Methods

Agency Consultation

Biologists at the United States Forest Service (USFS) Lake Tahoe Basin Management Unit (LTBMU), the Tahoe Regional Planning Agency and the California State Park system were consulted to determine which federal, state, or regional special status wildlife species could potentially occur within the Study Area. No protocol surveys for special status wildlife species were conducted.

Field Surveys

Field surveys were conducted on foot in Reaches 3 through 11 between August 6 and October 29, 2003. The surveys consisted of walking meandering paths along each side of the river. A list of wildlife species directly observed or detected based on their sign (e.g., scat, tracks) was compiled. Each species' association with Study Area plant communities was recorded.

All beaver dens, lodges, and dams were mapped. Because colonies can construct several dens, more than one den in an estimated 50-foot radius was considered part of the same system and recorded as one den. Active colony sites were distinguished from inactive sites by the presence of freshly cut vegetation, recent maintenance of dams, muddy canals, scent mounds, scat, tracks, and trails that showed recent use (e.g., trampled herbaceous growth).

Beaver Habitat Ranking

For this ranking, beaver habitat is defined as locations where colonies could be established and three criteria were used to develop three classes of beaver habitat in the Study Area (see Table 3.7): presence of riparian habitat, presence of additional water sources, and presence of beaver signs. Factors affecting colony site longevity were chosen as the criteria to rank Study Area habitat because long-term occupancy of an area is highly related to habitat suitability (Muller-Schwarze and Sun 2003). The Study Area habitat was ranked based on the assumption that areas with high quantities of these parameters provide more suitable habitat than areas with low amounts. The extent of riparian vegetation was measured using a dot grid over aerial photographs (1:300 and 1: 400 scale) and reviewing the project's plant community maps (Figures 2.30A-E). Both sides of the river were ranked independently of each other.

Table 3.7: Criteria used to define the three classes of beaver habitat on the Upper Truckee River.

High quality	Moderate quality	Poor-quality
At least 50 feet of riparian habitat is present with a variable moist, herbaceous understory.	Less than 50 feet of riparian habitat is present with a mostly dry herbaceous understory.	Less than 50 feet of riparian habitat is present with little or no herbaceous understory.
Presence of an additional stable water source, such as a spring, seep, or tributary, and abandoned river channels that could flow with water during spring run-off.	No additional water sources are present; any abandoned river channels are unlikely to fill with water during spring run-off.	No additional water sources or abandoned channels are present
Beaver sign* indicates long-term occupancy with little or no indication of a decline in beaver habitat quality (e.g., hedging of shrubs).	Beaver sign* indicates intermittent occupancy with scattered signs of a decline in beaver habitat quality (e.g., hedging of shrubs).	Scant to no beaver feeding sign is present, indicating rare to no use of the site.

* Beaver sign includes dens, lodges, and cuts on woody vegetation

Beaver Population Estimate

Adult beavers are colonial, non-migratory, and occupy an established territory and home range. While beaver populations are difficult to census accurately, counting the number of active beaver colonies and multiplying this figure by the average number of beavers per colony is a common procedure to estimate density (Busher and Jenkins 1983).

An estimated number of active beaver colonies in the Study Area from Reaches 3 through 11 was developed based on: (1) the linear extent of beaver signs along the river indicating current use (e.g., cuttings in water at den sites, actively maintained dams, trampled trails, lodges with cuttings, etc.), (2) the home range sizes of beaver families in Sagehen Creek, California of 656 to 2,625 feet (Busher 1975), (3) the average nearest neighbor distance between colonies at Sagehen Creek of 3,937 feet (Busher and Jenkins 1983), and (4) the number and location of scent mounds.

Data on Study Area beavers are compared with data on beavers from Sagehen Creek (located approximately 60 miles northwest of the Study Area), because they are the closest population of well-studied beavers. Data is available on a beaver population in Little Valley, Nevada, which is located approximately twenty miles northeast of the Study Area. However, because less data is available from this population (two versus more than thirty years for beavers at Sagehen Creek) and the population exhibited unusual colony composition (Busher and Jenkins 1983), it was not used for comparison.

Because each colony constructs only one winter food cache, a survey was conducted October 29 in Reaches 8 through 11 for winter food caches as an indicator of active colony sites.

Two colony types were recorded: established family colonies and colonizing colonies. The former were distinguished from colonizing colonies based on a subjective interpretation of the extent of sign indicating long-term occupancy and on consultation with local residents and El Dorado County officials regarding colony site longevity.

The distinction is important because beaver colonies consist of variable numbers of animals. Most family groups consist of the parents, young of the year, and yearlings. Two-year olds may or may not be present. Colonies can also consist of temporarily single adults and pairs without kits. According to Dr. Peter Busher (Boston University, November 5, 2003, personal communication), an average colony is composed of five to six beavers. This average holds across the beavers' distribution throughout the United States. Therefore, within the Study Area, six animals were assumed to occupy each established family colony. Young, colonizing beavers have small litters compared to established family colonies (Muller-Schwarze and Sun 2003). Therefore, within the Study Area, four animals were assumed to occupy each colonizing colony.

Where beaver sign (e.g., fresh cut branches) was detected at a distance greater than 2,625 feet from an active colony (the maximum home range of beavers in Sagehen Creek), or the sign was

isolated from all other signs of current beaver activity (i.e., outside the estimated home range of the closest colony), it was assumed to represent a single animal.

VEGETATION

At varying intervals, the following information was recorded for plants cut by beavers: species, height at which the vegetation was cut, and the diameter of the cut stem or trunk. Where aspens had been cut, the presence of juvenile-form and/or adult-form trees was recorded along with the height of the new growth. Recently cut woody vegetation was distinguished from older cuts by the color and condition of the wood. Searches were conducted to locate stumps and beaver cut logs that were obscured by an overstory of shrubs and/or herbaceous vegetation. The base of fallen trees in log jams across the river was examined to determine whether beavers were responsible.

III.3.C Agency Wildlife Management

The following section describes the agencies that administer the federal, state, and local environmental laws and policies that apply to special status wildlife species in the Study Area. Special status species are native species that are accorded special legal or management protection because of concern for their continued existence. There are several different categories of protection at both federal, state, and local levels, depending on the magnitude of threat to continued existence and existing knowledge of population levels. Special status species are defined as follows:

- Wildlife species listed or proposed for listing or candidates for listing under federal or state Endangered Species Acts;
- Wildlife species considered Species of Special Concern by the United States Fish and Wildlife Service (USFWS);
- Wildlife species considered sensitive by other federal agencies, such as the United States Forest Service (USFS);
- California Department of Fish and Game (CDFG) threatened, endangered, and Species of Special Concern; and
- Tahoe Regional Planning Agency Species of Special Interest.

FEDERAL ENDANGERED SPECIES ACT

In 1973, the United States Congress enacted the Federal Endangered Species Act (ESA) to protect those species that are endangered or threatened with extinction. The United States Fish and Wildlife Service (USFWS) is responsible for implementation of the ESA. The USFWS identifies specific species of wildlife as threatened, endangered, or sensitive.

Section 7 of the ESA directs federal departments and agencies to ensure that actions authorized, funded, or carried out by them are not likely to jeopardize the continued existence of any threatened or endangered species or result in the destruction or adverse modification of their critical habitat.

The USFS is required to manage National Forest lands so that all existing native and desired nonnative wildlife, fish, and plants can maintain at least viable populations. Forest activities are to be conducted so as to avoid actions that may cause a species to become threatened or endangered (FSM 2670.12). Current management direction is to manage National Forest system habitats and activities for threatened and endangered species to achieve recovery objectives so that special protection measures provided under the ESA are no longer necessary (FSM 2670.21).

California Endangered Species Act

In 1984, the State of California passed the California Endangered Species Act. The CDFG exercises authority to implement and enforce statutes that affect wildlife, particularly those that involve sensitive species. Through a cooperative agreement with the USFWS, the CDFG is responsible for sensitive species identified by the federal ESA.

