VEGETATION & WILDLIFE MONITORING REPORT

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Filoha Meadows Nature Preserve
Pitkin County, Colorado

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Summary

This report provides a comprehensive look at the vegetation and wildlife resources of Filoha Meadows Nature Preserve, which is one of the most important conservation properties within the Pitkin County Open Space and Trails system. In this report we present a detailed vegetation type map and descriptions of each vegetation community, include the results of the vegetation quantitative data collected from representative areas, discuss the rare plants and plant communities, present an updated noxious weed assessment, and include a complete vascular plant species list. We also include a short discussion on some of the important pollinator habitat at Filoha. In addition, we provide information regarding wildlife occurrence and use of Filoha. This information is based on field surveys conducted in 2018, consultation with Colorado Parks and Wildlife, and our prior experience evaluating the wildlife and wildlife habitat at Filoha and its environs.

The vegetation and wildlife monitoring conducted in 2018 at Filoha Meadows Open Space indicates that, as a whole, the management of the property has maintained diverse healthy ecological systems that are resilient to wildlife and human use. However, the site also has a long history of anthropogenic impacts and hence non-native plant species continue to threaten not only the upland habitats, but also the rare and unique plants and communities present in the hot spring meadow. The property supports rich and robust populations of wildlife that include species that live on the property throughout the year and others that depend on the property for only part of their annual life history requirements. The unique interspersion of abiotic and biotic habitat components makes Filoha particularly important to species of conservation concern such as bighorn sheep and Townsend's big-eared bats.

The recommendations provided in this report include continued monitoring of rare plants, as well as developing a strategy to control noxious weeds in the sensitive plant communities of the hot spring meadow. In addition, restoration of the lands impacted by past human activities are warranted aiming to increase the trajectory of these areas to fully functioning communities with a diverse array of native plants that are a benefit to all wildlife. Given the sensitivity of some of Filoha's most prominent wildlife, we include recommendations regarding recreation management on the property.

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1.0 INTRODUCTION

Filoha Meadows Nature Preserve (Filoha) is located in the scenic Crystal River Valley, two miles north of Redstone, Colorado. Filoha is one of the most biologically diverse properties in the Pitkin County Open Space and Trails (OST) system. "Filoha" is the Ethiopian word for "hot water" and the property contains unique ecological communities due to the hot springs and geothermal activity underlying the property. The geothermal activity results in snow free meadows, providing critical winter range for bighorn sheep. Elk calve near the Crystal River, beavers create wetlands, and predators like coyotes and foxes use the meadows for their hunting grounds. The rare and unique plant communities and the wildlife that depend upon them are unparalleled in the Crystal River Valley. However, some areas are degraded by non-native pasture grasses and noxious weeds and many of the low-lying vegetation communities have been altered by historic land clearing and agriculture. The variety of biotic and abiotic habitats at Filoha and the adjacent public lands supports a diverse array of wildlife. Containing varied habitats, this valuable conservation property provides important life history requisites for animals such as Rocky Mountain bighorn sheep, Rocky Mountain elk, peregrine falcons, American beaver, and numerous resident and migratory songbirds. Filoha is situated such that it provides an important ungulate migration link between summer and winter ranges on public lands.

Intensive survey work at Filoha for preparation of the current management plan was first conducted from 2003 through 2007. In preparation for a management plan update, additional field surveys were conducted in 2017 and 2018. The purpose of this report is to summarize the results of the vegetation and wildlife monitoring field work conducted over the last two years. Specifically, we map and classify all the vegetation types, present the results of the vegetation quantitative data collected from representative areas, discuss the rare plants and plant communities, present an updated noxious weed assessment, and include a complete vascular plant species list for the property. We also include a short discussion on some of the important pollinator habitat at Filoha. The report includes a summary of wildlife monitoring methods and results, provides background information for some of Filoha's species of particular conservation concern including recommended Management Indicator Species (MIS), and provides suggested management actions to improve conditions for MIS and other wildlife. Finally, we provide recommendations for future monitoring and protection of ecologically sensitive areas.

2.0 LANDSCAPE CONTEXT, TOPOGRAPHY AND CURRENT USE

The topography of Filoha includes gently sloping lands adjacent to the Crystal River and steep hillsides along Elephant Mountain. The elevations range from a low of approximately 6,800 feet to a high of 7,800 feet. The site is bisected by a historic narrow-gauge railroad bed, which is now used as a hiking trail by the public. Filoha also includes a pump system used by the previous owner to divert some of the hot springs water for a residential heating system, and an electric transmission line corridor. Filoha is closed to the public between October 1 and June 30 and dogs are not allowed. Visitors to Filoha are restricted to the existing trail only, unless led by a guide. Currently the Roaring Fork Conservancy hosts summer tours of the property to educate the public on the rare orchids, fireflies, and wildlife. See Map 1 for a project location map.

3.0 VEGETATION

Filoha supports both xeric and mesic plant communities influenced by abiotic factors such as moisture, elevation, aspect, and geology, but also past land management which has included grazing, farming, and irrigation. In addition, a historic railroad corridor bisects the property as well as electric transmission line corridors. Riparian and wetland plant communities flank the Crystal River and occur around the numerous hot springs and seeps located in the center of the property. Large expanses of grassland, now recovering from past farming and grazing occur between the wetlands and the steeper slopes which flank the eastern portion of Filoha. These steeper slopes support plant communities such as juniper woodlands, oak shrublands, and at the highest elevations are Douglas-fir forests. In the north are steep cliffs and rock talus that support their

own distinctive plant community. Finally, in the south are early successional shrublands amidst plantings of blue spruce trees installed by the previous owner, as well as a small aspen woodland.

The current vegetation conditions in the project area were documented by qualitative observations and quantitative data collection. Field visits occurred from early July through mid-September 2018 by Rea Orthner and one field technician. All quantitative data, including photographs, are contained in Appendix A. Map 2 presents a vegetation type map for the property. This section first includes a description of the updated vegetation classification for the property, including plant community descriptions and habitat descriptions, and then summarizes the quantitative data collected, which was first initiated in 2007.

3.1. VEGETATION CLASSIFICATION & MAPPING

The U.S. National Vegetation Classification (USNVC) is a central organizing framework for documentation, inventory, monitoring, and study of vegetation in the United States from broad scale formations like forests to fine-scale plant communities. The vegetation communities at Filoha were classified to the two most detailed or "lowest" levels of the classification hierarchy, alliances and associations. Alliances are classified based on diagnostic species, including some from the dominant growth form or layer, and are moderately similar in composition. Associations, which are more" fine-grained," are based on diagnostic species, usually from multiple growth forms or layers, and more narrowly similar. See Table 1 at the end of this section for a list of these alliances and associations, including the USNVC classification code and the quantitative transect number. Overall, 17 different alliances and 20 plant associations have been documented for Filoha. The following text describes these vegetation communities based on field reconnaissance conducted in 2017 and 2018. First upland plant communities are described, next wetland/riparian habitats. Table 1 provides a summary.

3.1.1 JUNIPER / SHRUB WOODLAND

Photo 1. Juniper - Oak Woodland (Aug-7-2018).

The Rocky Mountain Juniper – Gambel Oak (*Juniperus scopulorum – Quercus gambelii*) woodland occurs in the northern part of Filoha, south of the steep cliff habitat. This association is characterized by an open tree canopy (5-25% cover) of *Juniperus scopulorum*. The shrub layer typically covers about 40% with Gambel oak the most common. Other shrubs include snowberry (*Symphoricarpos rotundifolius*), Woods' rose (*Rosa woodsii*), serviceberry (*Amelanchier alnifolia*), and skunkbrush sumac (*Rhus aromatica* subsp. *trilobata*). Oregon grape (*Mahonia repens*), a subshrub, also occurs here. The herbaceous layer is variable with sparse to moderate cover of elk sedge (*Carex geyeri*), needle-and-thread grass (*Hesperostipa comata*), squirreltail (*Elymus elymoides*), western wheatgrass (*Pascopyrum smithii*), Letterman's needlegrass (*Achnatherum lettermanii*), Kentucky bluegrass (*Poa pratensis*), flexile milkvetch (*Astragalus flexuosus*), hairy goldenaster (*Heterotheca villosa*), smooth blue aster (*Symphyotrichum laeve*). Some smooth brome (*Bromus inermis*), a non-native pasture grass, is present in low quantities. Portions of these woodlands were subject to vegetation management practices aimed at

reducing the cover of juniper for the benefit of wildlife with particular emphasis on improving bighorn sheep (*Ovis canadensis canadensis*) habitat. Numerous slash piles are scattered throughout this community. Quantitative data transect T06 is located within this plant association.

3.1.2 ASPEN – GAMBEL OAK WOODLAND

Photo 2. Aspen - Gambel Oak Woodland (Sep-12-2018).

A small area of aspen (*Populus tremuloides*) mixed with Gambel oak occurs along the historic railroad grade in the southern portion of the property. This community is classified as the *Populus tremuloides / Quercus gambelii / Symphoricarpos oreophilus* Forest (USNVC 2017). This deciduous forest is known from central New Mexico, the southwestern Colorado Plateau and southern Rocky Mountains where it occurs along drainages on plateaus and in draws on mountain slopes. The vegetation is characterized by a fairly open canopy dominated by small-diameter aspen. Gambel oak dominates the tall-shrub layer (>30% cover). Other shrubs include snowberry, serviceberry, and Oregon grape. The herbaceous component is comprised of elk sedge, Kentucky bluegrass, and numerous forbs. Most of the aspen trees in this community are heavily impacted by Rocky Mountain elk (*Cervus canadensis nelsoni*). Elk strip the bark and browse the twigs of aspen primarily in winter when understory forage is minimal or covered by snow (Olmsted 1979). Bark-stripping contributes to an increase in disease, such as fungal infections, in the larger trees (Hinds 1985). Excessive browsing during the sapling stage reduces their chances for survival (DeByle and Winokur 1985), and can also significantly reduce or eliminate new root sprouts or suckers, the primary mode of aspen regeneration.

3.1.3 DOUGLAS FIR FOREST AND WOODLAND

Photo 3. Douglas-fir Forest (Aug-7-2018).

Douglas Fir (*Pseudotsuga menziesii*) forest and woodlands occupy the northern portion of the site around the base and lower slopes of "Elephant Mountain". There are also Douglas fir stands along the eastern edge of the property, which continue upslope on adjacent National Forest System lands. Douglas fir dominates the canopy with occasional Ponderosa pine (*Pinus ponderosa*) and Rocky Mountain juniper. The understory is characterized by Gambel oak and snowberry, with rock spirea (*Holodiscus discolor*) in the rockiest areas. The herbaceous layer is poorly represented but includes Oregon

grape and elk sedge in the forested communities and a variety of native grasses and forbs in the more open woodland structure. In some portions of this plant community there is a high percentage of rock which limits the cover of woody vegetation, but also acts to concentrate precipitation and conserve soil moisture.

3.1.4 GAMBEL OAK / SERVICEBERRY SHRUBLAND

This community is dominated by a thick cover of Gambel oak with scattered serviceberry, chokecherry (*Prunus virginiana* var. *melanocarpa*) and snowberry shrubs as well as Oregon grape. Common herbaceous understory species include natives such as elk sedge, Letterman's needlegrass, needle-and-thread grass, western wheatgrass, showy goldeneye (*Heliomeris multiflora*), hairy goldenaster, aspen fleabane (*Erigeron speciosus*), smooth blue aster, and Fendler meadow rue (*Thalictrum fendleri*). Houndstongue (*Cynoglossum officinale*), a non-native noxious weed, is also present. Other non-natives present include orchardgrass (*Dactylis glomerata*) and Kentucky bluegrass. Quantitative data transect T13 is located within this plant association.

3.1.5 STICKY RABBITBRUSH / KENTUCKY BLUEGRASS RUDERAL SHRUB GRASSLAND

The sticky rabbitbrush (*Chrysothamnus viscidiflorus*) ruderal shrub grassland occurs in the southern portion of Filoha west of the historic railroad grade. This association is currently known from the southern Rocky Mountains and Colorado Plateau and likely is more widespread (USNVC, 2017). Stands occur on the lower slopes of ridges, on terraces above drainages, and in valley bottoms. Soils are moderately well-drained to rapidly drained loams and silty clay loams derived from alluvium. The vegetation is characterized by a moderately dense herbaceous layer dominated by the introduced rhizomatous grass Kentucky bluegrass with an open to moderately dense (10-50% cover) short-shrub layer dominated by sticky rabbitbrush. Additional shrubs that provide low cover include mountain big sagebrush (*Artemisia tridentata* var. *vaseyana*), Oregon grape, Woods rose (*Rosa woodsii*) and snowberry. Other common graminoids with low cover include needle-and-thread grass, Letterman's needlegrass, squirrel tail, western wheatgrass, as well other introduced grasses including smooth brome and orchard grass. Forb cover is sparse but may be diverse and include hairy goldenaster, narrowleaf Indian paintbrush (*Castilleja linariifolia*), small-leaf pussytoes (*Antennaria parvifolia*), yarrow (*Achillea lanulosa*), lupine (*Lupinus argenteus*), Rocky Mountain penstemon (*Penstemon strictus*), and aspen fleabane. Several annual and biennial forbs are present as well. Vegetation Transect T14 is located within this community. In general, this plant community occurs in areas that have experienced significant disturbance such as over-grazing, historic conversion of native shrubland to grassland habitat, or fire. Sticky rabbitbrush is a seral species that quickly and aggressively invades disturbed open sites and often remains dominant for the first 15 years after disturbance, but then declines and is replaced by species such as big sagebrush (Tirmenstein 1999).

Photo 4. Sticky Rabbitbrush community (9/12/2018).

Photo 5. Non-Native Grassland Habitat that is proposed for Riparian Restoration activities (Sep-26-2017).

3.1.6 NON-NATIVE GRASSLAND

Much of Filoha is dominated by non-native grassland. These areas were once dominated by mountain big sagebrush, Gambel oak, or perhaps even riparian forest. These areas would have been cleared by early settlers for crop growing or animal husbandry. Today, these grasslands show a fair bit of recovery, especially in the absence of cattle grazing and annual control of noxious weeds. These areas are best classified as the Smooth Brome Ruderal Grassland (USNVC, 2017) which are found in disturbed dry to mesic grasslands throughout the western US. The plant community type is also widely planted for revegetating disturbed land, pasture and hay fields, and has escaped into a variety of habitats, including prairie, riparian grasslands, and mesic mountain meadows. At Filoha, a variety of non-native grasses are present including smooth brome, Kentucky bluegrass, orchardgrass, crested wheatgrass (*Agropyron cristatum*), along with Japanese brome (*Bromus japonicus*) and cheatgrass (*Bromus tectorum*), the latter two of which are annual grasses. Native grasses are usually less than 15% absolute cover and include western wheatgrass, needle-and-thread grass, squirrel tail, and Letterman's needlegrass. Hairy goldenaster, a native "weedy" forb, is almost always present and usually represents an equal or higher vegetative cover than the grasses. Other common forbs in this community include woolly cinquefoil (*Potentilla hippiana*), fragile prickly pear cactus (*Opuntia fragilis*), and purple locoweed (*Oxytropis lambertii*). Weedy forbs include wild licorice (*Glycyrrhiza lepidota*), salsify (*Tragopogon dubius*), and musk thistle (*Carduus nutans* subsp. *macrolepis*). A total of four permanent vegetation transects were located in this community: T4, T5, T7 and T11. One of the areas of non-native grassland habitat is currently being considered for a riparian restoration project. This site, located south of the hunting blind and west of the historic railroad bed, was once used for crop production and lacks any strong native component.

3.1.7 NATIVE GRASSLAND

Several areas of native grassland occur at Filoha. These areas are dominated by needle-and-thread grass along with hairy goldenaster, a native forb which is tolerant of disturbance. Also present are scattered patches of western wheatgrass, Letterman's needlegrass and Basin wildrye (*Leymus cinereus*). One of the densest patches of Letterman's needlegrass occurs on an alluvial fan to the east of the historic railroad bed. Transect T12 is located in this area. Non-natives present in relatively low frequency include Kentucky bluegrass, smooth brome, pale madwort (*Alyssum*

Photo 6. Native grassland habitat (Aug-07-2018).

alyssoides) as well as noxious weeds such as cheatgrass and occasional musk thistle. Most of these grasslands were not likely historically present at Filoha. Instead, they are communities formed after native sagebrush shrublands were cleared for agricultural use and animal husbandry.

Photo 7. Rock Spirea Rock Outcrop Vegetation (Aug-7-2018).

3.1.8 ROCK SPIREA ROCK OUTCROP SPARSE VEGETATION

This sparsely vegetated association is found in the northern portion of Filoha on the cliffs and talus deposits of Elephant Mountain. The vegetation is characterized by a sparse canopy of rock spirea (*Holodicus dumosus*) with scattered Gambel oak, Douglas fir and Rocky Mountain juniper. The ground surface has high cover of bedrock, large and small rocks, and bare soil. Soils are rapidly drained gravelly sandy loams. The herbaceous layer is mixture of graminoids and forbs contributing low to moderate cover.

3.1.9 NARROWLEAF COTTONWOOD- BLUE SPRUCE RIPARIAN FOREST

The Narrowleaf Cottonwood – Blue Spruce / Alder Riparian Forest (*Populus angustifolia – Picea pungens / Alnus incana)* is a common plant community of montane stream valleys, where both narrowleaf cottonwood and blue spruce are co-dominant in the understory and alder is the dominant shrub in the sub-canopy layer. At Filoha, this community type appears to have been impacted by past agricultural practices and a plan is underway to restore a portion of this community type (WER 2018). Other common plants observed include shrubs such as Woods' rose, serviceberry, mountain willow (*Salix monticola*), dogwood (*Cornus sericea*), chokecherry, river hawthorn (*Crataegus rivularis*), and herbaceous plants including starry false Solomon's seal (*Maianthemum stellatum*), largeleaf avens (*Geum macrophyllum*), roundleaf wintergreen (*Pyrola rotundifolia*), field horsetail (*Equisetum hyemale*), variegated scouring rush (*Equisetum variegatum*), and goldenrod (*Solidago velutina).* Non-native pasture grasses are also common in some areas and include redtop (*Agrostis gigantea*) in the wettest areas with orchardgrass, timothy (*Phleum pratense*) and smooth brome on the drier sites. See Transect T08. According to Carsey et al. (2003), this plant association is considered to be mid-seral, and with continued healthy river activity (i.e. flooding, sediment deposition, scouring), these two dominant trees will continue to persist along the stream reach with new cottonwood establishment being favored by steam channels that have overbank flow and sediment deposition, and blue spruce favoring deep valleys with strong cold-air

Photo 8. Blue Spruce - Narrowleaf Cottonwood Riparian Forest (Sep-26-2017).

drainage. If river dynamics were to change such that the floodplain is no longer active, then cottonwoods may eventually die, and the blue spruce will persist (Carsey et al., 2003). However, the extent to which vegetative or clonal reproduction in narrowleaf cottonwood occurs is not always well understood. Narrowleaf cottonwood sprouts from the root crown and roots, and sprouting is often linked to disturbance that scarifies stems and/or roots (Simonin 2001). It is believed that cloning is important in narrowleaf cottonwood gallery maintenance in many western states such as along the upper Yellowstone River in Montana (Polzin 2006).

A few isolated stands of cottonwoods also occur at Filoha on higher terraces above the river. These areas were tentatively classified as the Narrowleaf Cottonwood – Rocky Mountain Juniper association. This association is typically found on high dry stream terraces with a variable cover of narrowleaf cottonwood with occasional juniper, pinyon pine or Gambel oak. The understory is open and grassy, dominated by introduced species such as smooth brome. These mature riparian forests occupy some of the driest sites of the floodplain and the cottonwoods have limited self-sustaining capabilities except vegetatively by root sprouts. Many of the trees are decadent or dying, and junipers are commonly growing up under them, colonizing the drying terraces.

3.1.10 BOX ELDER RIPARIAN WOODLAND

Photo 9. Box Elder stand below talus slope (Aug-7-2018).

This small woodland occurs in a shallow swale at the bottom of a steep talus slope in the northern portion of Filoha. Box elder (*Acer negundo*) dominates the overstory with some Rocky Mountain juniper. A few scattered Gambel oak shrubs occur in the shrub layer and the understory is dominated by wild licorice, poison ivy (*Toxicodendron rydbergii*), and orchardgrass. Within its range in the Colorado Plateau and southwestern US, this association occurs on upper alluvial terraces near permanent or temporary streams, but are rarely flooded. It is likely that the stand at Filoha is receiving groundwater seeps from the steep talus slope above. It is questionable whether *Acer negundo* is native to Colorado or not. According to *Colorado Flora Western Slope,* one subspecies is native, while the other is not (Weber and Wittmann 2012). In *Flora of Colorado*, both subspecies are considered non-native (Ackerfield 2015). Box elder is a fast-growing tree and is sometimes considered weedy or invasive. However, the stand at Filoha does provide nesting and cover habitat for a wide variety of birds and small mammals.

3.1.11 COYOTE WILLOW WET SHRUBLAND

Stands of coyote or sandbar willow (*Salix exigua*) are scattered throughout Filoha. There are scattered stands along the Wilke Ditch as well as sporadically within the hot spring wetland meadow and along the edge of the Crystal River. Coyote willow, also called sandbar willow, is one of the most common willow species in Colorado. Diagnostic features of this association include the nearly pure stands of *Salix exigua* shrubs, with a dense herbaceous layer of at least 30% cover of mesic graminoids. It generally occurs along backwater channels and other perennially wet but less scoured sites, such as floodplain swales and irrigation ditches (USNVC 2017). Common plant associates include beaked and common spikerush (*Eleocharis rostellata, E.*

palustris), three square bulrush (*Schoenoplectus americanus*), redtop, and numerous others. This plant association is typical of recent floodplains and highly disturbed, low, wet areas and is considered early-seral. The amount of herbaceous growth in the understory is an indication of the amount of time since the last scouring (or depositional) flood event. *Salix exigua* is an excellent soil stabilizer with a deep root system and flexible stems that can withstand flooding. *Salix exigua* reduces erosion potential by increasing the friction of stream flow, trapping sediments and building a protected seed bed for a number of tree and shrub species (Carsey et al. 2003).

3.1.12 BEAKED SPIKERUSH MARSH

Photo 11. Beaked Spikerush (Jul-4-2018).

This association is known from low to mid elevations in widely scattered intermontane basins and plains of the West. It is documented to occur in Idaho, Montana, Washington, Oregon, California, Wyoming, and Colorado (USNVC 2017). This association is uncommon and often occurs in association with warm springs or fens with alkaline or calcareous soils at the northern limits of its range, but it is also known from cold springs in desert canyons. At Filoha, beaked spikerush (*Eleocharis rostellata*) is common in the hot springs wet meadows and is often found in association with three square bulrush, scratchgrass muhly (*Muhlenbergia asperifolia*), and smooth blue aster. Stands are relatively monotypic and low in species diversity. Beaked spikerush is a member of the sedge family and is unique within that family by being stoloniferous and having long, wiry, slightly compressed stems that become arching and root at the tips. Because of its stoloniferous growth habit, *Eleocharis rostellata* forms dense patches that are resistant to disturbance. Waterfowl eat the stems, roots and achenes of *Eleocharis rostellata*, but palatability is low for livestock and wildlife. *Eleocharis rostellata* is considered threatened and endangered in a number of states, mostly in the midwest and northeast, and it is uncommon to rare in Colorado. The Colorado Natural Heritage Program (CNHP) ranks this association as state imperiled (S2) in Colorado. Transect T02 is located within this rare plant association type, however beaked spikerush is a common associate in many of the other plant associations of the hot springs meadow. Stream orchid (*Epipactis gigantea*), a rare plant, is commonly found in this community.

3.1.13 BULRUSH MARSH

The Bulrush Marsh Alliance at Filoha contains two plant associations, the Three Square Bulrush Marsh (*Schoenoplectus americanus*) and the Hardstem Bulrush Marsh (*Schoenoplectus acutus*). Both of

Photo 10. Bulrush Marsh surrounding alkaline seep heavily used by wildlife (Sep-26-2017).

these associations occur in the hot springs meadow and often intergrade with each other. The Hard Stem Bulrush Marsh occurs in wet swales and overflow channels with standing water, while the threesquare bulrush marsh appears to be more common in slightly drier areas of the wet meadow. Common associates in both of these plant associations include beaked and creeping spikerush, Nuttall's sunflower (*Helianthus nuttallii*), smooth blue aster, fiddleleaf hawk's beard (*Crepis runcinata*), and Baltic rush (*Juncus arcticus* var. *balticus*). Bulrush (*Schoenoplectus* spp.) stands are generally considered permanent wetland communities. They will remain in place unless the hydrologic regime is severely altered. Stands of *Schoenoplectus* are important to wildlife species, especially birds, for cover and nesting habitat (Carsey et al. 2003).

3.1.14 COMMON REED WET MEADOW

Photo 12. Common Reed Wet Meadow (Sep-11-2018).

The common reed (*Phragmites australis*) vegetation community occurs in isolated stands of the hot springs meadow at Filoha. These stands are characterized by a dense six to eight foot tall layer of *Phragmites*. This species has strong rhizomes that allow it to out compete all but the most aggressive species, hence plant species diversity in these stands is generally low. Common plant associates at in this community type at Filoha include beaked spikerush, three-nerve goldenrod (*Solidago velutina*), smooth blue aster, starry false Solomon's seal, Nuttall's sunflower, Rocky Mountain gentian (*Gentiana affinis*), and showy milkweed (*Asclepias speciosa*). A small population of stream orchid also occurs in the community. As described in *Filoha Meadows Vegetation Descriptions and Stewardship* (EM Ecological 2007), the stands of *Phragmites* at Filoha are likely native.

This reed marsh type is found across the west-temperate regions of the United States and Canada. Stands occur in semi permanently flooded marshes, ditches, impoundments, etc. that have often been disturbed by human activity. The vegetation is often variable, as *Phragmites australis* will often invade existing natural or semi-natural communities present on the site. In Colorado, this reed marsh often occurs in small wet patches in seeps and backwater areas of large floodplains, around the fringes of irrigation ponds, ditches, and along railroad embankments that have poor drainage.

3.1.15 WATER SEDGE – BEAKED SEDGE WET MEADOW

The water sedge (*Carex aquatilis*) – Beaked sedge (*Carex utriculata*) wet meadow occurs at the beaver pond wetland fen located in the south-central portion of the property. The vegetation of the beaver pond/fen complex is dominated by beaked sedge, a common peat forming sedge of the Rocky Mountains. Numerous other common native plants were observed including creeping spikerush, Baltic rush, three-square bulrush, inland sedge (*Carex interior*), golden sedge (*Carex aurea*), field mint (*Mentha arvensis*), and Norton's Saint John's-wort (*Hypericum scouleri* subsp. *nortoniae*). Shrubs which occur in portions of this wetland complex include diamondleaf willow (*Salix planifolia*), mountain willow, sandbar willow, bog birch (*Betula glandulosa*), river birch (*Betula fontinalis*), and thinleaf alder. Less desirable plants include broadleaf cattail (*Typha latifolia*), which can form dense monocultures and outcompete other plants, redtop, a non-native pasture grass, and noxious weeds such as Canada thistle (*Cirsium arvense*) and oxeye daisy (*Leucanthemum vulgare*).

As document in the Ecological Condition Report (PeakEco and CWS 2018) portions of the fen contain areas of deep histosol soils and hence this area is considered to be a fen. Fens are rare and ecologically significant wetlands in Colorado and the Rocky Mountains and are colloquially known as "old-growth" wetlands because they can be thousands of years old. They are ancient ecosystems potentially 8,000 to 12,000 years old. Even though they occupy a small percentage of the landscape, they provide important headwater quality functions, including carbon storage, water storage, wildlife habitat, and biodiversity.

Photo 13. Wetland Fen at Beaver Pond (Sep-26-2018).

3.1.16 RED TOP RUDERAL MARSH

This semi-natural herbaceous association is typically found in mesic areas such as riparian floodplains and seasonally flooded wetlands in the semi-arid western U.S. where *Agrostis* spp. have escaped from cultivation. The vegetation is characterized by a moderate to dense perennial graminoid layer dominated by the introduced forage species *Agrostis gigantea* as well as a variety of other mesic graminoids and forbs. At Filoha, this plant association occurs on the western edge of the hot springs meadow in a stream orchid "hot-spot", however it occurs elsewhere as well. Common native plant associates include Baltic rush, Rocky Mountain gentian, Nuttall's sunflower, smooth blue aster, three nerve goldenrod, falsegold groundsel (*Packera pseudaurea*), blue-eyed grass (*Sisyrinchium montanum*), and scouringrush horsetail (*Equisetum hyemale*). Several other non-natives are present as well, such as the introduced grass meadow fescue (*Schedonorus pratensis*), and weeds such as bull thistle (*Cirsium vulgare*), ox-eye daisy, red clover (*Trifolium pratense*), and yellow sweet clover (*Melilotus officinalis*). Quantitative data Transect T01 is located in this community.

Photo 14. This stream orchid "hot spot" is in a redtop wet meadow community type. Ox-eye daisy, a noxious weed, is common in this area as well (Jul-2-2018).

TABLE 1. VEGETATION TYPES. FILOHA MEADOWS NATURE PRESERVE		
General Vegetation Type USNVC Alliance	**Detailed Vegetation Type USNVC Association**	**Quantitative Data Transect**
Upland Forest and Woodland Vegetation Types		
Juniper / Shrub Woodland A3496	Rocky Mountain Juniper – Gambel Oak Woodland CEGL002967 Juniperus scopulorum – Quercus gambelii Woodland	T06
Aspen Forest and Woodland A2036	Aspen- Gambel Oak / Mountain Snowberry Forest CEGL000598 Populus tremuloides / Quercus gambelii / Symphoricarpos oreophilus Forest	
Douglas Fir Forest and Woodland A3454	Douglas-Fir / Gambel Oak Forest CEGL000452 Pseudotsuga menziesii / Quercus gambelii Forest	
Upland Shrubland Vegetation Types		
Gambel Oak – Mountain Snowberry Shrubland Alliance A3735	Gambel Oak / Serviceberry Shrubland CEGL001109 *Quercus gambelii / Amelanchier alnifolia*	T13
	Gambel Oak - Rockspirea Shrubland CEGL002341 Quercus gambelii - Holodiscus dumosus Shrubland	
Sagebrush – Mixed Shrub Ruderal Understory Shrubland A4213	CEGL002933 Sticky rabbitbrush / Kentucky bluegrass Shrubland *Chrysothamnus viscidiflorus / Poa pratensis* Ruderal Shrub Grassland	T14
Herbaceous Vegetation Types		
Non-Native Grassland Smooth Brome – Crested Wheatgrass – Kentucky bluegrass Ruderal Grassland A3254	Smooth Brome Ruderal Grassland CEGL005264 Bromus inermis - (Pascopyrum smithii) Ruderal Grassland	T04, T05, T07, T011
Native Grassland Needle-and-Thread Grassland A1270	Needle-and-Thread Grassland CEGL001705 Hesperostipa comata Grassland	T12
Riparian and Wetland Vegetation Communities		
Narrowleaf Cottonwood Riparian Forest A3759	Narrowleaf Cottonwood – Blue Spruce / Alder Riparian Forest CEGL000934 *Populus angustifolia - Picea pungens / Alnus incana*	T08

TABLE 1. VEGETATION TYPES. FILOHA MEADOWS NATURE PRESERVE		
General Vegetation Type USNVC Alliance	**Detailed Vegetation Type USNVC Association**	**Quantitative Data Transect**
	Narrowleaf Cottonwood – Rocky Mountain Juniper Riparian Woodland CEGL002640 *Populus angustifolia - Juniperus scopulorum*	
Ruderal Riparian Forest Alliance A4155	Box Elder Riparian Forest CEGL002693 *Acer negundo* / Disturbed Understory Riparian Woodland	
Mixed Willow Montane Wet Shrubland A3769	Planeleaf Willow Wet Shrubland CEGL005937 Salix planifolia / Carex utriculata Wet Shrubland	T09
Salix exigua – Salix irrorata Shrubland A3800	Coyote/Sandbar Mesic Forbs Wet Shrubland CEGL001202 Salix exigua / Mesic Forbs Wet Shrubland	
Alkaline - Saline Marsh A3930	Beaked Spikerush Marsh CEGL003428 Eleocharis rostellata Marsh	T02
Bulrush Marsh A3895	Three Square Bulrush Marsh CEGL001585 Schoenoplectus americanus – Eleocharis palustris	
	Hardstem Bulrush Marsh CEGL001840 Schoenoplectus acutus Marsh	
Common Reed, Giant Reed, Meadow Foxtail Ruderal Marsh Alliance A3847	Common Reed Western Ruderal Wet Meadow CEGL001475 Phragmites australis Western Ruderal Wet Meadow	T03
Water Sedge – Beaked Sedge Wet Meadow A3804	Water Sedge – Beaked Sedge Wet Meadow CEGL001803 Carex aquatilis - Carex utriculata Wet Meadow	
Ruderal Marsh Alliance A3848	Redtop Marsh CEGL001558 Agrostis gigantea Ruderal Marsh	T01
Cliff, Scree and Rock		
Cliff, Scree & Rock Rockspirea Vegetation A3740	Rockspirea Rock Outcrop Sparse Vegetation CEGL002801 Holodiscus dumosus Rock Outcrop Sparse Vegetation	
USNVC [United States National Vegetation Classification]. 2017. United States National Vegetation Classification Database, V2.01. Federal Geographic Data Committee, Vegetation Subcommittee, Washington DC.		

3.2 QUANTITATIVE DATA - VEGETATION COVER AND SPECIES RICHNESS

3.2.1 LOCATION OF SAMPLING SITES

A total of 13 permanent vegetation transects were sampled throughout Filoha. These sites are located in representative vegetation communities as listed on Table 1. Transects 1 through 11 are located in the same location as previous sampling efforts (E.M.Ecological 2007). Transects 12 through 14 were set up in 2018. Transect 10 was not sampled in 2018. All transects are 50 meters in length, have permanent markers at each end, and are identified with the transect number. The start and end points of the transect were recorded with a sub-meter Trimble Geo7x GPS unit and the aspect, slope, and orientation (i.e. compass direction relative to the start point) were also recorded. Each transect was photographed from both ends. Field work occurred in August and September of 2018 by Rea Orthner and Denise Wilson. See Map 3.

3.2.2 SAMPLING METHODOLOGY

Vegetation cover data were collected as point-intercept data, using the Cover-Point optical scope along a 50 meter transect. Point data were collected at each meter, with one point at 0.5m from the center line on both sides of the transect for a total of 100 points (2 points at each meter x 50 meters). Data were recorded as first-hit and second-hit data for vegetation and standing dead plant material; and ground cover hits were recorded separately for bare soil, rock, litter, and water. Rock was considered to be any inorganic material greater than 1 cm. in diameter. Standing dead was considered to be any organic material that was still standing and was produced in the previous growing seasons. Consistent with previous work (EM Ecological, 2007), overstory hits were not taken in the data.

Data on species richness was collected by identifying and listing all plant species present in a two-meter-wide by 50 meter long quadrat centered along the cover transect. The final species richness value is presented as the number of species per 100 m^2.

