

ECOLOGICAL EVALUATION OF
THE POTENTIAL LAKE CREEK RESEARCH NATURAL AREA
WITHIN THE SHOSHONE NATIONAL FOREST,
PARK COUNTY, WYOMING

Prepared for the
Shoshone National Forest,
USDA Forest Service

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INTRODUCTION

The potential Lake Creek Research Natural Area (RNA) is located on the Beartooth Plateau in northwestern Wyoming. The area includes subalpine forest and wetlands on a rolling terrain of glaciated granitic bedrock. The potential RNA is in the Shoshone National Forest and is used primarily for recreation, watershed protection, and wildlife habitat.

In 1997, The Nature Conservancy entered a contract with the USDA Forest Service, Shoshone National Forest, to prepare ecological evaluations of areas in the Forest for use by the Forest Service in examining the suitability of the areas as research natural areas. The evaluation of the Lake Creek area was done by the Wyoming Natural Diversity Database. This report presents the results of that evaluation.

LAND MANAGEMENT PLANNING

In 1997, Lake Creek was selected by USDA Forest Service staff as a potential RNA for possible analysis during revision of the Land and Resource Management Plan. This ecological evaluation is intended to aid the Forest Service staff in that analysis.

OBJECTIVES

One of the primary objectives of research natural areas is to "...preserve a wide spectrum of pristine representative areas that typify important forest, shrubland, grassland, alpine, aquatic, geologic and similar natural situations..." (Forest Service Manual 4063.02).

The objectives of a Lake Creek RNA would be to 1) maintain a reference area for (a) monitoring effects of resource management techniques and practices applied to similar ecosystems, (b) comparing results from manipulative research, and (c) determining the range of natural variability; 2) protect elements of biological diversity; 3) provide a site for non-manipulative scientific research; and 4) provide on-site and extension educational opportunities.

PRINCIPAL DISTINGUISHING FEATURES

The principal distinguishing features of the potential Lake Creek RNA are (1) a subalpine forest of lodgepole pine, subalpine fir, and Engelmann spruce growing on a rolling surface of glaciated granitic bedrock, (2) fens and willow carrs (and a small area of *Sphagnum*-dominated wetland) around ponds and along streams, and (3) one vascular plant species (*Agoseris lackschewitzii*) on the Forest Service Region 2 Sensitive Species List.

LOCATION

The potential Lake Creek RNA is located within the Shoshone National Forest in northwestern Wyoming. The approximate center of the potential RNA is at latitude 44°57'50" N and longitude 109°41'05" W.

The potential RNA includes all or parts of the following sections (all on the 6th Principal Meridian): T57N, R107W, Sec 3, 4, 5, 6, 8, 9, 10; T58N, R107W, Sec 27, 28, 29, 30, 31, 32, 33, 34.

BOUNDARY

(See Figure 1).

The proposed boundary of the potential RNA follows an administrative boundary, cultural features, and landscape features. The eastern boundary follows National Forest Trail 568 and a ridgeline west of Muddy Creek. The northern boundary runs between a series of hilltops as it crosses Lake Creek, then lies on the divide between the drainages of Lake Creek to the southeast and Gilbert Creek to the northwest. The boundary on the southwest and the south follows the southern boundary of the Absaroka - Beartooth Wilderness Area.

AREA

The total area of the potential Lake Creek RNA, as measured on the 1:24,000-scale map with a digital planimeter, is approximately 5,801 acres (2349 ha).

ELEVATION

The elevation of the potential Lake Creek RNA ranges from approximately 7,710 feet (2,255 m) on Lake Creek on the southwestern boundary to 8,920 feet (2,721 m) in the north-central part.

ACCESS

The potential Lake Creek RNA may be reached via foot and horseback travel from public roads and trails. The western and northwestern portions are accessible from National Forest Roads 130 and 189 and National Forest Trail 617. The eastern and

northeastern portions of the area are accessible from National Forest Road 136 and National Forest Trails 568 and 612

ECOREGION

The potential Lake Creek RNA lies within the Southern Rocky Mountain Steppe-Open Woodland-Coniferous Forest-Alpine Meadow Province, Yellowstone Highlands Section (M331A) of the ecoregion classification of Bailey et al. (1994) (Freeouf 1996).

MAPS

USDA Forest Service 1/2 inch = 1 mile scale map of the Shoshone National Forest.

USDI Geological Survey 7.5-minute topographic Quadrangle Map: Muddy Creek, Wyoming.

VEGETATION

DESCRIPTION

Field work in 1996 and 1998 revealed the presence of the following plant associations (Anderson et al. 1998) in the potential Lake Creek RNA: *Calamagrostis canadensis* Western Herbaceous Vegetation, *Carex aquatilis* Herbaceous Vegetation, *Carex rostrata* Herbaceous Vegetation, *Salix planifolia*/*Carex aquatilis* Shrubland, *Salix wolfii*/*Carex aquatilis* Shrubland, *Abies lasiocarpa*/*Vaccinium scoparium* Forest, *Picea engelmannii*/*Linnaea borealis* Forest, and *Pinus contorta*/*Vaccinium scoparium* Forest. Synonyms for these names are shown in Appendix 5. Vegetation dominated by *Sphagnum* sp. on floating mats that apparently does not fit into a recognized plant association also is present. Data from sample plots and descriptions of vegetation at various locations are given in Appendix 3.

Upland vegetation

The upland vegetation in the potential RNA consists of subalpine forest with small openings of herbaceous vegetation or rock outcrop, most ≤ 30 acres (12 ha) and lying in the southern half of the area. The 1998 field work suggests that in most places, the overstory of the subalpine forest is clearly dominated by lodgepole pine and the undergrowth by grouse whortleberry, and the vegetation belongs to the *Pinus contorta*/*Vaccinium scoparium* Forest vegetation type (Anderson et al. 1998). Within this matrix lodgepole pine forest, three minor forest or woodland types occupy limited areas. Engelmann spruce grows in the overstory on lower slopes, especially those with a northerly aspect, and the *Picea engelmannii*/*Linnaea borealis* Forest type is a minor component of the subalpine forest. Another minor type is the *Abies lasiocarpa*/*Vaccinium scoparium* Forest type, which occurs primarily on north-facing slopes. Steep, rocky, south-facing slopes in the southern part of the potential RNA support small stands of woodland in which Douglas-fir dominates the overstory and lodgepole pine is present. The

open undergrowth in these stands consists mainly of elk sedge, Idaho fescue, several other graminoids and forbs, little clubmoss (*Selaginella densa*), and true moss. This vegetation appears to be a transition between the Douglas-fir woodlands typical of lower elevations and the subalpine lodgepole pine forest common over much of the region at higher elevations (Steele et al. 1983). Although stands of all four of these vegetation types can be identified in the area, they merge with one another, and drawing boundaries between them is difficult.