Tahoe Regional Planning Agency

Within the Lake Tahoe Basin, the Tahoe Regional Planning Agency (TRPA) has developed goals, policies, thresholds and ordinances pertaining to wildlife. TRPA has established Environmental Thresholds for wildlife that address special interest species, habitats of special significance, stream habitats, and instream flows. These Environmental Thresholds are used to establish the significance of an environmental effect to wildlife resources in the Lake Tahoe Basin.

The Thresholds establish a non-degradation management standard for significant wildlife habitat consisting of deciduous trees, wetlands, and meadows, while providing for opportunities to increase the acreage of such riparian associations.

The TRPA has designated six species and one category of species as species of special interest because of rarity or other public interest. The Thresholds provide a minimum number of population sites and designate disturbance zones for the species identified in Table 3.8.

Table 3.8: TRPA Environmental Thresholds for Special Interest Species.

Species of Interest	Population Sites	Disturbance Zone	Influence Zone
Goshawk	12	0.50	3.50
Osprey	4	0.25	0.60
Bald Eagle (Winter)	2	Mapped Areas	Mapped Areas
Bald Eagle (Nesting)	1	0.50	Variable
Golden eagle	4	0.25	9.0
Waterfowl	18	Mapped Areas	Mapped Areas
Deer	0	Meadows	Mapped Areas
Peregrine Falcon	2	0.25	7.6

The TRPA Goals and Policies provide for maintenance of suitable wildlife habitats for all game and non-game indigenous species by maintaining and increasing habitat diversity. Habitats essential for threatened, endangered, or sensitive (TES) wildlife species must be preserved and enhanced. The Goals and Policies also reinforce the provisions of state and federal protection for TES wildlife species. The TRPA Code of Ordinances establishes standards for wildlife resources. They require identification of potential impacts, such as habitat alteration, establish protection mechanisms, and require mitigation measures when necessary.

The TRPA Goals and Policies and Code of Ordinances provide that stream environment zones adjoining creeks and major drainages that link islands of habitat shall be managed, in part, for use by wildlife as movement corridors. Structures proposed within these movement corridors shall be designed so they do not impede the movement of wildlife. Riparian vegetation shall be protected and managed for wildlife.

United States Forest Service

Beaver Management Plan

The USFS Lake Tahoe Basin Management Unit (LTBMU) produced a beaver management plan in 1980 (Reed 1980). The report recommended dividing the Lake Tahoe Basin into beaver management zones. The physical boundaries, the carrying capacities, and the management priorities for each major area were to be determined through interdisciplinary consultation. The plan called for annual or biannual surveys to determine population parameters and distribution within each management zone. Removal of beaver was to be conducted when populations exceeded desired levels, the effects on the watershed and its vegetation were unacceptable, new areas were colonized where beavers were undesirable, beavers were damaging property and/or improvements, or any water supply occupied by beaver was determined to be infected with Giardia spp. or other diseases transmissible from beavers to humans. According to Kathy Campion, LTBMU wildlife biologist (August 13, 2003, personal communication) the beaver management plan was never implemented.

1988 Land Resource Management Plan

The LTBMU Land and Resource Management Plan (LRMP) (USDA1988) was developed to direct management of USFS lands in the Lake Tahoe Basin. For wildlife, the LRMP selected the following ten management indicator species (MIS) to monitor the effects of management practices on native and desired nonnative vertebrate species within the planning area: bald eagle, peregrine falcon, goshawk, spotted owl, mule deer, pileated woodpecker, mallard, black bear, blue grouse, and willow flycatcher. These MIS represent groups of species with similar habitat requirements. Management of these species to maintain viable population levels should also provide for viable populations of the remaining species in the group they represent.

For forest planning purposes, the LTBMU is divided into twenty-one management areas (MA). These MAs represent sections of land that have similar character and/or use, and MA-specific management direction is provided.

The Upper Reach Study Area is in the Tahoe Valley Management Area South Half. The resource emphasis in this area is to meet the recreation, scenic and special uses demands of the large visiting and urban population in the area. The desired future condition for this MA is to have healthy and diverse forest conditions that can support the variety and intensity of recreation and other activities demanded by the large nearby local and visiting population. No MA prescriptions are given for the section of the Tahoe Valley Management Area South Half where the Upper Truckee River is located.

Beaver management is not noted in the 1988 LRMP.

Sierra Nevada Framework

The Sierra Nevada Forest Plan Amendment (SNFPA) (USDA 2000) and Record of Decision (ROD) (USDA 2001) amend management direction in national forest land management plans, including the LTBMU Land and Resource Management Plan (USDA 1988). The SNFPA and ROD will guide activity-level decision making in the LTBMU until they are replaced through subsequent amendment or revision. Where there is overlap between the 1988 LTBMU Land and Resource Management Plan and the SNFPA and ROD, the latter two supplant the LRMP.

As required by the SNFPA and ROD, the LTBMU delineated land allocations for special status wildlife species. These delineations are based on records of occurrences and on areas with potentially suitable habitat characteristics. Each land allocation has a set of standards and guidelines that determine management. Management for lands allocated as protected activity centers (PACs) for the northern goshawk, California spotted owl, great gray owl, and den sites for fisher and marten are as follows:

- California spotted owl nest and roost sites: 300 acres of the best available habitat surrounding each owl activity center detected since 1986, arranged in as compact a unit as possible. Activity centers are based on documented nest sites, most recently known roost sites, or a central point based on repeated daytime detections.
- Northern goshawk breeding sites: 200 acres of the best available forested habitat surrounding nest sites (or, if the nest cannot be located, the location of territorial adults or recently fledged juveniles during the fledgling dependency period) in the largest contiguous blocks possible.
- Great gray owl nest sites: 50 acres of the best available forested habitat plus adjacent meadow habitat surrounding nest sites.
- Fisher den sites: 700 acres of the highest quality habitat in a compact arrangement surrounding den sites in the largest, most contiguous blocks available.
- Marten den sites: 100 acres of the highest quality habitat surrounding den sites, arranged in as compact a unit as possible.
- Willow flycatcher habitat. The standards and guidelines for willow flycatcher habitat include assessing impacts of livestock grazing and conducting surveys for willow flycatchers.
- California Spotted Owl Home Range Core Areas. California spotted owl home range core areas surround and include the 300-acre PAC. Home range core area sizes vary by national forest; for the Tahoe National Forest, it is 1,000 acres. Management objectives for California spotted owl home range core areas are identical to those for old forest emphasis areas. This direction applies to California spotted owl home range core areas, except where home range core areas overlap with urban wildland intermix zone.

Limited operating periods (LOPs) are applied to PACs and den sites during nesting and denning seasons to protect breeding adults and their offspring as follows:

- California spotted owl: within ¼ mile of nest site March 1 through August 31, unless surveys confirm that California spotted owls are not nesting.
- Northern goshawk: within ¼ mile of nest site February 15 through September 15, unless surveys confirm that northern goshawks are not nesting.
- Great gray owl nest sites: within ¼ mile of active great gray owl nest stands March 1 through August 15.
- Fisher den sites: March 1 through June 30.
- Marten den sites: May 1 through July 31.

Although the Framework (USDA 2001) does not include LOPs or buffer zones for willow flycatchers, the California Department of Fish and Game (CDFG) has implemented no-disturbance buffer zones of several hundred feet for any activities that could potentially impact nesting willow

flycatchers. The TRPA does not currently have limited operating periods or buffer zones for willow flycatchers, but defers to existing management schemes.

SENSITIVE HABITAT SITES WITHIN THE STUDY AREA

Sensitive habitats within the Study Area are sites that could affect project activities through imposition of agency restrictions on timing of activities and alteration of vegetation.

Sensitive habitats within the Study Area include those identified by the USFS as occupied, emphasis, and suitable willow flycatcher habitat and the habitat delineated as a spotted owl protected activity center.