3.2.3 DATA ANALYSIS

For each vegetation cover transect, the percent absolute cover of vegetation, rock, soil, litter, water, and standing dead was calculated using only first hit data. The relative cover of each plant species was calculated using both first and second hit data of vegetation. Species richness was calculated by counting the total number of vascular plants present in each 100 m^2 (2 meter by 50 meter) quadrat. The data were then summarized.by absolute cover (vegetation or non-vegetative cover), and relative cover of native versus non-native plants.

3.2.4 RESULTS

The results of the quantitative monitoring are summarized in Appendices A through C. Overall, the wetland plant communities showed the highest vegetative cover which ranged from 70% to 89%. The non-native grassland habitat had the lowest, from 36% to 43% absolute vegetative cover, and the native grassland had a 63% vegetative cover. Finally, shrublands varied from 48% to 67% vegetation cover. Litter (dead fallen plant material such as leaves) had the highest component of the non-vegetative cover (over rock, soil and standing dead). Non-native plants are present in virtually every plant community sampled. As expected, they had a significant percentage of the cover in the non-native grassland transects where the non-native plants comprised 15-33% of the plant cover. However, non-natives also had a high percentage in the redtop wet meadow. Redtop is a non-native grass, however it is widely naturalized in Colorado, meaning that is well established and now part of the ecosystem. Non-natives also had a high percentage (52%) in the rabbitbrush shrub grassland, mainly due a high percentage of Kentucky bluegrass. As this plant community is recovering from past disturbances, the presence of these non-native plants is to be expected.

3.3 RARE PLANTS AND PLANT COMMUNITIES

Three species of vascular plants currently tracked by the CNHP occur in the hot spring wetland meadow. These include beaked spikerush (*Eleocharis rostellata*), giant helleborine orchid (*Epipactis gigantea*), and canyon bog orchid (*Platanthera tescamnis*, syn=*Platanthera sparsiflora*). See Table 2.

In 2018, a long-term monitoring study to help understand whether populations of stream orchid are increasing, stable or declining at Filoha was initiated (PeakEco 2019b). In addition, each occurrence, or subpopulation, of this plant at Filoha was mapped and described. The initial results of this study show that the total size of the Filoha *Epipactis gigantea* population is likely around 300,000 plants, which is, by far, the largest population recorded for this plant species in the state of Colorado. See Map 4.

Photo 15. *Epipactis gigantea* in the hot spring meadows (7/5/17).

Photo 16. *Platanthera tescamnis* in the hot springs meadow (7/4/18).

Noxious weed populations in the vicinity of the rare plants appear to be their greatest threat. Both Canada thistle and oxeye daisy occur intermixed with portions of the giant helleborine and canyon bog orchid populations, and may compete with these rare plants for nutrients, light, and water. If left unchecked, the weeds could cause long term adverse effects to population viability. Concomitant with the rare plant study described above, an experimental noxious weed control program was initiated at Filoha in 2018 (PeakEco 2019a). In this study, three different treatment methods are being evaluated to determine the best way to control Canada thistle without detriment to the rare plants. The three treatment methods include biological control utilizing a rust fungus (*Puccinia punctiformis*) supplied by the Palisade Insectary, mechanical control (hand-pulling), and chemical control using Milestone, a selective herbicide which was hand-painted on each Canada thistle plant. Additional years of monitoring will be needed to determine the efficacy of the different treatment methods.

TABLE 2. RARE PLANTS TRACKED BY THE COLORADO NATURAL HERITAGE PROGRAM AT FILOHA MEADOWS NATURE PRESERVE

Scientific Name	Common Name	Family	CNHP Rank[1,2]
Eleocharis rostellata	Beaked spikerush	Cyperaceae	G3/S2[3]
Epipactis gigantea	Giant helleborine; stream orchid	Orchidaceae	G4/S1S2
Platanthera tescamnis (=syn P. sparsiflora var. *sparsiflora*	Canyon bog orchid;	Orchidaceae	G4G5T4?/ S3

Source: EM Ecological 2007

Notes:

[1]Ranking current as of February 2017. See http://www.cnhp.colostate.edu/download/list.asp

[2]See http://www.cnhp.colostate.edu/about/heritage.asp for a description of the ranking criteria

[3]Ranked at the community level only

3.4 NOXIOUS WEED ASSESSMENT

Seventeen (17) species of noxious weeds were documented during the 2017 and 2018 ecological surveys or were previously reported to be present at Filoha (EM Ecological 2007). See Table 3. Noxious weeds are currently being managed by the OST noxious weed contractor through the use of chemical spot spraying in upland areas, away from sensitive wetland habitat and the hot springs meadow. A concurrent study by Peak Ecological Services is looking at the most effective methods of noxious weed control (biological, mechanical, or chemical) adjacent to rare plant populations (PeakEco 2019a). The 2018 surveys also identified one tamarisk individual located along the Crystal River just north of the beaver pond fen complex. See Map 5.

The Colorado Noxious Weed Act directs the Department of Agriculture to develop and implement management plans for all List A and List B noxious weed species. There are no List A Noxious Weeds at Filoha Meadows Nature Preserve. However, there are ten List B species, seven of which (tamarisk, toadflax, sulphur cinquefoil, common tansy, plumeless thistle, musk thistle, and bull thistle) are slated for elimination. The other three species (Canada thistle, oxeye daisy, and houndstongue) are slated for suppression. There are also seven List C species at Filoha, which should also be controlled. Of particular concern is the List C species, cheatgrass, as well as Japanese brome, another invasive annual grass that occupies the same ecological niche.

TABLE 3. COLORADO LISTED NOXIOUS WEEDS. FILOHA MEADOWS NATURE PRESERVE

Scientific Name	Common Name	Family	Noxious Weed List	Management Status[4]
Trees/Shrubs				
Tamarix parviflora[1,2]	Tamarisk; Salt cedar	Tamaricaceae	B	Eliminate by 2019
Perennial Forbs				
Cichorum intybus	Chicory	Asteraceae	C	N/A
Cirsium arvense (=Breea)	Canada thistle	Asteraceae	B	Suppression
Convolvulus arvensis	Field bindweed	Convolvulaceae	C	N/A
Leucanthemum vulgare	Oxeye daisy	Asteraceae	B	Suppression
Linaria vulgaris[2]	Butter and eggs, toadflax	Plantaginaceae	B	Eliminate by 2021
Potentilla recta[2]	Sulphur cinquefoil	Rosaceae	B	Elimination[3]
Tanacetum vulgare[2]	Common tansy	Asteraceae	B	Eliminate by 2016
Annual/Biennial Forbs				
Arctium minus[2]	Lesser burdock	Asteraceae	C	N/A
Carduus acanthoides	Plumeless thistle	Asteraceae	B	Eliminate by 2018
Carduus nutans subsp. macrolepis	Musk thistle (Nodding plumeless thistle)	Asteraceae	B	Eliminate by 2022
Cirsium vulgare	Bull thistle	Asteraceae	B	Eliminate by 2020
Cynoglossum officinale	Houndstongue	Boraginaceae	B	Suppression
Erodium cicutarium	Redstem stork's bill	Geraniaceae	C	N/A
Sonchus arvensis	Field sowthistle	Asteraceae	C	N/A
Verbascum thapsus	Mullein	Scrophulariaceae	C	N/A
Annual Graminoids				
Anisantha tectorum[5]	Cheatgrass	Poaceae	C	N/A

TABLE 3. COLORADO LISTED NOXIOUS WEEDS. FILOHA MEADOWS NATURE PRESERVE

Notes: Common reed (*Phragmites australis*) is also reported for Filoha (EM Ecological, 2007), however it is the native ecotype, and therefore not a noxious weed at this location.

[1] Tamarisk was previously removed from the site, however one 5-ft tall tamarisk was observed along the Crystal River in 2018.

[2] Reported by EM Ecological, 2007 and not directly observed by the author.

[3] *Potentilla recta* occurs outside of the Pitkin County containment area, therefore elimination is the management strategy.

[4] Source: https://www.colorado.gov/pacific/agconservation/county-weed-programs; and List B Management Plan Web Database for Pitkin County (updated Apr-01-2017).

"Elimination" means the removal or destruction of all emerged, growing plants of a population of List A or List B species designated for eradication by the Commissioner. It is the first step in achieving Eradication and is succeeded by efforts to detect and destroy newly emerged plants arising from seed, reproductive propagule, or remaining root stock for the duration of the seed longevity for the particular species.

"Suppression" means reducing the vigor of noxious weed populations within an infested region, decreasing the propensity of noxious weed species to spread to surrounding lands, and mitigating the negative effects of noxious weed populations on infested lands. Suppression efforts may employ a wide variety of integrated management techniques.

[5] Japanese brome (*Bromus japonicus*), although not a Colorado listed noxious weed, is another invasive annual grass species that occupies the same ecological niche as cheatgrass. It should be controlled along with cheatgrass.

3.5 FLORISTIC INVENTORY & FLORISTIC QUALITY ASSESSMENT

In an era of significant environmental changes and pressures from humankind, there is an increased need for floristic data to understand, preserve, and manage biodiversity. Not only are floristic inventories important, but so is an assessment of the overall floristic quality. The Floristic Quality Assessment (FQA) is a standardized method used to determine the ecological condition of a site in terms of its native floristic quality. It is useful for assessing how human disturbances have affected plant community composition and for tracking changes in plant communities over time, which has practical implications in the continued management of open space areas and helps to form a complete picture of biodiversity.

3.5.1 SURVEY METHODS

A comprehensive list of all vascular plant species encountered at Filoha was compiled for the project area and summarized in table form with scientific name, common name, plant family, origin (native or introduced), and the coefficient of conservatism value (C-value). See Appendix D. The plant list was developed from that presented in *Vegetation Descriptions and Stewardship* (E.M.Ecological 2007) as well as 2017 and 2018 field reconnaissance. This list was updated to current taxonomic nomenclature as found in *The Flora of Colorado* (Ackerfield 2015).

In addition, an FQA assessment was completed (Rocchio 2007). The FQA method is based on the concept of species conservatism. In general, species conservatism is a measure of how sensitive a species is to disturbance, and the degree of fidelity it has to a particular habitat or environment. This is represented by the C-value, or Coefficient of Conservatism, an integer ranging from 0-10 that has been assigned for a given geographic area. Species with low C-values are highly tolerant to disturbance and exhibit little fidelity to natural areas, and they may be found virtually anywhere. In contrast, species with high C-values are highly intolerant to disturbance and are located in high-quality natural sites indicative of conditions prior to human settlement.

To assess the floristic quality within the project area, the mean C-values for the entire property as well as per species richness quadrat was calculated. The C-values were obtained from the CNHP's Colorado Floristic Quality Assessment Database (Colorado Natural Heritage Program (CNHP) 2009) and are included in the Vascular Plant Species List presented in Appendix D.

Photo 17. A Great-Spangled Fritillary (*Speyeria cybele charlotte*) butterfly feeding on showy milkweed (*Asclepias speciosa*) Jul-5-2018. Butterfly identification by Dr. Paul Opler.

3.5.2 RESULTS

A total of 198 vascular plant species were observed at the Filoha Meadows Nature Preserve. These include 10 species of trees, 27 shrubs/subshrubs, 48 perennial graminoids, 83 perennial forbs, four fern allies, one cactus species, 23 annual/biennial forbs, and two species of annual graminoids. Of the total, 46 or 23% are non-native and 17 species are Colorado State listed noxious weeds. Three plant species are tracked by the CNHP. See Section 3.3 above.

The results of the floristic quality assessment show that Filoha has a rich floristic diversity across all its habitats, with mean C-values per transect for native species of 3.9 to 5.9. When all species are considered, these values are understandably lower given the past land use history and that some non-native plants such as redtop and Kentucky bluegrass appear to be naturalized throughout the site. For the entire property, the mean C is 4.1 for all species and 5.3 for native species. In general, those areas with a mean C of >4.5 warrant an A-rating (excellent), between 3.5 and 4.5 is a B rating (good), between 2.5 and 3.5 is a C-rating (fair) and <2.5 is a D-rating (poor) (Rocchio 2006).

3.6 IMPORTANT POLLINATOR HABITAT

Filoha, with its open landscapes, good sun exposure and a high diversity of herbaceous plant species, provides important pollinator habitat. One particularly significant area occurs along the floodplain of the Crystal River in the northern portion of the project area. Here extensive stands of showy milkweed occur, a larval food for the Monarch butterfly, and foraging food for dozens of bees, other butterflies and other insects. During field studies in July of 2018, these milkweed flowers were being visited by a dizzying array and number of insects. Pollination, whether by native bees, butterflies, moths, flies, bats, beetles or other insects, is critical to ecosystem health as pollinators help plants reproduce and produce enough seeds for dispersal and propagation and maintain genetic diversity within plant populations.

Unfortunately, scientists have noticed that the health of pollinator populations has been negatively impacted over the recent decades by a variety of factors: the loss, degradation, and fragmentation of habitat; diminished quantity and quality of food sources; reduced availability of sites for mating, nesting, and migration; exposure to pesticides; and increased adverse effects from pathogens, arthropod pests, and parasites (USDA and USDOI 2015). Thus, managing for pollinators is an important component of land management. According to *Pollinator-Friendly Best Management Practices For Federal Lands* (USDA and USDOI 2015) managing for pollinators involves providing, protecting and ensuring long-term productivity of wildflower-rich foraging habitat; nest sites for native bees (i.e. undisturbed open ground or

downed woody debris); providing host plants for butterflies; and providing overwintering refuge for other insects.

4.0 WILDLIFE

Filoha provides habitat for a variety of wildlife, some of which are permanent residents while others pass through the area on an occasional or seasonal basis. The interspersion of the biotic (e.g., mixed montane shrubland, wetlands, riparian forest, and juniper woodland) and abiotic habitat types (e.g., scree, talus, cliffs, and water) and the intergrades between adjacent habitat types on Filoha result in a relatively rich wildlife community. The diversity of habitats provides an abundance of food, cover, and reproduction sites. The interspersion of open water (e.g., the Crystal River, beaver ponds), emergent wetlands, structurally complex riparian woodland, aspen woodland, and grasslands at the southern end of the property in combination with the mosaic of mixed montane shrublands, juniper woodland, marsh, wet meadows, the river, upland grassland, and cliffs at the northern end provides relatively high niche opportunities. In addition, the importance of Filoha to wildlife results from its landscape connection to the undeveloped lands of the White River National Forest (WRNF). Filoha is situated such that it provides an important ungulate migration link between summer and winter ranges on the WRNF.

4.1 GENERAL WILDLIFE SURVEYS

General wildlife surveys were conducted to determine wildlife species diversity and habitat use. The method used for these surveys was Terrestrial Visual Encounter Surveys (TVES), arranged according to the U.S. Forest Service (USFS) Multiple Species Inventory and Monitoring (MSIM) protocols (Manley et al. 2006). TVES are general wildlife surveys designed to detect a variety of terrestrial species, especially mammals (e.g., ungulates, lagomorphs), reptiles, and diurnal raptors (Forys and Humphrey 1997, Weckerly and Ricca 2000), as well as less common or difficult to detect landbirds (Manley et al. 2006). As a result, TVES is a core survey method for all classes of vertebrates as a companion to taxon-specific core survey methods. Sampling areas are contained within a 200 m radius hexagonal area occupying approximately 10 ha (Figure 1). The relatively large area occupied by the sampling hexagon reflects the desire for surveys to encounter the variety of vegetation types and conditions that occur in proximity to the center point, thus increasing the number of species available for detection (Manley et al. 2006). In addition, all visits to Filoha were considered walking surveys and any direct or indirect wildlife encounters of note were recorded.

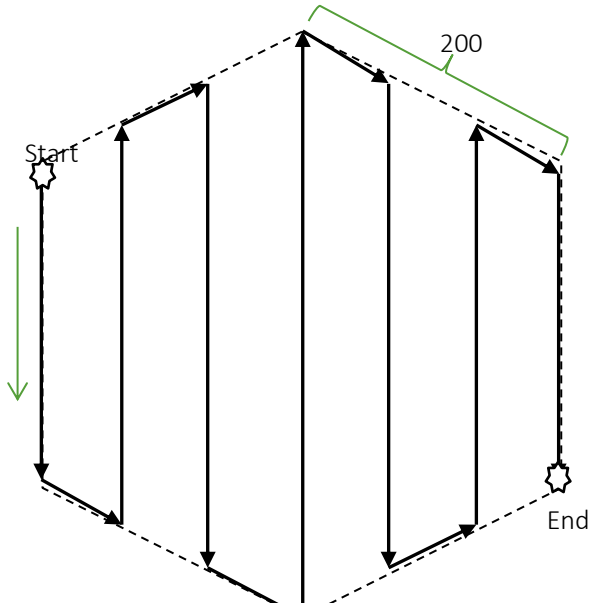

Figure 1. TVES hexagonal survey grid

4.1.1 METHODS

Two TVES hexagons were established in locations that provided the greatest representation of the major vegetation types (i.e., habitat) on Filoha (Map 6). Each corner and the center point of the TVES grid is permanently marked with wooden stakes or fiberglass rods and monumented via GPS. The TVES was conducted on July 1-2, 2018[1] between 0900 and 1400 hours. Two qualified observers searched

[1] If deemed necessary, additional TVES could be conducted in fall and/or winter to establish migration and winter use of the property.

within each TVES hexagon. Observers followed a transect that loops through the hexagon at ~50 m spacing (Figure 1). The length of each route on each half of the sample unit is approximately 1200 m, for a total of 2400 m, and covers approximately 10 hectares (24.7 ac). Observers used pre-established GPS coordinates along the center line and perimeter of the hexagon and a compass to walk the transect lines. All areas within 2 meters of either side of the transect line were surveyed.

4.1.2 SUMMARY OF RESULTS

In 2018, the TVES at Filoha resulted in 255 observations of 10 mammal species or sign of those species, and 977 total detections of all wildlife species (Figure 2). Sign was detected (e.g., scat, tracks, excavation, scrapes, beds, dens) of the following mammals (in order of abundance): Rocky Mountain elk (*Cervus elaphus nelsoni*), Rocky Mountain mule deer (*Odocoileus hemionus hemionus*), Rocky Mountain bighorn sheep (*Ovis canadensis* canadensis), northern pocket gopher (*Thomomys talpoides*), mountain cottontail (*Sylvilagus nuttalli*), least chipmunk (*Tamias minimus*), rock squirrel (*Otospermophilus variegatus*), American black bear (*Ursus americanus*), coyote (*Canis latrans*), and *golden*-mantled ground squirrel (*Callospermophilus lateralis*). Northern pocket gopher sign included mounds of dirt formed by soil they have removed from their tunnels to form a conical mound (Halfpenny 1986) as well as eskers, entry holes, and runways.

Although many birds were detected during TVES, under the protocol the only detections recorded would be those of raptors, Galliformes (e.g., grouse, turkeys, etc.), wading birds, waterfowl, or any occurrence of particular interest (e.g., rare, first detection, USFS Sensitive Species, etc.). None of these birds were detected in 2018.

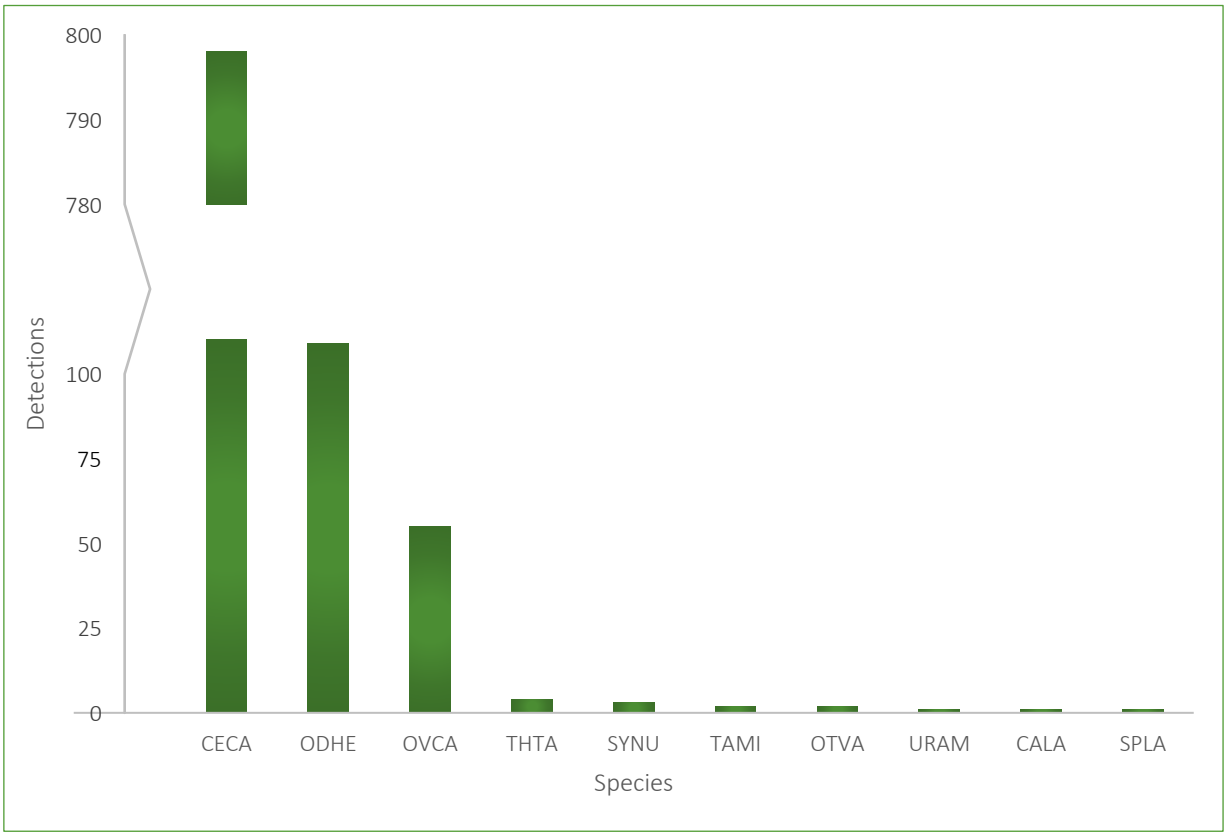

Figure 2. Number of TVES detections by species. Species codes: CECA=Elk, ODHE=Mule deer, OVCA=Bighorn sheep, THTA=Northern pocket gopher, SYNU=Mountain cottontail, TAMI=Least chipmunk, OTVA=Rock squirrel, URAM=Black bear, CALA=Coyote, SPLA=Golden-manteled ground squirrel

4.2 RARE AND NOCTURNAL MAMMALS

Camera arrays, in combination with the core TVES are an effective method to detect a large proportion of most medium to large mammal species with the additional benefit of increasing detections of those that are rare on the landscape (i.e., large home ranges) or nocturnal.

4.2.1 METHODS

Infrared cameras and associated scent stations were used to detect rare[2] and nocturnal mammals. Given the somewhat linear nature of Filoha and the distribution of the various habitat types, five survey stations were placed in strategic locations based on prior direct and indirect wildlife observations (Map 6). At each station, a motion sensitive monitoring camera was used to document species encounters. Bushnell® Trophy Cam brand cameras were set up to capture color photos during the day and infrared photos at night. Infrared LED night vision flash was used so that a visible flash would not scare wildlife or disclose the location of the cameras to humans. Each time the sensor detected movement, 3 still photos and 1 brief video were captured. This increased the likelihood that the species was correctly identified and improved our ability to detect and count groups of animals. The camera and infrared detector were attached to a tree or other suitable substrate[3], with the bait no higher than 0.5 m above the ground, and the camera positioned to detect visitation to the base of the bait tree. The camera and sensor are generally arranged vertically on the same tree or on adjacent trees. Cameras and detectors are attached to trees using Slate River EZ-Aim Trail Camera Mounts (Photo W1) and to T-posts using EZ-Aim T Post Game Camera Mounts. Each camera was left in place for a total of 14 days.

Camera stations were baited and set to maximize detections of a variety of species. The primary bait was half a chicken secured to the vertical substrate with wire mesh and zip-ties, approximately 0.5-1.5 m from the ground (Photo W2). The camera was positioned such that any visitation to the tree triggered the camera. A mixture of Caven's Gusto® brand, a skunk scent gland derivative; Carman's Superior Animal Lures Trails End® Lure, a lure for fox, coyotes and cats; and lanolin is used as a long-distance attractant. The lure mixture is prepared by combining a 1 oz jar of Gusto and 0.5 oz of Trails End with 32 oz of heated lanolin in liquid form. Approximately 1 to 3 tablespoons (T) of the mixture is placed within 4 m of the station on a substrate such as a tree branch. The mixture is applied on the setup day and is not reapplied or removed for the duration of the survey.

4.2.2 SUMMARY OF RESULTS

Over 4,300 photos were recorded by the 5 cameras placed at Filoha. Wildlife species of interest were recorded at all locations. A total of 75 photographs of 7 mammal species and 2 bird species were recorded (Figure 2). Of these, elk (Photo W3) were the most common species photographed (37.3% of total detection) followed by mule deer (34.7%; Photo W4), rock squirrel (*Otospermophilus variegatus*; 9.3%), coyote (*Canis* latrans; 8.0%; Photo W5), black bear (*Ursus americana*; 4.0%; Photos W6, W7), turkey vulture (*Cathartes aura*; 2.7%; Photo W8). In addition, 1 individual (1.3%) of each of the following species were detected by the cameras: long-tailed weasel (*Mustela frenata*; Photo W9), least chipmunk (*Tamias minimus*), and Steller's jay (*Cyanocitta stelleri*; Photo W10). Many of the photographs were triggered by wind moving vegetation, precipitation, and people rather than by wildlife.

All of the species detected were expected. A few mammals known to occur at Filoha were not detected including bighorn sheep, bobcat (*Lynx rufus*), mountain lion (*Puma concolor*), American mink (*Neovison vison*), and mountain cottontail. Given the duration of the survey, however, it is not surprising that these

[2] "Rare" in this case refers to animals that are uncommon across the landscape such as mountain lions and others that have large home ranges.
[3] When no tree was available, a T-post was used and left in place for future monitoring.

species, some of which occur at relatively low densities on the landscape, were not confirmed by the cameras. Bighorn sheep were not captured by the cameras since they only occur on the property from late fall through early spring.

4.3 DIURNAL RAPTORS

Raptors, also known as birds of prey, are a group of birds composed of the orders Falconiformes (i.e., falcons, eagles, hawks,) and Strigiformes (i.e., owls). Due to differences in their behavior, raptors are split into diurnal and nocturnal (Section 4.4 below) groups for surveying purposes. Specific objectives were to determine the presence and distribution of diurnal raptor species that use Filoha as part of their home range during the breeding season. Although all diurnal raptors are active during the day, they vary in detectability.

Some, such as red-tailed hawks, are readily observed if soaring over open fields. Others, notably the Accipiters such as northern goshawks (*Accipiter gentilis)* and Cooper's hawks (*A. cooperii*), tend to be more difficult to reliably detect, due to their preference for vegetation cover. Inconspicuous diurnal raptors were targeted for inventory purposes using call playback surveys. Surveys were conducted during the early summer (July 8) to increase our chances of detecting multiple species, which generally vary in their nesting chronology. Accipiter broadcast surveys were combined with informal surveys for all raptors during the other survey methods included in this report (e.g., TVES, owl surveys).

4.3.1 SURVEY METHODS

Broadcast survey methods were based on those outlined by Kennedy and Stahlecker (1993) and Joy et al. (1994), with modifications to suit project specific needs. Broadcast stations were established every 250± m along a single 2,122 m transect (Map 6). The survey was limited to this transect since it sufficiently covered the potential nesting habitat for the target species. The spacing between stations was based on the literature (Kennedy and Stahlecker 1993, Joy et al. 1994, Watson et al. 1999) concerning typical spacing of accipiter nesting areas and rough estimates of the broadcast range of the broadcast caller, striving for an interval that would maximize chances of detecting any existing territories. In addition to the broadcast survey, visual nest searches were conducted throughout Filoha to determine whether any inactive nests or non-responsive nesting raptors occurred on the property.

At each station, the observer broadcast alarm calls in four directions, at 45° angles to the transect. Each 10-sec broadcast in a specific direction was followed by 30 sec of scanning and listening for responses. At each station, the observer broadcast sharp-shinned hawk (*Accipiter striatus*), Cooper's hawk, and northern goshawk alarm calls, in that order, to avoid potential size-related inhibitory effects[4]. When a focal species was detected, the observer recorded the species, age, and sex, when possible; an assessment of the observer's confidence in identifying the responding species (i.e., confident or not confident, as supported by a description of what was heard and/or seen); time of response; time elapsed since first call broadcast; species of call broadcasted immediately preceding the detection; response type (i.e., call, call and approach, call and flyby, silent approach, silent fly-by); estimated distance and bearing to response; station number and location; and general vegetation characteristics surrounding the detection point (i.e., maturity and stature of aspen forest).

4.3.2 SUMMARY OF RESULTS

Only one raptor was detected during the broadcast surveys. A solitary golden eagle (*Aquila chrysaetos*) was observed circling over the property north of the barn. The eagle remained in a hunting pattern over the

[4] Although broadcasts were limited to Accipiter calls, Buteos (e.g., red-tailed hawks) respond to these calls as well. This is likely due to the perceived predator/competitor interaction.

property for more than 20 minutes. In addition, individual red-tailed hawks (*Buteo jamaicensis*), turkey vultures, and American kestrels (*Falco sparverius*) were visually observed at the property while conducting other surveys in 2018. American peregrine falcons (*Falco peregrinus anatum*), Cooper's hawks, and golden eagles (*Aquila chrysaetos*) have been observed at Filoha in prior years.

4.4 OWLS & OTHER NOCTURNAL BIRDS

As top predators, owls play an important trophic role in ecosystems. Consequently, owls are considered good indicators of ecological health. Due to their nocturnal behavior and time of breeding, however, owls often go undetected using traditional avian population monitoring methods. Therefore, although nocturnal broadcast surveys do not detect a large number of species per unit effort, they can generate reliable monitoring data on an important group of carnivores.

4.4.1 SURVEY METHODS

In 2018, nocturnal owl surveys were conducted at points established at regular intervals (350 meters) spaced such that they maximized representation of the different cover types while minimizing the likelihood of detecting the same owl at multiple stations . Each point was surveyed twice during the periods when vocal activity of the majority of species is greatest (April 23, June 20). Owls are strongly territorial during their breeding season, and readily respond to perceived conspecific intruders. Consequently, when a recorded owl calls within an owl's territory, the owl usually responds by calling back and often flying closer to the person (Fuller and Mosher 1987, Takats et al. 2001). Portions of this protocol were adapted from surveys conducted in western Montana since the mid 1980's (Holt and Hillis 1987).

At each station, the surveyor broadcast 3 times for 10 seconds in 3 directions, rotating 60˚ right or left (determined randomly) from the direction of travel, and then listened and searched in all directions for owl responses for 30 seconds (Joy et al. 1994). The broadcast and observation procedures were then repeated two more times after rotating 120˚ from the previous broadcast. The calls of all owl species that may occur in the Filoha vicinity were broadcast in approximate order of increasing size. This is important because some larger species of owls may compete with or prey upon smaller species; thus, smaller owls are less inclined to begin vocalizing if the larger species have already begun to vocalize. Any detection was recorded by the locations of survey points. A compass bearing and distance to the owl was also recorded with the location documented via GIS (RISC 2001, Takats et al. 2001, Blakesley 2009, Kissling and Lewis 2009). All other wildlife encountered was recorded by species and location. Calling equipment consisted of an MP3 player connected to a Cass Creek Big Horn XL© speaker, producing 80-110 dB output at 1 meter. Particular effort was made to note the occurrence of any non-owl nocturnal birds such as nightjars.

4.4.2 RESULTS

The 2018 nocturnal owl surveys at Filoha resulted in the detection of 1 northern pygmy owl (*Glaucidium gnoma*) on April 23, 2018. This owl, detected from calling point #2, was perched in a blue spruce approximately 18 meters due east at a 10˚ bearing from the point (Map 6). A nest and cavity search was conducted the following day but none was found. Calls and sounds were documented from at least 8 other species including: coyotes, boreal chorus frogs (*Pseudacris triseriata*), Wilson's snipe (*Gallinago delicata*), and mallards (*Anas platyrhynchos*).

4.5 WILDLIFE HABITAT RELATIONSHIPS

4.5.1 METHODS

In addition to the TVES surveys, the wildlife communities of Filoha were evaluated using a variation of the Wildlife Habitat Relationship (WHR) approach (Thomas 1979). In this approach, the likeliness of the presence

or absence of a given wildlife species, guild, or assemblage can be predicted based upon their known geographic and elevational distribution combined with habitat requirements for feeding, reproduction, and special needs such as migration, resting, and thermal cover. The required habitat inventory for this level of analysis is relatively quick and easy to accomplish by simple delineation of plant communities and their structural stage and condition. The accuracy of the results was greatly enhanced by familiarity of the habitats in a given area by the investigator. The biotic habitat types (i.e., plant communities) identified at Filoha are described in detail within the vegetation section. In addition, Filoha's biotic and abiotic habitat types were sampled by Colorado Wildlife Science (CWS) biologists concurrently with the TVES (described above) to provide baseline information for the species-habitat extrapolation. The abiotic habitat features such as cliffs and talus were evaluated from aerial photos and then on the ground.

4.5.2 WILDLIFE HABITAT RELATIONSHIP RESULTS

To a large degree, this section should be considered an update to the 2005 Filoha Meadows Nature Preserve Resource Management Plan: Wildlife Resources (CWS 2005). Although it is necessary to repeat some of the information contained in that report, an effort has been made to focus on species occurrence and/or habitat conditions that have changed in the 14 years since that report was submitted. In this section, the wildlife habitat and wildlife species of interest (i.e., listed by state or federal agencies, rare or endemic, culturally important) known or suspected to occur at Filoha are described, followed by an update to the recommended MIS and monitoring options, as well as suggested management actions to balance the protection of important wildlife resources with other management needs at Filoha.

WILDLIFE HABITAT

As stated in the 2005 Wildlife Resources Report, the interspersion of the abiotic, mixed shrubland, conifer forest, aspen forest, and riparian/mesic communities and the intergrades between adjacent types on Filoha (Map 9) provides habitat for a varied array of wildlife. Despite Filoha's relatively modest size, the diversity of habitats provides an abundance of food, cover, and reproduction sites.

MAMMALS[5]

Ten mammal species were identified via the TVES at Filoha. In addition, 33 additional mammal species are known or suspected to occur on Filoha (See Appendix E for a list of mammals known or likely to occur on Filoha). These mammals fall into 2 general categories – those that use Filoha to satisfy all of their life history requirements, spending most of their lives on the property (e.g., small mammals) and others that incorporate Filoha into a greater home range (e.g., ungulates, carnivores). Thirteen of those species are of particular conservation interest such as Species of Greatest Conservation Need (SGCN), CNHP/NatureServe ranked vulnerable to imperiled, BLM or USFS Sensitive, and/or declining. As a result, management of Filoha to maintain or improve conditions for these species is of particular importance.

UNGULATES

Filoha provides important habitat for mule deer, North American moose, Rocky Mountain bighorn sheep, and Rocky Mountain elk.