The non-forest upland vegetation appears to consist of sparse cover of vascular species (up to ca. 25% canopy cover) and at least as much cover of little clubmoss. Unvegetated rock is common in these openings in the subalpine forest.

Riparian and wetland vegetation

Wetland vegetation is found in a large wet meadow stretching for ca. 1.5 miles (2.4 km) along the eastern side of the potential RNA and in numerous smaller potholes and meadows scattered throughout the area. Most of these smaller wetlands cover less than 40 acres (16 ha), and many of them are mapped on the 7.5-minute topographic quadrangle as lakes. Color aerial photographs, though, show many of those lakes to be partly or completely filled with sediments or organic deposits.

Field work in 1996 and 1998 suggests that most of the wetland vegetation is beaked sedge (*Carex rostrata*) Herbaceous Vegetation and Wolf willow/water sedge (*Salix wolfii*/*Carex aquatilis*) Shrubland Vegetation. The former occupies the lowest, wettest sites, and the latter grows on slightly higher sites, but the two types are mixed in the large wetland on the eastern side of the area. Planeleaf willow/water sedge (*Salix planifolia*/*Carex aquatilis*) Shrubland also grows in wetlands in the area. Bluejoint reedgrass (*Calamagrostis canadensis*) Herbaceous Vegetation is common in the smaller wetlands of potholes and draws, where grows mixed with or next to the beaked sedge type. The bluejoint reedgrass vegetation grows on hummocks or the higher margins of the wetlands, and the beaked sedge type in the lower parts. Mosses are common in these wetland types.

A wetland dominated by sphagnum moss was sampled in NE 1/4 Sec 5 in the southwestern part of the potential RNA (plots 053 and 054). Part of this wetland consists of a floating mat around the margin of a kettle pond. No other sphagnum wetlands were observed during field work, but on a 1981 color aerial photograph, a wetland in the SE1/4 Sec 29 in the northern part of the area has the same color as the sphagnum wetland, and it may also be dominated by sphagnum. This wetland in Sec 29 is mapped as a lake on the 7.5-minute topographic quad.

AREA BY TYPE

The sole Kuchler vegetation type, western spruce-fir forest (Kuchler 1966), was mapped on 1:24,000-scale topographic map using aerial photographs and field reconnaissance. The area of that type was calculated by subtracting an estimate of the unforested area from an estimate of the area of the potential RNA. Those estimates were derived by measuring the potential RNA and the unforested areas on the 1:24,000-scale map with a digital planimeter. The remainder of the potential RNA (that is, the part not in western spruce-fir forest) apparently does not correspond to Kuchler's vegetation types.

Areas of complexes of plant community types (Table 2) were estimated by mapping each complex on the 1:24,000-scale map, using information from true-color aerial photographs (taken in 1981) and field survey, and measuring each complex with a digital planimeter. Areas of the individual plant communities were not estimated because the proportion of each community in each complex was unknown, given the difficulty of distinguishing closely-related plant communities from aerial photos and the limited extent of the field survey. Table 2 does, though, indicate which community type is thought to be a major constituent of each complex, based on information gathered during field survey.

Table 1. Area of the Kuchler Type (Kuchler 1966) in the potential Lake Creek RNA See Figure 1.

Cover Type	Acres	Hectares
Western spruce-fir forest (14)	5167	2093
Other (meadows, open water)	634	257

Table 2. Area of the SAF cover type (Eyre 1980) in the potential Lake Creek RNA See Figure 1.

Cover Type	Acres	Hectares
Engelmann spruce-subalpine fir (206)	5167	2093
Other (meadows, open water)	634	257

Table 3. Areas of complexes of plant community types in the potential Lake Creek RNA. Major communities in each complex are indicated by "(M)" following the names, and minor communities by "(m)". Appendix 5 contains synonyms.

Complex	Acres	Hectares
<i>Pinus contorta/Vaccinium scoparium</i> Forest (M)		
+ <i>Abies lasiocarpa/Vaccinium scoparium</i> Forest (m)	5167	2093
+ <i>Picea engelmannii/Linnaea borealis</i> Forest (m)		
<i>Carex rostrata</i> Herbaceous Vegetation (M)		
+ <i>Salix wolfii/Carex aquatilis</i> Shrubland (M)		
+ <i>Calamagrostis canadensis</i> Western Herbaceous Vegetation (m) +	370	150
<i>Salix planifolia/Carex aquatilis</i> Shrubland (m)		
+ <i>Sphagnum</i> sp. Herbaceous Vegetation (m)		
Upland herbaceous (M) + Spikemoss-herbaceous (M)	182	74
+ Upland non-vegetated (m)		
Open water	82	33

PHYSICAL AND CLIMATIC CONDITIONS

PHYSICAL SETTING

The potential Lake Creek RNA is located at the southern edge of the Beartooth Plateau. The terrain of the area consists of rounded, glaciated hills with local relief up to 500 feet (approx. 150 m). Most of the potential RNA lies within the drainage basin of Lake Creek, a high-gradient, perennial stream flowing southward through the middle of the area. The eastern edge of the area lies within the drainage basin of Muddy Creek, a southward-flowing, perennial stream with a gentler gradient. Throughout the potential RNA, low-gradient, first- and second-order streams form wetlands between the hills, and Muddy Creek forms a large wetland along the eastern boundary.

GEOLOGY

The bedrock in the proposed RNA is mainly Precambrian granitic rock (chiefly granitic gniess and granite). Quaternary moraine deposits and Quaternary alluvium occur along the eastern boundary in the valley of Muddy Creek and in small areas (primarily wetlands) within the area (Pierce and Nelson 1971).

DESCRIPTION OF VALUES

VEGETATION TYPES

See Table 1 for a list of the Kuchler (1966) vegetation types present in the area and the estimated acreage of each, and Table 2 for a list of the plant associations present.

FLORA

Threatened, Endangered, and Sensitive Plant Species

No federally listed Threatened or Endangered plant species are known from the Lake Creek Bogs potential RNA. *Agoseris lackschewitzii* is the only USFS Region 2 Sensitive plant species known from the area (Estill 1993; Fertig and Beauvais 1999). Seven WYNDD plant species of special concern are known from the potential RNA, and habitat may exist for four others (Fertig 1998; Fertig and Beauvais 1999). The status of each of these species is briefly summarized below. Complete Element Occurrence Records and location maps for each population are included in Appendix A.

Agoseris lackschewitzii (Pink agoseris)

Heritage Rank: G4Q/S3 (WYNDD Watch List).

Federal Status: USFS Region 2 Sensitive; USFS Region 4 Sensitive.