All riparian habitat consisting of willows and alders provide suitable habitat for willow flycatchers. Any activities in these locations would require annual pre-project surveys. If willow flycatchers are found, a variable LOP would be developed in consultation with agency biologists. Activities that caused the loss or temporary alteration of willows at documented willow flycatcher nesting sites would probably not be allowed.

The aspen and cottonwood forests in the Study Area are considered sensitive wildlife habitat. Aspen stands are designated an Ecologically Significant Area (ESA) in the Lake Tahoe Basin because they are uncommon and because they have an exceptionally diverse array of associated species. Manning and Schlesinger (2001) suggest that aspen and cottonwood in the Basin may function as keystone species because they rated relatively high in biological diversity despite occurring infrequently on their sample reaches. Project activities that occur in aspen or cottonwood forests would probably be subject to restrictions on loss or alteration of habitat.

III.3.D Results and Discussion

SPECIAL STATUS SPECIES

The following three special status species and category of special status species occur in the Study Area: willow flycatcher, spotted owl, mule deer, and waterfowl.

Willow flycatcher

Willow flycatchers are summer resident breeders in the Sierra Nevada. Suitable breeding habitat for willow flycatchers includes large, open stands of willows in wet meadows. The presence of water during the breeding season is an important habitat component. The minimum size meadow is assumed to be 0.62 acres (Fowler et al. 1991). While wet meadows are the most common habitat used for breeding, willow flycatchers have been found breeding in riparian habitats of various types and sizes, including grasslands, boggy areas, riparian deciduous shrubs along streams, and small lakes and ponds surrounded by willows with a border of meadow or grassland.

Breeding populations of willow flycatchers in the Sierra Nevada can occur in isolated mountain meadows up to 8,000 feet in elevation (Harris et al. 1988).

Willow flycatchers arrive at their breeding territories in early May and nesting begins between late May and late July. The cup-shaped nests are usually between 3.7 to 8.3 feet above the ground and are found most often near the edge of clumps of deciduous riparian shrubs (Sanders and Flett 1989; Harris 1991). Eggs are incubated about twelve days and chicks fledge after 12-15 days. The adults and fledglings generally remain in the breeding area through August. Willow flycatchers forage by either aerially gleaning or hawking insects.

Alteration and loss of riparian habitats are believed to be the main causes for declining breeding populations of willow flycatchers (Sanders and Flett 1989). Other factors that might have contributed to its decline include nest parasitism by brown-headed cowbirds (*Molothrus ater*), disturbance and habitat degradation from grazing, and events occurring on wintering grounds (Serena 1982; Harris et al. 1988).

Occupied habitat is meadow or riparian sites with documented willow flycatcher occupancy. Emphasis habitat is defined as meadows larger than 15 acres that have standing water on June 1 and a deciduous shrub component. Suitable (potential) habitat includes (1) occupied willow flycatcher habitat; (2) known willow flycatcher sites; (3) emphasis habitat; and (4) small, wet woody meadows (meadows less than 15 acres that have standing water on June 1 and a deciduous shrub component).

The LTBMU has mapped three types of willow flycatcher habitat within the Study Area. Approximately 20,610 feet are delineated occupied habitat in Reaches 5 through 11 and approximately 3,960 feet in Reach 3, approximately 2,640 feet are delineated emphasis habitat (Reach 4), and approximately 9,240 feet are mapped as suitable habitat (portions of Reaches 1 through 4).

The USFS implements a limited operating period from June 1 to August 31 due to willow flycatcher breeding. These dates may be modified when multi-year monitoring data support different dates for a particular breeding location.

California spotted owl

According to the California Spotted Owl Sierran Province Interim Guidelines Environmental Assessment (CASPO Report) (USDA 1993), nesting and roosting habitat typically includes a forest stand with greater than 70% canopy cover. Optimum habitat consists of dense, mature trees with multiple canopies and abundant snags and down woody material. Nesting habitat is characterized by dense canopy closure (>70%) with medium to large trees and usually at least two canopy layers present. In addition, nest stands usually have some large snags and an accumulation of logs and limbs on the ground (USDA 1993). Foraging habitat can include all medium to large tree stands with 50% or greater canopy closure.

The CASPO Report (USDA 1993) provides management guidelines for forests in the Sierran Province that support populations of the California spotted owl. The report specifies that a Protected Activity Center (PAC) be established around all known owl sites (including pair, resident single, and single bird locations) detected between 1987 and 1992. According to the technical team recommendations from a June 1994 meeting, if owls are detected on the LTBMU, then their habitat will be managed in accordance with the Modified Cumulative Effects Analysis (CEA) Process.

A spotted owl PAC is mapped in the vicinity of Reaches 10 and 11. A 1,000-acre home range core area is also designated around the PAC and encompasses the best available spotted owl habitat in closest proximity to the PAC.

A quarter-mile limited operating period prohibits activities within approximately ¼ mile of the nest during the breeding season from March 1 through August 31, unless surveys confirm that California spotted owls are not nesting. The LOP may be waived for individual projects or activities of limited scope and duration or when the biological evaluation documents that such projects are unlikely to result in breeding disturbance considering their intensity, duration, timing, and specific location. Where a biological evaluation determines that a nest site will be shielded from planned activities by topographic features that minimize disturbance, the LOP buffer may be reduced.

Mule deer

The Study Area contains summer range for the Carson deer herd. Deer habitat in the LTBMU consists of summer range only, mostly in the form of meadows and early to mid-successional vegetation stages with brush that can be used for forage and cover (USDA 1988). Preferred habitat requirements for fawning include undisturbed meadow and riparian areas that provide hiding cover and succulent forage. Mule deer preferentially browse on shrubs rather than graze on forbs and grasses. Preferred shrubs are mostly in the rose family and include bitterbrush, cliff-rose, and rose. Willows and many other riparian species are also favored. To avoid heavy snows and reduced forage, mule deer migrate primarily altitudinally. The regional migrations of the Carson deer herd entail movements from summer range into lower elevation winter range, located outside the Tahoe Basin, east of the Study Area.

The Study Area is located in summer habitat for the Carson Deer Herd. No mapped migration routes or critical winter, fawning, or summer range habitat for the Carson Deer Herd occurs in or near the Study Area. Mule deer beds, scats, and tracks were observed in the upper Study Area. Signs of browsing by deer on dogwood were conspicuous, but were not obvious on either willow or alder. The historic conditions described in this assessment's vegetation report (Section III.2) suggest that plant communities used by deer for foraging (e.g., mountain sagebrush scrub, Jeffrey/lodgepole pine savannah) were once more extensive. The invasion of meadows by conifers has reduced the extent of edge habitat preferred by deer. No restrictions, such as LOPs, are applied to the presence of mule deer.

Waterfowl

Preferred habitat for waterfowl includes marshes, wet meadows, creek drainages, and along the shallow shorelines of lakes. A total of 18 sites within the Lake Tahoe Basin are designated as mapped waterfowl habitat by TRPA. Mapped waterfowl habitat is present five miles north of the Study Area in the Upper Truckee River Marsh. This site is the primary nesting area used by waterfowl in the LTBMU (USDA 1988). More than half of the marsh has been replaced by urban development (USDA 1988). No mapped waterfowl habitat is delineated in the Study Area.

The waterfowl detected in the Study Area were common species such as Canada geese, mallards, and mergansers. Spotted sandpipers and killdeer were observed along the sandy, open shores of the river. Both are ground nesting species that nest in the Study Area. Snipes were observed in marshy areas in the vicinity of beaver dams that were constructed on side channels and springs. No restrictions, such as LOPs, are applied to the presence of waterfowl.

Field Survey

A list of wildlife species observed during the field surveys was compiled. A total of 41 bird species, 14 mammals, one reptile, and one amphibian species were detected either by direct observation or by sign, such as scat, tracks, burrows, and/or carcass. These species and their associated habitat types are shown in Tables 3.9 and 3.10. The habitat types are composed of one or more of the community types discussed in the vegetation report (Section III.2).

Table 3.9: Bird species observed in the Upper Reach Study Area, August 6 to October 29, 2003.