MULE DEER (*ODOCOILEUS HEMIONUS HEMIONUS*)

Filoha is situated within Colorado Parks and Wildlife (CPW) Mule Deer Data Analysis Unit (DAU) D-13 and Game Management Unit (GMU) 43 (Mao et al. 2011). Over the past 2 decades, there has been significant loss and degradation of mule deer habitat in D-13 largely resulting from residential development in winter habitat and increased year-round recreational use of public lands. In addition, long-term anthropogenic

[5] See Appendix E for a list of mammals known or likely to occur on Filoha.

intervention and natural ecological processes such as climate change, drought, and long-term fire suppression have altered plant community composition and altered plant succession towards less nutritious forage for deer. The 2017 post-hunt population estimate was 6,130 deer, which is down from 6,400 in 2009 and approximately 11,100 in 2004. In 2018, however, the CPW post-hunt population estimate for DAU 13 rose to 7,264. This increase is largely "…due to a change in the current (2018) model…" rather than a large increase in the deer population (J. Mao, Colorado Parks and Wildlife, personal communication).

It is important to conserve critical areas, especially winter ranges, to maintain the various habitats required by mule deer in order to counter the impacts of residential development, rangeland conversion, road and highway construction, and recreation. Currently, much of the shrublands comprising mule deer winter range in GMU 43 are over-mature to senescent. This particular seral stage does not produce much forage for deer. The effects of reduced mule deer winter range can be mitigated by improving the quality of cover and forage on lands that remain undeveloped. Habitat management programs include limiting livestock grazing in important winter range and the alteration of vegetational communities towards early seral stages. For mule deer, the optimal successional stages are subclimax plant communities that are most easily perpetuated anthropogenically (Wallmo 1981). Land managers have had great success using mechanical treatments (e.g., hydro-ax, brush hogs) to set back the Gambel oak shrublands and piñon-juniper to an early seral stage. Mule deer numbers have improved after just two or three years following such treatments (e.g., Basalt State Wildlife Area) (Clark 2004).

Mule deer occupying montane habitats such as those at Filoha, move within a broad range of elevations, climates, and topography which includes a wide range of vegetation. Mule deer also occupy agricultural areas that were converted from shrublands. Mule deer diets are as varied as the landscapes they inhabit. Kufeld et al. (1973) identified 788 plant species that have been eaten by mule deer; this list includes 202 trees and shrubs, 484 forbs, and 84 grasses, rushes, and sedges.

Mule deer are common on and around Filoha from late spring though mid-fall. Mule deer do not use Filoha as part of their winter range. Rather, most of the deer that summer on and in the vicinity of the property migrate down (north) to the piñon-juniper, Gambel oak, mountain mahogany, and antelope bitterbrush dominated shrublands in the Assignation Ridge-Thompson Creek area north of Perham Creek. Fawning and rearing by mule deer was confirmed on the property by means of the monitoring cameras (Photo W11).

Important vegetation types: Mountain shrub communities provide the most important mule deer habitat on Filoha, providing abundant cover, browse and mast. In addition, the aspen, Douglas fir, juniper, and riparian woodlands are used heavily during the summer providing relief from day-time heat. The interspersion of shrubland and forest vegetation types provides deer the security to forage in the open with ample escape to cover in the trees. The ponds, river, and wetlands at Filoha are important water sources for deer.

NORTH AMERICAN MOOSE (*ALCES AMERICANUS*)

Moose are relatively recent arrivals to the Crystal valley. Most of the moose appearing in the area have wandered over from the Grand Mesa reintroduction area. Between 2005 and 2007, 91 moose were released on the Grand Mesa to establish a self-sustaining herd (CPW 2012). Since then, moose have pioneered across the Grand Mesa and into the Crystal River Watershed and the greater Roaring Fork Watershed. Within proximity to Filoha, the Middle Thompson Creek - Assignation Ridge – Perham Creek area has been identified by CPW as a moose concentration area, and the area from North Thompson Creek south to McClure Pass on the west and Big Kline Creek on the east as moose winter range (Colorado Parks & Wildlife 2018a). Although moose have not been observed on Filoha to date, it is suitable and high quality moose habitat. Given the property's proximity to important moose habitat areas, it is likely that they will begin to use it for some part of their seasonal habitat in the near future.

Important vegetation types: Nearly all of the available vegetation types occurring at Filoha provide habitat for moose. The grasslands, wetlands, montane shrublands, and aspen forest at Filoha are all known to be used by moose in the Roaring Fork Watershed.

ROCKY MOUNTAIN BIGHORN SHEEP (*OVIS CANADENSIS CANADENSIS*)

Rocky Mountain bighorn sheep are characterized by low reproductive rates, long life spans, and populations adapted to live near carrying capacity in relatively stable environments (Geist 1971). Bighorn sheep eat a wide variety of plants, with diets that vary seasonally and throughout their geographic range (Cooperrider and Hansen 1982, Rominger et al. 1988). Succulent vegetation in summer and snow and ice in winter help bighorns to survive for long periods without freestanding water. Forbs generally dominate the diet, followed by grasses, and lastly browse (Krausman and Shackleton 2000). Some low-elevation Rocky Mountain bighorn sheep populations, however, have diets dominated by the leaves of 154 browse species, particularly true mountain-mahogany (Rominger et al. 1988). Bighorn sheep also use mineral licks, especially during summer when green, potassium-rich forage is consumed. Unlike other ungulates in which young disperse to new areas, bighorn sheep pass knowledge of home ranges and migration routes from one generation to the next. Therefore, bighorn sheep do not typically recolonize ranges where they have been extirpated (Singer and Gudorf 1999).

Bighorn avoid forest and thick brush to the maximum extent possible, and fire can play an important role in creating bighorn habitat as well as making existing patches safer relative to predators (Goodson 1991). Large areas that lack precipitous escape terrain represent substantial barriers to movement. Even within mountain ranges like the Elks, bighorn sheep habitat is frequently patchy and the population structure is one of natural fragmentation (Wakelyn 1987). Within individual home ranges, different habitats meet the specific requirements of wild sheep, including foraging, resting, mating, lambing, thermal cover, and predator avoidance. Warm temperatures on south-facing slopes result in earlier green-up, marking the transition from winter range to spring range. During the spring green-up, mineral licks like those at Filoha are an important component of bighorn sheep habitats where soils are derived from granitic materials. As temperatures continue to rise during late spring and early summer, bighorn make greater use of north, east, and west-facing slopes at higher elevations for foraging.

While bighorn sheep feed in open areas, they are rarely found more than 0.25 miles (400 m) from escape cover, where they have an advantage over most predators (Krausman and Leopold 1986). Bighorn sheep rely on keen vision to detect predators, and on rapid mobility on steep terrain as the principal means of avoiding predators. Thus, open, steep terrain is the defining component of bighorn sheep habitat (Risenhoover et al. 1988, Krausman and Shackleton 2000). Talus slopes, rock outcrops, and cliffs provide habitat for resting, lambing, and escape cover. Adult male sheep are known to move farther away from security cover than females. Young rams in particular have a propensity to wander great distances from escape cover, particularly during the breeding season (Schommer and Woolever 2008). Escape terrain is critical for ewes during lambing, even to the extent that they will sacrifice access to high quality forage for security (Bleich et al. 1997). Both ewes and lambs are vulnerable to predation immediately prior to and for one to two days after parturition. Adult female bighorns exhibit strong fidelity to parturition sites and often use the same lambing grounds year after year. In the Rocky Mountains, lambing areas are usually on or very close to wintering areas (Geist 1971).

Key elements of winter ranges for bighorn sheep include low snow depth and wind-swept areas with sufficient forage and adjacent escape terrain for eluding predators (Krausman and Bowyer 2003). Wind, cold temperatures, and heavy snow accumulation are likely limiting factors for Rocky Mountain bighorn sheep in some areas. Consequently, most bighorn winter ranges occur on steep south, southwest, or southeast-facing slopes where maximum heat gain reduces cold stress and snow cover, and increases the availability of forage (Goodson 1991). In some areas, bighorn sheep may remain at or move to high elevation, wind-swept ridges

to avoid heavy snow depths at lower elevations (Geist 1971). Snow quality and the proximity of security cover are other factors influencing sheep use of winter ranges.

Filoha is within CPW Bighorn Sheep Management Area S-25 (Snowmass West) that covers portions of Pitkin, Garfield, and Gunnison Counties, and the sheep that use the property are a subset of what is known as the "Avalanche Creek herd." Bighorn sheep historically use the lower elevations of Filoha from the time that snow depths drive them from higher elevations in the fall until early summer after lambing. Filoha provides fall and spring transition habitat (Photo W12), winter range (Photo W13), and severe winter range, and encompasses portions of an important winter concentration area (Map 7).

It has been estimated that 20,000 to 30,000 bighorn sheep roamed Colorado in the 1870s (Wolfe 1990). These numbers declined rapidly as the mountainous areas of the state were increasingly settled. The largest decline on a statewide basis coincided with the advent of domestic livestock, particularly domestic sheep, spreading into the habitat of wild bighorn sheep (Wolfe 1990). Entire herds of bighorn died out following contact with domestic sheep. Although bighorn population numbers have improved statewide – in 1970 Colorado had an estimated 2,200 sheep, there are now approximately 6,200 sheep statewide (Colorado Parks & Wildlife 2018b) – S-25 sheep and, more specifically, the Avalanche Creek herd, has been in decline since the early 1990s. Many of these sheep are infected with bacterial pathogens and lungworm (*Protostrongylus* spp.). When stressed, these infections can often progress to pneumonia, which is a major factor in the decline of Colorado's bighorn sheep. The high infection rate with lungworm and susceptibility to pulmonary viral and bacterial infections increase the incidence of respiratory tract diseases and mortality from fatal bacterial (*Pasteurella multocida* and/or *Mannheimia haemolytica*) pneumonia. CPW has noted that the overall bighorn sheep population in Game Management Unit S-25 has dropped from 220 +/- sheep in the 1980s (J. Groves, CPW, Personal Communication) to approximately 45 in 2016 and only 35 in 2018 (Colorado Parks & Wildlife 2018b). According to CPW District Wildlife Manager John Groves, the current population estimate is 45 and 10 lambs (yearlings) have been counted this spring including 5 at Filoha (Groves, Personal Communication). Rocky Mountain bighorn sheep are a CPW Tier 2 Species of Greatest Conservation Need[6] (SGCN; Colorado Parks & Wildlife 2015).

The minimum limiting factors for bighorn sheep in the Crystal River watershed are production areas and winter range. In contrast, summer range for these sheep is extensive. Filoha contains important winter range that provides forage year-round due to the warming action of the numerous hot springs on the property. The property also contains a portion of an important winter concentration area which extends from the toe of the southwesterly facing slopes on the property northeast to the top of the steep bare rock and sparsely vegetated slopes on Filoha and adjacent WRNF lands. In addition, the hot springs adjacent to the river have been identified as an area that provides minerals important to bighorn sheep for meeting basic nutritional needs. The sheep that winter in the vicinity of Filoha migrate to their lambing habitat and summer range via the Avalanche Creek, East Creek, Gift Creek, and Hawk Creek drainages (Wright 2005). There is also a movement corridor between the Penny Hot Springs area and Avalanche Creek along the old railroad grade and the cliff band above it. The protection of Filoha also maintains the connectedness of the northern and southern portions of the herd's home range.

Important vegetation types: Without question, the grasslands and meadows at Filoha are the most important vegetation types, but it is their proximity to Filoha's somewhat unique abiotic habitat features that makes it

[6] SGCN Tier 1 are those species of highest conservation priority in the state, and to which CPW will likely focus resources over the life of the 2015 State Wildlife Action Plan (Colorado Parks & Wildlife 2015). Tier 2 species remain important in light of forestalling population trends or habitat conditions that may lead to a threatened or endangered listing status, but the urgency of such action has been judged to be less.

so valuable to bighorn sheep. The adjacency of the hot springs results in available, nutritious forage in even the worst winters while the steep slopes and cliffs provide critical escape cover from predators.

ROCKY MOUNTAIN ELK (*CERVUS CANADENSIS NELSONI*)

Filoha is situated within CPW Elk DAU E-15 and GMU 43 (Mao et al. 2013). According to Mao et al. (2013), outdoor recreation and other anthropogenic disturbance; habitat loss and fragmentation due to development; and continued lack of large-scale habitat improvement projects have been the major issues for this elk herd. Increased predator populations could also be affecting the elk population. Undeveloped habitat has been degraded not only by human recreational impacts, but also by vegetation changes resulting from long-term fire suppression and lack of habitat management which has led to older-aged, less productive forage. Areas close to developments are now unlikely to be allowed to burn due to potential damage to property. The cumulative effect is that both quantity and quality of habitat has declined for elk in E-15. The 2018 post-hunt population estimate was 4,235 elk, which is down slightly from 4,330 in 2017 and 4,500 in 2013 (J. Mao, personal communication). In addition, the post-hunt calf:cow ratio in E-15 has been in an overall decline for the past 3 decades (Mao et al. 2013). In the 1980s, the calf ratio averaged 59 calves:100 cows; in the 1990s, the average was 49; and in the 2000s, the average was 41. The 3-year average from 2009-2011 was only 39. This post-hunt ratio is used as an index of herd productivity. This index grossly reflects the combined summer natality and summer-to-early winter survival rate of calves relative to cows (Mao et al. 2013).

Filoha provides important elk winter range and has been identified by CPW as an elk winter concentration area (Map 8; Colorado Parks & Wildlife 2018). In addition, Filoha is situated within an important elk migration pattern and is heavily used as transition habitat (Photo W14) by elk moving between summer and winter habitats. Abundant sign such as barking scars on aspen, browse on preferred forage shrubs, game trails, tracks, and pellets provide evidence that the riparian woodland, montane shrublands, and meadows on Filoha are heavily used by elk. Large bands of elk, sometimes as many as 75-100, have often been observed on the property in late fall through early spring. Elk move back and forth from the slopes with southerly and westerly exposures above (east of) the property to the nutritious winter forage and shallow snow resulting from the geothermal energy of the hot springs on the property.

Filoha is not mapped by CPW as elk production habitat. CWS biologists have, however, observed young spotted calves on the property in mid-June (Photos W15, W16). On the WRNF, calving commonly occurs within mature aspens with a thick understory of shrubs such as chokecherry and snowberry within 183 m (200 yd) of a water source (Seidel 1977b, a). Personal observation of calving behavior in Pitkin County by the author has largely confirmed this assessment, except that active elk calving habitat in the Roaring Fork Watershed is known to occur on variable aspects, but there is always significant woody understory vegetation which provides calves with hiding cover and good access to water. In addition, cottonwood riparian woodlands along the Roaring Fork and Crystal Rivers often provide the structural components sought by cows for parturition. CPW District Wildlife Manager John Groves believes that limited calving occurs within the riparian forest south of Redstone (J. Groves, CPW, personal communication). In addition, elk use those areas as post-parturition neonatal habitat. It is likely that some of the calves observed on the property in June were born elsewhere, then moved down toward Filoha for forage and access to water. Both professional and amateur observers of elk often confuse neonatal habitat use for production areas because it is assumed that where the calf was first observed was also the parturition site (Seward 2003). Typically, observed calves are several days old and are more mobile thus making them more “observable” and have likely dispersed from the calving site.

Although elk occasionally occur at Filoha after calving season, most animals that winter on and around the property migrate to summer range on the WRNF in the western Elk Range to the east and the Huntsman Ridge area to the west. As the days shorten and snow begins to accumulate in the late summer and early

fall, elk begin migrating back to lower elevations and eventually back to their winter range on and around Filoha.

Important vegetation types: Most of the plant communities at Filoha are actively used by elk. The montane shrublands and meadows provide important forage, the riparian woodland provides valuable rearing habitat, and the juniper woodland provides visual and thermal cover.

PREDATORS & OMNIVORES

Filoha provides habitat for 11 species of predatory mammals (Table 4). Five of these mammals are known to occur at Filoha as a result of direct observation by CWS biologists and 4 have been confirmed on the Property by means of sign such as tracks, scat, or territorial marks.

TABLE 4. PREDATORS & OMNIVORES AT FILOHA MEADOWS NATURE PRESERVE

Common Name	Scientific Name	Confirmed (Y/N)	How	CNHP / CPW* Status
Canids				
Coyote	*Canis latrans*	Yes	Observation	G5 S5
Red fox	*Vulpes vulpes*	Yes	Observation	G5 S5
Felids				
Bobcat	*Lynx rufus*	Yes	Sign	G5 S5
Mountain lion	*Puma concolor*	Yes	Sign	G5 S5
Mustelids				
American badger	*Taxidea taxus*	Yes	Sign	G5 S5
American marten[7]	*Martes americana*	No	--	G4G5 S4 / SGCN T2
American mink	*Neovison vison*	Yes	Sign	G5 S5
Long-tailed weasel	*Mustela frenata*	Yes	Observation	G5 S5
Striped skunk	*Mephitis mephitis*	Yes	Observation	G5 S5
Other				
American black bear	*Ursus americanus*	Yes	Observation	G5 S5
Raccoon	*Procyon lotor*	Yes	Sign	G5 S5
*Only if SGCN				

Most of these species are habitat generalists with large home ranges – up to 294 mi^2 for male mountain lions (Anderson et al. 1992), but some of the smaller species may have home ranges completely within Filoha.

AMERICAN BLACK BEAR (*URSUS AMERICANUS*)

Black bears occur at Filoha during the non-winter months. The Gambel oak dominated mixed montane shrublands on the east side of the property and the riparian woodland at the southwest side provide important forage and are mapped within a black bear fall concentration area by CPW (Colorado Parks &

[7] Molecular investigations recently resurrected the Pacific marten (*Martes caurina*) as a species distinct from the American pine marten (*M. americana*) (Colella et al. 2018). American martens inhabit the higher-latitude taiga of northern North America, while insular Pacific martens persist in temperate old-growth coastal forests, and mainland *M. caurina* inhabit the forests of the southern Rockies, intermountain west, and southwestern sky islands. Since this nomenclature remains mixed as of this writing, martens will be described in this report as "American martens."

Wildlife 2019). The slopes on the north and east sides of the property also provide many opportunities for winter denning.

Important vegetation types: As described above, the variety of fruit- and mast-bearing shrubs in the montane shrublands and riparian woodland are valuable to bears. The Gambel oak, skunkbush sumac (*Rhus aromatica* subsp. *trilobata*), and serviceberry in the montane shrubland and the chokecherry, Wood's rose, and currants (*Ribes* sp.) are all favored by black bears.

BATS

Bats mark the presence of healthy, functioning ecological communities. Threats to bats in Colorado and worldwide have led to multiple mortality events (e.g., direct killing by humans; chemical contaminants; global increase of industrial wind-power facilities; outbreak of white-nose syndrome) (O'Shea et al. 2016). Coupled with roosting and foraging habitat loss, these threats create the potential for declines in bat populations. Nine bat species are either known or likely occur at Filoha (Adams 2003, Siemers et al. 2012). The diverse geology in combination with the mining history in the vicinity of Filoha and the Crystal Valley contribute to the importance of the property for bat conservation. The interspersion of complex rocky habitats, surface water, and insect-attracting hot springs at Filoha results in a unique landscape that supports at 9 or more bat species (Table 5). Colorado bat species mostly hibernate locally, undergoing short seasonal migrations that may require moving to a higher elevation in order to find suitable winter roosts (J. Neubaum et al. 2006). Abandoned mines and caves such as those occurring on and within proximity to Filoha are used as hibernacula by some species, particularly Townsend's big-eared bats (*Corynorhinus townsendii*; Ingersoll et al. 2010; Hayes et al. 2011). Rock crevices and talus are thought to be used as hibernacula as well (J. Neubaum et al. 2006). Mines are used as habitat by 7 of the 9 species that may occur at Filoha: big brown bat, fringed myotis, little brown bat, long-eared myotis, long-legged myotis, Townsend's big-eared bat, and western small-footed myotis (which are strongly associated with Townsend's big-eared bats).

TABLE 5. BATS KNOWN OR LIKELY TO OCCUR AT FILOHA MEADOWS NATURE PRESERVE

Common Name	Scientific Name	Known or Likely	How	CNHP/ CPW Status
Big brown bat	*Eptesicus fuscus*	Likely	Habitat/Distribution	G5 S5
Fringed myotis	*Myotis thysanodes*	Likely	Habitat/Distribution	G4 S3 / SGCN T1
Hoary bat	*Lasiurus cinereus*	Likely	Habitat/Distribution	G3G4 S3S4B / SGCN T2
Little brown bat	*Myotis lucifugus*	Known	Observation	G3 S4 / SGCN T1
Long-eared myotis	*Myotis evotis*	Likely	Habitat/Distribution	G5 S4
Long-legged myotis	*Myotis volans*	Likely	Habitat/Distribution	G4G5 S5
Silver-haired bat	*Lasionycteris noctivagans*	Likely	Habitat/Distribution	G3G4 S3S4
Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	Known	Observation	G4T3T4 S2 / SGCN T1
Western small-footed myotis	*Myotis ciliolabrum*	Likely	Habitat/Distribution	G5 S4

TOWNSEND'S BIG-EARED BAT (*CORYNORHINUS TOWNSENDII PALLESCENS*)

Of the bats known or with the potential to occur at Filoha, Townsend's big-eared bats are particularly adapted to and dependent on the property's mosaic of habitats. Although found in a variety of vegetation types, the globally Vulnerable (G3G4 T3T4) and state Imperiled (S2) (NatureServe 2018) Townsend's big-eared bat distribution is limited to areas with adequate roosting sites (e.g., caves, mines) that are proximate

to foraging habitat (e.g., wooded streams, forest edges) (Sherwin et al. 2000, Ellison et al. 2003). Townsend's big-eared bats are also a Tier 1 SGCN and USFS Region 2 Sensitive Species. Although no Townsend's big-eared bats have been confirmed on Filoha, they are known to occur within similar habitats at the same elevation with mines serving as cave surrogates for hibernacula, maternity roosts, and bachelor roosts (Sherwin et al. 2000, Siemers 2002, Gruver and Keinath 2006). Listed by the State of Colorado as a SGCN, Townsend's big-eared bats have also been reported to use bridges, rock crevices and hollow trees as roost sites (Ellison et al. 2003).

Filoha is a significant conservation site for this imperiled bat. A very large Townsend's big-eared bat maternity colony occurs on WRNF lands near Filoha. These colonies form between March and June with pups born between May and July. Maternity colonies choose sites that have warm, stable temperatures for pup rearing. Males remain solitary during the maternity season. Young are born in mid-June with about 90 percent of all females in the nursery colonies producing young. Only one young is born per female. Pups will begin flying at about 3 weeks old. Disturbances to mines and caves, especially those hosting such maternity colonies, are the primary threat to this species. As abandoned mines throughout Colorado are closed for hazard abatement, there is potential for loss of bat roosts. In addition, this species is sensitive to human disturbance and will leave roost sites following human visitation (Pierson et al. 1999, Armstrong et al. 2011). Disruption of colonies, hibernacula, and/or roosts by recreationists may cause abandonment of maternity sites (Pierson et al. 1999) and the premature expenditure of critical fat reserves during hibernation (Thomas 1995).

Important vegetation types: Townsend's big-eared bats depend on Filoha's abiotic habitat such as surface water, cliffs, and rocky outcrops in combination with all of the woody vegetation types.

SMALL MAMMALS – SHREWS, RODENTS, & LAGOMORPHS

Small mammals are an important component of the ecological communities at Filoha. In addition to their direct contribution to species richness, they play a major role in trophic dynamics, consuming plant material and invertebrates, and in turn serving as prey for a number of species of snakes, raptors, and small to mid-sized mammalian carnivores. The small mammals known or likely to occur at Filoha vary from very small (3.2 in./0.06 oz. dwarf shrew) to relatively large (3 ft./45 lb. common porcupine), and from unseen fossorial species (e.g., northern pocket gophers) to conspicuous arboreal species (e.g., red squirrel). The variety of moisture conditions and plant communities provides appropriate habitat for at least 4 of the 6 species of soricid shrews (*Sorex* spp.) known to occur in western Colorado (Spackman et al. 1999, Armstrong et al. 2011). One of these, the dwarf shrew (*Sorex nanus*) is a Tier 2 SGCN (Colorado Parks & Wildlife 2015). Filoha is known to be home to one lagomorph: mountain cottontail (Table 6).

TABLE 6. RODENTS & OTHER SMALL MAMMALS AT FILOHA MEADOWS NATURE PRESERVE

Common Name	Scientific Name	Known or Likely	How	CNHP / CPW Status
Mice, Rats, & Voles				
Bushy-tailed woodrat	*Neotoma cinerea*	Known	Sign	G5 S5
Common muskrat	*Ondatra zibethicus*	Known	Observation	G5 S5
Deer mouse	*Permomyscus manilculatis*	Known	Observation	G5 S5
Long-tailed vole	*Microtus longicaudus*	Likely	Habitat/ Distribution	G5 S5
Meadow vole	*Microtus pennsylvanicus*	Likely	Habitat/Distribution	G5 S5
Montane vole	*Microtus montanus*	Likely	Habitat/Distribution	G5 S5
Western jumping mouse	*Zapus princeps*	Likely	Habitat/Distribution	G5 S5

TABLE 6. RODENTS & OTHER SMALL MAMMALS AT FILOHA MEADOWS NATURE PRESERVE				
Common Name	Scientific Name	Known or Likely	How	CNHP / CPW Status
Lagomorphs				
Mountain cottontail	*Silvilagus nuttalii*	Known	Observation	G5 S5
Sciurids				
Golden-mantled ground squirrel	*Callospermophilus lateralis*			
Least chipmunk	*Neotamias miimus*	Known	Observation	G5 S5
Red squirrel	*Tamiasciurus hudsonicus*	Known	Observation	G5 S5
Rock squirrel	*Otospermophilus variegatus*	Known	Observation	G5 S5
Wyoming ground squirrel	*Urocitellus elegans*	Known	Observation	G5 S5
Yellow-bellied marmot (Photo W17)	*Marmota flaviventris*	Known	Observation	G5 S5
Soricids & Fossorial Mammals				
American water shrew	*Sorex palustris*	Likely	Habitat/Distribution	G5 S4
Dwarf shrew	*Sorex nanus*	Likely	Habitat/Distribution	G4 S2 / SGCN T2
Masked shrew	*Sorex cinereus*	Likely	Habitat/Distribution	G5 S5
Montane shrew	*Sorex monticolus*	Likely	Habitat/Distribution	G5 S5
Northern pocket gopher	*Thomomys talpoides*	Known	Sign	G5 S5
Other				
American beaver	*Castor canadensis*	Known	Sign	G5 S5
North American porcupine	*Erithizon dorsatum*	Known	Sign	G5 S5

BIRDS[8]

The biogeophysical attributes of Filoha provide for a rich assemblage of birds. Ninety-three bird species are known or suspected to occur on Filoha. Nine of these species are of particular conservation interest such as SGCN, CNHP/NatureServe ranked vulnerable to imperiled, BLM or USFS Sensitive, and/or declining. As a result, management of Filoha to maintain or improve conditions for these species is of particular importance.

The diversity of habitat types at Filoha supports a relatively high bird species richness including habitat-interior species (e.g., blue-gray gnatcatcher, plumbeous vireo), habitat specialists (e.g., cordilleran flycatcher, white-throated swift, Virginia's warbler), and species known to be sensitive to human activity and anthropogenic habitat change. Although this is an indication that Filoha provides effective habitat for sensitive birds (Temple 1991), management could further improve the quality of that habitat. The lack of structural and age class diversity in some vegetation types (e.g., montane shrublands) negatively affects diversity of avifauna. For example, densities of small-diameter oaks have sharply increased in the past 140 years during a period of fire exclusion following Euro-American settlement (Abella and Fulé 2008).

Birds are monitored on Pitkin County Open Space with three main objectives: 1) to measure species composition and diversity, 2) to monitor population trends, and 3) to evaluate the effects of specific management actions. Breeding birds were surveyed on Filoha for the first time in 2003. In 2011, CWS reported that from 2003 through 2008, 599 ($\overline{x}_{year}$ = 120) individuals of 56 species were detected at Filoha.

[8] See Appendix E for scientific names of birds.

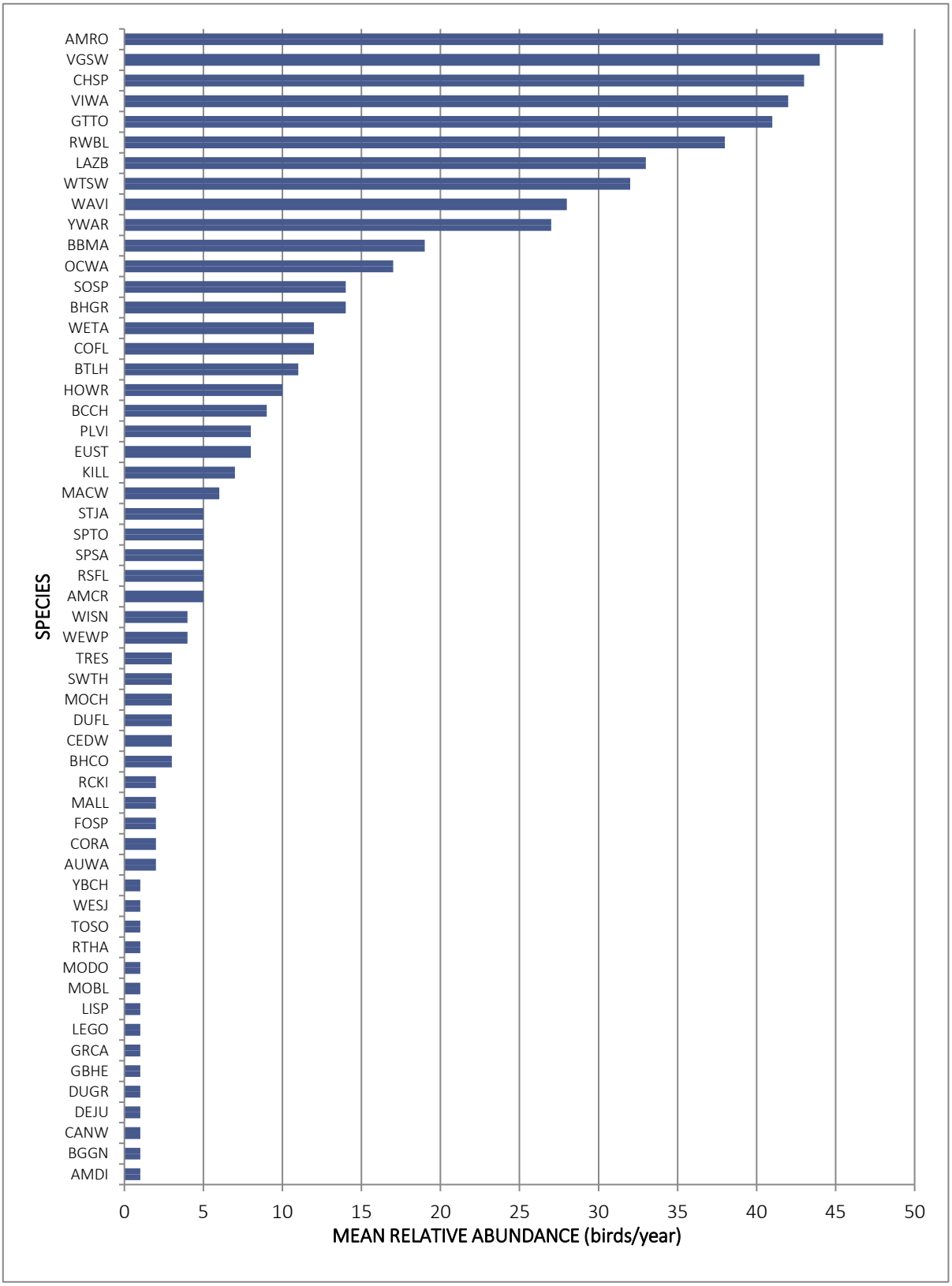

Figure 3. Mean relative abundance (2003-2008) of bird species at Filoha. For each species, mean relative abundance was derived by summing the maximum abundance in each year and averaging over the 5 survey years (CWS 2011).

Estimated species richness at Filoha between 2001 and 2008 varied from a low of 30.77 in 2004 to a high of 49.67 in 2006 ($\overline{x}_{year}$ = 42.89) (CWS 2011). Although the linear trend of species richness at Filoha for that period indicates a slight upward trend, only 1% of the variation in species richness can be explained by the model. The remaining 99% can be explained by unknown variables or inherent variability.

On average, most of the species (93.32%, SE = 0.01) detected contributed less than 10 individuals to the total number of individuals. The 10 most abundant species represented an annual mean of 69.16% (SE = 0.02) of the total individuals detected with a maximum of 72.17% in 2007 and a minimum of 63.25% in 2006. American robins, chipping sparrows, violet-green swallows, and Virginia's warblers were among the 10 most detected each year and green-tailed towhees and red- winged blackbirds were among the 10 most detected every year except one. The majority of birds including most raptors in the United States are protected by the Migratory Bird Treaty Act, 16 U.S.C. 703 (MBTA). Eagles are also protected by the Bald and Golden Eagle Protection Act, 16 U.S.C. 668 (Eagle Act).

The major habitats on Filoha from an avian perspective are (1) Aspen Woodland; (2) Cliff/Rock; (3) Grasslands; (4) Mid-elevation Riparian Woodland; (5) Montane Shrubland; (6) Juniper Woodland; and (7) Wetlands.

DECIDUOUS WOODLAND

Vegetation Classification: Aspen – Gambel Oak Woodland

There is a small portion of a larger aspen stand in the extreme southeastern portion of the property. Healthy aspen stands with diverse understories support some of the highest levels of vertebrate diversity in the Southern Rocky Mountains. Because aspen is seral and is usually mixed with adjacent conifer types, the importance of aspen-dominated woodlands to birds and other wildlife far exceeds the areal extent of the stands themselves (DeByle 1985). Currently, the numerous elk using the property are limiting regeneration of aspen and negatively affecting development of a robust understory. Consequently, this stand is in moderate to poor condition and does not support the avian density or richness as healthier stands adjacent to the property. Birds strongly associated with aspen habitat such as broad-tailed hummingbirds, red-naped sapsuckers, tree swallows, violet-green swallows, and warbling vireos would benefit from management of this stand to make it more resilient to the effects of elk on regeneration and understory development.

CLIFF / ROCK HABITAT

Vegetation Classification: Rock Spirea Rock Outcrop Sparse Vegetation

Although the avifauna of cliff/rock habitat is small compared to other habitats, the species that depend on these abiotic features are highly specialized. Birds that use cliffs for nesting may be more susceptible to loss of nesting habitat than many other species because they rely completely on cliffs as nest sites (Camp and Knight 1998, Martínez-Abraín et al. 2010). Thus, the number of suitable nest sites is finite and essentially non-renewable. All suitable nest sites in some areas may be used, making any disruption of a nest site by humans result in a direct reduction in the population. Conflicts related to nesting birds that use cliffs, rocky ledges, and small rocky out thrusts include rock climbing, mining, road construction, hiking, bicycle and horseback trails, and housing development (Knight and Cole 1995). All of these activities can have a negative impact whether they are conducted at the base or the top of a cliff, rocky ledge, or small rocky out thrust.

Bird species strongly associated with cliff/rock documented at Filoha include canyon wren, common raven, rock wren, golden eagle, peregrine falcon, turkey vulture, and white-throated swift. There is an historic peregrine falcon nesting area on cliffs within a ½ mile of Filoha Meadows Nature Preserve. This eyrie (i.e., nest site) has been active as recently as 2000 and peregrines have been observed hunting over the property as recently as 2017. Although the historic eyrie is on WRNF lands, Filoha meets all of the criteria for high quality peregrine hunting habitat. Formerly listed as Endangered, peregrines were delisted from the Federal

Threatened and Endangered Species list in 1999. Peregrines are a Tier 2 SGCN and ranked G4T4, S2B by CNHP.