Geographic Range: Regional endemic of east-central Idaho, southwest Montana, and northern Wyoming (Fertig et al. 1994). In Wyoming, known from the Beartooth, Wind River, Gros Ventre, and Bighorn Ranges and Yellowstone Plateau in Big Horn, Fremont, Johnson, Park, Sheridan, Sublette, Teton, and Washakie Counties.

Habitat: Wet montane and subalpine meadows.

Comments: Stephanie Mills discovered a small population of pink agoseris along Muddy Creek within the potential Lake Creek RNA in 1995 (Mills and Fertig 1996). This species is known from 9 other records on the Shoshone National Forest and nearly 40 sites statewide (at least 10 of which are protected in national park or wilderness areas). WYNDD recently dropped this species to its "watch list" due to its new-found abundance and wide distribution in the state. A change in its Sensitive status may be justified in the near future (Fertig 1997).

Carex diandra (Lesser panicled sedge)

Heritage Rank: G5/S1S2

Federal Status: None.

Geographic Range: Circumpolar; in North America it occurs from Newfoundland to Yukon south to New Jersey, Indiana, Colorado, and California. In Wyoming, lesser panicled sedge is found in the

Absaroka, Beartooth, and Medicine Bow Ranges, Yellowstone Plateau, and Jackson Hole in Albany, Park, and Teton Counties.
Habitat: Wet, calcareous meadows and wetlands. Occurs on floating mats of *Sphagnum* at the edge of small wetlands in the potential Lake Creek RNA.

Comments: A new population of this species was discovered in the potential RNA along the banks of two unnamed ponds about 0.7 miles northeast of Lily Lake by Fertig and Mellmann-Brown in 1996 (Fertig 1997). Approximately 10 other small populations are known in Wyoming, only three of which are currently protected (Fertig 1998).

Carex leptalea (Bristly-stalk sedge)

Heritage Rank: G5/S1

Federal Status: None.

Geographic Range: Labrador to Alaska south to Florida, Texas, Colorado, and northern California. In Wyoming, known from the Absaroka, Beartooth, and Teton Ranges, Jackson Hole, and the Yellowstone Plateau in Park and Teton Counties.

Habitat: Meadows and wetlands. Plants in the Lake Creek area are found mostly on thick tussocks on the drier margins of wetlands.

Comments: Fertig and Mellmann-Brown discovered a new population of bristly-stalk sedge in the potential RNA in 1996 (Fertig 1997). This species is known from 12 sites in Wyoming, most of which are very small and restricted to specialized microhabitats (Fertig 1998). At least nine populations are currently protected in national parks, wilderness areas, and the Swamp Lake Special Botanical Area.

Carex limosa (Mud sedge)

Heritage Rank: G5/S2.

Federal Status: None.

Geographic Range: Circumboreal; south in North America to the Great Lakes, Iowa, Wyoming, Utah, and California. In Wyoming, it occurs in the Bighorn, Absaroka, Wind River, and Beartooth Ranges, the Sierra Madre, and the Yellowstone Plateau in Big Horn, Carbon, Park, Sublette, and Teton Counties.

Habitat: *Sphagnum* bogs, wet meadows, and calcareous fens. Populations in the Lake Creek area occur on floating mats of *Sphagnum* and in wet meadows of *Carex aquatilis* and *C. buxbaumii*.

Comments: A large colony of several thousand plants was discovered in the potential RNA along the unnamed ponds ca. 0.7 mile northeast of Lily Lake by Fertig and Mellmann-Brown in 1996 (Fertig 1997). Approximately 10 other populations occur in the state, including five in wilderness, national park, and other protected areas.

Drosera anglica (English sundew)

Heritage Rank: G5/S2.

Federal Status: None.

Geographic Range: Eurasia and Alaska to California, east to northwest Wyoming, Montana, and the Great Lakes. In Wyoming, known from the Yellowstone Plateau, Jackson Hole, and Beartooth Mountains in Park and Teton counties.

Habitat: Wetlands with saturated soils. At the Lake Creek site, English sundew occurs on floating *Sphagnum* mats with *Carex diandra*, *C. limosa*, and *Potentilla palustris*.

Comments: Fertig and Mellmann-Brown observed 5000-7000 plants at a new population in the potential RNA approx. 0.7 mile northeast of Lily Lake in 1996 (Fertig 1997). This species and its habitat are extremely sensitive to overharvest and trampling damage. Six other populations occur in Wyoming, 5 of which are in national park or wilderness areas (Fertig 1998).

Epilobium palustre* var. *palustre (Swamp willow-herb)

Heritage Rank: G5/S1S2.

Federal Status: None.

Geographic Range: Circumboreal, south in North America to Washington, Idaho, Colorado, Wisconsin, and Pennsylvania. In Wyoming, it is known from the Yellowstone Plateau, Sweetwater River Valley, and Laramie, Beartooth, Wind River, and Absaroka Ranges in Albany, Fremont, Park, Sublette, and Teton Counties.

Habitat: Occurs in saturated, often calcareous, soils.

Comments: A small colony of 10 plants was observed in the potential RNA near the wetland ca. 0.7 mile northeast of Lily Lake by Fertig and Mellmann-Brown in 1996 (Fertig 1997). This population is atypical in having slightly hairy leaf surfaces, suggesting some affinity with var. *gracile*. Nine populations are known in Wyoming, of which 6 are found in national parks, wilderness areas, or other special management sites (Fertig 1998). This species is probably more widespread in Wyoming than currently known, but is usually restricted to specialized microhabitats.

Equisetum fluviatile (Water horsetail)

Heritage Rank: G5/S1.

Federal Status: None.

Geographic Range: Labrador to Alaska south to Virginia, Illinois, northwest Wyoming, northern Idaho, and Washington. In Wyoming, it is known from Jackson Hole, the Yellowstone Plateau, and Beartooth Range in Park and Teton Counties.

Habitat: Shallow water and muddy shores of small ponds. The potential Lake Creek RNA colony is found in dried ponds within an extensive sedge meadow dominated by *Carex rostrata* and *C. aquatilis*.

Comments: Fertig, Mellmann-Brown, and Houston discovered a small colony in the potential RNA along dried ponds bordering Muddy

Creek in 1996 (Fertig 1997). This species is known from only 2 extant and one historical population in Wyoming (Fertig 1998).

Eriophorum gracile (Slender cotton-grass)

Heritage Rank: G5/S1

Federal Status: None.

Geographic Range: Circumboreal; south in North America to Pennsylvania, Iowa, Colorado, and California. In Wyoming, known from the Beartooth Range and Jackson Hole in Park and Teton Counties.

Habitat: Saturated or flooded soils of sedge meadows and floating mats.