COMMON NAME	SCIENTIFIC NAME	SIGN*	PREFERRED HABITAT **
American robin	*Turdus migratorius*	O, V	ALL TYPES
Mallard	*Anas platyrhyncos*	O, V	WM, RI
Common merganser	*Mergus merganser*	O, S	RI
Common snipe	*Gallinago sericea*	O, S	WM, RI
Killdeer	*Charadrius vociferus*	O	WM, RI
Spotted sandpiper	*Actitis macularia*	O, V	RI
Canada goose	*Branta canadensis*	S	WM, DM, M
Belted kingfisher	*Ceryle alcyon*	O, V	RI
Cooper's hawk*	*Accipiter cooperi*	F	CF, MF, DF
American dipper	*Cinculus mexicanus*	O, V	RI
Red-tailed hawk	*Buteo jamaicensis*	O	CF, MF, DF, R, M, WM
Cassin's finch	*Carpodacus cassinii*	O	CF, MF, DF
Hermit thrush	*Cathartes aura*	O	CF, MF, DF
Northern flicker	*Colaptes auratus*	O, V	CF, MF, DF
Band-tailed pigeon	*Columba fasciata*	O	CF, MF, DF
Western wood-peewee	*Contopus sordidulus*	O, V	CF, MF, DF, R, EDGES
Common raven	*Corvus corax*	O	ALL TYPES
Stellar's jay	*Cyanocitta stelleri*	O, V	CF, MF, DF
Yellow-rumped warbler	*Dendroica coronata*	O, V	CF, MF, DF
Brewer's blackbird	*Euphagus cyanocephalus*	O, V	R, M, WM
Red-winged blackbird	*Agelaius phoeniceus*	O, V	R, M, WM
Tree swallow	*Tachycineta bicolor*	O	R, M, WM, RI

COMMON NAME	SCIENTIFIC NAME	SIGN*	PREFERRED HABITAT **
Black phoebe	*Sayornis nigricans*	O	R, M, WM, RI
Barn swallow	*Hirundo rustica*	O	R, M, WM, RI
Dark-eyed junco	*Junco hyemalis*	O, V	CF, MF, DF, WM, EDGE
Song sparrow	*Melospiza melodia*	O, V	R, WM, FOREST EDGE
Clark's nutcracker	*Nucifraga Columbiana*	O	CF, MF, DF
Fox sparrow	*Passerella iliaca*	O, V	CF, MF, DF, R, MS
Cliff swallow	*Petrochelidon pyrrhonota*	O	R, M, WM, RI
Black-headed grosbeak	*Pheucticus melanocephalus*	O	R, M, WM
Downy woodpecker	*Picoides pubescens*	O	CF, MF, DF
Mountain chickadee	*Poecile gambeli*	O, V	CF, MF, DF
Mountain bluebird	*Sialia currocoides*	O	M, WM. MS
Red-breasted nuthatch	*Sitta canadensis*	O	CF, MF, DF
White-breasted nuthatch	*Sitta carolinensis*	O, V	CF, MF, DF
Western meadowlark	*Sturnella neglecta*	O	M, WM
House wren	*Troglodytes aedon*	O	CF, MF, DF
Warbling vireo	*Vireo gilvus*	O, V	MF, DF, R
Wilson's warbler	*Wilsonia pusilla*	O	R, M, WM
Mourning dove	*Zenaida macroura*	O, V, C	CF, MF, DF, R, M, WM
White-crowned sparrow	*Zonotrichia leucophrys*	O, V	R, WM

* O–Observed, V-Vocalization, B-Burrow, T-tracks, S-scat, F-foraging sign, C-carcass

** Coniferous forest (CF) (Lodgepole pine forest Jeffrey pine forest)

Mixed forest (MF) (Jeffrey pine-aspen forest, Pine-black cottonwood forest)

Deciduous forest (DF) (Black cottonwood forest, Quaking aspen forest)

Riparian (R) (Mountain alder-mixed willow riparian scrub, willow scrub)

Meadow (M) (Dry meadow, Revegetation dry meadow, Mesic graminoid meadow, Mesic forb community)

Wet Meadow (WM) (Wet graminoid meadow, Obligate sedge wetland)

Mountain sagebrush (MS)

River (RI)

Table 3.10: Mammal, reptile, and amphibian species detected in the Study Area, August 6 to October 29, 2003.

COMMON NAME	SCIENTIFIC NAME	SIGN*	PREFERRED HABITAT **
Coyote	*Canis latrans*	O, T, S	ALL TYPES
Porcupine	*Erithrozon dorsatum*	S, F	CF, MF, DF
Vole	*Microtus spp.*	O, S, B	M, WM
Mule deer	*Odocoileus hemionus*	T, S, F	ALL TYPES, EDGES
Raccoon	*Procyon lotor*	T	R
Shrew	*Sorex spp.*	C	M, WM
Golden-mantled ground squirrel	*Spermophilus lateralis*	O, B	M, MS
Douglas squirrel	*Tamiasciurus douglasii*	O, V	CF, MF, DF
Mountain pocket gopher	*Thomomys monticola*	B	CF, M, MS
Broad-footed mole	*Scapanus latimanus*	B	CF, M, MS
Black bear	*Ursus americanus*	S, T	CF, MF, DF, WM, M, R
Western gray squirrel	*Sciurus griseus*	O	CF, MF, DF
Beaver	*Castor canadensis*	O, S, F, T	R, RI
Muskrat	*Ondatra zibethicus*	S, T	R, RI
Garter snake	*Thamnophis spp*	O	R, WM
Pacific tree frog	*Hyla regilla*	O	R, WM

BEAVERS

Habitat Ranking

Using the criteria in Table 3.7, the approximate number of linear feet in each category for each reach is presented in Table 3.11. The high quality habitat is depicted on Figures 3.30A-E. The plant communities associated with the three classes of beaver habitat are presented in Table 3.12.

Table 3.11: Approximate linear extent (feet) of the three categories of beaver habitat quality n Reaches 3 through 11. The linear length is for both sides of the river.

Reach Number	High quality	Moderate quality	Poor quality
1	NS	NS	NS
2	NS	NS	NS
3	0	5,250	0
4	1,800	2,000	1,150
5	0	8,800	0
6	0	7,150	0
7	0	4,100	0
8	1,050	5,550	0
9	0	2,400	0
10	1,200	300	0
11	0	2,750	0
Total	4,050	38,250	1,150

NS=Not surveyed for beavers

Table 3.12: Study Area plant communities associated with the three classifications of beaver habitat.

Preferred Habitat	Moderate quality	Poor-quality
Cottonwood forest	Pine-cottonwood forest	Lodgepole pine forest
Aspen forest	Jeffrey pine aspen forest	Jeffrey pine forest
Pine-cottonwood forest	Dry meadow	Sagebrush-dry meadow
Alder-willow thicket	Alder-willow thicket	
Willow thicket	Willow thicket	
Mesic forb	Mesic forb	
Wet meadow		
Obligate marsh		

The number of dens and lodges per project reach are summarized in Table 3.13 and depicted on Figures 3.30A-E. The number of signs indicating beaver colony presence (i.e., dens and lodges) does not correlate with habitat quality. The number of dens and lodges shows locations that beavers have established colonies. Fewer dens and lodges are constructed in high quality habitat with long-term occupants, thus these features do not increase in number. Dispersing beavers that must occupy less suitable habitat will use existing lodges and dens but might also need to construct new lodges or dens.

Table 3.13: Number of beaver bank den sites and lodges on the Upper Truckee River detected during surveys conducted between August 6 and October 29, 2003.

Reach Number	Dens	Lodges
1	NS	NS
2	NS	NS
3	10	0
4	15	0
5	12	0
6	8	1
7	4	0
8	16	2
9	4	0
10	0	1
11	8	0

NS=Not surveyed for beavers

Beavers do not appear to have established colonies in sections of the river that are narrow and confined. Signs of foraging were also scarcer in these areas. For example, no dens or lodges were found in the confined, upstream portion of Reach 9. Such sections might be more appropriately ranked as poor quality beaver habitat. A model that included physical factors such as floodplain width and water depth would further refine the ranking of beaver habitat in the Study Area.