TABLE 7. BIRDS OF CONSERVATION CONCERN KNOWN TO OCCUR AT FILOHA MEADOWS NATURE PRESERVE

Common Name	Scientific Name	USFS	BLM	FWS	PIF	CNHP	CPW
Diurnal Raptors & Owls							
American peregrine falcon	*Falco peregrinus anatum*	S	S	C		G4T4 S2B	SC, SGCN T2
Bald eaqle	*Haliaeetus leucocephalus*	S	S	C		G5 S1BS3N	SC, SGCN T2
Golden eagle	*Aquila chrysaetos*			C		G5 S3S4B.S4N	SC, SGCN T1
Northern harrier	*Circus cyaneus*	S				G5 S3S4B	SGCN T2
Columbidae – Pigeons & Doves							
Band-tailed pigeon	*Patagioenas fasciata*					G4 S4B	SGCN T2
Passerines							
Lazuli bunting	*Passerina amoena*					G5 S5B	SGCN T2
Lewis's woodpecker	*Melanerpes lewis*	S		C		G5 S5	SGCN T2
Pinyon jay	*Gymnorhinus cyanocephalus*			C	W	G5 S5	SGCN T2
Virginia's warbler	*Oreothlypis virginiae*				W	G5 S5	SGCN T2

Special management designations: USFS=United States Forest Service, S=US Forest Service Region 2 Sensitive Species; FWS=U.S. Fish and Wildlife Service, C=Bird of Conservation Concern for Bird Conservation Regions (BCR) 16 & 18; BLM=Bureau of Land Management, S=BLM Sensitive Species in Colorado; CPW=Colorado Parks & Wildlife, SGCN=Species of Greatest Conservation Need; PIF=Partners In Flight, W=Watch List.

GOLDEN EAGLE (AQUILA CHRYSAETOS)

The cliffs on the north end of the property are also suitable golden eagle nesting habitat and golden eagles are frequently observed hunting Filoha. Golden eagles, a Tier 1 SGCN, use a very wide range of habitats. For nesting they most frequently use cliffs and steep escarpments but will also nest in trees. Because of their large size and predatory nature, they require large areas of foraging habitat. Golden eagles have been noted to be sensitive to some forms of anthropogenic presence (Palmer 1988). Steidl et al. (1993) found when observers were camped 400 meters from nests of golden eagles, adults spent less time near their nests, fed their juveniles less frequently, and fed themselves and their juveniles up to 67% less food than when observers were camped 800 meters from nests. In studies of golden eagle populations in the southwest (New Mexico and Texas) and the Front Range of the Rocky Mountains (New Mexico, Colorado and Wyoming), Boeker and Ray (1971) reported that human disturbance accounted for at least 85% of all known nest losses.

Important vegetation types: Tundra, high- and mid-elevation pine forest, piñon-juniper woodlands, sagebrush and other shrub habitats, grassland, and agricultural habitats are all used by golden eagles.

GRASSLAND HABITAT

Vegetation Classification: Native Grassland, Non-Native Grassland

At present the dominant plant community at Filoha by area is grassland and most of that is dominated by non-natives. It is likely that given a normal disturbance regime, grasslands would occupy some proportion of the total cover on the property. This acreage, however, would likely be lower than the current condition. In addition, the dominant species would be native grasses and forbs rather than the introduced pasture grasses

that dominate now. Such grasses have low to moderate forage value for wildlife. Monitoring data suggests that this habitat type on Filoha supports the lowest species richness of all of the habitats found on the property. This is due to a combination of factors: (1) As discussed above, the dominant plant species are not native to this region; and (2) There is very low structural diversity for foraging, nesting, and perching (Rotenberry and Wiens 1980, Rotenberry and Wiens 1998).

One of the species that benefits from the presence of this habitat is mountain bluebirds. The current condition of the property is particularly suited to mountain bluebirds given the interspersion of excellent foraging and nesting habitat. Mountain bluebirds are particularly adapted to early successional communities resulting from disturbance adjacent to appropriate nesting habitat (Guinan et al. 2000). Proximity of the old hayfields/pastures and wetlands with piñon-juniper, Gambel oak shrublands, and aspen at Filoha results in excellent mountain bluebird habitat. Winter distribution and abundance is strongly influenced by the availability of fruits (especially juniper)(Guinan et al. 2000). Although vesper sparrows have been documented by CWS in similar habitat at the same elevation, none have been documented at Filoha.

MID-ELEVATION RIPARIAN FOREST HABITAT

Vegetation Classification: Narrowleaf Cottonwood - Blue Spruce Riparian Forest, Box Elder Riparian Woodland

Although riparian systems occupy no more than 3% of the Colorado landscape (Kingery 1998), 75% of the bird species in the West use riparian areas during some part of their life cycle (Howe 1996). The narrowleaf cottonwood-blue spruce riparian forest at Filoha is found along the Crystal River south of the Johnson residence. While this mixed deciduous and evergreen forest comprises a small portion of the property, it probably supports the greatest avian richness. Twenty (40.8%) of the species recorded during point transects were identified in the riparian forest. American robin and yellow warbler were the species most frequently detected. Other species detected included broad-tailed hummingbird, cordilleran flycatcher, house wren, mountain chickadee, northern flicker, ruby-crowned kinglet, song sparrow, Swainson's thrush, warbling vireo, western wood-pewee, yellow-rumped warbler, and western tanager.

Of the bird species known to breed at Filoha, two species are strongly associated with healthy riparian communities: cordilleran flycatcher and Lewis's woodpecker. Both of these species have been found to exhibit detectable population response to changes in the quality of riparian habitat.

CORDILLERAN FLYCATCHER (*EMPIDONAX OCCIDENTALIS*)

Cordilleran flycatchers are relatively common in the more mesic ecological communities of Filoha. They generally nest in shady coniferous, deciduous, and mixed forests, usually near streams or moist gulches. Cordilleran flycatchers usually place their nest in roots of upturned trees and forked branches, small cavities in rock ledges, dirt banks, trees, and snags (Bailey and Niedrach 1965, Dobkin 1994, Wickersham 2007). These conspicuous flycatchers are also commonly associated with lodgepole pine forest and mixed conifer forest dominated by Douglas fir (Hejl et al. 1995). They are more likely to occur in areas with a relatively large number of snags, reflecting an association with the older, denser vegetation types (Hutto and Young 1999). Cordillerans are ranked "high physiographic area priority" and "moderately high global vulnerability" (Colorado Partners in Flight 2000).

Important vegetation types: Cordilleran flycatchers have been documented in Filoha's aspen forest, riparian aspen forest, and subalpine fir – aspen forest during the breeding season.

LEWIS'S WOODPECKER (*MELANERPES LEWIS*)

Lewis's woodpeckers have been documented nesting at Filoha every year since monitoring has been conducted. They are year-round residents in the Crystal Valley and are designated a Tier 2 SGCN by CPW, a Sensitive species by Region 2 of the USFS (USDA Forest Service 2017) and categorized as a moderately high

priority species on the Partners in Flight National Watch List (Partners in Flight 2016). In western Colorado, Lewis's woodpeckers nest in open ponderosa pine forest and open riparian woodland dominated by large cottonwoods with a brushy understory offering ground cover, dead or downed woody material, available perches, and abundant insects (Bock 1970, Linder and Anderson 1998).

Important vegetation types: Lewis's woodpeckers have only been observed in Filoha's cottonwood-spruce riparian woodland on the south end of the property and the riparian area north around the scree field at the northern end of the property.

MONTANE SHRUBLAND HABITAT

Vegetation Classification: Gambel Oak / Serviceberry Shrubland

Although Filoha is adjacent to hundreds of acres of Gambel oak dominated montane shrublands, this habitat type occupies only a small portion of the property on the northerly facing slopes on the eastern boundary. In Colorado, most mountain shrubland bird species are currently meeting their habitat requirements fairly well (Colorado Partners in Flight 2000). Colorado Partners in Flight Priority Species for this habitat type are Virginia's warbler and green-tailed towhee (Colorado Partners in Flight 2000). Both species currently breed on Filoha and are recommended as MIS for the mixed mountain shrubland habitat type.

VIRGINIA'S WARBLER (*OREOTHLYPIS VIRGINIAE*)

Virginia's warblers are strongly associated with mature Gambel oak and are fairly abundant in appropriate habitat. Virginia's warblers are ranked as a Tier 2 SGCN by CPW and watchlisted by Partners in Flight (Partners in Flight 2019). Virginia's warblers are uncommon and their numbers declined by 46% between 1970 and 2014, according to Partners in Flight. They are a Yellow Watch List species with a restricted range, and have a Continental Concern Score of 14 out of 20. Partners in Flight estimates that if current rates of decline continue, Virginia's warblers will lose another half of their remaining population within the next 61 years. The causes for decline in Virginia's warblers are not well understood. In some areas forest management techniques such as controlled burning can reduce available breeding habitat. In other areas where brown-headed cowbirds are abundant, cowbirds frequently lay eggs in the nests of Virginia's warblers, preventing the warblers from raising offspring of their own. Climate change may also affect these birds as they frequently associate with wet drainages, which may shrink as climate warms. They nest in dense shrublands and on scrub-adorned slopes of foothills, open draws, and mountain valleys in semiarid country. They also use scrubby brush, draws covered with Gambel oak, and dense shrublands – especially Gambel oak (Colorado Partners in Flight 2000). Virginia's warblers are endemic to Arizona, Colorado, New Mexico, and Utah. Accordingly, it is important that stewards of Virginia's warbler habitat in Colorado consider their requirements when making management decisions.

Important vegetation types: Virginia's warblers are more or less restricted to the Gambel oak dominated shrublands below 9,000 feet.

GREEN-TAILED TOWHEE (*PIPILO CHLORURUS*)

Green-tailed towhees are fairly common and despite some local decreases, overall their populations were stable from 1966 to 2014, according to the North American Breeding Bird Survey (Sauer et al. 2014). Partners in Flight estimates a global breeding population of 4.1 million with 100% spending part of the year in the U.S. and 61% wintering in Mexico (Partners in Flight 2019). The species rates a 10 out of 20 on the Continental Concern Score and is a U.S.-Canada Stewardship species. These birds are sensitive to habitat degradation in the vast sagebrush shrub-steppes of the interior West, much of which has been altered by grazing, agriculture, and changed fire regimes. In mountain forests, green-tailed towhees benefit from the shrubby communities that come along after forest fires, making proper fire management important for this and many other species. They typically breed in dry shrubby hillsides (Gambel oak, mountain mahogany, serviceberry,

sagebrush, snowberry, chokecherry, and antelope bitterbrush) and in sagebrush flats (Colorado Partners in Flight 2000) at elevations between 6,000-9,000 ft (Wickersham 2007).

Important vegetation types: Breeding green-tailed towhees prefer xeric shrubby hillsides dominated by Gamble oak, mountain mahogany, serviceberry, and sagebrush; more mesic Gambel oak dominated montane shrublands; and sagebrush shrublands.

JUNIPER WOODLAND HABITAT

Vegetation Classification: Juniper / Shrub Woodland

Juniper woodland habitat supports one of the largest nesting bird species list of any upland vegetation type in western Colorado. The avian species richness in this ecological community is due, in part, to the fact that it occurs at such a broad range of elevations (approximately 4,500 – 8,500 feet) (Balda and Masters 1980).

Like montane shrublands described above, many acres of juniper habitat on WRNF land border Filoha. The areal extent of this habitat type on the property, however, is less than what would naturally occur. Again, this is largely due to past anthropogenic intervention. As time passes since maintenance of the hayfields/pastures ceased, the extent of the juniper cover type will likely increase. It is important to note that fire suppression in grasslands adjacent to juniper woodland has allowed the woodlands to advance by out-competing grasses (Kingery 1998).

Of the Priority Species for this habitat type listed by Colorado Partners in Flight, only one has been identified on Filoha, pinyon jay. The others, such as gray vireo and juniper titmouse occur at lower elevations (Colorado Partners in Flight 2000). Other bird species strongly associated with high elevation juniper dominated woodlands at Filoha include blue-gray gnatcatchers, canyon wren, chipping sparrow, and mountain bluebird.

WETLANDS HABITAT

Vegetation Classification: Coyote Willow Wet Shrubland, Beaked Spikerush Marsh, Bulrush Marsh, Common Reed Wet Meadow, Water Sedge – Beaked Sedge Wet Meadow, Redtop Ruderal Marsh

Wetlands are only exceeded in areal extent at Filoha by the non-native grasslands. Filoha's marshes, wet meadows, and willow wetlands support a vigorous wetland bird community. Thirty-seven of Colorado's breeding bird species are dependent on wetlands (Wickersham 2007). Although many of the species that depend on Filoha's wetlands are common and are presently of little current conservation concern (e.g., red-winged blackbird) others are declining and/or experiencing habitat loss (Partners in Flight 2019). Bird species strongly associated with graminoid marshes and shrub-scrub wetlands recorded on the property include killdeer, lazuli bunting, red-winged blackbird, song sparrow, sora, Wilson's snipe, and yellow warbler. In addition, cinnamon teal, gadwall, green-winged teal, mallard, and spotted sandpipers have been observed on or around the ponds.

The shrub-scrub wetland is home to a small colony of beavers that are important to the maintenance of this ecological community. In addition, this wetland contains three ponds that have historically supported a small number of nesting waterfowl. As the process of eutrophication continues, these ponds could be replaced by emergent wetlands resulting in the loss of the waterfowl habitat. The role the beavers and the irrigation ditch play in the maintenance of the open water component of this wetland should be investigated.

The bulrush dominated wetland around the hot springs is a seasonal wetland that supports a number of wetland bird species. Numerous red-winged blackbirds breed here as do a few pairs of killdeer. Harriers have been observed hunting over this wetland on a few occasions but no nest has been located to date.

RAPTORS

Filoha provides suitable breeding and foraging habitat for falcons, hawks, and owls. American kestrels, Cooper's hawks, northern goshawks, peregrine falcons, red-tailed hawks, and sharp-shinned hawks have been observed on Filoha during the breeding season. Flammulated owls, great horned owls, northern pygmy owls, northern saw-whet owls, and western screech owls may occur on Filoha based on habitat preferences but have not been confirmed on the property.

HERPETOFAUNA

Herpetofauna sampling has not been conducted at Filoha, however western terrestrial garter snakes (*Thamnophis elegans*) have been regularly observed on Filoha. Boreal chorus frogs (*Pseudacris maculata*) likely occur and smooth green snakes (*Opheodrys vernalis*) may occur at Filoha. Chorus frogs are common to a wide range of waterbodies including urban, rural, and mountain ponds, flooded meadows, backwaters along streams, and cattle ponds (Hammerson, 1999). Breeding usually occurs in shallow, grassy or reedy ponds that lack fish predators and have no current. Larger ponds and lakes may be utilized if grassy edges are available (Hammerson 1999). Smooth green snakes may occur at Filoha and are typically found in riparian vegetation along montane streams between 5,500 and 9,000 feet (Hammerson 1999). They have been documented by CWS in similar habitat in the Crystal Valley. Although Filoha encompasses suitable habitat for northern leopard frogs, they have been extirpated from the area and do not occur. In addition, although Filoha is at the upper end of their elevational range, bullsnakes (*Pituophis catenifer*) have been observed on the property. These large snakes (up to 9 feet) are found in a wide variety of habitats, including woodlands, deserts, agricultural areas (such as cultivated fields), prairies, chaparral, and shrublands. Typical prey includes small mammals, birds, lizards, smaller snakes, insects, and eggs (Hammerson 1999). Tiger salamanders (*Ambystoma tigrinum*) likely occur in the ponds.

4.6 MANAGEMENT INDICATOR SPECIES (MIS)

Pitkin County OST plans to update the management plan for Filoha in 2019. This plan will incorporate the MIS concept as an integral part of the adaptive management effort. Since managers cannot measure everything of potential interest within an ecosystem, the choice of what to measure is critical. According to Noss et al. (1997), this step is among the most difficult and controversial in developing a monitoring program. Valuable indicators may possess some or all of the following characteristics:

- Provide early warning of natural responses to environmental impacts (Noss 1990, Munn 1993, Woodley 1996b).
- Directly indicate the cause of change rather than simply the existence of change (e.g. Measuring fecundity and survival rather than simple measurements of abundance) (Woodley 1996a).
- Provide continuous assessment over a wide range and intensity of stresses (Woodley 1996a). This allows for detection of numerous impacts on the ecosystem and also means that an indicator will not bottom out or level off at certain thresholds (Noss 1990, Woodley 1996b).
- Are cost-effective to measure and can be accurately estimated by a broad-range of all personnel (including even non-specialists) involved in the monitoring (Davis 1989, di Castri 1992).

4.6.1 AVIAN MONITORING

CORDILLERAN FLYCATCHER

Selection: Cordilleran flycatchers are currently plentiful at Filoha which contains particularly suitable habitat given the interspersion of the montane riparian forests, cliffs, and open water.

Conservation Issues: Habitat degradation from timber harvesting, heavy grazing, or development are the most significant threats. Cordilleran flycatchers are somewhat tolerant of human presence around nests, but may be vulnerable to disturbance just prior to fledging (USDA Forest Service 1994).

Management Recommendations:

1. Preserve standing dead trees. The loss of snags reduces nesting sites.
2. Any activity that would remove the dense understory preferred by this species would be detrimental.
3. Use of cut banks and other physical cover features may make them particularly vulnerable to damage to streambanks from over grazing or overuse for recreation.
4. Restore riparian habitat where it has been removed or degraded.

VIRGINIA'S WARBLER

Selection: The dense oak shrublands at Filoha provide excellent Virginia's warbler habitat and they are currently abundant at Filoha. Any management of the oak shrublands, whether burning or mastication to improve habitat for other species or recreational development, has the potential to affect these mature shrubland dependent warblers.

Conservation Issues: Virginia's warblers are strongly associated with Gambel oak. They nest on the ground in dense shrublands and on scrub-adorned slopes of mesas, foothills, open ravines, and mountain valleys in semiarid country. They also use scrubby brush and juniper woodland with a well-developed shrubby understory and Gambel oak component, ravines covered with Gambel oak, and dense shrublands – especially Gambel oak (Colorado Partners in Flight 2000). Virginia's warbler is considered to be vulnerable due to its narrow geographic distribution on breeding and wintering ranges, and small populations in its breeding range. Other species that may benefit from habitat management for this species on Filoha include MacGillivray's warbler, common poorwill, green-tailed towhee, spotted towhee, black-headed grosbeak, and broad-tailed hummingbird.

Management Recommendations:

1. Maintain mature Gambel oak dominated shrublands where Virginia's warblers occur.
2. Maintain herbaceous vegetation for nesting cover where Virginia's warblers occur.
3. Produce a mosaic of habitat age classes on a landscape scale.
4. Maintain dense stands of Gambel oak shrub habitat of at least 20 acres.
5. Avoid applying herbicides in Gambel oak dominated habitat while young are in the nest (May 15-June 30th).
6. Delay habitat manipulations in Virginia's warbler habitat until after July 20th.
7. Avoid management practices that create or increase the amount of edge between shrubland habitat and converted or highly altered land. These edges support brown-headed cowbirds, nest predators, and invasive grasses and forbs.

Recommended Research:

1. Continue to annually monitor Virginia's warbler populations through the PCOST Monitoring Protocol. Annually analyze 5-year trend to determine stability of population.
2. Determine best methods for controlling non-native invasions and reestablishing native habitat (Rotenberry 1998).

3. Investigate use of prescribed burns that promote regeneration of shrubs and native understory grasses.

GREEN-TAILED TOWHEE

Selection: This species was selected for monitoring to answer the question, "Does current management maintain populations of species dependent on open shrub habitat?" Green-tailed towhees often breed in similar habitat as Virginia's warblers but often select more open, xeric shrublands with greater representation of mountain mahogany, sagebrush, and/or antelope bitterbrush.

Conservation Issues: Conflicts related to the nesting, resting, and foraging of green-tailed towhees include mining, road construction, hiking trails, fire, conversion of rural areas to urban subdivisions (ski resorts), and intentional alteration of habitat to enhance livestock grazing. Large scale prescribed fires that eliminate the shrub component would be detrimental to this species.

Colorado contains between 20% and 40% of the entire breeding population of green-tailed towhees (Kingery 1998); therefore, Colorado has a high responsibility for the conservation of this species (Colorado Partners in Flight 2000). Colorado Breeding Bird Atlas abundance calculations rank this towhee as the thirteenth most numerous species in Colorado, with almost a million breeding pairs (Kingery 1998). Mountain shrubland habitat on the West Slope is one of the most important breeding habitat types for green-tailed towhees. Other species that may benefit from habitat management for this species on Filoha include the common poorwill, spotted towhee, black-headed grosbeak, and broad-tailed hummingbird.

Management Recommendations:

1. Survey areas for breeding green-tailed towhees before considering altering montane shrubland by herbicide treatment, mechanical alteration, or burning.
2. Strive to produce landscape-scale mosaics of altered and unaltered habitat, and to prevent invasion of exotic plants such as cheatgrass.
3. Schedule habitat manipulations and/or prescribed burning in early spring before birds arrive and not during the bird's breeding and nesting season.
4. Ensure that habitat manipulations and/or prescribed fires leave adequate amounts of unburned shrubs to provide breeding habitat.
5. Maintain existing larger stands of shrublands and continuity between stands wherever possible.
6. Avoid applying herbicides in Gambel oak dominated habitat when while young are in the nest (May 15-June 30th).
7. Avoid management practices that create or increase the amount of edge between shrubland habitats and converted or highly altered land. These edges support brown-headed cowbirds, nest predators, and invasive grasses and forbs.
8. Management for natural shrubland mosaics interspersed with other shrub species and shrub habitats should favor green-tailed towhees (Braun 1976, Knopf 1990).

Recommended Research:

1. Continue to annually monitor green-tailed towhee populations through the PCOST Monitoring Protocol. Annually analyze 5-year trend to determine stability of population.
2. Research threshold levels below which green-tailed towhees drop in significant breeding numbers to determine where the critical loss of shrub cover occurs.

3. Determine best methods for controlling non-native invasions and reestablishing native habitat (Rotenberry 1998).
4. Investigate use of prescribed burns that promote regeneration of shrubs and native understory grasses.

WARBLING VIREO

Selection: Selection of the warbling vireo addresses concerns regarding management of aspen woodlands. In Colorado, the vast majority of warbling vireos breed in aspen woodlands (Barrett 1998) of the western mountains (to around 9,000 feet) from around May 21 to around August 10 (Kingery 1998). They are also commonly found in montane and lowland riparian forests but are rarely found where conifers dominate (Andrews and Righter 1992). Warbling vireos show a particular affinity for aspen stands that are interspersed with willows (Winternitz 1973). In addition, warbling vireos are believed to be negatively correlated with Sudden Aspen Decline (SAD) (Bombacia and Korba 2009). The work of Matson (2000) also suggests that the warbling vireo may be used as an indicator species of aspen habitats, given their strong association with aspen.

Conservation Issues: Since warbling vireos commonly favor nest sites with canopy cover, probably to provide thermoregulation and protection from heat stress (Walsberg 1981), the decrease in canopy cover and associated increase in crown fade in declining aspen stands may be particularly impactful on warbling vireo populations. This species is sensitive to removal of aspen or other deciduous vegetation in breeding areas and conifer invasion of aspen stands are likely to negatively impact warbling vireo populations (Dobkin 1994). Habitat disturbance by humans may limit breeding success (Fraterrigo and Wiens 2005). Warbling vireo nests are frequently parasitized by brown-headed cowbirds, which combined with nest predation, may be limiting to the population in some areas (Ward and Smith 2000).

Management Recommendations:

1. Continue monitoring this species.
2. Manage aspen to achieve at least 35% canopy cover; can be up to 70% closure.
3. Create large exclosures to protect aspen suckers and saplings from browsing elk.
4. Monitor aspens for biotic threats such as aspen bark beetles, poplar borer beetles, bronze borer beetles, and cytospora canker.

4.6.2 MAMMALIAN MONITORING

ROCKY MOUNTAIN BIGHORN SHEEP

Selection: Bighorn sheep were selected as a MIS because they are: (1) a species of national, regional, and local concern; (2) indicators of high quality grazing opportunities secure from human disturbance; and (3) indicators of connectivity between low elevation winter and transition range to higher elevation lambing areas and summer range. Transitional and winter use of Filoha by bighorn sheep can be monitored via seasonal counts, winter track surveys, and browse assessments, and cooperatively with CPW telemetry efforts and aerial counts.

Conservation Issues: Filoha contains critical winter range for a herd of bighorn that have suffered population declines resulting from a variety of factors, not the least of which is loss of winter habitat (See bighorn sheep section above). As the manager of this property, it is incumbent on Pitkin County OST to maintain or improve this property such that it continues to support this population of bighorn sheep through the non-summer months. There are three major threats to the quality of bighorn winter range at Filoha:

1. Cheatgrass: If not treated, cheatgrass has a propensity to out-compete other grasses (both native and introduced pasture grasses) and can eventually form a monotypic community with little to no wildlife value. Cheatgrass poses a special threat to grazers such as bighorn. At maturity, the pointed, barbed fruits can work into the eyes, nostrils and mouths of livestock, causing inflammation and often serious injury. Sometimes the intestines are pierced and death results (Clements et al. 2003).

2. Juniper woodland and montane shrubland expansion: The advancement of non-palatable woody shrubs and trees such as juniper and Gambel oak into the region's grasslands has been blamed on two primary anthropogenic influences: (1) Cattle grazing and (2) Fire suppression. Heavy grazing reduced community diversity and plant competition; as a result there were no fine fuels to carry surface and ground fires which were once common in the area's grasslands. Grazing also reduced competition from herbaceous species and allowed rapid growth of piñon, juniper, and other woody plants into adjacent grassland communities. Prior to white settlement, fires likely burned through pinyon-juniper woodlands every 10–30 years (Touchan et al. 1995). Such frequent fires resulted in a shifting steady-state mosaic (Bormann and Likens 1979)of grasslands and woodlands. Over time, fire suppression has resulted in an expansion of piñon-juniper woodlands and montane shrublands in bighorn sheep winter range with a net loss of the grasslands that provide critical winter forage.

3. Recreation: Many authors have found that human disturbance can alter habitat use and activity patterns of bighorn sheep (For example, Miller and Smith 1985, Etchberger 1989, Papouchis et al. 2000). Population declines (Etchberger 1989, Harris 1992), shifts in habitat use (Van Dyke et al. 1983), and interruption of seasonal migration routes (Ough and deVos 1984) have been linked to human disturbance. Timing and location of recreation in bighorn habitat, the distance between sheep and humans, and the presence of domestic dogs have a role in the impact of human activities on bighorn sheep.

   MacArthur et al. (1982) found that bighorn sheep exhibited elevated heart rates in response to the presence of people, especially when people were approaching with a dog or from over a ridge. Miller and Smith (1985) found that bighorn had a stronger adverse reaction to 1 or 2 humans on the ground than to parked vehicles or a light airplane circling overhead. Papouchis et al. (2000) found that bighorn sheep had a greater flight response to hikers than to mountain bikers or cars. King and Workman (1986) noted that responses may be more severe in areas where animals have historically been exposed to relatively high levels of human activity. Krausman et al. (2001) concluded that human recreation was a contributing factor in the decline of bighorn sheep in three southwest populations.

   Response based on distance between the bighorn and the source of disturbance has been generally documented. Both flight and cardiac responses seem to be stimulated between about 50 and 100 meters (MacArthur et al. 1982, Holl and Bleich 1983, Miller and Smith 1985). It should be noted, however, that the distance at which sheep become aware of the disturbance can also affect how far they move away from the disturbance (Miller and Smith 1985). Distance alone is a poor predictor of behavioral response to disturbance. Responses are variable and group size and gender compositions are also important factors (Miller and Smith 1985).

   Domestic dogs can have a significant impact on bighorn sheep. Bighorn evolved with canine predators and thus react very strongly to domestic dogs (Geist 1971). Disturbance of bighorn by dogs causes heart rate increases and flight response (MacArthur et al. 1979, Purdy and Shaw 1981, MacArthur et al. 1982). Sheep will remain nervous and alert for up to 30 minutes following a dog encounter, responding to subtle stimuli which otherwise evoked no response (MacArthur et al. 1982). Goodson et al. (1999) noted that the elimination of camping and dogs in important sheep habitat resulted in a reduction in the effects of human disturbance to bighorn.

Objectives:

1. Maintain the integrity of Filoha as a safe refuge for bighorn sheep.
2. Preserve migration routes to and from the property.
3. Protect, enhance, and restore the bighorn sheep habitat on the property.

Management Recommendations:

1. Continue the effort to improve bighorn winter range via mechanical removal of the juniper-oak woodland on the two alluvial fans at the north end of the property. This will increase the acreage of usable grazing habitat and improve sight distances for predator avoidance.
    a. Lop and scatter techniques are not acceptable for bighorn sheep habitat improvements since the scattered material is an impediment to movement. Mastication or cut and burn methods are preferred for this reason.
2. Prohibit dogs on the property.
3. Prohibit recreation on the east side of the Crystal River within 100 meters of bighorn winter range from October 1st through May 15th.
4. Preserve the integrity of the movement corridor along the old railroad right-of-way between Filoha and Avalanche Creek.
5. Continue cheatgrass control at Filoha with the ultimate goal of eradication..
6. Fences should be prohibited on the property except where necessary to achieve management goals. Such fences should be built such that they do not impede movement of bighorn sheep.

Recommended Research:

1. Annually monitor bighorn sheep use of the property.
2. Collaborate with CPW, USFS on a larger population assessment.
3. Continue to cooperate with CPW medical treatments (for *Pasteurella*, *Mannheimia*, *Mycoplasma ovipneumoniae*, and lungworm) and monitoring efforts.
4. Determine best methods for controlling cheatgrass.

ROCKY MOUNTAIN ELK

Elk have been chosen for 2 reasons: (1) because they may be over-utilizing the property due to a hunting induced refuge effect; and (2) they are charismatic and provide an excellent watchable wildlife opportunity. In addition, because elk are sensitive to the size and configuration of habitat patches across a landscape, they are indicators of ecological conditions at broad scales and, therefore, are helpful in the process of landscape scale conservation planning. Elk migration and winter use of the property could be monitored via seasonal counts, winter track surveys, and browse assessments.

Conservation Issues: As discussed above, Filoha provides important elk winter range and migration habitat in a valley where exurban development is decreasing the acreage of effective winter and transition habitat. As described above, residential development in the Crystal River and Roaring Fork watersheds has resulted in the direct and indirect loss of important winter range, calving habitat, and blocked historic migration routes.

Recreation is increasingly causing problems for elk as well. The disruption of migration routes, loss of seasonal habitat, and the reduction in habitat security on winter range and calving habitat from recreation, roads, livestock grazing, etc., are serious problems for some elk herds. One researcher (Cassirer 1992) has

reported even the sight of a relatively quiet backcountry skier in Yellowstone National Park caused wintering female elk to move an average of 1,675 m (usually until a topographical break or tree line shielded their view from the skier). The authors recommended a minimum buffer of 650 m between cross country skiers and non-habituated elk on winter range (Cassirer 1992). Lieb and Mossman (1966) found that human disturbance caused elk with young calves to move to secondary forage areas away from the central parts of their home ranges. Phillips and Alldredge (2000) were able to show that repeated displacement resulting from hiker disturbance during the calving season resulted in major declines in survival of elk calves. Whenever elk or any wild animal must move unnecessarily, that extra action burns calories the animals cannot afford to lose at this time of year.

Habitat for elk on Filoha can be improved so other species such as bighorn sheep and mule deer will benefit as well. Thinning dense Gambel oak shrublands to increase herbaceous production can improve the forage for elk as well as deer and sheep. As long as shrubs remain available in critical winter browse areas, such treatments will increase production and nutrient content of plants preferred by both browsers and grazers. Thinning dense Gambel oak can greatly improve the forage value for elk, which primarily are grazers, by increasing herbaceous production. Although deer mainly are browsers and are heavily dependent on shrubs throughout much of the year, thinning oak and piñon-juniper also can be beneficial for deer because it stimulates tender young shoots that are more nutritious, palatable, and easily reached. For both deer and elk, however, thinning must be done in relatively small blocks so that adequate densities of tall brush and trees remain nearby for the requisite thermal and hiding cover.

Objectives:

1. Protect, enhance, and restore the transition and winter habitat on the property while minimizing negative impacts on the habitat of other species.
2. Preserve the watchable wildlife opportunity that wintering elk provide at Filoha.

Management Recommendations:

1. Maintain elk populations at a level that the shrub community can support and continue to regenerate.
2. Seasonal recreation restrictions should be continued and enforced on the east side of the Crystal River to provide minimum elk habitat effectiveness (e.g., November 1st through June 30th).
3. Manage shrublands (e.g., thinning via mastication) to produce a mosaic of habitat age classes on a landscape scale.
4. Create elk exclosures as controls to evaluate browsing pressure within the aspen forest.
5. Monitor elk use of the property during hunting season to evaluate refuge effect.
6. If the hunting-induced refuge effect is occurring, cooperate with CPW to develop a program to reduce the refuge effect, and facilitate population management.
7. Fences should be avoided on the property except where necessary to achieve management goals. Fences necessary for recreation management should be wildlife friendly and should have gaps every 50 – 100 feet to facilitate passage of elk calves and mule deer fawns.

5.0 MANAGEMENT RECOMMENDATIONS

Filoha Meadows Nature Preserve harbors unique plant communities and healthy riparian habitat along the Crystal River. Filoha also encompasses agricultural meadows (i.e., old hay fields and pastures) that occupy significant portions of the area. The following management recommendations should be implemented in order to preserve and enhance the ecological integrity of Filoha.

5.1 VEGETATION RECOMMENDATIONS

1. Continue noxious weed control in upland grassland habitats away from the hot springs meadow. We recommend control of noxious weeds with an emphasis on List B species and those slated for eradication by the Pitkin County Weed Management Plan (Table 3). In addition, we recommend control of the invasive grasses cheatgrass and Japanese brome. Weed control with herbicides should be completed by licensed professional pesticide applicators. Communication with PCOST staff or a qualified botanist/ecologist is strongly encouraged to ensure that no drift occurs that might impact rare plant communities. Limited spot-spraying with backpack type equipment is preferred over truck mounted or boom spraying. One young tamarisk plant was noted along the Crystal River just north of the beaver pond wetland fen; this should be removed.
2. Continue rare plant (*Epipactis gigantea*) monitoring studies to help better understand the population demographics of this rare plant. Are the rare plant populations increasing, decreasing, or remaining stable over time? Are there management actions OST should be doing to conserve and protect this rare plant?
3. Continue to the experimental noxious weed study in the hot springs meadow to determine the best way of limiting the growth and spread of noxious weeds without detriment to this important habitat and rare plants it supports.
4. Implement riparian restoration in the historic agricultural field south of the beaver pond fen wetland.
5. Consider improving the trajectory and recovery of the non-native grassland habitat by seeding with additional native plant species. If possible, seed should be drilled into these areas using a no-till or low-till type of drill. Planting of additional forb species would also benefit bighorn sheep as forbs are considered to be more palatable than grasses.
6. Consider ways to improve the diversity and presence of native forbs in all restoration activities at Filoha, which is important for native pollinators. More specifically:
    - When planting wildflower seeds, use minimum till drills that use small seed boxes specifically built to deliver small forb seeds.
    - If seeding grasses, seed forbs in separate rows or in separate areas from where grasses are seeded. Grasses are very competitive and may outcompete forbs if planted in same location. Seed native grass species in amounts to allow native forbs to establish successfully; i.e., do not "over-seed" grasses.
    - Seed a diversity of forb species with different flowering times, different colored flowers and shapes, and from different plant families to attract a greater diversity of pollinators for foraging adults as well as to sustain larval forms.