Comments: Fertig and Mellmann-Brown discovered a new colony of this species within the potential RNA in 1996 (Fertig 1997). Four or five other populations are known in Wyoming, three of which occur in national parks and wilderness areas (Fertig 1998).

Potential habitat may occur for four other species of special concern: *Potamogeton amplifolius*, *P. praelongus*, *Salix candida*, and *S. farriarum*. Each of these species is found in wetlands near Lily Lake and Little Moose Lake, just outside the boundaries of the potential Lake Creek RNA (Mills and Fertig 1996; Fertig 1997). Habitat also exists for *Carex buxbaumii* and *Potentilla palustris* in the potential RNA, two taxa that were recently dropped as species of concern by WYNDD (Fertig and Beauvais 1999).

Plant Species List

The following species checklist is based on field surveys conducted by the authors in late August 1996 and early September 1998. For more information on the vascular flora of the Beartooth Range, consult Lesica (1993). Nomenclature follows Dorn (1992) for scientific names and Hitchcock and Cronquist (1973) and Welsh et al. (1993) for common names. Family acronyms are based on Weber (1982).

<u>Scientific Name</u>	<u>Common Name</u>	<u>Family</u>
	Trees	
<i>Abies lasiocarpa</i>	Subalpine fir	PIN
<i>Picea engelmannii</i>	Engelmann spruce	PIN
<i>Picea glauca</i>	White spruce	PIN
<i>Pinus contorta</i> var. <i>latifolia</i>	Lodgepole pine	PIN

Shrubs

<i>Alnus incana</i>	Mountain alder	BET
<i>var. occidentalis</i>		
<i>Betula glandulosa</i>	Bog birch	BET
<i>Juniperus communis</i>	Common juniper	CUP
<i>var. depressa</i>		
<i>Ledum glandulosum</i>	Trapper's tea	ERI
<i>Linnaea borealis</i>	Western twinflower	CPR
<i>Lonicera involucrata</i>	Bearberry honeysuckle	CPR
<i>Rosa sayi</i>	Prickly rose	ROS
<i>Salix boothii</i>	Booth willow	SAL
<i>Salix geyeriana</i>	Geyer willow	SAL
<i>Salix planifolia</i>	Planeleaf willow	SAL
<i>Salix wolfii</i>	Wolf willow	SAL
<i>Shepherdia canadensis</i>	Canada buffaloberry	ELE
<i>Vaccinium membranaceum</i>	Thin-leaved blueberry	ERI
<i>Vaccinium scoparium</i>	Grouse whortleberry	ERI

Forbs

<i>Agoseris lackschewitzii</i>	Pink agoseris	AST
<i>Allium brevistylum</i>	Short-style onion	LIL
<i>Angelica sp.</i>	Angelica sp.	API
<i>Antennaria anaphaloides</i>	Tall pussytoes	AST
<i>Aster foliaceus</i>	Leafybract aster	AST
<i>Drosera anglica</i>	English sundew	DRS
<i>Epilobium angustifolium</i>	Fireweed	ONA
<i>Epilobium palustre</i>	Swamp willow-herb	ONA
<i>var. palustre</i>		
<i>Fragaria virginiana</i>	Virginia strawberry	ROS
<i>Galium trifidum</i>	Small bedstraw	RUB
<i>Gentianella detonsa</i>	Smaller fringed-gentian	GEN
<i>var. elegans</i>		
[<i>Gentianopsis detonsa var. elegans</i>]		
<i>Geranium richardsonii</i>	White geranium	GER
<i>Geum macrophyllum</i>	Large-leaved avens	ROS
<i>var. perincisum</i>		
<i>Habenaria dilatata</i>	White bog-orchid	ORC
<i>Habenaria obtusata</i>	Blunt-leaf rein-orchid	ORC
<i>Listera borealis</i>	Northern twayblade	ORC
<i>Maianthemum stellatum</i>	Starry false Solomon's	LIL
	-seal	
<i>Mentha arvensis</i>	Field mint	LAM
<i>var. canadensis</i>		
<i>Menyanthes trifoliata</i>	Buckbean	MNY
<i>Mitella sp.</i>	Mitrewort sp.	SAX
<i>Moneses uniflora</i>	Woodnymph	ERI

<i>Nuphar polysepalum</i>	Spatterdock	NYM
<i>Parnassia fimbriata</i>	Fringed grass-of-Parnassus	SAX
<i>Pedicularis groenlandica</i>	Elephant's-head	SCR
<i>Potentilla gracilis</i>	Slender cinquefoil	ROS
<i>Potentilla palustris</i>	Marsh cinquefoil	ROS
<i>Pyrola asarifolia</i>	Pink wintergreen	ERI
<i>Senecio cymbalarioides</i>	Alpine meadow groundsel	AST
<i>Spiranthes romanzoffiana</i>	Hooded ladies'-tresses	ORC
<i>Stellaria longipes</i>	Longstalk starwort	CRY
<i>Streptopus amplexifolius</i>	Clasping-leaved twisted-stalk	LIL
<i>Thalictrum sp.</i>	Meadow-rue	RAN
<i>Trollius laxus</i>	American globe-flower	RAN
<i>Utricularia sp.</i>	Bladderwort sp.	LNT
<i>Viola sp.</i>	Violet sp.	VIO

Graminoids

<i>Bromus ciliatus</i>	Fringed brome	POA
<i>Calamagrostis canadensis</i>	Bluejoint wheatgrass	POA
<i>Carex aquatilis</i>	Water sedge	CYP
<i>Carex aurea</i>	Golden sedge	CYP
<i>Carex buxbaumii</i>	Buxbaum's sedge	CYP
<i>Carex canescens</i>	Gray sedge	CYP
<i>Carex diandra</i>	Lesser panicled sedge	CYP
<i>Carex disperma</i>	Soft-leaved sedge	CYP
<i>Carex gynocrates</i>	Yellow bog sedge	CYP
<i>Carex interior</i>	Inland sedge	CYP
<i>Carex lasiocarpa</i>	Slender sedge	CYP
<i>Carex leptalea</i>	Bristly-stalk sedge	CYP
<i>Carex limosa</i>	Mud sedge	CYP
<i>Carex praegracilis</i>	Clustered field sedge	CYP
<i>Carex rostrata</i>	Beaked sedge	CYP
[<i>Carex utriculata</i>]		
<i>Carex saxatilis</i>	Russet sedge	CYP
<i>Deschampsia cespitosa</i>	Tufted hairgrass	POA
<i>Eleocharis sp.</i>	Spikerush sp.	CYP
<i>Eriophorum gracile</i>	Slender cotton-grass	CYP
<i>Eriophorum polystachion</i>	Many-spiked cotton-grass	CYP
<i>Glyceria borealis</i>	Northern mannagrass	POA
<i>Glyceria striata</i>	Fowl mannagrass	POA
<i>Juncus mertensianus</i>	Mertens' rush	JUN
<i>Juncus tracyi</i>	Tracy's rush	JUN
<i>Luzula parviflora</i>	Small-flowered woodrush	JUN
<i>Phleum alpinum</i>	Alpine timothy	POA
<i>Poa palustris</i>	Fowl mannagrass	POA