Beavers maintain an underwater entrance to their lodge or bank den for security and safety from land predators. Usually dams are necessary to provide sufficient water depth for this purpose. The inactive dens and lodges provide indirect information regarding the river's likely location when these features were constructed. They also indicate the general locations beavers constructed dams.

The location of high quality habitat is dynamic and can change unfavorably for beavers if the additional source of flowing water is compromised. For example, at one time, approximately 750 feet of the west side of the river in Reach 5 provided high quality habitat. A pond depicted on the 1992 USGS Echo Lake quadrangle appears to be due to a beaver dam on a side channel of the river. Observations of beaver herbivory in the vicinity suggest this was a long-term colony site. However, once the flow of water into this site was altered, perhaps during the 1997 rain on snow event, the beavers probably abandoned the area.

Another example of the beavers' response to change in the flow regime of the additional water source is from the colony in Reach 10. The large beaver pond in this reach began to decline in depth in late August, 2003. By the end of October, the water level was several feet lower than in August and no longer surrounded the lodge. The site's function was compromised and the beavers began to build dams in the main channel of the river. The cause of the declining water is not known, but it did not appear to be due to a breach in their dam. This site has previously provided suitable winter habitat, as evidenced by the lodge and the presence of old winter food caches.

In high quality habitat, much damming activity occurs on side channels, springs, and seeps, although dams are also constructed on the main river channel. An additional water source is essential to the development of long-term colonies in the Study Area. Beaver colonization in high quality habitat typically produces many of the benefits associated with beavers, such as improved wildlife habitat complexity and diversity. These positive effects occur because dams constructed in locations other than the river's main channel are relatively stable.

In habitat ranked as moderate quality, less water is available to dam in areas away from the main river channel, and therefore colonies must construct dams in the main river channel. These main channel dams are less stable and more likely to blow out during high runoff years. Predicting where beavers will establish colonies is difficult. However, there are sites within the moderate quality habitat where old remnant channels or ephemeral drainages are present. These sites lack enough water for the beavers to establish functional dams. Restoration projects that cause these sites to fill with water would increase their suitability for beavers. Beaver colonization of these locations could subsequently produce more complex habitats.

Population Estimate

Surveys for winter food caches are reliable indicators of active beaver colonies. However, the October 29 survey for winter food caches in Reaches 8 through 11 was not effective in locating food caches at all active colony sites. Because of the poor results, this method was not used to confirm the presence of active colonies in other reaches.

The estimated number of all colony types in the Study Area from Reaches 3 through 11 is six (Table 3.14). Assuming six beavers per established family colony and four beavers per colonizing colony, the six colonies consist of 28 beavers. Including the three single beavers, the total number of beavers in the surveyed portion of the Study Area is 31. Using a distance of 4.3 miles between Reaches 3 and 11, the number of beavers per mile is 7.2.

This number is greater than the highest number of beavers per mile reported by Busher (1987) for beavers at Sagehen Creek. Busher summarized the 34-year demographic history of this non-trapped, marked, beaver population. He identified two demographic phases in which the beaver population was high. For both periods, the number of beavers was 6.4 individuals per mile. Busher used habitable length of stream when calculating Sagehen Creek's population density. When correcting for uninhabitable length of stream in the Study Area (1,150 poor quality habitat in Reach 4), the number of beavers per mile is 7.6.

Busher et al (1983) reported a mean number of beavers per colony of 4.8 for colonies in Sagehen Creek. When using 4.8 to compute the number of beavers in the Study Area's established family colonies, the number of beavers per mile is 6.7 (for a population of 29). The indirect data collected to determine beaver numbers in this study could overestimate the number of beavers by including the category individual beavers. Even when that number is excluded, the number of beavers per mile is 6.5.

An assessment was made that the beaver activity in Reach 11 is from the same colony of animals occupying Reach 10. If this assumption is incorrect, then the number of colonies within the Study Area would be increased by one colonizing colony, with a concomitant increase in population size.

The total colony density in Reaches 3 through 11 is 1.39 colonies per mile. Suitable habitats can accommodate 1.8 colonies per mile (Muller-Schwarze and Sun 2003). Busher (1987) found a family colony density of 1.12 per mile at Sagehen Creek. Beaver colony densities in other regions range from 0.64 per mile in Alaska to 1.76 per mile in Brunswick, New Jersey (Muller-Schwarze and Sun 2003).

Table 3.14: Estimated number of active beaver colonies and number of single beavers per reach determined from surveys conducted between August 6 and October 29, 2003.

Reach Number	Established Family Colony	Colonizing Colony	Single Beavers
1	NS	NS	NS
2	NS	NS	NS
3	0	1	0
4	1	0	0
5	0	0	1
6	0	0	1
7	0	2	0
8	0	1	1
9	0	0	0
10	1	0	0
11	*	0	0
TOTAL	2	4	3

* The home range of the established family colony in Reach 10 encompasses Reach 11
NS= Not surveyed for beaver

Including both active and inactive sites, beavers have colonized the entire Study Area, however the river is not currently saturated with beavers. This is most likely due to ongoing nuisance beaver removal. Whether the Study Area's population is expanding, stable, or declining can be determined only from long-term studies, although a review of CDFG records could contribute to a better understanding. The comparison of the population estimate derived from the field survey with the data reported from Sagehen Creek suggests that the population is approaching carrying capacity, although long stretches of the river are currently unoccupied by colonies (e.g., Reach 5).

Effects on Study Area Vegetation

The entire Study Area provides potential foraging habitat for beavers. Signs of foraging by beavers were continuously present along most portions of the surveyed reaches. The distance from the river at which signs of foraging were found was variable. In one location (Reach 5), beavers foraged up to 120 feet from the river, in other locations with less suitable habitat, only riparian shrubs immediately adjacent to the river were cut.

Riparian Vegetation

Willows exhibited good vigor and a wide variety of age classes and sizes, despite heavy use in some reaches. Excessive foraging on individual plants can cause a hedged architecture. Hedged plants have more basal branches and are shorter than willows farther away from the river. Hedging of willows and alders growing along the river's edge was noted primarily in Reaches 3 and 4.

No preference by beaver for one species of willow over another was detected. However, willows growing in tree form were used more often in winter (based on cut height) than those in shrub form. The secondary stems growing from the primary trunk of tree-form willows were preferred by beavers rather than the large primary trunks. Each cut stem subsequently produced tertiary stems that beavers harvested in following seasons.

Willow cutting by beavers promotes suckering and rapid growth (Kindschy 1989). It does not typically result in loss of the willow plants. However, in one location in Reach 6, several very old willow plants that had been cut by beavers were observed. These plants never regenerated and thus died. Browsing by beaver, in conjunction with other herbivores such as cattle and elk was found to cause the loss of young shoots and saplings (Zeigenfuss et al. 2002; Muller-Schwarze and Sun 2003). While deer browsing on dogwood was apparent, no other herbivore browsing was observed that could account for the death of the willows. Other conditions, such as water stress due to altered hydrology, could have made the plants more vulnerable to herbivory and reduced their ability to compensate for the lost stems and foliage.

Compared to willows and alder, dogwood was the least preferred food plant. Dogwood is present in discrete patches along the river corridor, but is the most abundant shrub in Reach 11. This species was cut less often than alder or willows, except in Reach 11. Beavers at all sites cut dogwood but they mainly used it for construction of dams and food caches. The leaves and bark were often not stripped from dogwood branches prior to use in dams. The leaves of alder branches were typically stripped but the bark was often left intact. Willow branches were always stripped of leaves and were usually stripped of their bark.