5.2 WILDLIFE RECOMMENDATIONS

As described above, Filoha is a highly altered ecological landscape, yet the juxtaposition of the diverse biotic and abiotic habitat features provides resources that are highly valuable for the wildlife of the Crystal River Valley. The wildlife habitat at Filoha varies from excellent with little disturbance to highly disturbed. That being said, the function of the existing habitat is relatively high but, given the sensitive nature of the species that depend on the habitat features at Filoha, the integrity of that function remains somewhat precarious. Management actions specific to each MIS are described above. Other major issues related to habitat effectiveness at Filoha are:

1. Human disturbance – The current management plan restricts human activity at Filoha to research and management activities in combination with a limited number of guided educational programs with seasonal restrictions. As long as this level of activity is not exceeded, human disturbance should remain minimal. Any increase in recreational use would likely have substantial consequences for sensitive species such as bighorn sheep, elk, and songbirds. Recommended management actions:
    a. Continue current restrictions on recreation and educational groups.

2. Juniper encroachment – As described above, the Avalanche Creek bighorn sheep herd is one of the greatest conservation concerns in the Crystal River watershed. Protecting the effectiveness of habitat important to the persistence of this herd should be a priority for managers. Recommended management actions:
    a. Continue juniper removal efforts to improve bighorn sheep forage areas with substantial predator detection sightlines.
    b. Preferred methods are prescribed fire, mastication, and hand cutting. If hand cutting (i.e., chainsaw crews) is implemented then slash must be removed from the site, burned, or chipped. Existing scattered material from the last treatment is an impediment to sheep movement.
    c. The treatments should be limited to areas below (west of) the rocky slopes and cliffs in the northern portion of Filoha.
    d. Not all of the junipers and oaks should be removed. Clusters of sufficient size (≥ 0.5 acre) should be left to provide hiding and thermal cover.
3. Riparian habitat – Given the importance of high quality riparian habitat to most of the wildlife species that occur or have the potential to occur at Filoha, protection of existing riparian habitat and restoration of disturbed riparian areas would likely have the greatest impact on habitat conditions for the greatest number of species than any other management action. Recommended management actions:
    a. Implement and maintain the riparian restoration effort designed in 2018.
    b. Monitor other areas of degraded riparian habitat along the river to determine whether restoration is warranted and feasible.
4. Cheatgrass/Japanese brome control – As these invasive annual grasses begin to dominate an area, they alter the native plant communities and displace native plants, thus impacting wildlife. In addition, the window of palatability is substantially narrower than native perennial grasses, causing a significant cost in forage quality and quantity for grazers such as bighorn sheep and elk. Recommended management actions:
    a. Continue and expand efforts to control cheatgrass. Prevent cheatgrass and Japanese brome from spreading to bighorn sheep grazing areas and elk winter concentration area.
5. Gambel oak, the dominant shrub species on the westerly facing slopes on and above Filoha, is arguably the most important shrub for wildlife in the Crystal Valley and western Colorado. It provides both vertical and horizontal heterogeneity, potentially increasing species diversity by increasing the number of available habitats (Pearson et al. 1996). In addition to enhancing habitat for many small birds, Gambel oak dominated shrublands provide valuable food and cover for deer, elk, rabbits, turkeys, grouse, and squirrels (Pendleton et al. 1992). The oak dominated montane shrublands on and adjacent to Filoha are very dense and, in some areas, senescent. Old stands, containing large amounts of dead crown and hollow boles and limbs, present fire concerns and are less valuable to big game than younger stands. Under natural conditions, Gambel oak stands experience relatively frequent disturbance from fires that result in ecologically healthy and productive multi-aged stands. Recommended management actions:
    a. If feasible, cooperate with the WRNF to continue their prescribed burn plan on Filoha and adjacent WRNF lands.
    b. If burning is not feasible, design and implement mechanical and/or hand treatments to emulate natural disturbance patterns mimicking spot fires such that the matrix remains mature shrubland with patches where the successional trajectory is reset. The following treatment parameters will help ensure the protection of ecologically valuable elements of the treatment areas while improving age class diversity:
        i. Senescent, decadent, or diseased oak should be prioritized for treatment.
        ii. Healthy arborescent stands will be flagged and maintained.

iii. Other shrub species, such as Saskatoon serviceberry (*Amelanchier alnifolia*), mountain mahogany (*Cercocarpus montanus*), and antelope bitterbrush (*Purshia tridentata*) should be avoided.
iv. Great care shall be taken to minimize harm to the surrounding and understory vegetation.
v. Methods and implementation shall be restricted to those that result in the creation of mulch that does not exceed 3 inches in depth of ground cover. Deep mulches resulting from mastication can inhibit growth of understory vegetation.

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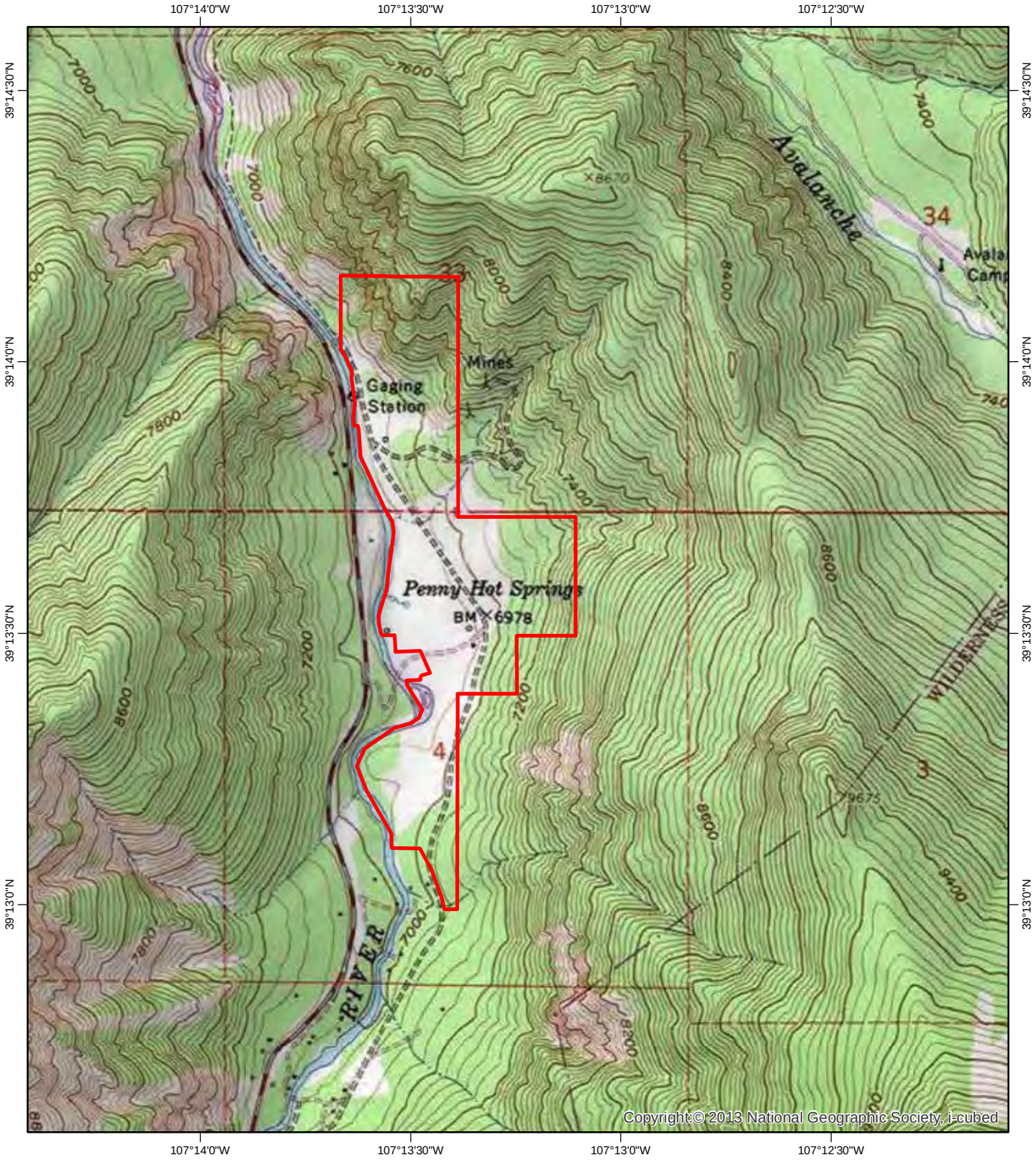
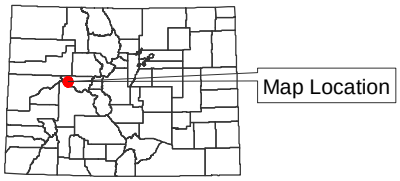
7.0 MAPS



BASE: USGS 7.5' Redstone, Colorado Quadrangle
Grid Lat/Long WGS 1984

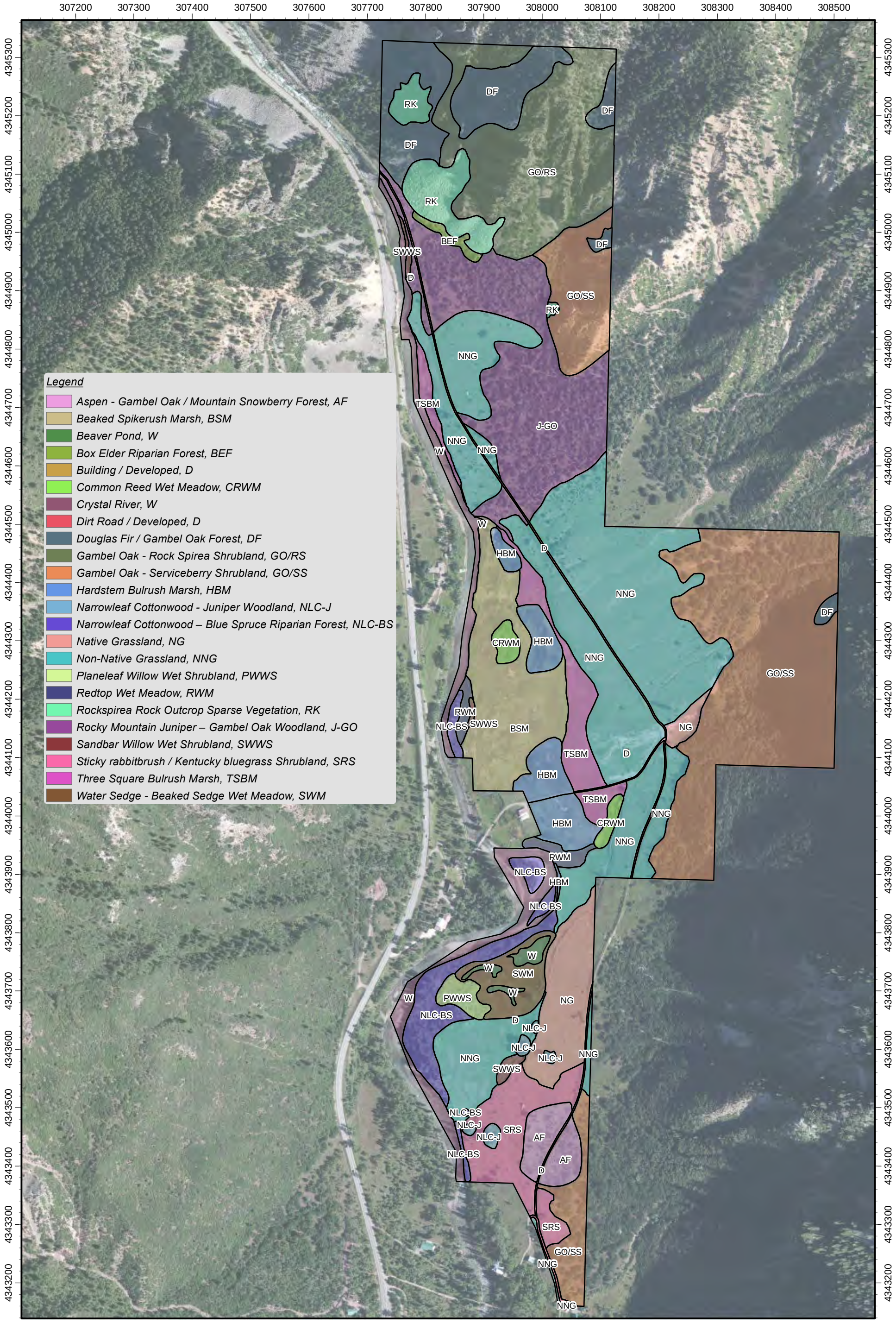


N

Scale: 1:24,000
1 inch = 2,000 feet

Map 1. Project Location
Filoha Meadows Nature Preserve
Pitkin County, Colorado

Peak Ecological Services LLC
301 Boulder Canyon Drive
Nederland, CO 80466
info@peakecological.com



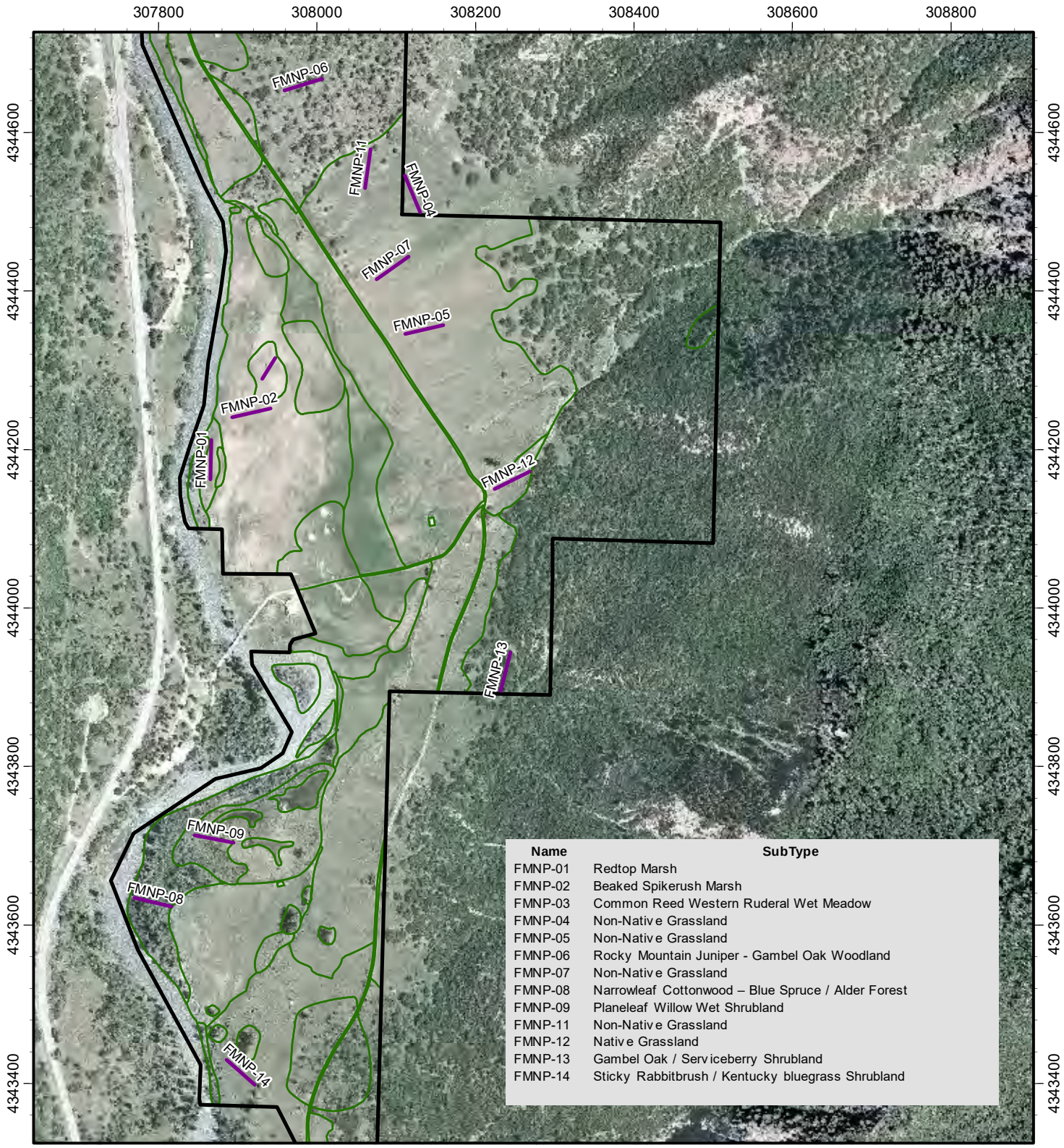
BASE: Pitkin County 6-inch aerials (2014)
GRID: UTM NAD83 Z13

Date: May 2019
Scale: 1:6,000
1 inch = 500 feet

N

Map 2. Vegetation Types
Filoha Meadows Nature Preserve Open Space
Piktin County, Colorado

Peak Ecological Services LLC
301 Boulder Canyon Drive
Nederland, CO 80466
info@peakecological.com



Name	SubType
FMNP-01	Redtop Marsh
FMNP-02	Beaked Spikerush Marsh
FMNP-03	Common Reed Western Ruderal Wet Meadow
FMNP-04	Non-Native Grassland
FMNP-05	Non-Native Grassland
FMNP-06	Rocky Mountain Juniper - Gambel Oak Woodland
FMNP-07	Non-Native Grassland
FMNP-08	Narrowleaf Cottonwood – Blue Spruce / Alder Forest
FMNP-09	Planeleaf Willow Wet Shrubland
FMNP-11	Non-Native Grassland
FMNP-12	Native Grassland
FMNP-13	Gambel Oak / Serviceberry Shrubland
FMNP-14	Sticky Rabbitbrush / Kentucky bluegrass Shrubland

BASE: Pitkin County 6-inch aerials (2014)
GRID: UTM NAD83 Z13

Map 3. Vegetation Transect Locations
Filoha Meadows Nature Preserve Open Space
Piktin County, Colorado

Legend

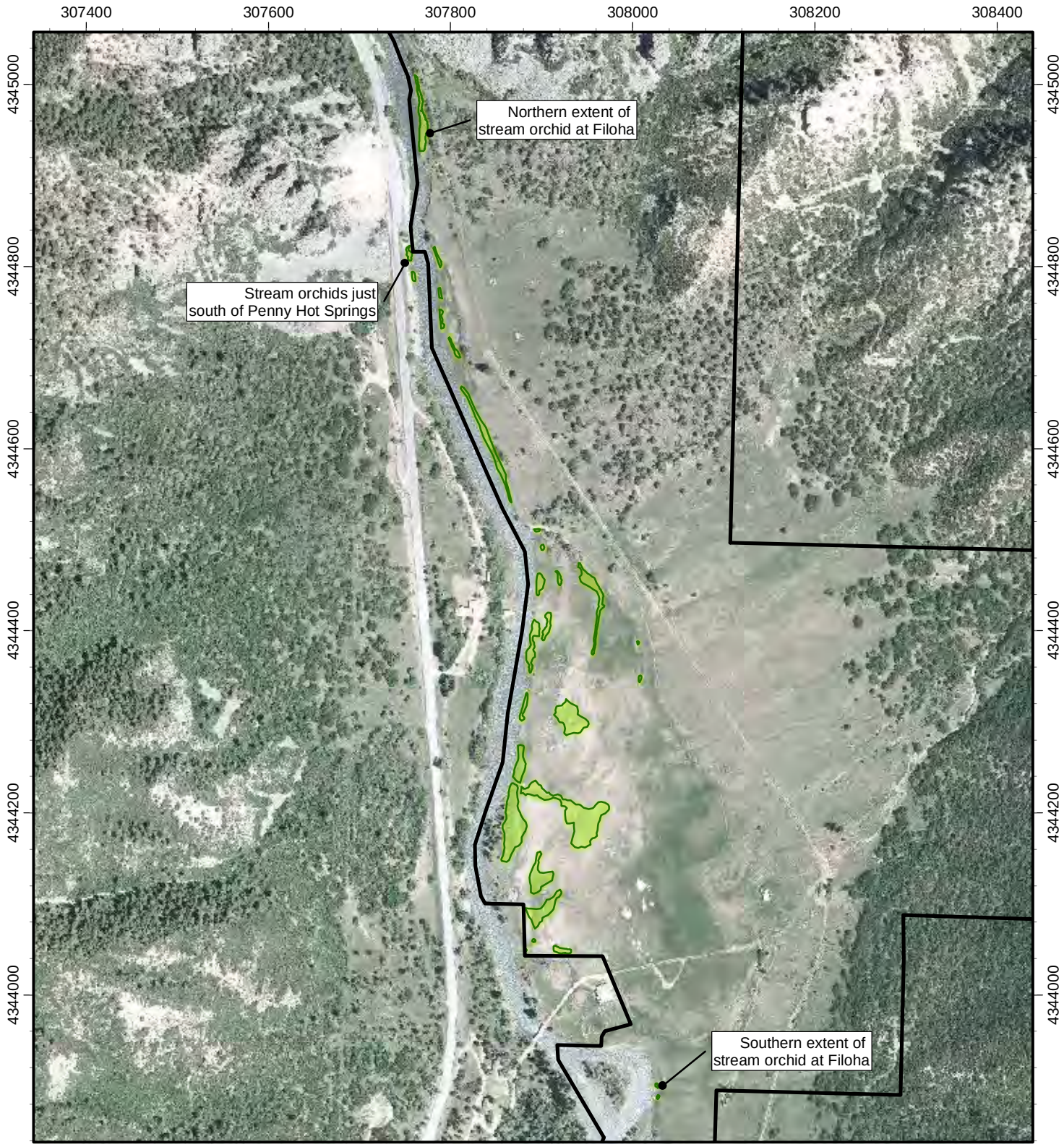
Filoha Meadows Open Space Boundary

50m Vegetation Transects

N

Date: May 2019
Scale: 1:6,900
1 inch = 575 feet

Peak Ecological Services LLC
301 Boulder Canyon Drive
Nederland, CO 80466
info@peakecological.com



BASE: Pitkin County 6-inch imagery (2014)
GRID: UTM NAD83 Z13

Map 4. Rare Plant Survey Results
Filoha Meadows Nature Preserve Open Space
Piktin County, Colorado

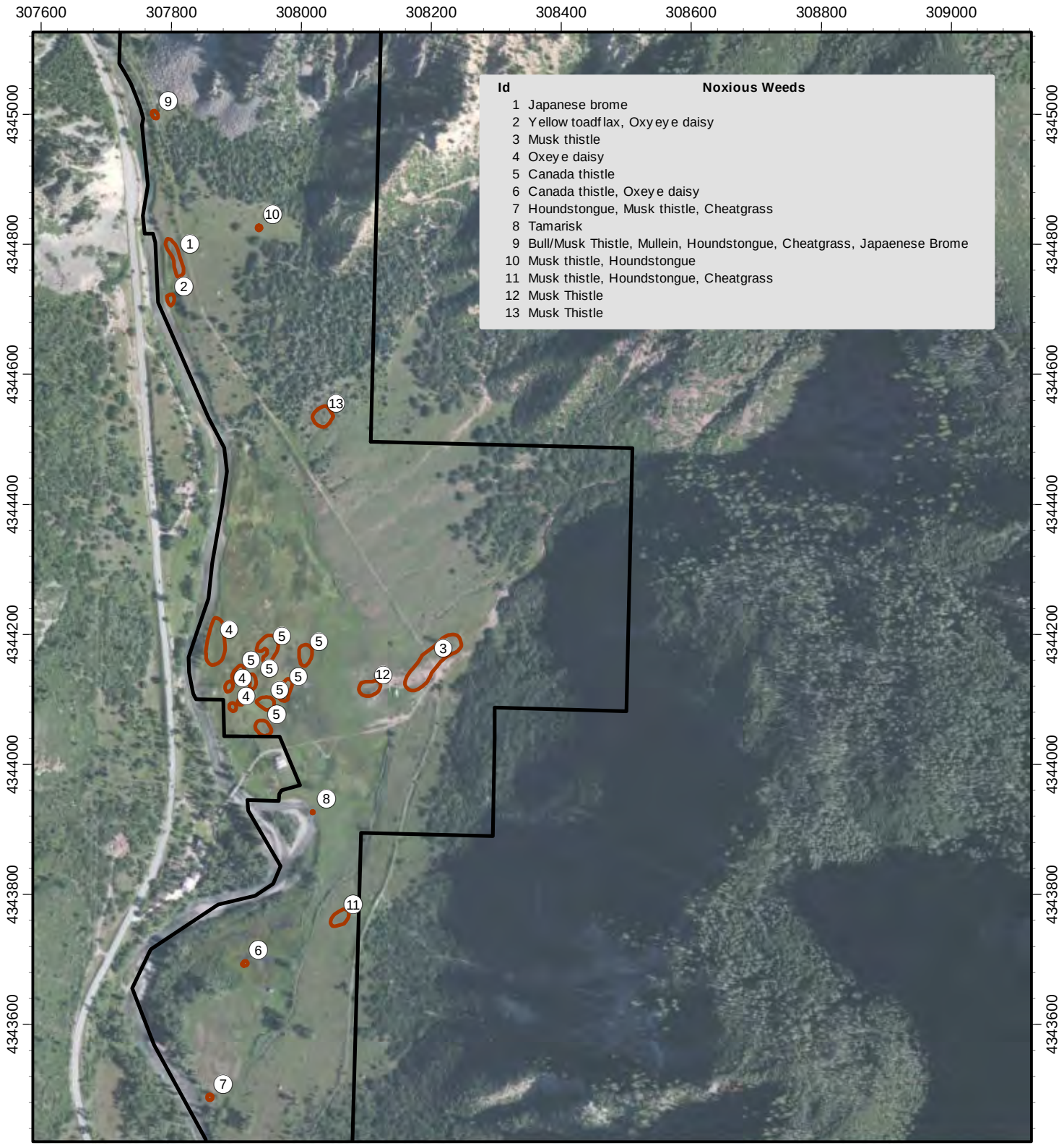
Legend

- *Filoha Meadows Open Space Boundary*
- *Stream Orchid (Epipactis gigantea)*

N

Date: May 2019
Scale: 1:6,000
1 inch = 500 feet

Peak Ecological Services LLC
301 Boulder Canyon Drive
Nederland, CO 80466
info@peakecological.com



BASE: ESRI World Imagery (Clarity)
GRID: UTM NAD83 Z13

Map 5. Noxious Weeds
Filoha Meadows Nature Preserve Open Space
Piktin County, Colorado

Legend

- *Filoha Meadows Open Space Boundary*
- *Mapped Noxious Weed Populations*

N

Date: May 2019
Scale: 1:8,400
1 inch = 700 feet

Peak Ecological Services LLC
301 Boulder Canyon Drive
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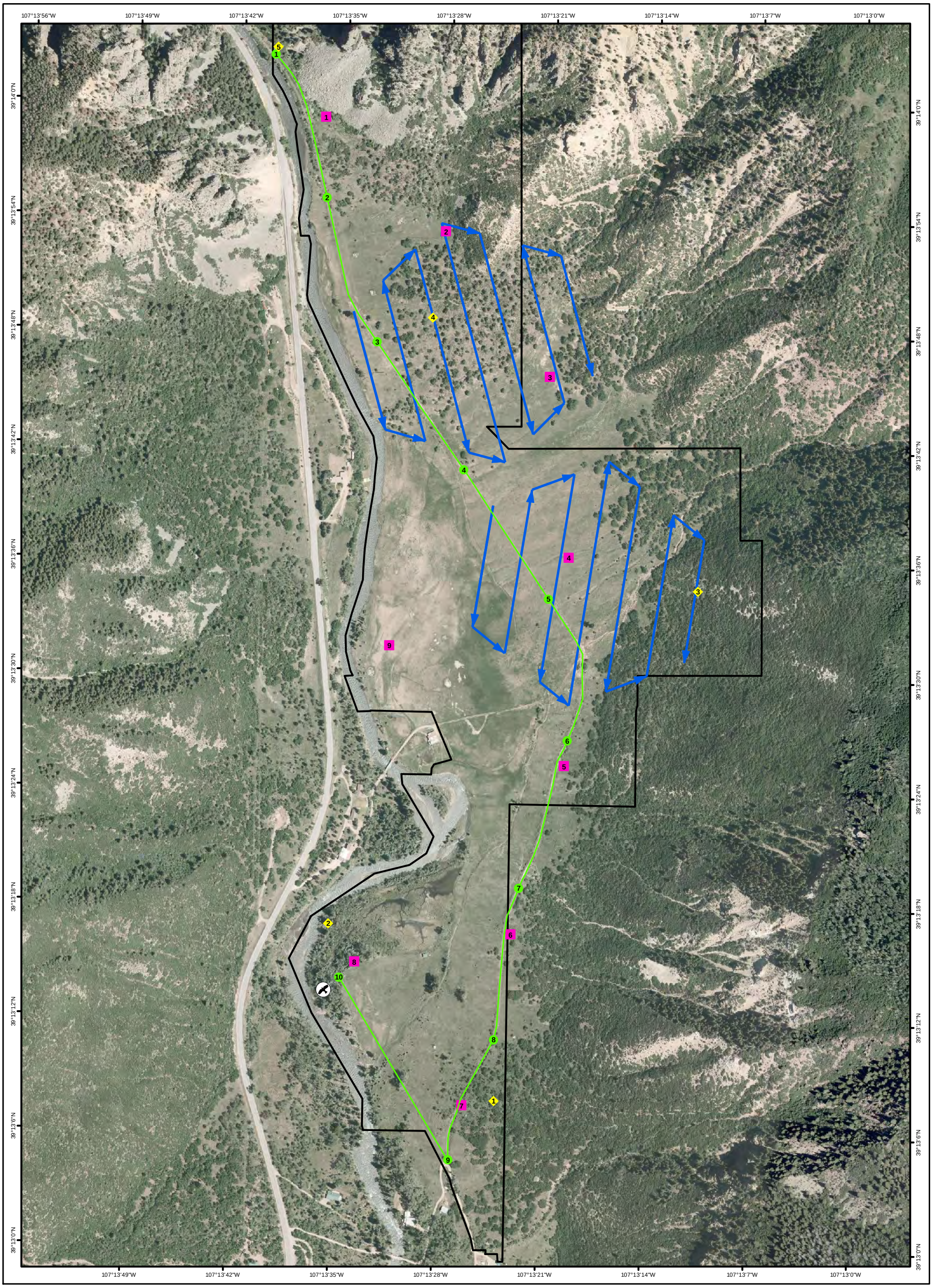

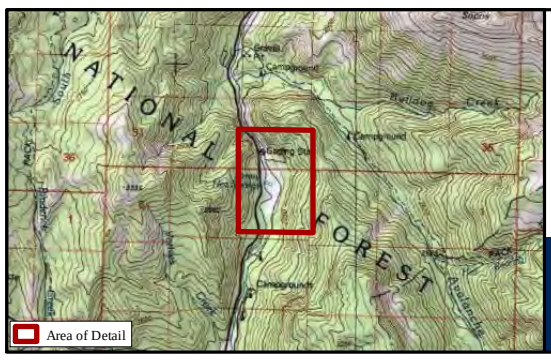

Filoha Meadows Nature Preserve

Pitkin County, CO

2018 Wildlife Monitoring

Map 6. Wildlife Survey Locations & Northern Pygmy Owl Detection

Legend:

- Property Boundary
- Northern Pygmy Owl Detection
- TVES Survey Leg
- 3 Avian Monitoring Point
- 3 Camera Survey Point
- 3 Raptor/Owl Broadcast Point
- Raptor/Owl Transect

N

0 25 50 100 150 200 Meters

1 in = 140 meters

NOTE: Boundaries are approximate.

Base Layer Source:
Pitkin County GIS
2014 Digital Orthophotos

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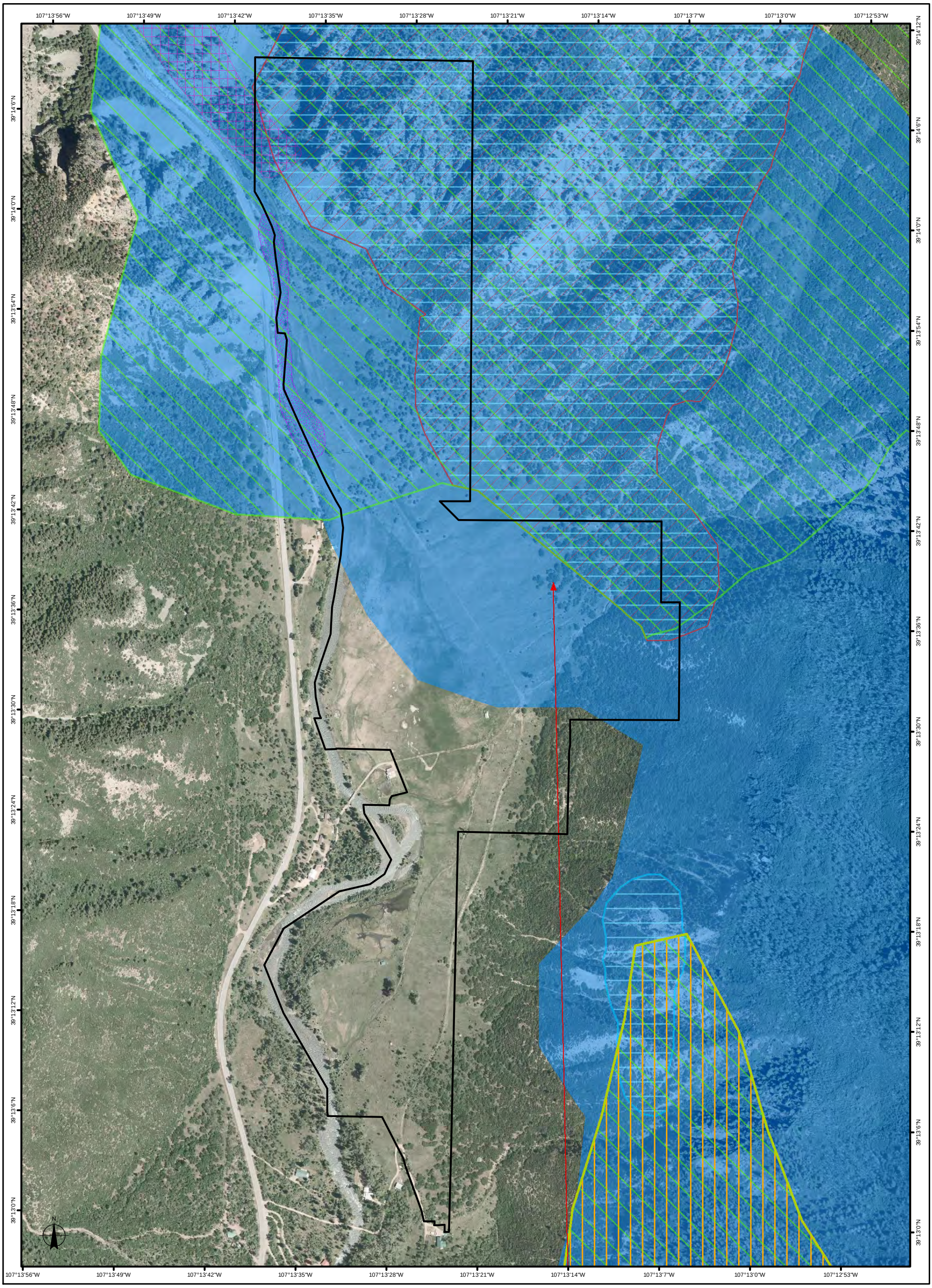
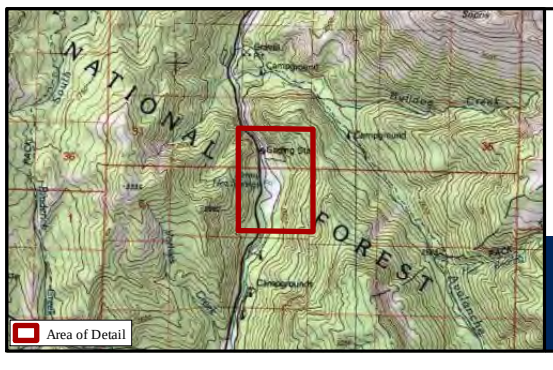
0100 Elk Run Dr, Ste 128, Basalt, CO 81621 970.927.4549
jonathan@coloradowildlifescience.com
http://coloradowildlifescience.com





Filoha Meadows Nature Preserve

Pitkin County, CO

2018 Wildlife Monitoring

Map 7. CPW Mapped & Field Verified Bighorn Sheep Seasonal Habitat

Legend:

- Property Boundary
- Winter Range
- Migration Pattern
- Severe Winter Range
- Winter Concentration
- Summer Range
- Mineral Lick
- Production Area
- Migration Corridor

0 25 50 100 150 200 Meters

1 in = 160 meters

NOTE: Boundaries are approximate.