Ferns and Fern Allies

<i>Equisetum arvense</i>	Common horsetail	EQU
<i>Equisetum fluviatile</i>	Water horsetail	EQU
<i>Equisetum hyemale</i> var. <i>affine</i>	Common scouring-rush	EQU
<i>Equisetum laevigatum</i>	Smooth scouring-rush	EQU
<i>Lycopodium annotinum</i>	Stiff clubmoss	LYC
<i>Selaginella dense</i>	Spikemoss	SEL

FAUNA

Threatened, Endangered, and Sensitive Vertebrates

As of May 1999, WYNDD files contain no extant occurrences of Federally threatened or endangered species from this site. However, it is likely that Canada lynx (*Lynx canadensis*) will be soon listed as threatened under the U. S. Endangered Species Act, and lynx, a USDA Forest Service Region 2 Sensitive Species, and the presence of lynx was documented in the vicinity by the Wyoming Game and Fish Department in 1985. The montane and subalpine forest on the site has the potential to support lynx activity. Also, this area is well within the current range of the Yellowstone grizzly bear (*Ursus arctos*) population, a federally listed threatened species, and may support some grizzly bear activity.

Muddy Creek, on the eastern edge of the site, supports one of the few genetically pure populations of Yellowstone cutthroat trout (*Onchorhynchus clarki bouveri*), a USDA Forest Service Region 2 Sensitive Species, in the region. An element occurrence record for this population can be found in Appendix 6. Although this area is within the historic range of Yellowstone cutthroat trout, the origin (endemic or stocked) of this population is unknown. Also, the numerous wetlands and ponds on the site have very high potential to support populations of several rare and sensitive amphibians (e.g., *Bufo boreas boreas*, *Rana luteiventris*, *Rana pipiens*).

Animal Species List

The field work in the potential Lake Creek RNA did not include identification of the animal species present.

LANDS

The potential Lake Creek RNA is National Forest System land and is surrounded by National Forest System land of the Clark's Fork Ranger District of the Shoshone National Forest. The

potential RNA lies entirely within the Absaroka - Beartooth Wilderness Area.

SUITABILITY FOR RESEARCH NATURAL AREA SELECTION

An area is suitable for designation as a research natural area according to how well it meets four criteria: quality, condition, viability, and defensibility (USDA Forest Service 1993). Each criterion is briefly defined below, and the information collected during field work that is pertinent to each criterion is described.

QUALITY

The degree to which the potential RNA represents the range in variability within the ecosystem types that it contains.

Two major ecosystem types, upland subalpine forest and subalpine wetlands, occur in the potential Lake Creek RNA. Most of the upland subalpine forest grows on *Abies lasiocarpa* habitat types, which are widespread and common in the region (Pfister et al. 1977, Steele et al. 1983). Subalpine forests on *A. lasiocarpa* habitat types often are mixtures of *Pinus contorta*, *Picea engelmannii*, and *Abies lasiocarpa*, with *P. contorta* dominating (Pfister et al. 1977, Steele et al. 1983). These mixed overstories are common in Rocky Mountain subalpine forests in general (Eyre 1980 [Lodgepole pine cover type], Knight 1994), not just on *A. lasiocarpa* habitat types. The subalpine forest of the potential Lake Creek RNA, dominated for the most part by *Pinus contorta* but with various amounts of *Picea engelmannii* and *Abies lasiocarpa*, and containing stands where the latter two trees dominate, appears to represent the subalpine forest typical of much of the Rocky Mountains.

The subalpine wetlands appear to be represented mainly by sedge meadows and willow/sedge wetlands. Sedge wetlands dominated by *Carex rostrata*, and willow/sedge wetlands with *Salix wolfii*, *S. planifolia*, *Carex rostrata*, and *C. aquatilis*, all are common throughout montane and subalpine zones of the Rocky Mountains (Windell et al. 1986, Walford et al. 1997). The potential RNA contains wetlands of a variety of sizes, from depressions of several acres to the meadow on Muddy Creek that extends for approximately 1.5 miles (2.4 km) along the area's eastern boundary.

CONDITION

The degree to which the potential RNA has been altered from pre-settlement conditions.

- Exotic Plants

Two exotic plant species, Kentucky bluegrass (*Poa pratensis*) and common dandelion (*Taraxacum officinale*), were observed in the

potential RNA, but neither species was noted to contribute more than a trace of canopy cover to the vegetation. Exotic species apparently play a minor ecological role in the area.

- Structures

No buildings, roads, trails, or other human structures were observed in the potential RNA, and none are shown on the 1:24,000-scale topographic quad or on the Shoshone National Forest map as occurring in the area.

VIABILITY

The prospect for long-term maintenance of the ecosystem types in the area and the survival of their constituent species.

The long-term maintenance of the ecosystem types in the potential RNA depends in large part on maintenance of the ecological processes that shaped those ecosystems. In Rocky Mountain subalpine forests, fire has been a major ecological force (Peet 1988). The role of fire in the potential Lake Creek RNA can only be known from research in the area, but some aspects of fire's role can be inferred from research elsewhere. The subalpine forest in the potential Lake Creek RNA apparently belongs to fire group 7 or fire group 8 described by Fischer and Clayton (1983) for Montana. In fire group 7 (cool habitat types usually dominated by *Pinus contorta*) above approximately 7,500 feet (2,287 m) elevation in eastern Montana, fire intervals were on the order of 150 years to several hundred years, and fires generally were small. Fire suppression may have little effect in vegetation with such long fire intervals. Fire group 8 includes the lower-elevation, dry subalpine forest habitat types, and the role of fire is uncertain.

Field survey suggests that the major ecological process operating in the wetlands is the primary succession generally thought to operate in wetlands: the ponds fill with sediment and become wet meadows (often with an intervening floating vegetation mat stage), and wet meadows become either dry meadows (as the ground surface is raised by vegetation growth) or forested wetlands. No signs of beaver were noted, and the potential RNA appears to contain little of the aspen and willows that beaver typically depend on for food, so beaver apparently are unimportant in the area. The review by Windell et al. (1986) indicates that the rate at which this succession proceeds, and the pathways that it follows, differ from one site to another. Details of the change in the wetlands of the potential Lake Creek RNA can only be learned by research in the area, but no signs were noted during field survey to suggest that management has a major role.