Aspen

Aspen reproduces asexually by root sprouts that occur in two morphologies: adult-form sprouts have small leaves and heavy lateral branching, and juvenile-form sprouts have large leaves and an absence of lateral branching. In areas newly occupied by beaver, adult-form sprouts predominate, whereas an abundance of juvenile-form sprouts is associated with prolonged beaver activity (Basey et al. 1988). Due to altered chemistry, juvenile-form sprouts are avoided by beavers when adult-form sprouts are available (Basey et al. 1990). Based on tree height and stem diameter, the age of the juvenile-growth form aspens in the Study Area ranged from less than one year to ten years of age.

In some areas, beavers can cause local extinction of aspens (Beier and Barrett 1987). Local extinction of aspen due to beavers (both browsing and flooding) was found outside of the Study Area, approximately 0.6 miles south and upstream of Reach 11. However, no locations were found within the Study Area where aspen was used to the point of extinction, or where most stems have died

Longer occupancy by beavers at a site is reflected by greater use of aspen (Basey et al 1990). The beaver colony in Reach 10 has been active for at least 17 years, although beaver occupancy might have been interrupted during some years due to unconfirmed nuisance beaver removal. Even so, a large stand of vigorous aspen of mixed ages is present east of the colony site. Historic use of this stand is evident by cut stumps, but large stands of mature aspen remain, as well as extensive stands of adult-form saplings. It is likely that potential loss of aspen stands due to beaver foraging is moderated by nuisance beaver removal.

Two sites were identified in the Study Area where beavers affected the presence of aspens. In Reach 9, a mature aspen grove was cut by beavers and replaced by tree-like alders that measure between five and eight inches in diameter (at one foot high) and are approximately 20 feet high. Both mature and sapling-sized aspens still grow on the periphery of this site. Beavers caused the loss of the mature aspen, but additional conditions are likely responsible for the lack of root suckering at this site (Dr. Adrian Juncosa, project botanist, November 4, 2003, personal communication).

An extensive area of declining aspen numbers was noted for approximately 1,200 feet on the west side of Reach 5. Beavers have cut the aspens in this area, which grow in a relatively narrow swath. Root suckering has occurred in places and juvenile-form aspens are also present. The beaver cutting, in conjunction with conifer invasion (e.g., lodgepole, white fir), has contributed to a decline in stand vigor as more dead than live stems were present.

One decadent stand of aspen was noted in the southernmost portion of Reach 6 on the river's west bank. Several standing dead aspens were observed, but the mortality was not due to cutting by beaver. Beaver cut mature aspen in this area and are currently cutting smaller aspen. Based on the spongy, wormy quality of the wood present in cut stumps, the mature trees were probably cut at least twenty years ago (Dr. Adrian Juncosa, project botanist, November 25, 2003, personal communication). No suckering on the large cut stumps was present. Both adult-form and juvenile-form aspens are present west of this old cutting area. Based on the fifteen-foot height of the adult-form saplings and stems measuring one to three inches diameter at breast height (dbh), these trees are between ten and twenty years old (Gese and Shadle 1943; Stegeman 1954).

Cottonwood

Cottonwood trees are discontinuously distributed from Reaches 4 through 11. The trees typically occur as single plants with multiple trunks or as small stands of several trees. In general, the trees appear similar in age with a trunk diameter at 20 inches height (the approximate height at which beavers cut cottonwood trees) of three to four feet, although a few smaller individuals were noted.

Historic and current beaver foraging activities appear to have minimal effects on survival of mature cottonwood trees in the Study Area. In a 1,800-foot section (900 feet up and 900 feet back) encompassing parts of Reach 6 and 7 (from UTM 0758802/4301197 to 0758859/4302242), the location of all cottonwood trees was recorded, along with whether the trees were cut by beavers or not.

A total of 28 sites with cottonwood trees were documented along both sides of the river (approximately 1,800 feet in length). At three sites, some cottonwood trees were protected with wire. Of the 28 sites, beaver cutting was found on six sites (21%). On some tree trunks, adventitious buds and branches developed below the cuts, which beavers subsequently cut at various intervals. Except for two sites, the beaver cuts did not result in the trees falling or in tree mortality. In the two cases of felled trees, the felled trees were much smaller than the mature specimens noted throughout the majority of the Study Area (16 inches at cut height of approximately 19 inches). The felled cottonwoods were located beneath alder thickets that measured approximately 15 to 20 feet in height, which suggests the trees were felled more than ten years ago. No cuts were noted on the alder.

To varying extents, similar trends in cuts on mature cottonwood trees were noted in the other reaches. Beavers do not appear to preferentially forage on mature cottonwood trees. Compared to younger specimens, the thick platey bark of mature cottonwood trees might render them less palatable to beavers (Dr. Peter Busher, Boston University, November 5, 2003, personal communication). Sufficient sources of other food plants, including aspen, willows, and herbaceous vegetation, might also reduce the need for beavers to cut mature cottonwoods.

Trees larger than approximately 20’ dbh in log jams across the Upper Truckee River were examined for signs that beavers had felled them. Cottonwood trees were distinguished from other tree species on the basis of morphology, such as branch characteristics and the presence of bark. Trees in seventeen log jams were examined. Only one contained a cottonwood tree felled by beavers.

Five sites were noted in the 1,800-foot section where cottonwood regeneration was occurring. Multiple sprouted cottonwoods and/or saplings were present at these sites. At three sites, the trees measured between three and four feet in height, while trees at the other sites were approximately 15 feet in height. Cottonwood regeneration was noted in a few other reaches, but not to the same extent as that found in the 1,800-foot surveyed section. The current regeneration

throughout the Study Area might not be sufficient to replace the existing cottonwood stands as they become decadent.

Signs of beavers browsing on cottonwood saplings were not found. However, if beavers prefer smaller cottonwoods, cottonwood recruitment could be suppressed as beavers selectively forage on these trees in the future.

Beavers can cause local extinction of cottonwood trees and this effect was documented in the Truckee River Basin, California (Beier and Barrett 1987). The potential effects of beaver foraging on smaller cottonwood trees could be moderated by the presence of other food species, such as aspen and willows, which are abundant in this area. In addition, beaver numbers in this area are likely to remain low due to nuisance beaver removal.

III.3.F Beaver Mediated Effects in the Study Area

Beaver dams constructed on the main river channel often do not last following spring runoff and must be constructed again in the summer and fall. Dam failure could lead to erosion of banks and loss of bank vegetation, including trees. There might be areas where the likelihood of failure for main channel dams is minimized and where the effects of dam failure could also be reduced. Identification of these locations could assist in river restoration. In areas where dam wash-outs could cause bank failure, beavers could be controlled in the fall, prior to dam construction. Following any beaver removal, dams should also be removed.

It should be assumed that beavers will dam any side channels with flowing water, especially when the channels occur in conjunction with suitable habitat, such as herbaceous and woody vegetation. The beaver dams raise the water table level, which support further growth of these plant communities. The networks of dams placed in side channels do not appear to fail during spring runoff as they were still readily detectable in numerous places without active colonies. Beaver dam activity in side channels increases the complexity and diversity of the system.

Greater numbers and diversity of wildlife were observed in dammed side channels compared to these pools of water created when beavers dammed the main river channel. Dammed pools on the river did not develop the complex plant communities associated with the side channels, probably because the dams frequently blow out.

The vegetation report prepared for this assessment concluded that riparian shrub and herbaceous communities, specifically ones dominated by hydrophytic species and lacking any coniferous component, were much more extensive prior to the last few decades. These types of communities provide preferred habitat conditions for several special status species, including the willow

flycatcher and mountain yellow legged frog. Beavers can help to create these community types through the sequence of events that transpire following construction of their dams at stable sites.

The greater extent of historic riparian vegetation predicted by the assessment's vegetation report would have provided suitable willow flycatcher habitat. Beaver colonies help create suitable breeding habitat for willow flycatchers. Specifically in Reach 10, the extensive network of dams in the wet meadow, in addition to the large dam on the beavers' main pond, creates a wetter environment than what would be present without the beavers. Many of the willow flycatcher's insect prey species have aquatic life stages. The presence of abundant water in a variety of forms, still water with a silt bottom in addition to running water in the Upper Truckee River, probably increases habitat suitability for this species. In addition, by cutting willows and building dams, the beavers have created an environment where a variety of willow seral stages are present.