Base Layer Source:
Pitkin County GIS
2014 Digital Orthophotos

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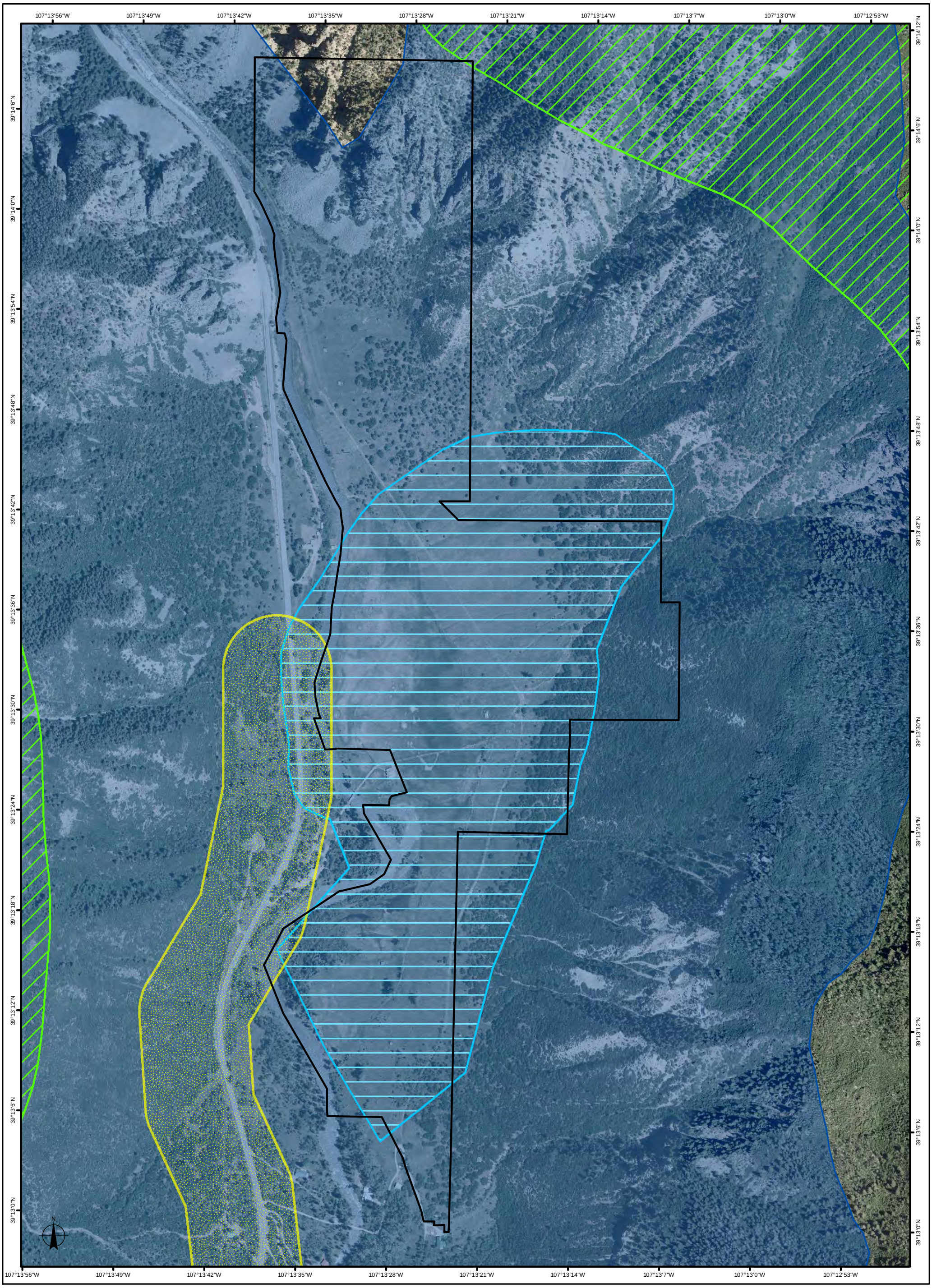

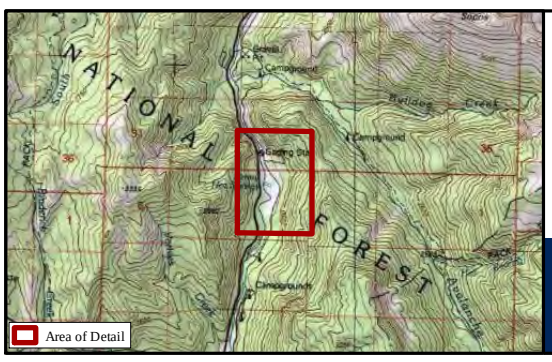

Filoha Meadows Nature Preserve

Pitkin County, CO

2018 Wildlife Monitoring

Map 8. CPW Mapped & Field Verified Rocky Mountain Elk Seasonal Habitat

Legend:

- Property Boundary
- Winter Range
- Migration Pattern
- Severe Winter Range
- Summer Range
- Production Area
- Highway Crossing
- Winter Concentration

0 25 50 100 150 200 Meters

1 in = 160 meters

NOTE: Boundaries are approximate.

Base Layer Source:
Pitkin County GIS
2014 Digital Orthophotos

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Filoha Meadows Nature Preserve

Pitkin County, CO

2018 Wildlife Monitoring

Map 9. Wildlife Habitat at Filoha Meadows Nature Preserve

Generalized Vegetation Types / Wildlife Habitat:

- Aspen Woodland
- Wetland - Marsh
- Open Water - Pond or River
- Riparian Forest
- Building / Developed
- Douglas Fir Forest
- Gambel Oak Shrubland
- Grassland
- Willow Wet Shrubland
- Rock Outcrop Sparse Vegetation
- Juniper – Gambel Oak Woodland

0 25 50 100 150 200 Meters

1 in = 155 meters

NOTE: Boundaries are approximate.

Data Sources:
Baselayer: Pitkin County GIS 2014 Digital Orthophotos

Habitat layer: Derived from Peak Ecological Services LLC vegetation mapping

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APPENDIX A. QUANTITATIVE VEGETATION DATA

Sample #		T01				
Vegetation Type		Redtop Wet Meadow				
USNVC (2017) Association Code		CEGL001558				
Date						8/6/2018
Number Species						28
Number Non-Native Species						9
Total C						42
Mean C All						1.5
Mean C Natives						2.2
Absolute Cover Natives						42.0
Relative Cover Natives						60.0%
Total Hits						100
Total Vegetation Cover						70
Total Non-Veg Cover						30
Scientific Name	**Common Name**	**Origin**	**C-Value**	**1st Hit Data**	**Absolute Cover**	**Relative Cover**
Shrubs/Subshrubs						
Salix exigua	Sanbar willow, coyote willow	N	3	p		
Shrubs/Subshrubs Total						
Perennial Graminoids						
Agrostis gigantea	Redtop	I	0	17	17.0%	24.3%
Bromus inermis	Smooth brome	I	0	p		
Elymus trachycaulus	Slender wheatgrass	N	4	p		
Juncus arcticus	Arctic rush	N	4	13	13.0%	18.6%
Muhlenbergia asperifolia	Scratchgrass muhly	N	4	1	1.0%	1.4%
Poa pratense	Kentucky bluegrass	I	0	p		
Schedonorus pratensis	Meadow fescue	I	0	11	11.0%	15.7%
Schoenoplectus acutus	Hardstem bulrush	N	3	p		
Perennial Graminoids Total					**42.0%**	**60.0%**
Perennial Forbs						
Asclepias speciosa	Showy milkweed	N	3	1	1.0%	1.4%
Cichorium intybus	Chicory	N	6	p		
Cirsium arvense	Canada thistle	I	0	p		
Epipactis gigantea	Giant helleborine, Stream orchid	N	9	6	6.0%	8.6%
Gentiana affinis	Rocky Mountain gentian	N	8	4	4.0%	5.7%
Glycyrrhiza lepidota	Wild licorice	N	3	P		
Helianthus nuttallii	Nattall's sunflower	N	3	3	3.0%	4.3%
Leucanthemun vulgare	Oxeye daisy	N	6	p		
Packera pseudaurea	Falsegold groundsel	N	7	2	2.0%	2.9%
Plantago lanceolata	Narrowleaf plantain	I	0	p		
Platanthera tescamnis	Canyon bog orchid	N	9	p		
Sisyrinchium montanum	Rocky Mountain blued-eyed grass	N	6	p		
Solidago velutina subsp. sparsiflora	Three-nerve goldenrod	N	6	2	2.0%	2.9%
Symphyotrichum laeve var. geyeri	Smooth blue aster	N	6	8	8.0%	11.4%
Trifolium pratense	Red clover	I	0	p		
Perennial Forbs Total					**26.0%**	**37.1%**
Ferns and Fern Allies						
Equisetum hyemale	Scouringrush horsetail	N	4	2	2.0%	2.9%
Ferns and Fern Allies Total					**2.0%**	**2.9%**

Sample #		**T01**				
Annual/Biennial Forbs						
Cirsium vulgare	Bull thistle	I B	0	p		
Melilotus officinale	Yellow sweetclover	I	0	P		
Annual/Biennial Forbs Total						
TOTAL VEGETATION COVER					**70.0%**	**100.0%**
Non-Vegetation Cover						
Litter				30	30.0%	
TOTAL NON-VEGETATION COVER					**30.0%**	

Sample #		T02				
Vegetation Type		Beaked Spikerush Marsh				
USNVC (2017) Association Code		CEGL003428				
Date						8/6/2018
Number Species						5
Number Non-Native Species						0
Total C						80
Mean C All						16
Mean C Natives						16
Absolute Cover Natives						80.0
Relative Cover Natives						100.0%
Total Hits						100
Total Vegetation Cover						80
Total Non-Veg Cover						20
Scientific Name	**Common Name**	**Origin**	**C-Value**	**1st Hit Data**	**Absolute Cover**	**Relative Cover**
Perennial Graminoids						
Eleocharis rostellata	Beaked spikerush	N	6	52	52.0%	65.0%
Elymus trachycaulus	Slender wheatgrass	N	4	1	1.0%	1.3%
Muhlenbergia asperifolia	Scratchgrass muhly	N	4	2	2.0%	2.5%
Schoenoplectus americanus	Olney's three-square bulrush	N	4	18	18.0%	22.5%
Perennial Graminoids Total					**73.0%**	**91.3%**
Perennial Forbs						
Symphyotrichum laeve var. geyeri	Smooth blue aster	N	6	7	7.0%	8.8%
Perennial Forbs Total					**7.0%**	**8.8%**
TOTAL VEGETATION COVER					**80.0%**	**100.0%**
Non-Vegetation Cover						
Litter				20	20.0%	
TOTAL NON-VEGETATION COVER					**20.0%**	

Sample #		T03				
Vegetation Type		Common Reed Wet Meadow				
USNVC (2017) Association Code		CEGL001475				
Date						8/6/2018
Number Species						17
Number Non-Native Species						3
Total C						80
Mean C All						4.7
Mean C Natives						5.7
Absolute Cover Natives						80.0
Relative Cover Natives						97.6%
TOTAL HITS						100
Total Vegetation Cover						82
Total Non-Veg Cover						18
Scientific Name	**Common Name**	**Origin**	**C-Value**	**1st Hit Data**	**Absolute Cover**	**Relative Cover**
Trees						
Juniperus scopulorum	Rocky Mountain juniper	N	5	p		
Trees Total						
Shrubs/Subshrubs						
Rosa woodsii	Woods' rose	N	5	p		
Salix exigua	Sanbar willow, coyote willow	N	3	1	1.0%	1.2%
Shrubs/Subshrubs Total					**1.0%**	**1.2%**
Perennial Graminoids						
Agrostis gigantea	Redtop	I	0	1	1.0%	1.2%
Distichlis stricta	Saltgrass	N	4	p		
Eleocharis rostellata	Beaked spikerush	N	6	30	30.0%	36.6%
Elymus trachycaulus	Slender wheatgrass	N	4	p		
Phragmites australis	Common reed	N	3	30	30.0%	36.6%
Perennial Graminoids Total					**61.0%**	**74.4%**
Perennial Forbs						
Agoseris glauca	Pale agoseris	N	6	p		
Asclepias speciosa	Showy milkweed	N	3	1	1.0%	1.2%
Cirsium arvense	Canada thistle	I	0	p		
Gentiana affinis	Rocky Mountain gentian	N	8	1	1.0%	1.2%
Helianthus nuttallii	Nattall's sunflower	N	3	4	4.0%	4.9%
Maianthemum stellatum	Starry false Solomon's seal	N	7	p		
Solidago velutina subsp. sparsiflora	Three-nerve goldenrod	N	6	13	13.0%	15.9%
Symphyotrichum laeve var. geyeri	Smooth blue aster	N	6	p		
Perennial Forbs Total					**19.0%**	**23.2%**
Annual/Biennial Forbs						
Cirsium vulgare	Bull thistle	I B	0	1	1.0%	1.2%
Annual/Biennial Forbs Total					**1.0%**	**1.2%**
TOTAL VEGETATION COVER					**82.0%**	**100.0%**

Sample #		T03				
Non-Vegetaion Cover						
Litter				17	17.0%	
Soil				1	1.0%	
TOTAL NON-VEGETAION COVER					**18.0%**	

Sample #		T04				
Vegetation Type		Non-Native Grassland				
USNVC (2017) Association Code		CEGL005264				
Date						8/6/2018
Number Species						18
Number Non-Native Species						6
Total C						35
Mean C All						1.9
Mean C Natives						2.9
Absolute Cover Natives						35.0
Relative Cover Natives						81.4%
TOTAL HITS						100
Total Vegetation Cover						43
Total Non-Veg Cover						57
Scientific Name	**Common Name**	**Origin**	**C-Value**	**1st Hit Data**	**Absolute Cover**	**Relative Cover**
Trees						
Juniperus scopulorum	Rocky Mountain juniper	N	5	1	1.0%	0.0%
Trees Total					**1.0%**	**0.0%**
Shrubs/Subshrubs						
Rosa woodsii	Woods' rose	N	5	p		
Symphoricarpos rotundifolius	Roundleaf snowberry	N	5	p		
Shrubs/Subshrubs Total						
Perennial Graminoids						
Pascopyrum smithii	Western wheatgrass	N	5	1	1.0%	0.0%
Achnatherum lettermanii	Letterman's needlegrass	N	6	3	3.0%	0.1%
Poa pratense	Kentucky bluegrass	I	0	8	8.0%	0.2%
Hesperostipa comata	Needle and thread grass	N	6	13	13.0%	0.3%
Bromus inermis	Smooth brome	I	0	p		
Elymus elymoides	Squirreltail	N	4	p		
Perennial Graminoids Total					**25.0%**	**0.6%**
Perennial Forbs						
Artemisia frigida	Fringed sage, prairie sagewort	N	4	1	1.0%	0.0%
Heterotheca villosa	Hairy false goldenaster	N	3	15	15.0%	0.3%
Glycyrrhiza lepidota	Wild licorice	N	3	p		
Oxytropis lambertii	Purple locoweed	N	5	p		
Perennial Forbs Total					**16.0%**	**0.4%**
Annual/Biennial Forbs						
Alyssum alyssoides	Pale madwort	I	0	p		
Carduus nutans	Musk thistle (Nodding plumeless thistle)	I B	0	p		
Tragopogon dubius	Western salsify	I	0	p		
Annual/Biennial Forbs Total						
Annual Graminoids						
Bromus japonicus	Japanese brome	I	0	p		
Annual Graminoids Total						

Sample #		T04				
Cryptograms						
moss		N	5	1	1.0%	0.0%
Cryptograms Total					**1.0%**	**0.0%**
TOTAL VEGETATION COVER					**43.0%**	**1.0%**
Non-Vegetation Cover						
Litter				51	51.0%	
Soil				5	5.0%	
Rock				1	1.0%	
NON-VEGETATION COVER TOTAL					**57.0%**	

Sample #		T05				
Vegetation Type		**Non-Native Grassland**				
USNVC (2017) Association Code		**CEGL005264**				
Date						**8/6/2018**
Number of Species						**18**
Number Non-Native Species						**9**
Total C						**24**
Mean C All						**1.3**
Mean C Natives						**2.7**
Absolute Cover Natives						**24.0**
Relative Cover Natives						**66.7%**
TOTAL HITS						**100**
Total Vegetation Cover						**36**
Total Non-Veg Cover						**64**
Scientific Name	**Common Name**	**Origin**	**C Value**	**1st Hit Data**	**Absolute Cover**	**Relative Cover**
Perennial Graminoids						
Achnatherum lettermanii	Letterman's needlegrass	N	6	7	7.0%	19.4%
Bromus inermis	Smooth brome	I	0	5	5.0%	13.9%
Hesperostipa comata	Needle and thread grass	N	6	2	2.0%	5.6%
Poa pratense	Kentucky bluegrass	I	0	4	4.0%	11.1%
Perennial Graminoids Total					**18.0%**	**50.0%**
Perennial Forbs						
Allium cf. geyeri	Geyer's onion	N	5	p		
Glycyrrhiza lepidota	Wild licorice	N	3	p		
Heterotheca villosa	Hairy false goldenaster	N	3	14	14.0%	38.9%
Medicago sativa	Alfalfa	I	0	1	1.0%	2.8%
Opuntia fragilis	Fragile pricklypear	N	5	p		
Oxytropis lambertii	Purple locoweed	N	5	1	1.0%	2.8%
Potentilla gracilis	Slender cinquefoil	N	5	p		
Potentilla hippiana	Wolly cinquefoil	N	5	p		
Perennial Forbs Total					**0.2%**	**44.4%**
Annual/Biennial Forbs						
Alyssum alyssoides	Pale madwort	I	0	p		
Camelina microcarpa	False flax	I	0	p		
Carduus nutans	Musk thistle (Nodding plumeless thistle)	I B	0	p		
Tragopogon dubius	Western salsify	I	0	p		
Bromus japonicus	Japanese brome	I	0	p		
Bromus tectorum	Cheatgrass, Downy brome	I C	0	2	2.0%	5.6%
Annual/Biennial Forbs Total					**2.0%**	**5.6%**
TOTAL VEGETATION COVER					**36.0%**	**100.0%**
Non-Vegetative Cover						
Litter					50.0%	
Soil					14.0%	
NON-VEGETATIVE COVER TOTAL					**64.0%**	

Sample #		T06					
Vegetation Type		Juniper-Oak Woodland					
USNVC (2017) Association Code		CEGL002967					
Date							8/6/2018
Number Species							19
Number Non-Native Species							4
Total C							67
Mean C All							3.5
Mean C Natives							4.5
Absolute Cover Natives							67.0
Relative Cover Natives							100.0%
Total Hits							100
Total Vegetation Cover							67
Total Non-Veg Cover							33
Scientific Name	**Common Name**	**Origin**	**C-Value**	**1st Hit Data**	**2nd Hit Data**	**Absolute Cover**	**Relative Cover**
Trees							
Juniperus scopulorum	Rocky Mountain juniper	N	5	21		21.0%	28.4%
Trees Total						**21.0%**	**28.4%**
Shrubs/Subshrubs							
Mahonia repens	Oregon grape	N	5	2	2	2.0%	5.4%
Quercus gambelii	Gambel oak	N	5	24	2	24.0%	35.1%
Rhus trilobata	Skunkbush sumac	N	5	2		2.0%	2.7%
Rosa woodsii	Woods' rose	N	5	p			
Symphoricarpos rotundifolius	Roundleaf snowberry	N	5	5		5.0%	6.8%
Shrubs/Subshrubs Total						**33.0%**	**50.0%**
Perennial Graminoids							
Achnatherum lettermanii	Letterman's needlegrass	N	6	p			
Bromus inermis	Smooth brome	I	0	p			
Carex geyeri	Elk sedge	N	6	2		2.0%	2.7%
Dactylis glomerata	Orchardgrass	I	0	p			
Elymus elymoides	Squirreltail	N	4	1		1.0%	1.4%
Hesperostipa comata	Needle and thread grass	N	6	2		2.0%	2.7%
Pascopyrum smithii	Western wheatgrass	N	5	2		2.0%	2.7%
Poa pratense	Kentucky bluegrass	I	0		1		1.4%
Perennial Graminoids Total						**7.0%**	**10.8%**
Perennial Forbs							
Astragalus flexuosus	Flexile milkvetch	N	6	p			
Fragaria virginiana	Mountain strawberry	N	5	p			
Heterotheca villosa	Hairy false goldenaster	N	3	6	1	6.0%	9.5%
Medicago sativa	Alfalfa	I	0		1		1.4%
Symphyotrichum laeve var. geyeri	Smooth blue aster	N	6	p			
Perennial Forbs Total						**6.0%**	**10.8%**
Annual/Biennial Forbs							
Tragopogon dubius	Western salsify	I	0	p			
Annual/Biennial Forbs Total							
Annual Graminoids							

Sample #		T06					
Bromus japonicus	Japanese brome	I	0	p			
Annual Graminoids Total							
TOTAL VEGETATION COVER						**67.0%**	**100.0%**
Non-Vegetation Cover							
Litter				21		21.0%	
Soil				2		2.0%	
Rock				5		5.0%	
Slash				5		5.0%	
TOTAL NON-VEGETATION COVER						**33.0%**	

Sample #		T07				
Vegetation Type		**Non-Native Grassland**				
USNVC (2017) Association Code		**CEGL005264**				
Date						**8/6/2018**
Number of Species						**16**
Number Non-Native Species						**8**
Total C						**31**
Mean C All						**1.9**
Mean C Natives						**3.9**
Absolute Cover Natives						**31.0**
Relative Cover Natives						**77.5%**
TOTAL HITS						**100**
Total Vegetation Cover						**40**
Total Non-Veg Cover						**60**
Scientific Name	**Common Name**	**Origin**	**C Value**	**1st Hit Data**	**Absolute Cover**	**Relative Cover**
Shrubs/Subshrubs						
Rosa woodsii	Woods' rose	N	5	11	11.0%	27.5%
Shrubs/Subshrubs Total					**11.0%**	**27.5%**
Perennial Graminoids						
Achnatherum lettermanii	Letterman's needlegrass	N	6	1	1.0%	2.5%
Bromus inermis	Smooth brome	I	0	1	1.0%	2.5%
Dactylis glomerata	Orchardgrass	I	0	5	5.0%	12.5%
Elymus elymoides	Squirreltail	N	4	p		
Hesperostipa comata	Needle and thread grass	N	6	1	1.0%	2.5%
Poa pratense	Kentucky bluegrass	I	0	3	3.0%	7.5%
Perennial Graminoids Total					**11.0%**	**27.5%**
Perennial Forbs						
Glycyrrhiza lepidota	Wild licorice	N	3	p		
Heterotheca villosa	Hairy false goldenaster	N	3	18	18.0%	45.0%
Medicago sativa	Alfalfa	I	0	p		
Oxytropis lambertii	Purple locoweed	N	5	p		
Plantago lanceolata	Narrowleaf plantain	N	5	p		
Potentilla gracilis	Slender cinquefoil	N	5	p		
Perennial Forbs Total					**18.0%**	**45.0%**
Annual/Biennial Forbs						
Carduus nutans	Musk thistle (Nodding plumeless thistle)	I B	0	p		
Tragopogon dubius	Western salsify	I	0	p		
Annual/Biennial Forbs Total						
Annual Graminoids						
Bromus japonicus	Japanese brome	I	0	p		
Annual Graminoids Total						
TOTAL VEGETATION COVER					**40.0%**	**100.0%**
Non-Vegetative Cover						
Litter					38.0%	
Soil					22.0%	
NON-VEGETATIVE COVER TOTAL					**60.0%**	

Sample #		T08					
Vegetation Type		Narrowleaf Cottonwood / Blue Spruce Riparian Forest					
USNVC (2017) Association Code		CEGL000934					
Date							8/6/2018
Number Species							24
Number Non-Native Species							5
Total C							73
Mean C All							3.0
Mean C Natives							3.8
Absolute Cover Natives							73.0
Relative Cover Natives							86.9%
Total Hits							100
Total Vegetation Cover							84
Total Non-Veg Cover							16
Scientific Name	**Common Name**	**Origin**	**C-Value**	**1st Hit Data**	**2nd Hit Data**	**Absolute Cover**	**Relative Cover**
Trees							
Picea pungens	Blue spruce	N	6	56	1	56.0%	54.8%
Trees Total						**56.0%**	**54.8%**
Shrubs/Subshrubs							
Alnus incana	Thinleaf alder	N	6	8	2	8.0%	9.6%
Amelanchier alnifolia	Serviceberry	N	6	1		1.0%	1.0%
Cornus sericea	Redosier dogwood	N	7	3	6	3.0%	8.7%
Crataegus rivularis	River hawthorn	N	6	p			
Prunus virginiana	Chokecherry	N	4	2	2	2.0%	3.8%
Quercus gambelii	Gambel oak	N	5	p			
Rosa woodsii	Woods' rose	N	5	p			
Salix monticola	Mountain willow	N	6	1		1.0%	1.0%
Shrubs/Subshrubs Total						**15.0%**	**24.0%**
Perennial Graminoids							
Agrostis gigantea	Redtop	I	0	7	4	7.0%	10.6%
Bromus inermis	Smooth brome	I	0	2	1	2.0%	2.9%
Dactylis glomerata	Orchardgrass	I	0	1		1.0%	1.0%
Phleum pratense	Timothy	I	0	p			
Poa pratense	Kentucky bluegrass	I	0	1	1	1.0%	1.9%
Perennial Graminoids Total						**11.0%**	**16.3%**
Perennial Forbs							
Geranium richardsonii	Richardson's geranium	N	6	p			
Geum macrophyllum	Largeleaf avens	N	6	p			
Leucanthemun vulgare	Oxeye daisy	N	6	p			
Maianthemum stellatum	Starry false Solomon's seal	N	7	1	3	1.0%	3.8%
Pyrola chlorantha	Greenflowered wintergreen	N	8	p			
Pyrola rotundifolia	Roundleaf wintergreen	N	8	p			
Sidalcea candida	White checkermallow	N	5	1		1.0%	1.0%
Symphyotrichum laeve var. geyeri	Smooth blue aster	N	6	p			
Perennial Forbs Total						**2.0%**	**4.8%**
Ferns and Fern Allies							
Equisetum arvense	Field horsetail	N	4	p			
Equisetum variegatum	Variegated scouringrush	N	5	p			
Ferns and Fern Allies Total							

Sample #		T08					
TOTAL VEGETATION COVER						**84.0%**	**100.0%**
Non-Vegetation Cover							
Litter				8		8.0%	
Standing Dead				8		8.0%	
TOTAL NON-VEGETATION COVER						**16.0%**	

Sample #		T09					
Vegetation Type		Diamondleaf Willow Wet Shrubland					
USNVC (2017) Association Code		CEGL005937					
Date							8/6/2018
Number Species							35
Number Non-Native Species							5
Total C							87
Mean C All							2.5
Mean C Natives							2.9
Absolute Cover Natives							87
Relative Cover Natives							97.8%
Total Hits							100
Total Vegetation Cover							89
Total Non-Veg Cover							11
Scientific Name	**Common Name**	**Origin**	**C-Value**	**1st Hit Data**	**2nd Hit Data**	**Absolute Cover**	**Relative Cover**
Shrubs/Subshrubs							
Alnus incana	Thinleaf alder	N	6	17		17.0%	16.8%
Lonicera involucrata	Twinberry honeysuckle	N	7	p			
Potentilla fruticosa	Shrubby cinquefoil	N	4	p			
Rosa woodsii	Woods' rose	N	5	p			
Salix exigua	Sanbar willow, coyote willow	N	3	5		5.0%	5.0%
Salix monticola	Mountain willow	N	6	1		1.0%	1.0%
Salix planifolia	Planeleaf willow	N	7	12		12.0%	11.9%
Shrubs/Subshrubs Total						**35.0%**	**34.7%**
Perennial Graminoids							
Agrostis gigantea	Redtop	I	0	2		2.0%	2.0%
Bromus ciliatus	Fringed brome	N	5	1		1.0%	1.0%
Carex capillaris	Hair-like sedge	N	9	p			
Carex interior	Inland sedge	N	7	9	5	9.0%	13.9%
Carex utriculata	Beaked sedge	N	5	9	4	9.0%	12.9%
Deschampsia cespitosa	Tufted hairgrass	N	4	p			
Glyceria striata	Fowl mannagrass	N	6	p			
Juncus arcticus	Arctic rush	N	4	16	2	16.0%	17.8%
Juncus ensifolius	Swordleaf rush	N	6	p			
Juncus longistylis	Longstyle rush	N	6	1		1.0%	1.0%
Muhlenbergia filiformis	Pullup muhly	N	8	8		8.0%	7.9%
Poa palustris	Fowl bluegrass	N	6	p			
Poa pratense	Kentucky bluegrass	I	0	p			
Triglochin maritima	Arrowgrass	N	6	p			
Perennial Graminoids Total						**46.0%**	**56.4%**
Perennial Forbs							
Cirsium arvense	Canada thistle	I	0	p			
Epilobium saximontanum	Rocky Mountain willowherb	N	6	p			
Hypericum scouleri	Norton's St. John's -wort	N	7	p			
Leucanthemun vulgare	Oxeye daisy	N	6	p			
Maianthemum stellatum	Starry false Solomon's seal	N	7	1		1.0%	1.0%
Medicago lupulina	Black medic	I	0	p			
Packera pseudaurea	Falsegold groundsel	N	7	1		1.0%	1.0%
Platanthera huronensis	Green bog orchid	N	7	p			
Pyrola rotundifolia	Roundleaf wintergreen	N	8	p			
Rumex occidentalis	Western dock	N	5	p			

Sample #		T09					
Solidago velutina subsp. sparsiflora	Three-nerve goldenrod	N	6	2		2.0%	2.0%
Trifolium pratense	Red clover	I	0	p			
Perennial Forbs Total						**4.0%**	**4.0%**
Ferns and Fern Allies							
Equisetum laevigatum	Smooth horsetail	N	4	1		1.0%	1.0%
Equisetum variegatum	Variegated scouringrush	N	5	3	1	3.0%	4.0%
Ferns and Fern Allies Total						**4.0%**	**5.0%**
TOTAL VEGETATION COVER						**89.0%**	**100.0%**
Non-Vegetation Cover							
Litter				7		7.0%	
water				4		4.0%	
TOTAL NON-VEGETATION COVER						**11.0%**	

Sample #		T11				
Vegetation Type		Non-Native Grassland				
USNVC (2017) Association Code		CEGL005264				
Date						8/6/2018
Number Species						30
Number Non-Native Species						9
Total C						35
Mean C All						1.2
Mean C Natives						1.7
Absolute Cover Natives						35.0
Relative Cover Natives						85.4%
TOTAL HITS						100
Total Vegetation Cover						41
Total Non-Veg Cover						59
Scientific Name	**Common Name**	**Origin**	**C-Value**	**1st Hit Data**	**Absolute Cover**	**Relative Cover**
Trees						
Juniperus scopulorum	Rocky Mountain juniper	N	5	p		
Trees Total						
Shrubs/Subshrubs						
Ericameria nauseosa	Rubber rabbitbrush	N	3	p		
Mahonia repens	Oregon grape	N	5	p		
Rosa woodsii	Woods' rose	N	5	p		
Symphoricarpos rotundifolius	Roundleaf snowberry	N	5	1	1.0%	2.4%
Shrubs/Subshrubs Total					**1.0%**	**2.4%**
Perennial Graminoids						
Achnatherum lettermanii	Letterman's needlegrass	N	6	10	10.0%	24.4%
Bromus inermis	Smooth brome	I	0	p		
Dactylis glomerata	Orchardgrass	I	0	p		
Elymus elymoides	Squirreltail	N	4	1	1.0%	2.4%
Elymus trachycaulus	Slender wheatgrass	N	4	p		
Koeleria macrantha	Prairie Junegrass	N	6	p		
Pascopyrum smithii	Western wheatgrass	N	5	p		
Poa pratense	Kentucky bluegrass	I	0	5	5.0%	12.2%
Perennial Graminoids Total					**16.0%**	**39.0%**
Perennial Forbs						
Allium cf. geyeri	Geyer's onion	N	5	p		
Antennaria parvifolia	Small-leaf pussytoes	N	5	1	1.0%	2.4%
Astragalus flexuosus	Flexile milkvetch	N	6	p		
Fragaria virginiana	Mountain strawberry	N	5	p		
Glycyrrhiza lepidota	Wild licorice	N	3	p		
Heterotheca villosa	Hairy false goldenaster	N	3	21	21.0%	51.2%
Medicago sativa	Alfalfa	I	0	1	1.0%	2.4%
Oxytropis lambertii	Purple locoweed	N	5	1	1.0%	2.4%
Penstemon caespitosus	Mat penstemon	N	7	p		
Potentilla hippiana	Wolly cinquefoil	N	5	p		
Symphyotrichum falcatum	White prairie aster	N	4	p		
Symphyotrichum laeve var. geyeri	Smooth blue aster	N	6	p		
Perennial Forbs Total					**24.0%**	**58.5%**
Annual/Biennial Forbs						
Carduus nutans	Musk thistle (Nodding plumeless thistle)	I B	0	p		

Sample #		T11				
Cynoglossum officinale	Houndstongue	I B	0	p		
Melilotus officinale	Yellow sweetclover	I	0	p		
Tragopogon dubius	Western salsify	I	0	p		
Annual/Biennial Forbs Total						
Annual Graminoids						
Bromus japonicus	Japanese brome	I	0	p		
Annual Graminoids Total						
TOTAL VEGETATION COVER					**41.0%**	**100.0%**
Non-Vegetation Cover						
Litter				47	47.0%	
Soil				7	7.0%	
Rock				2	2.0%	
Standing Dead				2	2.0%	
Cut Stump				1	1.0%	
TOTAL NON-VEGETATION COVER					**59.0%**	