DEFENSIBILITY

The extent to which the area can be protected from extrinsic, anthropogenic factors that might worsen the condition of the area or threaten the viability of the ecosystems present.

The potential Lake Creek RNA contains no formally established trails or roads, no unofficial trails or roads were noted during field survey, and outstanding attractions such as fishing lakes apparently are absent from the area. Furthermore, the area is not particularly rugged. Consequently, although the area is readily accessible to hikers and horseback riders, there is little in the area to attract people. Because the potential RNA is within the Absaroka - Beartooth Wilderness Area, the area is unlikely to change in ways that attract people.

DEGREE TO WHICH THE POTENTIAL RNA MEETS CRITERIA

Field survey and review of maps and aerial photographs suggest that the potential Lake Creek RNA meets the criteria established by the Forest Service for RNA designation. The area represents the composition and structure typical of subalpine forests and of several herbaceous and shrub wetland types of the Rocky Mountains. The mix of forest and wetlands apparently represents a landscape typical of glaciated granitic bedrock. The condition of the ecosystems in the potential RNA appears to have been unaltered by roads, trails, or structures, and exotic plants are present only in trace amounts and therefore probably have little effect on the area. No major threats to the viability of the ecosystems, either through alteration of important ecological processes or introduction of novel ecological processes, were noted during field survey. Location of the potential RNA within a wilderness area, and the lack of established travel routes and of obvious attractions, suggest that defense against extrinsic, anthropogenic disturbances will not be particularly difficult. Introduction of exotic plants along the trail on the eastern boundary of the area may present a problem.

IMPACTS AND POSSIBLE CONFLICTS

This section is limited to the conflicts obvious from field survey and from conversations with USDA Forest Service staff.

MINERAL RESOURCES

No signs were noted of past exploration for or development of mineral resources. No claim stakes or other signs of active mineral exploration were noted. The area is withdrawn from mineral entry because of its status as a wilderness area.

GRAZING

No livestock or signs of grazing were observed during the 1998 field survey of the area, although cattle were present along Muddy Creek east of the southeastern corner of the potential RNA. The undergrowth in the subalpine forest appears to offer little forage for livestock, and the herbaceous wetlands are generally so small and scattered that they probably offer little attraction to livestock. The possible exception is the large wetland on Muddy Creek along the eastern boundary. Because the vegetation in this wetland had been sampled in 1996, the wetland was not surveyed in 1998.

TIMBER

The potential RNA is within a wilderness area and so is closed to timber harvest.

WATERSHED VALUES

No watershed structures were noted that might conflict with RNA designation.

RECREATION VALUES

Recreational use apparently is limited to hunting in the fall and incidental use by hikers and horseback riders. No evidence was observed during field survey of recreational use that would conflict with RNA designation.

WILDLIFE AND PLANT VALUES

The potential RNA contains a population of one vascular plant species on the Forest Service Region 2 Sensitive Species list. This species appear to require no management that would conflict with RNA designation.

TRANSPORTATION VALUES

The potential RNA contains no established roads or trails, and no unofficial travel routes were noted during field survey. National Forest Trail 568 runs along the eastern boundary of the area, but is outside the potential RNA.

MANAGEMENT CONCERNS

No management concerns were identified durin the 1998 field work.

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APPENDIXES

APPENDIX 1. MAPS OF THE POTENTIAL LAKE CREEK RESEARCH NATURAL
AREA

Figure 1. Contour map showing complexes of Kuchler (1966) vegetation types and SAF cover type (Eyre 1980) in the potential Lake Creek RNA.













Kuchler/SAF Types	Map Symbol
Kuchler: Western spruce-fir forest (14) SAF: Engelmann spruce-subalpine fir (206)	
Other	  
Sample plots	
Locations of vegetation descriptions	

Figure 2. Contour map showing complexes of plant communities in the potential Lake Creek RNA. Synonyms for community names are listed in Appendix 5.

Communities	Map Symbol
<i>Pinus contorta</i> / <i>Vaccinium scoparium</i> Forest (M) + <i>Abies lasiocarpa</i> / <i>Vaccinium scoparium</i> Forest (m) + <i>Picea engelmannii</i> / <i>Linnaea borealis</i> Forest (m)	
<i>Carex rostrata</i> Herbaceous Vegetation (M) + <i>Salix wolfii</i> / <i>Carex aquatilis</i> Shrubland (M) + <i>Calamagrostis canadensis</i> Western Herbaceous Vegetation (m) + <i>Salix planifolia</i> / <i>Carex aquatilis</i> Shrubland (m) + <i>Sphagnum</i> sp. Herbaceous Vegetation (m)	
Upland herbaceous (M) + Spikemoss-herbaceous (M) + Upland non-vegetated (m)	
Open water	
Sample plots	
Locations of vegetation descriptions	

APPENDIX 2. PHOTOGRAPHS FROM THE POTENTIAL LAKE CREEK RNA

All photographs are by G. Jones

Photo 97GJ5.32

View northwest over area from Clay Butte to the southeast.
August 23, 1997.

Photo 98GJ4.23

Engelmann spruce forest, representing vegetation of much of
the area. September 9, 1998.

Photo 98GJ4.22

Carex rostrata (*C. utriculata*) herbaceous vegetation,
present in most wetlands in the area. September 9, 1998.

APPENDIX 3. CANOPY COVER OF PLANTS IN PLOTS AND AT LOCATIONS OF
VEGETATION DESCRIPTIONS IN THE POTENTIAL LAKE CREEK RESEARCH
NATURAL AREA

Estimates of canopy cover from sample plots are shown in tables. The cover values for species are midpoints of the following cover classes:

<u>Cover Value</u>	<u>Range of Canopy Cover</u>
1	<1%
3	1% - 5%
10	5% - 15%
20	15% - 25%
30	25% - 35%
40	35% - 45%
50	45% - 55%
60	55% - 65%
70	65% - 75%
80	75% - 85%
90	85% - 95%
97	95% - 100%

The vegetation descriptions are for parts of stands and were not made for formal sample plots. At each location, the species in each stratum of the vegetation are listed approximately in order from those with the most canopy cover to those with the least.

Locations of sample plots and of vegetation descriptions are shown on Figure 2.

Table 3-1. Canopy cover (and height, for trees) of plants in the forest sample plots in the potential Lake Creek RNA. Single numbers in cells are canopy cover values; for trees, numerators are canopy cover values and denominators are height in meters.