Stable, inactive beaver dams were observed to accumulate sediment and silt. This led to changes in plant succession as riparian shrubs and wetland plants invaded the former ponds. An interesting example of this phenomenon is located in Reach 6, in the vicinity of a westward flowing tributary to the Upper Truckee River. Multiple dams are present with no evidence of failure. Deposition of sediment and silt behind the dams created flat areas with lush herbaceous vegetation. Snipe, bear, and muskrat were detected at this location, and a single beaver appears to be re-colonizing this site adjacent to the river. Opportunities for succession are limited to stable dams constructed outside the river's main channel.

Although beavers will cut all sizes of preferred species such as aspen, they do prefer smaller aspens (2-4" dbh) when available (Basey et al 1990). Based on the record of beaver herbivory provided by cut stumps, it appears that mainly mature aspen were cut when beavers first entered an area. This might be because only mature trees were available. Assuming the same rate of decomposition for stumps of variable sizes, the lack of sapling-sized cut stumps in these areas supports this assumption. Beaver cutting of mature aspen stands has resulted in a shift toward younger age classes for most aspen stands in the Study Area. In some locations, juvenile-form aspen predominate, but in other areas a mix of both adult- and juvenile-forms are present, along with mature individuals.

Aspen regenerate in response to disturbance such as fire. Fire suppression in the Basin could have resulted in mostly mature aspen stands with less diverse age classes. Aspen cutting by beaver in some locations might contribute to the renewal of aspen stands. Changes in stand composition due to foraging by beavers affects tree height and canopy cover. Canopy cover is lower in mature aspen stands (25 to 60%) than in young and intermediate aged stands ((60-100%) (Verner 1988). Wildlife species associated with mature stands (e.g., northern goshawk) might be expected to decline while wildlife species associated with young stands (e.g., mule deer) might be expected to increase as a result of this shift.

III.3.F Opportunities and Constraints

Opportunities

- A beaver management plan should be developed for the Study Area. Managing beaver populations is necessary; unmanaged beaver populations will grow to capacity and saturate their habitat (Muller-Schwarze and Sun 2003). Beaver populations change slowly and do not experience the cyclical population patterns that characterize other rodent species. Beaver populations do experience some self-regulation. For example, sparse populations produce more offspring than saturated populations. However, before self-regulation is likely to occur, beavers will be in conflict with people and other resources.

  Coyotes (*Canis latrans*) are a major predator of beavers (Jenkins and Busher 1979) and they, along with black bears (*Ursus americansus)*, are one of the few potential predators of beavers present in the Study Area. Because there are few predators that could prey on Study Area beavers, nuisance removal is an important component that will prevent beavers from exceeding the Study Area's carrying capacity.

  Management of beaver colonies requires providing sites for dispersing beavers to colonize. Beavers leave their home colony at about two years old. Young beavers may emigrate considerable distances over both land and water. Distances traveled average about 4.8-9.6 stream miles. In one study of yearling movements (Muller-Schwarze and Sun 2003), 70% moved at least one mile, one individual moved six miles, and another individual moved ten miles. Thus, beavers dispersing from Study Area colonies could remain within the Study Area, move farther up or downstream, or move out of the watershed. Likewise, beavers dispersing from colonies outside the Study Area (i.e., Upper Watershed of Upper Truckee River, Elbert Lake, etc.) could emigrate into the Study Area.

  Ideally, population density should be low enough so that young beavers leaving their parental colony can find places to settle without becoming nuisance beavers in conflict with people's land use. On a landscape level, this means management activities should be designed to provide suitable immigration sites by keeping enough stream sections and other wetlands free of beavers.

  Determining a suitable number of colonies within the Study Area and vicinity is necessary. North American wildlife managers aim for 10-30% occupancy of potential beaver sites (Muller-Schwarze and Sun 2003). Based on 30% occupancy of the Study Area, two colonies are appropriate for Reaches 3 through 11.

  Currently, beaver management in the Study Area and vicinity consists of responding to residents' complaints, which results in the elimination of the nuisance animals. Nuisance beavers have also been removed by California State Park officials from Lake Valley State

Recreation Area and Washoe Meadows State Park (Reaches 1 and 2) (California State Parks Document, 1989).

A better approach would be proactive management to reduce conflict between beavers, people, and other resources (e.g., other wildlife, erosion). The best places for beavers to settle are defined as sites where they cause the least amount of damage and the most benefits. Beavers could be allowed to colonize such locations. Management actions could be directed away from these colonies and instead could focus on colonies that produce neutral or undesirable results. As habitat conditions change over time, the location of beaver management sites would change.

Colonies that produce neutral or positive effects can still be in conflict with people (e.g., Reaches 8 and 10, due to residents and county roads, respectively). In such cases, measures to minimize the concurrent negative effects could be implemented (e.g., dam leveler pipe systems, coating specimen trees with sand and paint to deter cutting).

- Project actions that contribute to water flowing into old channels would improve habitat conditions for a variety of wildlife, such as waterfowl, muskrats, beavers, and neotropical birds, including willow flycatchers. Some side channels only have water during spring runoff. Beaver dams constructed at these sites fail to retain sufficient water and beavers move into the main river channel after water levels drop. Actions that restore historic overbank flow regimes could contribute to increased riparian and wetland communities in these channels. This would improve the likelihood of standing water being present on June 1, which would improve habitat suitability for willow flycatchers. Restoration projects that help retain water longer in these side channels could also reduce the need for beavers to dam the main channel.
- Reaches 1 through 3 are the best areas to improve wildlife habitat. These areas show less diversity and complexity than that found in the other project reaches. Restoration of areas with native vegetation in Reaches 1 and 2 would improve habitat quality for wildlife. In addition, restoration activities that improve the quality of the wetland areas associated with the river would also improve wildlife habitat.
- Hand thinning invading conifers could contribute to the long-term viability and renewal of declining aspen in Reach 5 and other locations.
- Allowing beaver colonies to remain established on some side channels could result in improved habitat for willow flycatchers (i.e., to the extent possible, minimize nuisance beaver removal in these locations).
- Although widely distributed from Reaches 4 through 11, the majority of cottonwood trees in the Study Area appear to be even aged. Events that contribute to cottonwood recruitment do not appear to have been replicated in succeeding years. The saplings and recently sprouted cottonwood trees noted in the Study Area are not sufficient for stand replacement. Cottonwood trees provide valuable wildlife habitat. Restoration of processes

that result in additional recruitment of cottonwood saplings would improve future habitat conditions for wildlife in the Study Area. To the extent that proposed restoration projects improve recruitment and retention of cottonwood trees, wildlife habitat would be improved.

- The restoration actions suggested in the vegetation report (Section III.2) will contribute to improved habitat for wildlife.

CONSTRAINTS

- The Limited Operating Periods for special status wildlife species provide potential time constraints on proposed environmental improvement projects in the watershed. The LOPs would be implemented if any of the special status wildlife species are determined to be nesting or denning within the vicinity of the restoration project area.
- Willow flycatchers are known to nest in portions of the Study Area. A LOP between June 1 to August 31 is applied to a variable radius around known nest sites. In addition, some of the USFS SNFPA Standard & Guideline's for willow flycatchers could affect implementation of restoration projects (see FEIS Volume 4, Appendix D1-12-D13, Preferred Alternative Standards and Guidelines). Surveys for willow flycatchers will need to be performed prior to any project activities.
- California spotted owls are known to nest in the southernmost portion of the Study Area. A LOP within ¼ mile of active nest sites is applied between March 1 through August 31 unless surveys confirm that California spotted owls are not nesting. At this time, PACs and LOPs applicable to other special status species are not expected to affect implementation of potential restoration projects. If any projects are scheduled within the vicinity of the spotted owl PAC, the USFS unit wildlife biologist should be consulted to determine whether a survey for nesting owls is necessary.
- Damming and foraging activities of beavers could affect restoration projects. Delineating areas where beavers will be actively managed from those where no or minimal management will occur can assist in mitigating any impacts from dam construction. Using a mix of shrub species during revegetation, including alder and dogwood in addition to willow, would minimize any adverse effects from beaver foraging.