Sample #		T12				
Vegetation Type		Native Grassland				
USNVC (2017) Association Code		CEGL001705				
Date						8/6/2018
Number Species						21
Number Non-Native Species						13
Total C						59
Mean C All						2.8
Mean C Natives						7.4
Absolute Cover Natives						59.0
Relative Cover Natives						93.7%
Total Hits						100
Total Vegetation Cover						63
Total Non-Veg Cover						37
Scientific Name	**Common Name**	**Origin**	**C-Value**	**1st Hit Data**	**Absolute Cover**	**Relative Cover**
Perennial Graminoids						
Achnatherum hymenoides	Indian ricegrass	N	5	p		
Achnatherum lettermanii	Letterman's needlegrass	N	6	48	48.0%	76.2%
Bromus inermis	Smooth brome	I	0	p		
Dactylis glomerata	Orchardgrass	I	0	3	3.0%	4.8%
Pascopyrum smithii	Western wheatgrass	N	5	4	4.0%	6.3%
Sporobolus cf. airoides	Alkali sacaton	N	5	p		
Perennial Graminoids Total					**55.0%**	**87.3%**
Perennial Forbs						
Grindelia squarrosa	Curlycup gumweed	N	1	p		
Heterotheca villosa	Hairy false goldenaster	N	3	6	6.0%	9.5%
Symphyotrichum falcatum	White prairie aster	N	4	p		
Taraxacum officinale	Dandelion	I	0	p		
Perennial Forbs Total					**6.0%**	**9.5%**
Annual/Biennial Forbs						
Arctium minus	Lesser burdock	I C	0	p		
Carduus nutans	Musk thistle (Nodding plumeless thistle)	I B	0	p		
Cynoglossum officinale	Houndstongue	I B	0	p		
Descurainia incana	Mountain tansymustard	N	2	1	1.0%	1.6%
Lactuca serriola	Prickly lettuce	I	0	p		
Lepidium perfoliatum	Clasping pepperweed	I	0	p		
Melilotus officinale	Yellow sweetclover	I	0	1	1.0%	1.6%
Sisymbrium altissimum	Tumble mustard	I	0	p		
Tragopogon dubius	Western salsify	I	0	p		
Verbascum thapsus	Mullien	I C	0	p		
Annual/Biennial Forbs Total					**2.0%**	**3.2%**
Annual Graminoids						
Bromus tectorum	Cheatgrass, Downy brome	I C	0	p		
Annual Graminoids Total						
TOTAL VEGETATION COVER					**63.0%**	**100.0%**
Non-Vegetaion Cover						
Litter				34	34.0%	

Sample #		T12				
Soil				2	2.0%	
Rock				1	1.0%	
TOTAL NON-VEGETAION COVER					**37.0%**	

Sample #		T13				
Vegetation Type		Gambel Oak - Serviceberry Shrubland				
USNVC (2017) Association Code		CEGL001109				
Date						8/6/2018
Number Species						22
Number Non-Native Species						4
Total C						34
Mean C All						1.5
Mean C Natives						1.9
Absolute Cover Natives						34
Relative Cover Natives						70.8%
Total Hits						100
Total Vegetation Cover						48
Total Non-Veg Cover						52
Scientific Name	**Common Name**	**Origin**	**C-Value**	**1st Hit Data**	**Absolute Cover**	**Relative Cover**
Shrubs/Subshrubs						
Amelanchier alnifolia	Serviceberry	N	6	3	3.0%	6.3%
Mahonia repens	Oregon grape	N	5	3	3.0%	6.3%
Prunus virginiana	Chokecherry	N	4	1	1.0%	2.1%
Quercus gambelii	Gambel oak	N	5	19	19.0%	39.6%
Ribes inerme	Whitestem gooseberry	N	5	p		
Rosa woodsii	Woods' rose	N	5	p		
Symphoricarpos rotundifolius	Roundleaf snowberry	N	5	1	1.0%	2.1%
Shrubs/Subshrubs Total					**27.0%**	**56.3%**
Perennial Graminoids						
Achnatherum lettermanii	Letterman's needlegrass	N	6	p		
Carex geyeri	Elk sedge	N	6	4	4.0%	8.3%
Dactylis glomerata	Orchardgrass	I	0	1	1.0%	2.1%
Pascopyrum smithii	Western wheatgrass	N	5	p		
Poa pratense	Kentucky bluegrass	I	0	13	13.0%	27.1%
Perennial Graminoids Total					**18.0%**	**37.5%**
Perennial Forbs						
Clematis ligusticifolia	Western white clematis	N	4	1	1.0%	2.1%
Erigeron speciosus	Aspen fleabane	N	5	1	1.0%	2.1%
Heliomeris multiflora	Showy goldeneye	N	4	p		
Heterotheca villosa	Hairy false goldenaster	N	3	p		
Symphyotrichum falcatum	White prairie aster	N	4	p		
Symphyotrichum laeve var. geyeri	Smooth blue aster	N	6	1	1.0%	2.1%
Thalictrum fendleri	Fendler's meadow-rue	N	6	p		
Perennial Forbs Total					**3.0%**	**6.3%**
Annual/Biennial Forbs						
Cynoglossum officinale	Houndstongue	I B	0	p		

Sample #		T13				
Tragopogon dubius	Western salsify	I	0	p		
Annual/Biennial Forbs Total						
Cryptograms						
moss		N	5	p		
Cryptograms Total						
TOTAL VEGETATION COVER					**48.0%**	**100.0%**
Non-Vegetation Cover						
Litter				44	44.0%	
Soil				2	2.0%	
Rock				5	5.0%	
Standing Dead				1	1.0%	
TOTAL NON-VEGETATION COVER					**52.0%**	

Sample #		T 14				
Vegetation Type		Sticky Rabbitbrush Shrub Grassland				
USNVC (2017) Association Code		CEGL002933				
Date						8/6/2018
Number Species						32
Number Non-Native Species						11
Total C						27
Mean C All						0.8
Mean C Natives						1.3
Absolute Cover Natives						27
Relative Cover Natives						48.2%
Total Hits						100
Total Vegetation Cover						56
Total Non-Veg Cover						44
Scientific Name	**Common Name**	**Origin**	**C-Value**	**1st Hit Data**	**Absolute Cover**	**Relative Cover**
Shrubs/Subshrubs						
Artemisia tridentata var. vaseyana	Mountain big sagebrush	N	5	3	3.0%	5.4%
Chrysothamnus viscidiflorus	Sticky rabbitbrush	N	5	9	9.0%	16.1%
Mahonia repens	Oregon grape	N	5	1	1.0%	1.8%
Rosa woodsii	Woods' rose	N	5	p		
Shrubs/Subshrubs Total					**13.0%**	**23.2%**
Perennial Graminoids						
Achnatherum lettermanii	Letterman's needlegrass	N	6	2	2.0%	3.6%
Bromus inermis	Smooth brome	I	0	2	2.0%	3.6%
Dactylis glomerata	Orchardgrass	I	0	8	8.0%	14.3%
Elymus elymoides	Squirreltail	N	4	2	2.0%	3.6%
Hesperostipa comata	Needle and thread grass	N	6	1	1.0%	1.8%
Juncus arcticus	Arctic rush	N	4	p		
Pascopyrum smithii	Western wheatgrass	N	5	2	2.0%	3.6%
Poa pratense	Kentucky bluegrass	I	0	18	18.0%	32.1%
Perennial Graminoids Total					**35.0%**	**62.5%**
Perennia Forbs						
Achillea lanulosa	Yarrow	N	4	p		
Antennaria parvifolia	Small-leaf pussytoes	N	5	p		
Artemisia dracunculus (=Oligosporus)	Wild tarragon	N	3	p		
Castilleja linariifolia	Narrowleaf Indian paintbrush	N	6	p		
Erigeron speciosus	Aspen fleabane	N	5	p		
Heterotheca villosa	Hairy false goldenaster	N	3	3	3.0%	5.4%
Lupinus argenteus	Silvery lupine	N	5	1	1.0%	1.8%
Medicago sativa	Alfalfa	I	0	P		
Penstemon strictus	Rocky Moutain penstemon	N	5	p		
Plantago lanceolata	Narrowleaf plantain	I	0	p		
Potentilla gracilis	Slender cinquefoil	N	5	1	1.0%	1.8%
Potentilla hippiana	Wolly cinquefoil	N	5	p		
Symphyotrichum lanceolatum subsp. hesperium	White panicle aster	N	5	2	2.0%	3.6%
Taraxacum officinale	Dandelion	I	0	1	1.0%	1.8%
Perennial Forbs Total					**8.0%**	**14.3%**
Annual/Biennial Forbs						
Carduus acanthoides	Plumeless thistle	I B	0	p		
Carduus nutans	Musk thistle (Nodding plumeless	I B	0	p		
Hackelia floribunda	Manyflower stickseed	N	3	p		
Lepidium densiflorum	Common petterweed	I	0	p		

Sample #		T 14				
Tragopogon dubius	Western salsify	I	0	p		
Turritis glabra	Tower rockcress	I	0	p		
Annual/Biennial Forbs Total						
TOTAL VEGETATION COVER					**56.0%**	**100.0%**
Non-Vegetation Cover						
Litter				28	28.0%	
Soil				15	15.0%	
Rock				1	1.0%	
TOTAL NON-VEGETATION COVER					**44.0%**	

APPENDIX B. QUANTITATIVE VEGETATION PHOTOS

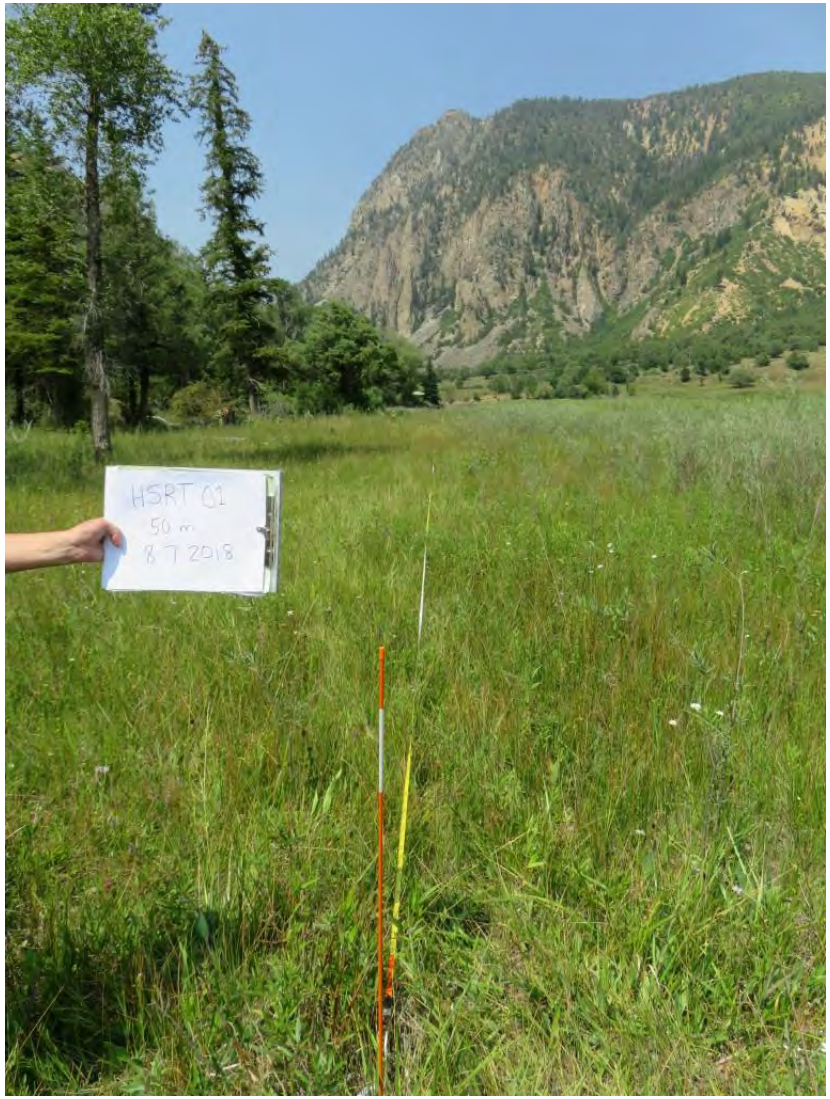
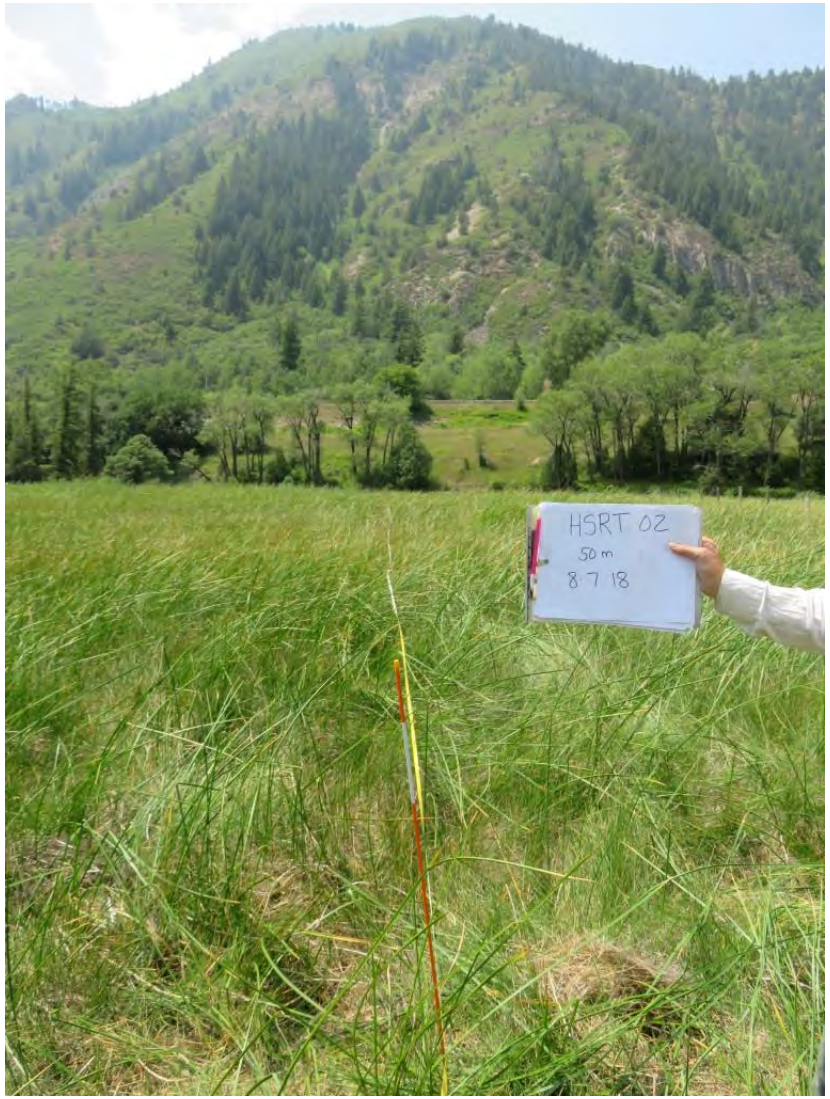


Photo T01 Start (Aug-7-2018)

Photo T01-End (Aug-6-2018)

HSR-T02-Start (Aug-7-2018)



HSR-T02-End (Aug-7-2018)

HSR-T03-Start (Aug-7-2018)

HSR-T03-End (Aug-7-2018)

HSR-T04-Start (Aug-6-2018)

HSR-T04-End (Aug-6-2018)

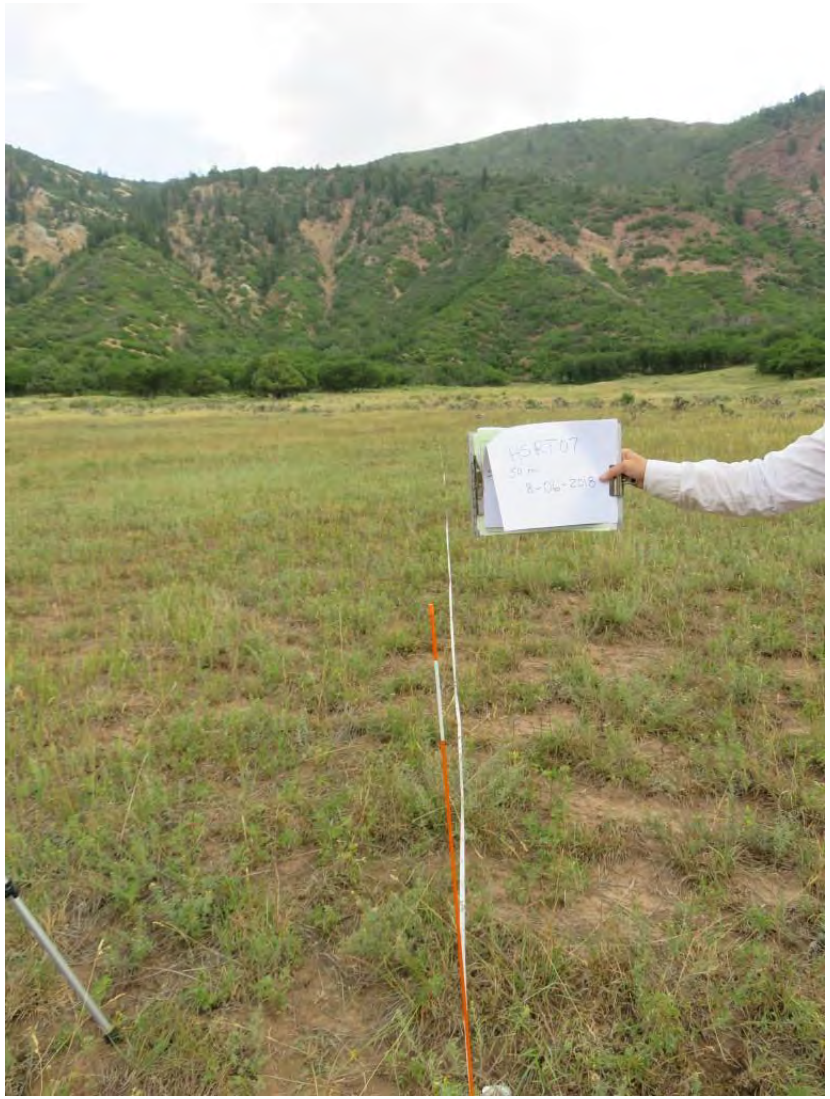
HSR-T05-Start (Aug-6-2018)

HSR-T05-End (Aug-6-2018)

HSR-T06-Start (Aug-7-2018)

HSR-T06-End (Aug-7-2018)

HSR-T07-Start (Aug-6-2018)

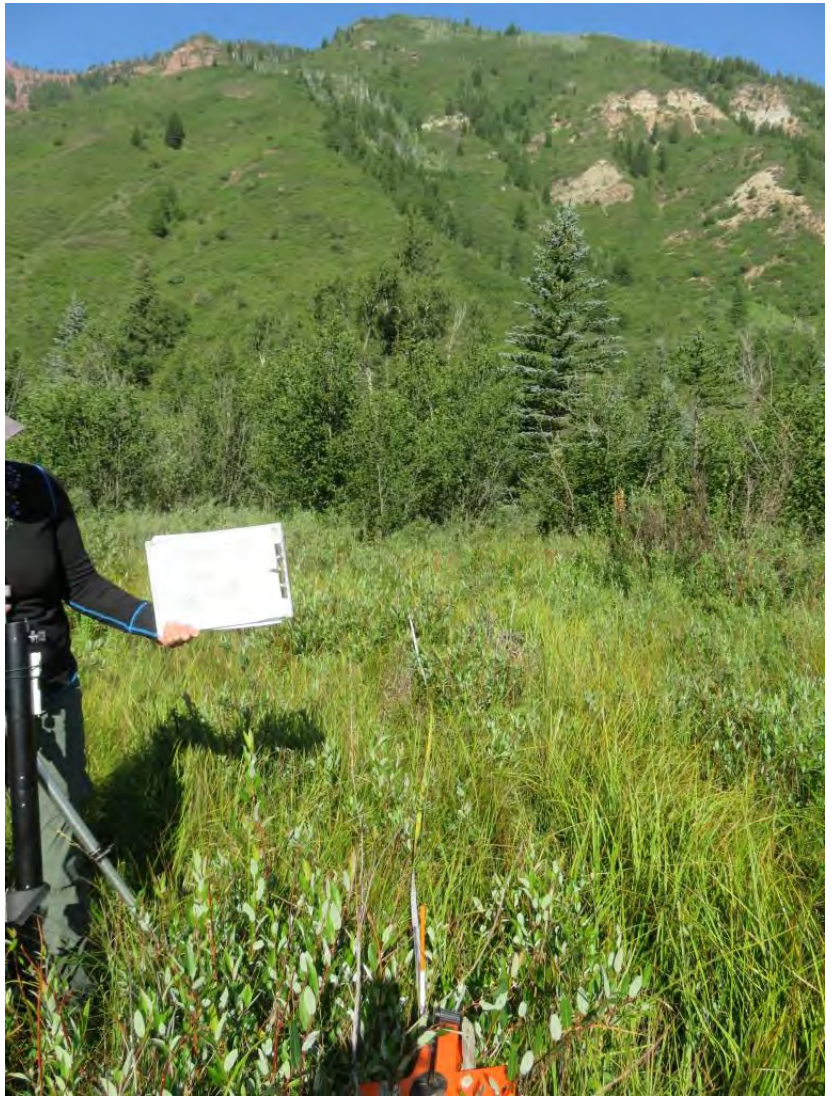


HSR-T07-End (Aug-6-2018)

HSR-T08-Start (Aug-8-2018)

HSR-T08-End (Aug-8 2018)

HSR-T09-Start (Aug-9-2018)



HSR-T09 End (Aug-9-2018)

HSR-T11-Start (Aug-6-2018)

HSR-T11-End (Aug-6-2018)

HSR-T12-Start (Sep-11-2018)

HSR-T12 End (Sep-11-2018)

HSR-T13-Start (Sep-11-2018)

HSR-T13-End (Sep-11-2018)

HSR-T14-Start (Sep-12-2018)

HSR-T14-End (Sep-12-2018)

APPENDIX C. VEGETATION DATA RESULTS

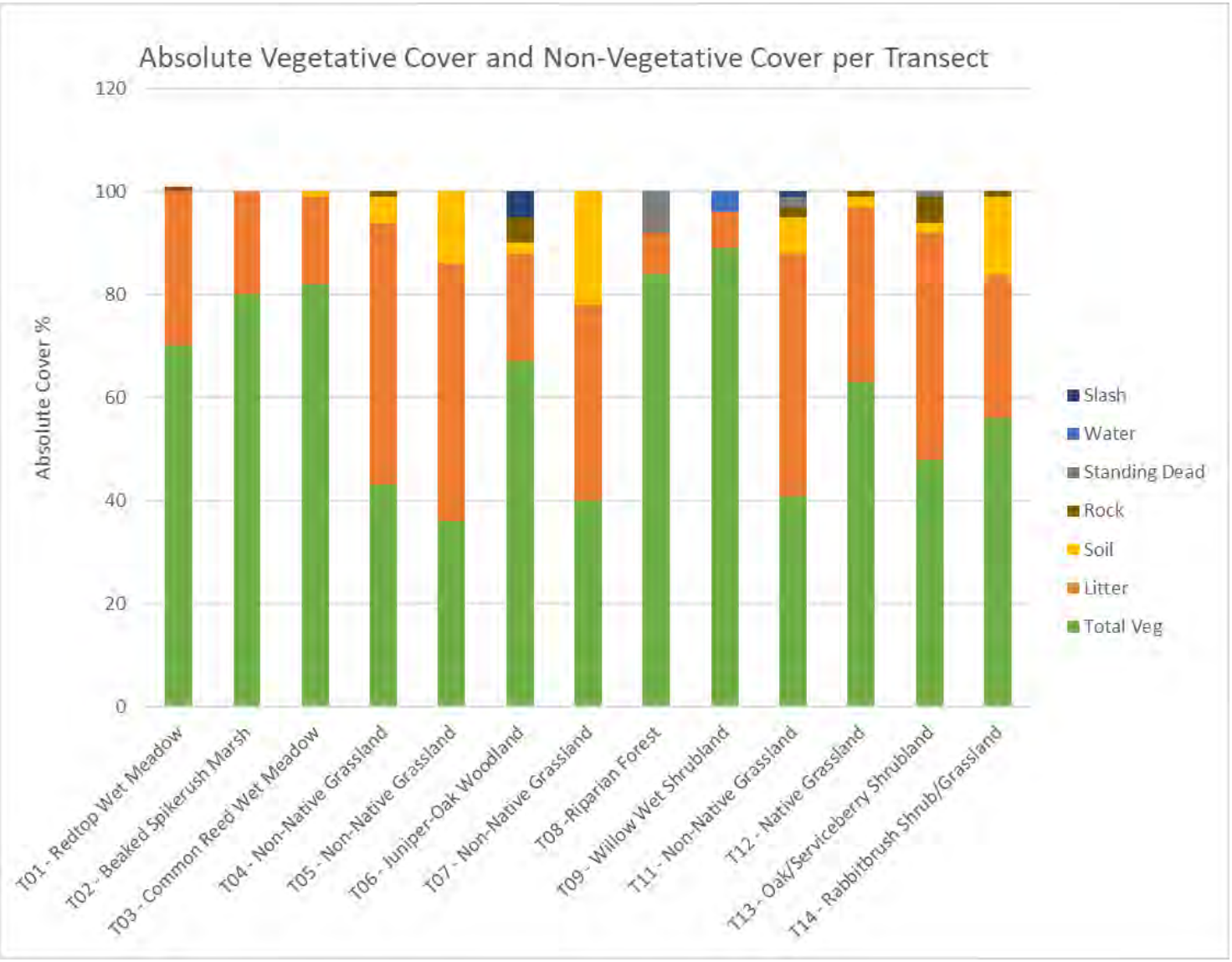


Figure C-1. Absolute Vegetative Cover and Non-Vegetative Cover per Transect

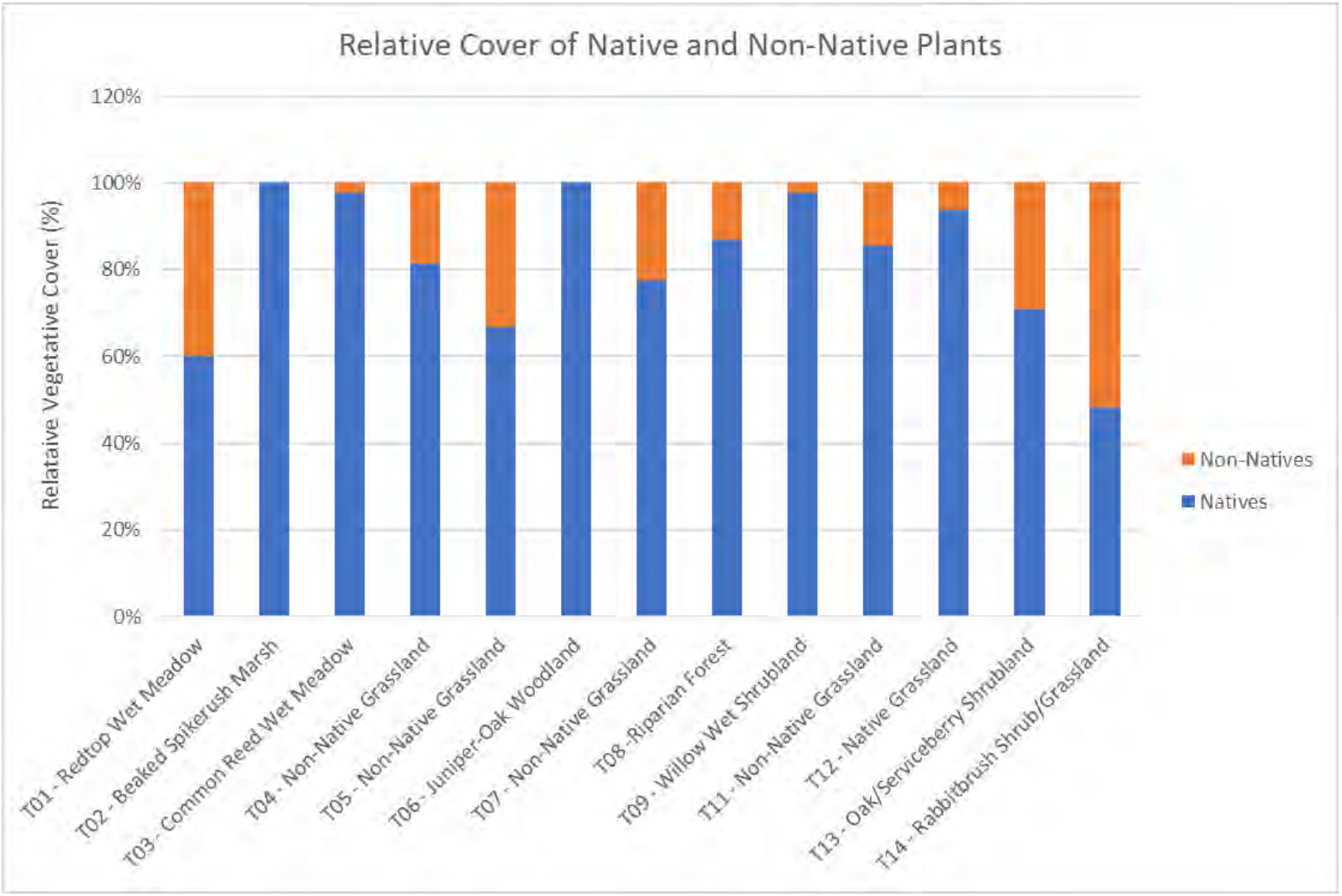


Figure C-2. Relative Cover of Native and Non-Native Plants

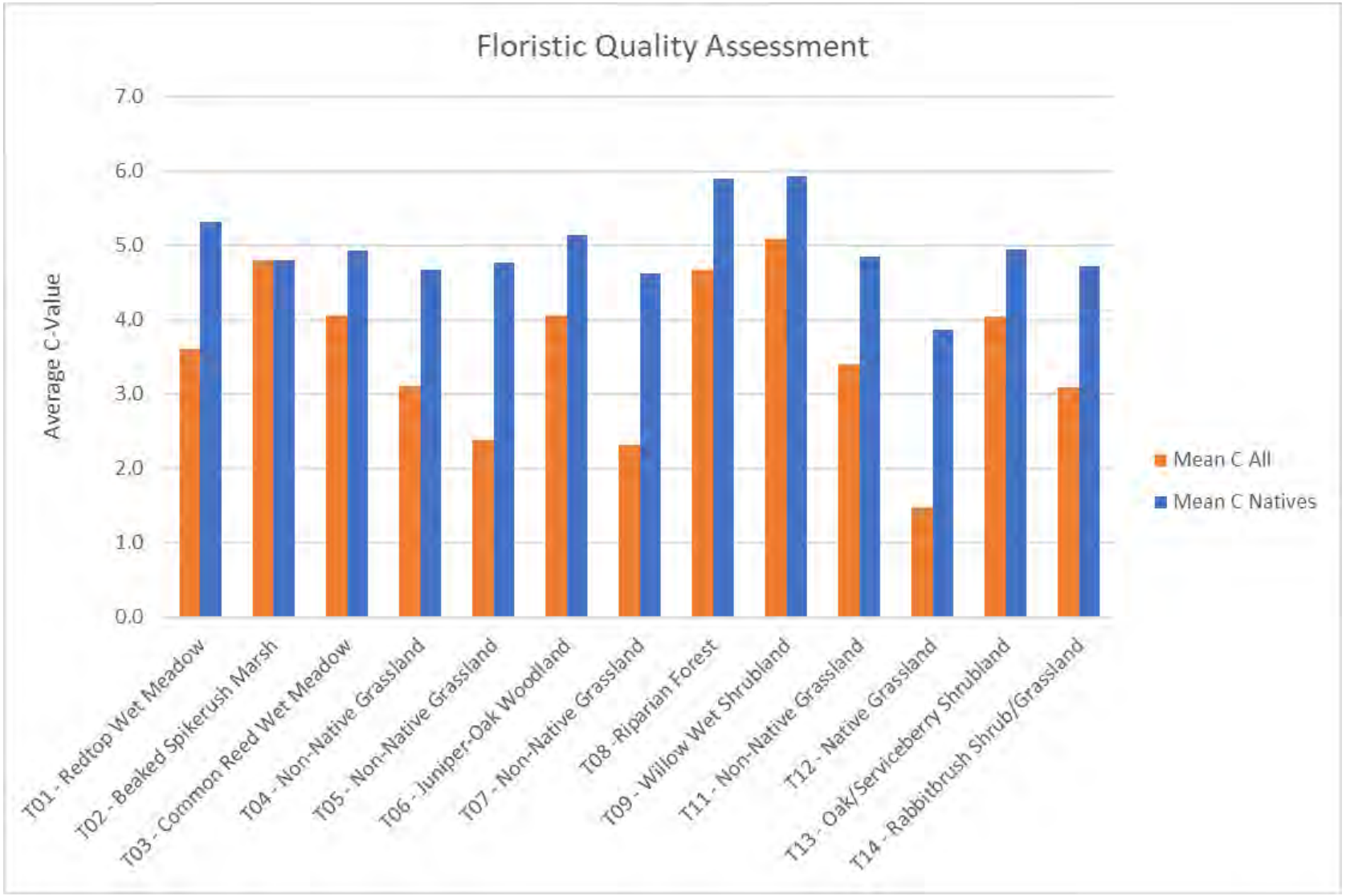


Figure C-3. Floristic Quality Assessment

APPENDIX D. VASCULAR PLANT SPECIES LIST

Filoha Meadows Nature Preserve - 2018 Vascular Plant Species List

Scientific Name	Common Name	Family	Origin	C-Value	Voucher	Photo
Trees						
Acer negundo (=Negundo aceroides)	Box elder	Sapindaceae	N	7	☐	☐
Juniperus osteosperma (=Sabina)	Utah juniper	Cupressaceae	N	5	☐	☐
Juniperus scopulorum (=Sabina)	Rocky Mountain juniper	Cupressaceae	N	5	☐	☐
Malus domestica	Apple	Rosaceae	I	0	☐	☐
Picea pungens	Blue spruce	Pinaceae	N	6	☐	☐
Pinus edulis	Pinyon pine	Pinaceae	N	6	☐	☐
Pinus ponderosa subsp. scopulorum	Ponderosa pine	Pinaceae	N	5	☐	☐
Populus angustifolia	Narrowleaf cottonwood	Salicaceae	N	5	☐	☐
Populus tremuloides	Quaking aspen	Salicaceae	N	5	☐	☐
Pseudotsuga menziesii	Douglas fir	Pinaceae	N	5	☐	☐
Shrubs/Subshrubs						
Acer glabrum	Rocky Mountain maple	Sapindaceae	N	7	☐	☐
Alnus incana subsp. tenuifolia	Thinleaf alder	Betulaceae	N	6	☐	☐
Amelanchier alnifolia	Serviceberry	Rosaceae	N	6	☐	☐
Artemisia tridentata var. vaseyana	Mountain big sagebrush	Asteraceae	N	5	☐	☐
Betula glandulosa	Bog birch	Betulaceae	N	9	☐	☐
Betula occidentalis (=B. fontinalis)	River birch	Betulaceae	N	8	☐	☐
Ceanothus fendleri	Fendler's ceanothus, buckbrush	Rhamnaceae	N	7	☐	☐
Chrysothamnus viscidiflorus	Sticky rabbitbrush	Asteraceae	N	5	☐	☐
Cornus sericea subsp. sericea	Redosier dogwood	Cornaceae	N	7	☐	☐
Crataegus rivularis	River hawthorn	Rosaceae	N	6	☐	☐
Ericameria nauseosa (=Chrysothamnus)	Rubber rabbitbrush	Asteraceae	N	3	☐	☐
Holodiscus discolor	Rock spirea; Oceanspray	Rosaceae	N	8	☐	☐
Juniperus communis subsp. alpina	Common juniper	Cupressaceae	N	6	☐	☐
Lonicera involucrata (=Distegia)	Twinberry honeysuckle	Caprifoliaceae	N	7	☐	☐
Mahonia repens	Oregon grape	Berberidaceae	N	5	☐	☐
Paxistima myrsinites	Mountain lover	Celastraceae	N	7	☐	☐