	Pincon/Vacsco	Piceng/ Linbor	Abilas/ Vascso
	Plot 70.05	Plot 70.01	Plot 70.04
Species			Plot 70.03
TREES			
<i>Abies lasiocarpa</i>		10/5	3/30
<i>Picea engelmannii</i>			40/30
<i>Pinus contorta</i> var. <i>latifolia</i>	50/20	50/30	10/30
SHRUBS			
<i>Abies lasiocarpa</i> (sapling)		1	1
<i>Amelanchier alnifolia</i>		1	
<i>Juniperus communis</i> var. <i>depressa</i>	1	1	1
<i>Picea engelmannii</i> (sapling)		1	1
<i>Pinus flexilis</i> (sapling)		1	1
<i>Shepherdia canadensis</i>	1	1	1
<i>Spiraea betulifolia</i>		1	1
<i>Vaccinium globulare</i>			1
GRAMINOIDS			
<i>Agrostis scabra</i>			
<i>Bromus ciliatus</i>			1
<i>Calamagrostis canadensis</i>		1	
<i>Carex diandra</i>			
<i>Carex lasiocarpa</i>			
<i>Carex rossii</i>	3	3	
<i>Festuca idahoensis</i>	1		
<i>Poa nervosa</i> var. <i>wheeleri</i>	10	1	
<i>Trisetum spicatum</i>	1	1	1
FORBS			
<i>Antennaria racemosa</i>	10	20	3
<i>Antennaria umbrinella</i>	1		
<i>Arnica cordifolia</i>			3
<i>Aster perelegans</i>	1	1	1
<i>Epilobium angustifolium</i>	1	1	1
<i>Heuchera cylindrica</i>	1		
<i>Hieracium albiflorum</i>		1	
<i>Linnaea borealis</i> var. <i>longiflora</i>			40
<i>Lupinus argenteus</i>		1	1
<i>Penstemon fruticosus</i>	1		
<i>Potentilla</i> sp.	1		
<i>Pyrola chlorantha</i>		1	1
<i>Saxifraga bronchialis</i> var. <i>austrom</i>	1		
<i>Solidaga missouriensis</i> var. <i>misso</i>	1		
<i>Thalictrum occidentale</i>		1	1
<i>Vaccinium scoparium</i>		40	30
<i>Valeriana</i> sp.	1		

Table 3-1 (continued).

	Pincon/Vacsco		Piceng/ Linbor	Abilas/ Vascso
	Plot 70.05	Plot 70.01	Plot 70.04	Plot 70.03
TOTAL VEG COVER	60	70	85	80
GROUND COVER (%)				
Soil	1	1		
Rock	30	1	1	
Bedrock				
Litter	62	88	84	83
Wood	3	5	7	7
Basal Veg	3	4	4	4
Lichen & Moss	1	1	3	6
LANDSCAPE				
Slope (degrees)	25	1	1	1
Aspect (degrees)	215	235	355	110

NOTES:

- 70.01: Plot 25m x 25 m. *P. contorta* overstory with patchy understory of *A. lasiocarpa* saplings. *J. communis* cover greatest beneath trees; *C. rossii* and grass cover greatest beneath canopy openings. Fallen trees (*P. contorta*) common. Elevation 8300 feet.
- 70.03: Plot 10 m x 25 m. Canopy of *P. engelmannii* and *A. lasiocarpa* of intermediate density, above patchy sub-canopy of *A. lasiocarpa*. Herbaceous undergrowth dense. Fallen logs common. Elevation 8300 feet.
- 70.04: Plot 25 m x 25 m, representing mesic, middle and lower, north-facing slope. Merges downslope with *Calamagrostis canadensis* wetland, and upslope into *P. contorta/Vaccinium scoparium* woodland. Elevation 8300 feet.
- 70.05: Plot 10 m x 30 m, representing dry, west-facing, upper slope with benches. Elevation 8400 feet.

ACRONYMS

Abilas = *Abies lasiocarpa*
 Linbor = *Linnaea borealis*
 Piceng = *Picea engelmannii*
 Pincon = *Pinus contorta*
 Vacsco = *Vaccinium scoparium*

Table 3-2. Canopy cover (and height, for trees) of plants in the herbaceous and shrub sample plots in the potential Lake Creek RNA. Single numbers in cells are canopy cover values; for trees, numerators are canopy cover values and denominators are height in meters

Species	Sphagnum		Calcan	Carros	Salpla/ Caraqu	Salwol/Caraqu	
	Plot 053	Plot 054	Plot 70.06	Plot 058	Plot 059	Plot 70.02	Plot 060
TREES						1	
<i>Picea engelmannii</i>						1/1	
<i>Pinus contorta</i>						1/1.5	
SHRUBS					20	25	70
<i>Betula glandulosa</i>		3					
<i>Salix planifolia</i> var. <i>planifolia</i>		3			20		
<i>Salix wolfii</i>			1			30	70
GRAMINOIDS				40	80	80	20
<i>Agrostis scabra</i>			1			1	
<i>Bromus ciliatus</i>			1				
<i>Calamagrostis canadensis</i>	10	1	80		3	10	3
<i>Carex aquatilis</i>		10	1		30	60	10
<i>Carex buxbaumii</i>		10					
<i>Carex canescens</i>						10	
<i>Carex diandra</i>	1						
<i>Carex disperma</i>			1				
<i>Carex lasiocarpa</i>	3	1					
<i>Carex limosa</i>	3	1					
<i>Carex microptera</i>							1
<i>Carex nebrascensis</i>						1	
<i>Carex norvegica</i> var. <i>stevenii</i>							1
<i>Carex rostrata</i>		1		40	20	40	1
<i>Carex vesicaria</i>				1		3	
<i>Danthonia intermedia</i>			1				
<i>Eleocharis</i> sp.	3						
<i>Elymus lanceolatus</i> var. <i>riparius</i>							3
<i>Equisetum fluviatile</i>				3		1	
<i>Eriophorum polystachion</i>		1					
<i>Juncus parryi</i>			1				
<i>Phleum alpinum</i>			1				1
<i>Poa pratensis</i> *							1

Table 3-2 (continued).