III.3.G References

Allen, A.W. 1983. Habitat suitability index models: beaver. USFWS. FWS/OBS-82/10.30. 20pp.

Basey, J.M., S.H. Jenkins, and P.E. Busher. 1988. Optimal central-place foraging by beavers: tree size selection in relation to defensive chemicals of quaking aspen. Oecologia. 76:278-282.

Basey, J.M. S.H. Jenkins, and G.C. Miller. 1990. Food selection by beavers in relation to inducible defenses of Populus tremuloides. Oikos. 59:57-62.

Beier, P. and R.H. Barrett. 1987. Beaver habitat use and impact in Truckee River Basin, California. J. Wildl. Manage. 51(4):794-799.

Busher, P. 1975. Movements and activities of beavers, *Castor canadensis*, on Sagehen Creek, California (M.A. Thesis). San Francisco: San Francisco State University.

Busher, P. 1987. Population parameters and family composition of beaver in California. J. Mamm. 68(4):860-864.

Busher, Peter. Personal communication. November 5, 2003. Professor, Department of Biology. Boston University, Boston, Massachusetts.

Busher, P. and S.H. Jenkins. 1983. Population density, colony composition, and local movements in two Sierra Nevada beaver populations. J. Mamm. 64:314-318.

Butts, W.L. 1992. Changes in local mosquito fauna following beaver (*Castor canadensis)* activity- an update. Journal of American Mosquito Control Association 8:331-332.

Butts, W.L. 2001. Beaver ponds in upstate New York as a source of anthropophilic mosquitoes. Journal of American Mosquito Control Association 17(1): 85-86.

California State Parks Document. 1989. Beaver control at Lake Valley SRA and Washoe Meadows State Park. Prepared January 1989 by Gary Walter, Associate State Park Resource Ecologist.

Campion, Kathy. Personal communication. August 13, 2003. LTBMU wildlife biologist.

Craven, Bill. Personal communication. October 2, 2003. Resident, Fallen Leaf Lake, CA.

Fowler, C.B., B. Valentine, S. Sanders, and M. Stafford. 1991. Suitability Index Model: Willow Flycatcher (*Empidonax traillii*). Unpublished document. USDS Forest Service, Tahoe National Forest. 15 pp.

Gese, C.G. and A.R. Shadle. 1943. Restoration of aspen after complete cutting by beavers. J. Wildl. Manage. 7(2):223-228.

Harris, J. 1991. Effects of brood parasitism by brown-headed cowbirds on will flycatcher nesting success along the Kern River, California. Western Birds 22:13-26.

Harris, J.H., S.D. Saunders, and M.A. Flett. 1988. Willow flycatcher surveys in the Sierra Nevada. Western Birds 18:27-36.

Howard, R.J. and J.S. Larson. 1985. A stream habitat classification system for beaver. J. Wildl. Manage. 49(1):19-25.

Jenkins, S.H. 1979. Seasonal and year-to-year differences in food selection by beavers. Oecologia. 44:112-116.

Jenkins, S.H. and P.E. Buscher. 1979. *Castor canadensis*. Mamm. Species, 120:1-8.

Juncosa, Adrian. Personal communication. November 4, 2003. Project botanist.

Juncosa, Adrian. Personal communication. November 25, 2003. Project botanist.

Kindschy, R.R. 1985. Willow response to beaver use. J. Wildl. Manage. 49(1):26-28.

Kindschy, R.R. 1989. Regrowth of willow following simulated beaver cutting. Wildl. Soc. Bull. 17: 290-294.

Lindström, Susan. Personal communication. September 17, 2003. Project archeologist.

Lindström, Susan. Personal communication. September 23, 2003. Project archeologist.

Lindström, Susan. E-mail communication. Fall, 2003. Project archeologist.

Manning, P. and M.D. Schlesinger. 2001. Riparian biological diversity in the Lake Tahoe Basin. April 2001. A final report to the California Tahoe Conservancy.

Maslich, W.J., J.D. Brotherson, and R.G. Cates. 1988. Relationships of aspen (*Populus tremuloides*) to foraging patterns of beaver (*Castor canadensis*) in the Strawberry Valley of central Utah. Great Basin Naturalist. 48(2):250-262.

Muller-Schwarze, D. and L. Sun. 2003. The beaver Natural History of a Wetlands Engineer. Comstack Publishing Associates, division Cornell University Press. Ithaca, NY.

Naiman, R.J., C.A. Johnston, and J.C. Kelly. 1988. Alteration of North American streams by beaver. Bioscience 38(11):753-762.

Orr, R.T. 1949. Mammals of Lake Tahoe. California Academy of Sciences. San Francisco, CA.

Peralt. Personal communication. September 11, 2003. Retired CDFG warden.

Reed, S.B. 1980. Beaver management plan. U.S. Forest Service Lake Tahoe Basin Management Unit. Report on file USFS-LTBMU. South Lake Tahoe, CA.

Robel, J.R., L.B. Fox, and K.E. Kemp. 1993. Relationship between habitat suitability index values and ground counts of beaver colonies in Kansas. Wildl. Soc. Bull. 21:415-421.

Sanders, S.D. and M.A. Flett. 1989. Ecology of a Sierra Nevada population of willow flycatchers (*Empidonax traillii*), 1986-1987. California Department of Fish and Game, Wildl. Manage. Div. Admin. Rep. 88-3.

Sererna, M. 1982. The status and distribution of the willow flycatcher in the Sierra Nevada. California Department of Fish and Game Wildlife Mgmt. Branch Admin. Rep 87-2.

Simonsen. T.A. 1973. Feeding ecology of the beaver (*Castor fiber L.*). Medd. Statens. Viltunders. 2: 20-61.

Slough, B.G. and R.M.F.S. Sadleir. 1977. A land capability classification system for beaver (*Castor canadensis Kuh*l). Can. J. Zool. 55:1324-1335.

Stegeman, L.C. 1954. The production of aspen and its utilization by beaver on the Huntington forest. J. Wildl. Manage. 18(3):348-358.

Svendsen, G.E. 1980. Seasonal change in feeding patterns of beavers in southeastern Ohio. J. Wildl. Manage. 44(1) 285-290.

Tappe, D.T. 1942. The status of beavers in California. State of California, Department of Natural Resources, Division of Fish and Game. Game Bulletin No. 3.

Taylor, Shirley. Personal communication. September 26, 2003. Resident, South Lake Tahoe, CA.

United States Department of Agriculture. 1988. Land and resources management plan. Forest Service, Region Five, Tahoe National Forest, Lake Tahoe Basin Management Unit. South Lake Tahoe, CA.

United States Department of Agriculture. 1993. California Spotted Owl Sierran Province Interim Guideline Environmental Assessment. Forest Service, Pacific Southwest Region. San Francisco, CA January.

United States Department of Agriculture. 2000. Sierra Nevada Forest Plan Amendment Final Environmental Impact Statement. Forest Service, Pacific Southwest Region, December 2000.

United States Department of Agriculture. 2001. Sierra Nevada Forest Plan Amendment Final Environmental Impact Statement, Record of Decision. Forest Service, Pacific Southwest Region, January 2001.

Verner,J. 1988. Aspen. Pages 66-67 in Mayer,K.E. and W.F. Laudenslayer, Jr., eds. A guide to wildlife habitats of California. California Department of Fish and Game, Sacramento, CA.

Willis, R.M. 1978. A beaver habitat classification system for the Truckee River. M.S. Thesis, Univ. Nevada, Reno. 69 pp.

Zeigenfuss, L.C., F.J, Singer, S.A. Williams, and T.L. Johnson. 2002. Influences of herbivory and water on willow in elk winter range. J. Wildl. Manage. 66(3):788-795.