Scientific Name	Common Name	Family	Origin	C-Value	Voucher	Photo
Potentilla fruticosa (=Pentaphylloides floribunda)	Shrubby cinquefoil	Rosaceae	N	4	☐	☐
Prunus virginiana var. melanocarpa	Chokecherry	Rosaceae	N	4	☐	☐
Quercus gambelii	Gambel oak	Fagaceae	N	5	☐	☐
Rhus aromatica subsp. trilobata	Skunkbush sumac	Anacardiaceae	N	5	☐	☐
Ribes inerme	Whitestem gooseberry	Grossulariaceae	N	5	☐	☐
Rosa woodsii	Woods' rose	Rosaceae	N	5	☐	☐
Salix exigua	Sanbar willow, coyote willow	Asteraceae	N	3	☐	☐
Salix monticola	Mountain willow	Salicaceae	N	6	☐	☐
Salix planifolia	Planeleaf willow	Salicaceae	N	7	☐	☐
Symphoricarpos rotundifolius (=S. oreophilus)	Roundleaf snowberry	Caprifoliaceae	N	5	☐	☐
Tamarix parviflora	Tamarisk, Salt Cedar	Tamaricaceae	I B	0	☐	☐
Perennial Graminoids						
Achnatherum hymenoides	Indian ricegrass	Poaceae	N	5	☐	☐
Achnatherum lettermanii	Letterman's needlegrass	Poaceae	N	6	☐	☐
Agropyron cristatum (=A. desertorum)	Crested wheatgrass	Poaceae	I	0	☐	☐
Agrostis gigantea	Redtop	Poaceae	I	0	☐	☐
Bromus ciliatus (=Bromopsis canadensis)	Fringed brome	Poaceae	N	5	☐	☐
Bromus inermis	Smooth brome	Poaceae	I	0	☐	☐
Calamagrostis stricta	Slimstem reedgrass	Poaceae	N	7	☑	☐
Carex aquatilis	Water sedge	Cyperaceae	N	6	☐	☐
Carex aurea	Golden sedge	Cyperaceae	N	7	☑	☐
Carex capillaris	Hair-like sedge	Cyperaceae	N	9	☐	☐
Carex geyeri	Elk sedge	Cyperaceae	N	6	☐	☐
Carex interior	Inland sedge	Cyperaceae	N	7	☑	☐
Carex nebrascensis	Nebraska sedge	Cyperaceae	N	5	☐	☐
Carex pellita (=C. lanuginosa)	Woolly sedge	Cyperaceae	N	6	☑	☐
Carex praegracilis	Clustered field sedge	Cyperaceae	N	5	☑	☐
Carex utriculata	Beaked sedge	Cyperaceae	N	5	☐	☐
Dactylis glomerata	Orchardgrass	Poaceae	I	0	☐	☐

Scientific Name	Common Name	Family	Origin	C-Value	Voucher	Photo
Deschampsia cespitosa	Tufted hairgrass	Poaceae	N	4	☐	☐
Distichlis stricta (=D. spicata)	Saltgrass	Poaceae	N	4	☐	☐
Eleocharis palustris	Creeping spikerush	Cyperaceae	N	3	☐	☐
Eleocharis rostellata	Beaked spikerush	Cyperaceae	N	6	☑	☐
Elymus elymoides	Squirreltail	Poaceae	N	4	☐	☐
Elymus trachycaulus	Slender wheatgrass	Poaceae	N	4	☐	☐
Glyceria striata	Fowl mannagrass	Poaceae	N	6	☐	☐
Hesperostipa comata	Needle and thread grass	Poaceae	N	6	☐	☐
Hierochloë hirta subsp. arctica	Northern sweetgrass	Poaceae	N	9	☐	☐
Hordeum jubatum	Foxtail barley	Poaceae	N	2	☐	☐
Juncus arcticus var. balticus (=J. balticus)	Baltic rush	Juncaceae	N	4	☐	☐
Juncus ensifolius (=J. saximontanus)	Swordleaf rush	Juncaceae	N	6	☑	☐
Juncus longistylis	Longstyle rush	Juncaceae	N	6	☑	☐
Juncus nodosus	Knotted rush	Juncaceae	N	6	☑	☐
Koeleria macrantha	Prairie Junegrass	Poaceae	N	6	☐	☐
Leymus cinereus	Basin wildrye	Poaceae	N	5	☐	☐
Muhlenbergia asperifolia	Scratchgrass muhly	Poaceae	N	4	☑	☐
Muhlenbergia filiformis	Pullup muhly	Poaceae	N	8	☐	☐
Pascopyrum smithii	Western wheatgrass	Poaceae	N	5	☐	☐
Phalaris arundinacea	Reed canarygrass	Poaceae	I	0	☐	☐
Phleum pratense	Timothy	Poaceae	I	0	☐	☐
Phragmites australis	Common reed	Poaceae	N	3	☐	☐
Poa palustris	Fowl bluegrass	Poaceae	N	6	☑	☐
Poa pratensis	Kentucky bluegrass	Poaceae	I	0	☐	☐
Poa secunda	Sandberg bluegrass	Poaceae	N	6	☑	☐
Schedonorus pratensis (=Festuca)	Meadow fescue	Poaceae	I	0	☑	☐
Schoenoplectus acutus	Hardstem bulrush	Cyperaceae	N	3	☐	☐
Schoenoplectus americanus (=Scirpus)	Olney's three-square bulrush	Cyperaceae	N	4	☑	☐
Sporobolus airoides	Alkali sacaton	Poaceae	N	5	☐	☐
Triglochin maritima	Arrowgrass	Juncaginaceae	N	6	☐	☐
Triglochin palustris	Marsh arrowgrass	Juncaginaceae	N	7	☑	☐

Scientific Name	Common Name	Family	Origin	C-Value	Voucher Photo	
Perennial Forbs						
Achillea lanulosa	Yarrow	Asteraceae	N	4	☐	☐
Agoseris glauca	Pale agoseris	Asteraceae	N	6	☐	☐
Allium acuminatum	Tapertip onion	Alliaceae	N	8	☐	☐
Allium geyeri	Geyer's onion	Alliaceae	N	5	☐	☐
Anaphalis margaritacea	Pearly everlasting	Asteraceae	N	4	☐	☐
Antennaria parvifolia	Small-leaf pussytoes	Asteraceae	N	5	☐	☐
Apocynum cannabinum	Indian hemp	Apocynaceae	N	2	☐	☐
Artemisia dracunculus (=Oligosporus)	Wild tarragon	Asteraceae	N	3	☑	☐
Artemisia frigida	Fringed sage, prairie sagewort	Asteraceae	N	4	☐	☐
Asclepias speciosa	Showy milkweed	Asclepiadaceae	N	3	☐	☐
Astragalus flexuosus	Flexile milkvetch	Fabaceae	N	6	☐	☐
Calochortus gunnisonii	Mariposa lily	Liliaceae	N	7	☐	☐
Castilleja linariifolia	Narrowleaf Indian paintbrush	Orobanchaceae	N	6	☐	☐
Cichorium intybus	Chicory	Asteraceae	I C	0	☐	☐
Cirsium arvense (=Breea)	Canada thistle	Asteraceae	I B	0	☐	☐
Cirsium tracyi	Tracy's thistle	Asteraceae	N	5	☐	☐
Clematis ligusticifolia	Western white clematis	Ranunculaceae	N	4	☐	☐
Convolvulus arvensis	Field bindweed	Convolvulaceae	I C	0	☐	☐
Crepis runcinata (Psilochenia)	Fiddleleaf hawksbeard	Asteraceae	N	6	☑	☐
Epilobium saximontanum	Rocky Mountain willowherb	Onagraceae	N	6	☐	☐
Epipactis gigantea	Giant helleborine, Stream orchid	Orchidaceae	N	9	☐	☑
Erigeron speciosus	Aspen fleabane	Asteraceae	N	5	☐	☐
Fragaria virginiana	Mountain strawberry	Rosaceae	N	5	☐	☐
Frasera speciosa	Monument plant, Elkweed	Gentianaceae	N	6	☐	☐
Galium boreale (=G. septentrionale)	Northern bedstraw	Rubiaceae	N	6	☐	☐
Gentiana affinis (=Pneumonanthe)	Rocky Mountain gentian	Gentianaceae	N	8	☐	☐
Geranium richardsonii	Richardson's geranium	Geraniaceae	N	6	☐	☐
Geum macrophyllum var. perincisum	Largeleaf avens	Rosaceae	N	6	☐	☐

Scientific Name	Common Name	Family	Origin	C-Value	Voucher	Photo
Glycyrrhiza lepidota	Wild licorice	Fabaceae	N	3	☐	☐
Grindelia squarrosa	Curlycup gumweed	Asteraceae	N	1	☐	☐
Helianthus nuttallii	Nuttall's sunflower	Asteraceae	N	3	☑	☑
Heliomeris multiflora	Showy goldeneye	Asteraceae	N	4	☐	☐
Heterotheca villosa	Hairy false goldenaster	Asteraceae	N	3	☐	☐
Hippuris vulgaris	Common mare's-tail	Hippuridaceae	N	6	☐	☐
Hypericum scouleri susp. nortoniae (=H. formosum)	Norton's St. John's-wort	Clusiaceae	N	7	☑	☑
Ipomopsis aggregata	Scarlet gilia	Polemoniaceae	N	5	☐	☐
Leucanthemum vulgare	Oxeye daisy	Asteraceae	I B	0	☐	☐
Linaria vulgaris	Butter and eggs, toadflax	Plantaginaceae	I B	0	☐	☐
Lithospermum ruderale	Western stoneseed	Boraginaceae	N	4	☐	☐
Lupinus argenteus	Silvery lupine	Fabaceae	N	5	☐	☐
Maianthemum stellatum	Starry false Solomon's seal	Ruscaceae	N	7	☐	☐
Medicago lupulina	Black medic	Fabaceae	I	0	☐	☐
Medicago sativa	Alfalfa	Fabaceae	I	0	☐	☐
Mentha arvensis	Wild mint	Lamiaceae	N	4	☐	☐
Monarda fistulosa var. menthifolia	Wild bergamot	Lamiaceae	N	6	☐	☐
Oenothera villosa subsp. strigosa	Hairy evening primrose	Onagraceae	N	4	☐	☐
Orobanche fasciculata (=Aphyllon)	Clustered broomrape	Orobanchaceae	N	5	☐	☐
Oxytropis lambertii	Purple locoweed	Fabaceae	N	5	☑	☐
Packera pseudaurea	Falsegold groundsel	Asteraceae	N	7	☑	☐
Pastinaca sativa	Wild parsnip	Apiaceae	I	0	☐	☐
Penstemon caespitosus	Mat penstemon	Plantaginaceae	N	7	☐	☐
Penstemon strictus	Rocky Mountain penstemon	Plantaginaceae	N	5	☐	☐
Plantago lanceolata	Narrowleaf plantain	Plantaginaceae	I	0	☐	☐
Plantago major	Common plantain	Plantaginaceae	I	0	☐	☐
Platanthera aquilonis	Northern green orchid	Orchidaceae	N	7	☑	☑
Platanthera huronensis	Green bog orchid	Orchidaceae	N	7	☐	☐
Platanthera tescamnis (=Limnorchis sparsiflora, L. ensifolia)	Canyon bog orchid	Orchidaceae	N	9	☑	☑
Potentilla gracilis	Slender cinquefoil	Rosaceae	N	5	☐	☐

Scientific Name	Common Name	Family	Origin	C-Value	Voucher	Photo
Potentilla hippiana	Woolly cinquefoil	Rosaceae	N	5	☐	☐
Potentilla recta	Sulphur cinquefoil	Rosaceae	I B	0	☐	☐
Prunella vulgaris	Common selfheal	Lamiaceae	N	4	☑	☐
Pseudognaphalium stramineum	Winged cudweed	Asteraceae	N	4	☑	☑
Pyrola chlorantha	Greenflowered wintergreen	Ericaceae	N	8	☐	☐
Pyrola rotundifolia subsp. asarifolia	Roundleaf wintergreen	Ericaceae	N	8	☐	☐
Rumex occidentalis	Western dock	Polygonaceae	N	5	☐	☐
Rumex triangulivalvis (=R. salicifolius)	Willow dock	Polygonaceae	N	4	☐	☐
Saxifraga bronchialis var. austromontana (=Ciliaria austromontana)	Spotted saxifrage	Saxifragaceae	N	8	☐	☐
Sidalcea candida	White checkermallow	Malvaceae	N	5	☐	☐
Sidalcea neomexicana	Rocky Mountain checker-bloom	Malvaceae	N	5	☐	☐
Sisyrinchium montanum	Rocky Mountain blue-eyed grass	Iridaceae	N	6	☐	☐
Solidago velutina subsp. sparsiflora	Three-nerve goldenrod	Asteraceae	N	6	☑	☐
Spiranthes romanzoffiana	Hooded lady's tresses	Orchidaceae	N	7	☐	☐
Symphyotrichum ascendens (=Virgulaster)	Western aster	Asteraceae	N	2	☐	☐
Symphyotrichum falcatum (=Vigulus)	White prairie aster	Asteraceae	N	4	☑	☐
Symphyotrichum laeve var. geyeri (=Aster)	Smooth blue aster	Asteraceae	N	6	☑	☐
Symphyotrichum lanceolatum subsp. hesperium (=Aster)	White panicle aster	Asteraceae	N	5	☑	☐
Tanacetum vulgare	Common tansy	Asteraceae	I B	0	☐	☐
Taraxacum officinale	Dandelion	Asteraceae	I	0	☐	☐
Thalictrum fendleri	Fendler's meadow-rue	Ranunculaceae	N	6	☐	☐
Toxicodendron rydbergii	Western poison ivy	Anacardiaceae	N	3	☐	☐
Trifolium pratense	Red clover	Fabaceae	I	0	☐	☐
Typha latifolia	Broadleaf cattail	Typhaceae	N	2	☐	☐
Valeriana edulis	Tobacco root; Edible valerian	Valerianaceae	N	7	☐	☐
Ferns and Fern Allies						
Equisetum arvense	Field horsetail	Equisetaceae	N	4	☐	☐

Scientific Name	Common Name	Family	Origin	C-Value	Voucher	Photo
Equisetum hyemale subsp. affine (=Hippochaete)	Scouringrush horsetail	Equisetaceae	N	4	☐	☐
Equisetum laevigatum (=Hippochaete)	Smooth horsetail	Equisetaceae	N	4	☑	☐
Equisetum variegatum subsp. variegatum (=Hippochaete)	Variegated scouringrush	Equisetaceae	N	5	☐	☐
Cacti						
Opuntia fragilis	Brittle pricklypear	Cactaceae	N	3	☐	☐
Annual/Biennial Forbs						
Alyssum alyssoides	Pale madwort	Brassicaceae	I	0	☐	☐
Arctium minus	Lesser burdock	Asteraceae	I C	0	☐	☐
Atriplex heterosperma	Twoscale saltbush	Chenopodiaceae	I	0	☑	☐
Atriplex subspicata	Saline saltbush	Chenopodiaceae	N	3	☑	☐
Camelina microcarpa	False flax	Brassicaceae	I	0	☐	☐
Carduus acanthoides	Plumeless thistle	Asteraceae	I B	0	☐	☐
Carduus nutans subsp. macrolepis	Musk thistle (Nodding plumeless thistle)	Asteraceae	I B	0	☐	☐
Cirsium vulgare	Bull thistle	Asteraceae	I B	0	☐	☑
Cynoglossum officinale	Houndstongue	Boraginaceae	I B	0	☐	☐
Descurainia incana	Mountain tansymustard	Brassicaceae	N	2	☐	☐
Erodium cicutarium	Redstem stork's bill	Geraniaceae	I C	0	☐	☐
Hackelia floribunda	Manyflower stickseed	Boraginaceae	N	3	☐	☐
Lactuca serriola	Prickly lettuce	Asteraceae	I	0	☐	☐
Lepidium campestre (=Neolepia)	Field pepperweed	Brassicaceae	I	0	☐	☐
Lepidium densiflorum	Common pepperweed	Brassicaceae	I	0	☑	☐
Lepidium perfoliatum	Clasping pepperweed	Brassicaceae	I	0	☐	☐
Melilotus albus	White sweetclover	Fabaceae	I	0	☐	☐
Melilotus officinale	Yellow sweetclover	Fabaceae	I	0	☐	☐
Sisymbrium altissimum	Tumble mustard	Brassicaceae	I	0	☐	☐
Sonchus arvensis	Field sowthistle	Asteraceae	I C	0	☐	☐
Tragopogon dubius subsp. major	Western salsify	Asteraceae	I	0	☐	☐
Turritis glabra	Tower rockcress	Brassicaceae	I	0	☐	☐
Verbascum thapsus	Mullein	Scrophulariaceae	I C	0	☐	☐
Annual Graminoids						

Scientific Name	Common Name	Family	Origin	C-Value	Voucher	Photo
Bromus japonicus	Japanese brome	Poaceae	I	0	☐	☐
Bromus tectorum (=Anisantha)	Cheatgrass, Downy brome	Poaceae	I C	0	☐	☐

Source: Field reconnaissance by R.Orthner in 2018 and EM Ecological (2007). Notes: Nomenclature generally follows Flora of Colorado (Ackerfield 2015) with Weber and Wittmann (2012) synonyms in parantheses. Origin: N=Native; I=Introduced, I+A,B,C,W = Colorado Listed Noxious Weed and Rank. C-Value from Rocchio (2007), where 0 (non-native species); 1-3 (commonly found in non-natural areas), 4-6 (equally found n natural and non-natural areas); 7-9 (obligate to natural areas but can sustain some habitat degredation); 10 (obligate to high quality natural areas (relatively unaltered from pre-European settlement). Voucher / Photo: checkmark indicates whether a voucher and/or photograph were taken, respectively.

APPENDIX E. WILDLIFE – VERTEBRATES KNOWN OR SUSPECTED TO OCCUR AT FILOHA

Common Name	Species	CPW SGCN Priority Tier	Federal Status	State Status	USFS Sensitive Species	BLM Sensitive Species	USFWS Birds of Conservation Concern	PIF US-Canada Watch List	CNHP/ NatureServe Global	CNHP/ NatureServe State	Declining Trend
HERPETOFAUNA											
Boreal chorus frog	*Pseudacris maculata*								G5	S5	
Bullsnake (syn. Gopher snake)	*Pituophis catenifer*								G5	S5	
Smooth green snake	*Liochlorophis vernalis*								G5	S4	
Tiger salamander	*Ambystoma tigrinum*								G5	S5	
Western terrestrial garter snake	*Thamnophis elegans*								G5	S5	
BIRDS											
American Coot	*Fulica americana*								G5	S5B,S4N	
American Crow	*Corvus brachyrhynchos*								G5	S5	
American Dipper	*Cinclus mexicanus*								G5	S5	
American Kestrel	*Falco sparverius*								G5	S5B	
American Robin	*Turdus migratorius*								G5	S5	
Bald Eagle	*Haliaeetus leucocephalus*	Tier 2		SC	X	X	X		G5	S1B,S3N	
Band-tailed Pigeon	*Patagioenas fasciata*	Tier 1							G4	S4B	
Bank Swallow	*Riparia riparia*								G5	S5	
Belted Kingfisher	*Megaceryle alcyon*								G5	S5B	
Black-billed Magpie	*Pica hudsonia*								G5	S5	
Black-capped Chickadee	*Poecile atricapillus*								G5	S5	
Black-headed Grosbeak	*Pheucticus melanocephalus*								G5	S4B	
Cinnamon Teal	*Spatula cyanoptera*								G5	S5B	
Dusky Grouse	*Dendragapus obscurus*								G5	S5	
Blue-gray Gnatcatcher	*Polioptila caerulea*								G5	S5B	
Broad-tailed Hummingbird	*Selasphorus platycercus*								G5	S5	
Brown Creeper	*Certhia americana*								G5	S5	
California Scrub-Jay	*Aphelocoma californica*								G5	S5	
Cassin's Finch	*Carpodacus cassinii*	Tier 2					X		G5	S5	X
Cedar Waxwing	*Bombycilla cedrorum*								G5	S5	

Common Name	Species	CPW SGCN Priority Tier	Federal Status	State Status	USFS Sensitive Species	BLM Sensitive Species	USFWS Birds of Conservation Concern	PIF US-Canada Watch List	CNHP/ NatureServe Global	CNHP/ NatureServe State	Declining Trend
Chipping Sparrow	*Spizella passerina*								G5	S4B,S5N	
Clark's Nutcracker	*Nucifraga columbiana*								G5	S5	
Cliff Swallow	*Petrochelidon pyrrhonota*								G5	S5B	
Common Nighthawk	*Chordeiles minor*								G5	S5	
Common Poorwill	*Phalaenoptilus nuttallii*								G5	S5	
Common Raven	*Corvus corax*								G5	S5	
Cooper's Hawk	*Accipiter cooperii*								G5	S3S4B,S4	
Cordilleran Flycatcher	*Empidonax occidentalis*								G5	S5B	
Dark-eyed Junco	*Junco hyemalis*								G5	S5	
Downy Woodpecker	*Picoides pubescens*								G5	S5	
Dusky Flycatcher	*Empidonax oberholseri*								G5	S5B	
Eurasian Collared-Dove*	*Streptopelia decaocto*								G5	S5	
European Starling*	*Sturnus vulgaris*								G5	S5	
Flammulated Owl	*Otus flammeolus*	Tier 2			X		X	X	G4	S4	
Fox Sparrow	*Passerella iliaca*								G5	S4B	
Gadwall	*Mareca strepera*								G5	S5B	
Golden Eagle	*Aquila chrysaetos*	Tier 1					X		G5	S3S4,	
Gray Jay	*Perisoreus canadensis*								G5	S5	
Great Blue Heron	*Ardea herodias*								G5	S3B	
Great Horned Owl	*Bubo virginianus*								G5	S5	
Green-winged Teal	*Anas crecca*								G5	S5B,S4N	
Green-tailed Towhee	*Pipilo chlorurus*								G5	S5	X
Hairy Woodpecker	*Picoides villosus*								G5	S5	
House Wren	*Troglodytes aedon*								G5	S5	
Killdeer	*Charadrius vociferus*								G5	S5	
Lazuli Bunting	*Passerina amoena*	Tier 2							G5	S5B	X
Lesser Goldfinch	*Spinus psaltria*								G5	S4B	

Common Name	Species	CPW SGCN Priority Tier	Federal Status	State Status	USFS Sensitive Species	BLM Sensitive Species	USFWS Birds of Conservation Concern	PIF US-Canada Watch List	CNHP/ NatureServe Global	CNHP/ NatureServe State	Declining Trend
Lincoln's Sparrow	*Melospiza lincolnii*								G5	S5B	
MacGillivray's Warbler	*Geothlypis tolmiei*								G5	S4B	X
Mallard	*Anas platyrynchyus*								G5	S5	
Mountain Bluebird	*Sialia currucoides*								G5	S5	
Mountain Chickadee	*Poecile gambeli*								G5	S5	
Mourning Dove	*Zenaida macroura*								G5	S5	
Northern Flicker	*Colaptes auratus*								G5	S5	
Northern Goshawk	*Accipiter gentilis*	Tier 2			X	X			G5	S3B	
Northern Pygmy-Owl	*Glaucidium gnoma*								G4G5	S3B	?
Northern Saw-whet Owl	*Aegolius acadicus*								G5	S5	
Olive-sided Flycatcher	*Contopus cooperi*	Tier 2			X			X	G4	S3S4B	X
Orange-crowned Warbler	*Oreothlypis celata*								G5	S5	?
Peregrine Falcon	*Falco peregrinus anatum*	Tier 2		SC	X	X	X		G4T4	S2B	
Pine Siskin	*Carduelis pinus*								G5	S5	
Plumbeous Vireo	*Vireo plumbeus*								G5	SNRB	
Red-breasted Nuthatch	*Sitta canadensis*								G5	S5	
Red-naped Sapsucker	*Sphyrapicus nuchalis*								G5	S5	
Red-tailed Hawk	*Buteo jamaicensis*								G5	S5	
Rock Pigeon*	*Columba livia*								G5	SNA	
Ruby-crowned Kinglet	*Regulus calendula*								G5	S5B	
Rufous Hummingbird	*Selasphorus rufus*								G5	SNA	
Sharp-shinned Hawk	*Accipiter striatus*								G5	S3S4B,S4	
Song Sparrow	*Melospiza melodia*								G5	S5	
Sora	*Porzana carolina*								G5	S3S4B	
Spotted Sandpiper	*Actitis macularius*								G5	S5	
Spotted Towhee	*Pipilo maculatus*								G5	S5	
Steller's Jay	*Cyanocitta stelleri*								G5	S5	

Common Name	Species	CPW SGCN Priority Tier	Federal Status	State Status	USFS Sensitive Species	BLM Sensitive Species	USFWS Birds of Conservation Concern	PIF US-Canada Watch List	CNHP/ NatureServe Global	CNHP/ NatureServe State	Declining Trend
Swainson's Thrush	*Catharus ustulatus*								G5	S5B	
Townsend's Solitaire	*Myadestes townsendi*								G5	S5	
Tree Swallow	*Tachycineta bicolor*								G5	S5	
Turkey Vulture	*Cathartes aura*								G5	S4B	
Violet-green Swallow	*Tachycineta thalassina*								G5	S5	
Virginia Rail	*Rallus limicola*								G5	S4B	
Virginia's Warbler	*Oreothlypis virginiae*	Tier 2						x	G5	S5	
Warbling Vireo	*Vireo gilvus*								G5	S5B	
Western Kingbird	*Tyrannus verticalis*								G5	S5B	
Western Screech-Owl	*Megascops kennicottii*								G4G5	S4B	
Western Tanager	*Piranga ludoviciana*								G5	S4B	
Western Wood-Pewee	*Contopus sordidulus*								G5	S5	
White-breasted Nuthatch	*Sitta carolinensis*								G5	S5B,S4N	
White-throated Swift	*Aeronautes saxatalis*								G5	S5B	
Wild Turkey	*Meleagris gallopavo*								G5	S5	
Williamson's Sapsucker	*Sphyrapicus thyroideus*								G5	S4B	x
Wilson's snipe	*Gallinago delicata*								G5	S5	
Yellow Warbler	*Dendroica petechia*								G5	S5	
Yellow-rumped Warbler	*Setophaga coronata*								G5	S5	
MAMMALS											
(American) marten	*Martes americana (M. caurina)*	Tier 2			x				G4G5	S4	
Big brown bat	*Eptesicus fuscus*								G5	S5	
Black bear	*Ursus americanus*								G5	S5	
Bobcat	*Lynx rufus*								G5	S5	
Bushy-tailed woodrat	*Neotoma cinerea*								G5	S5	
Common porcupine	*Erethizon dorsatum*								G5	S5	
Coyote	*Canis latrans*								G5	S5	

Common Name	Species	CPW SGCN Priority Tier	Federal Status	State Status	USFS Sensitive Species	BLM Sensitive Species	USFWS Birds of Conservation Concern	PIF US-Canada Watch List	CNHP/ NatureServe Global	CNHP/ NatureServe State	Declining Trend
Deer mouse	*Peromyscus maniculatus*								G5	S5	
Dwarf shrew	*Sorex nanus*	Tier 2							G4	S2	
Fringed myotis	*Myotis thysanodes*								G4	S3	x
Golden-mantled ground squirrel	*Spermophilus lateralis*								G5	S5	
Hoary bat	*Lasiurus cinereus*	Tier 2							G5	S5B	
Least chipmunk	*Tamias minimus*								G5	S5	
Little brown myotis	*Myotis lucifugus*								G3	S5	x
Long-eared myotis	*Myotis evotis*								G5	S4	x
Long-legged myotis	*Myotis volans*								G4G5	S5	x
Long-tailed vole	*Microtus longicaudus*								G5	S5	
Long-tailed weasel	*Mustela frenata*								G5	S5	
Masked shrew	*Sorex cinereus*								G5	S5	
Montane shrew	*Sorex monticolus*								G5	S5	
Montane vole	*Microtus montanus*								G5	S5	
Moose	*Alces americanus*										
Mountain cottontail	*Sylvilagus nuttallii*								G5	S5	
Mountain lion	*Felis concolor*								G5	S5	
Mule deer	*Odocoileus hemionus hemionus*								G5	S5	
Northern pocket gopher	*Thomomys talpoides meritus*								G5	S5	
Raccoon	*Procyon lotor*								G5	S5	
Red squirrel	*Tamiasciurus hudsonicus*								G5	S5	
Pygmy shrew	*Sorex hoyi*	Tier 2			X				G5T3T4	S2	
Red fox	*Vulpes vulpes*								G5	S5	
Rock squirrel	*Spermophilus variegatus*								G5	S5	
Rocky Mountain elk	*Cervus canadensis nelsoni*								G5	S5	
Silver-haired bat	*Lasionycteris noctivagans*								G3G4	S5	X
Southern red-backed vole	*Myodes gapperi*	Tier 2							G5	S5	

Common Name	Species	CPW SGCN Priority Tier	Federal Status	State Status	USFS Sensitive Species	BLM Sensitive Species	USFWS Birds of Conservation Concern	PIF US-Canada Watch List	CNHP/ NatureServe Global	CNHP/ NatureServe State	Declining Trend
Striped skunk	*Mephitis mephitis*								G5	S5	
Townsend's big-eared bat	*Plecotus townsendii pallescens*	Tier 1		SC	X	X			G3G4	S2	
Uinta chipmunk	*Neotamias umbrinus*								G5	S5	
Water shrew	*Sorex palustris*								G5	S5	
Western heather vole	*Phenacomys intermedius*								G5	S5	
Western jumping mouse	*Zapus princeps*								G5	S5	
Western small-footed myotis	*Myotis ciliolabrum*								G5	S4	
Wyoming ground squirrel	*Spermophilus elegans*								G5	S5	
Yellow-bellied marmot	*Marmota flaviventris*								G5	S5	

APPENDIX F. WILDLIFE PHOTOS

Photo W1. Monitoring camera mounted on a Gambel oak.

Photo W2. Chicken mounted to tree with zip-tie.

Photo W3. Bull elk captured by monitoring camera.

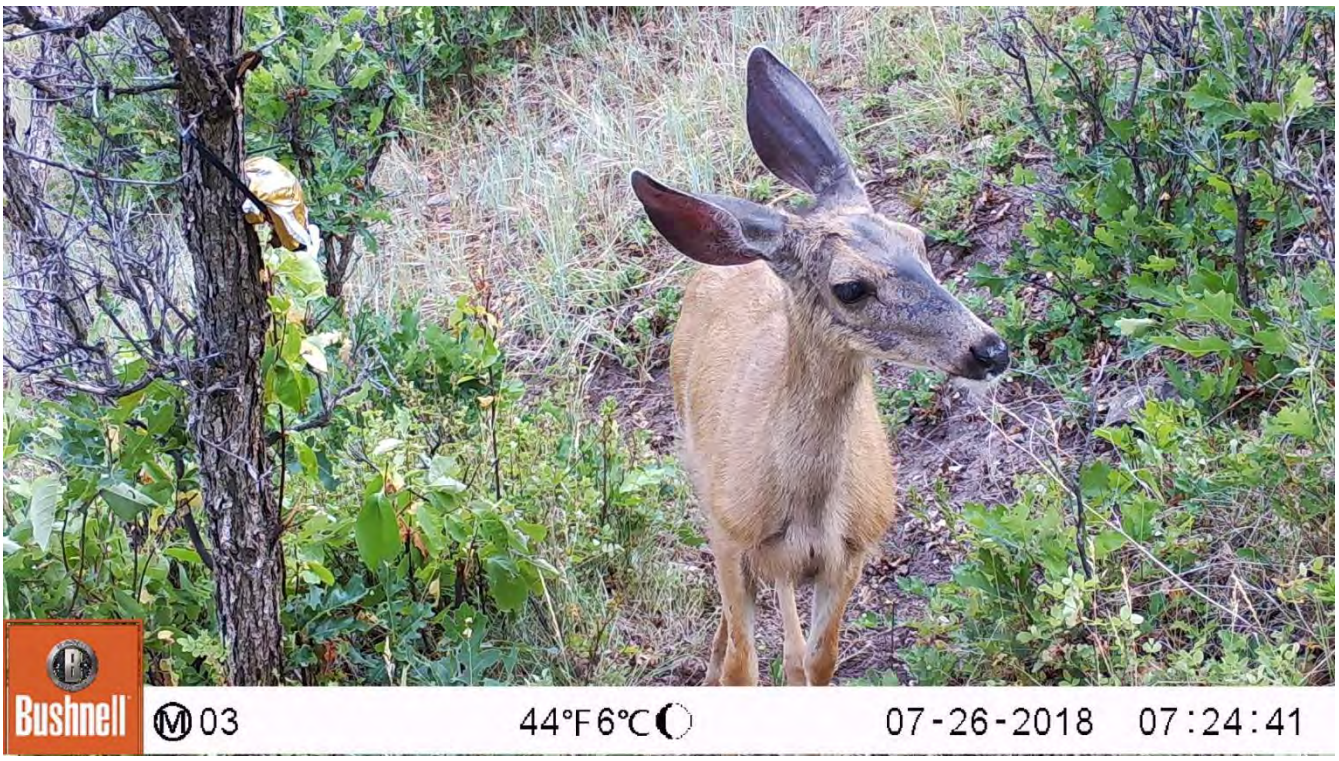


Photo W4. Mule deer doe documented by monitoring camera #3.

Photo W5. A coyote attracted to camera site by trapping lure.

Photo W6. Two-tone black bear at camera #2 with summer coat coming in a different color than its winter coat.

Photo W7. Black bear with pelage matching its name.

Photo W8. Turkey vulture drawn to camera #2 by rotting chicken.

Photo W9. Likely long-tailed weasel after inspecting bait at camera station 4.

Photo W10. Steller's jay at camera station 4.

Photo W11. Young twin mule deer fawns and their mom.

Photo W12. Bighorn sheep on transition range at Filoha

Photo W13. Wintering bighorn sheep at Filoha. Note the lamb experiencing its first winter at far right.

Photo W14. Cow-yearling band of elk on Filoha in early June.

Photo W15. Young spotted elk calves observed at Filoha in June confirming use of the property as rearing habitat.

Photo W16. Yellow-bellied marmot observed on Filoha