Species	Sphagnum		Calcan	Carros	Salpla/ Caraqu	Salwol/Caraqu	
	Plot 053	Plot 054	Plot 70.06	Plot 058	Plot 059	Plot 70.02	Plot 060
FORBS					1	1	20
<i>Achillea millefolium</i>							1
<i>Aster foliaceus</i> var. <i>parryi</i>			1		1		20
<i>Cirsium scariosum</i>							1
<i>Drosera anglica</i>	3						
<i>Epilobium ciliatum</i>							1
<i>Erigeron lonchophyllus</i>							1
<i>Fragaria virginiana</i>			1				3
<i>Galium trifidum</i>						1	
<i>Gentianella detonsa</i> var. <i>elegans</i>		1			1		
<i>Geranium viscosissimum</i>			3				1
<i>Geum macrophyllum</i>						1	1
<i>Menyanthes trifoliata</i>	3						
<i>Pedicularis groenlandica</i>	1	1	1		1		
<i>Potentilla gracilis</i>							1
<i>Potentilla palustris</i>	3	3					
<i>Rorippa curvipes</i>						1	
<i>Senecio cymbalarioides</i>		3					
<i>Senecio pseud aureus</i>							1
<i>Senecio triangularis</i>			1				
<i>Spiranthes romanzoffiana</i>	1						
<i>Stellaria longipes</i>							1
<i>Taraxacum ceratophorum</i>			1				
<i>Taraxacum officinale</i> *							1
<i>Thalictrum occidentale</i>			3				
<i>Trollius laxus</i>			1				
<i>Valeriana occidentalis</i>							1
<i>Viola</i> sp.		1	1				
<i>Sphagnum</i> sp.	60	70					

Table 3-2 (continued).

	Sphagnum		Calcan	Carros	Salpla/ Caraqu	Salwol/Caraqu	
Species	Plot 053	Plot 054	Plot 70.06	Plot 058	Plot 059	Plot 70.02	Plot 060
TOTAL VEG COVER	90	90			80		
GROUND COVER (%)							
Soil				10	80	10	1
Gravel							
Rock							
Bedrock							
Litter				80	5	80	50
Wood							
Basal Veg					5		
Lichen & Moss	20	20			20		30
LANDSCAPE							
Slope (degrees)				0	<1	0	3
Aspect (degrees)				-	225	-	240

NOTES

- Plot 053: Represents floating moss mat (*Sphagnum* sp.) mat along edge of pothole pond; continuous along south shore of pond but patchy on north shore. *Calamagrostis* is main vascular species on mat. Band of mineral soil on landward edge of mat dominated by *Carex lasiocarpa*. Elevation ca. 8000 feet.
- Plot 054: Represents *Sphagnum* sp. with sedges on hummocky mineral soil, between floating mat in pond (plot 053) and *C. lasiocarpa*-*C. rostrata* zone farther from pond. Soil moist, rich in organic matter (histic?). Elevation ca. 8000 feet.
- Plot 70.08: Plot 10 m x 25m, representing wetland patch ca. 10 m x 70 m in shallow swale, very small channel present, without water; soil moist. *Picea engelmannii* trees grow along edge. Merges on north with *Carex rostrata* wetland (plot 70.02). Elevation ca. 8250 feet.
- Plot 058: Plot 37 ft. radius (4300 sq ft), representing sedge vegetation in ephemeral ponds and dry stream meanders in wet meadow. Elevation ca. 8080 feet.
- 70.02: Plot 25 m x 25 m, in treeless depression (pothole) ca. 100 m x 100 m. Soil saturated. *C. rostrata* mostly near channel; other species throughout.
- Plot 059: Plot 37 ft. radius (4300 sq ft) representing willow patches along edge of wet meadow. Willows grow on low hummocks. Elevation ca. 8080 feet.

Table 3-2 (continued).

Plot 060: Plot 37 ft. radius (4300 sq. ft) representing dry end of moisture gradient in wet meadow. Vegetation < 2 feet tall. Adjoins C. rostrata-C. aquatilis wet meadow downslope (plot 059), Picea engelmannii woodland upslope. Elevation 8080 feet.

ACRONYMS

Calcan = Calamagrostis canadensis

Caraqu = Carex aquatilis

Carros = Carex rostrata

Salwol = Salix wolfii

Salpla = Salix planifolia

Sphagnum = Sphagnum sp.

VEGETATION DESCRIPTIONS

Numbers following species names indicate canopy cover classes shown on page .

LOCATION 1. Slopes on eastern boundary of area.

ELEVATION: 8200-8600 feet (2500-2621 meters).

1a. *Pinus contorta/Vaccinium scoparium* Forest

ASPECT: Various

TOPOGRAPHIC POSITION: Upper, middle, and lower slopes

DESCRIPTION: Tree canopy cover is ca. 60%. Lodgepole pine dominates overall. *Picea engelmannii* is common on lower slopes, especially those with northerly aspects, and is present on all but upper west- and south-facing slopes. *Abies lasiocarpa* also is present on north-facing slopes. *Pseudotsuga menziesii* is present on south-facing slopes. *Shepherdia canadensis* and *Juniperus communis* are widespread but contribute <5% cover. *Vaccinium scoparium* is the most common undergrowth species; other species in the undergrowth are *Linnaea borealis*, *Senecio streptanthifolius*, and *Arnica cordifolia*.

Trees: *Pinus contorta* dominates overall; *Picea engelmannii* common on lower, north-facing slopes; *Abies lasiocarpa* present on north-facing slopes; *Pseudotsuga menziesii* present on upper south-facing slopes.

Dwarf Shrubs: *Shepherdia canadensis*, *Juniperus communis* (\leq 2% cover)

Graminoids & Forbs: *Vaccinium scoparium*, *Senecio streptanthifolia*, *Arnica cordifolia*, *Linnaea borealis*

NOTES: This appears to be the matrix vegetation in the southern part of the potential RNA.

1b. *Carex rostrata* wetland

ASPECT: Flat

TOPOGRAPHIC POSITION: Depressions and kettle ponds between granite outcrops.

DESCRIPTION: *Carex rostrata* dominates in the lowest, wettest parts and often is the only species present. *Calamagrostis canadensis* grows on hummocks and around the margins of kettles. Moss forms a dense carpet in wet areas. *Picea engelmannii* grows around the margin of the wetland.

Trees: *Picea engelmannii*, around the margin

Shrubs:

Dwarf Shrubs:

Graminoids & Forbs: *Carex rostrata* in lowest, wettest part; *Calamagrostis canadensis* on hummocks and around margin.

NOTES: These wetlands are small patches (up to ca. 1000 sq. meters) in the matrix of *Pinus contorta* forest.

LOCATION 2. Granite outcrops in southern part of area
ELEVATION: 8200-8300 feet (2500-2530 meters).

2a. Rock Outcrop

ASPECT: East

TOPOGRAPHIC POSITION: Upper slope

DESCRIPTION: Spikemoss and moss (ca. 60% cover) with patchy vascular plant cover (<20% cover) on rock outcrops.

Trees:

Shrubs:

Dwarf Shrubs: *Juniperus communis* (cover <1%)

Graminoids & Forbs: *Agrostis scabra*, *Penstemon fruticosus*,
Potentilla sp., *Erigeron compositus*, *Elymus elymoides*, *Poa secunda*

Non-vascular: *Selaginella densa*, moss

NOTES: This type forms patches in the matrix *Pinus contorta* forest.

2b. *Pseudotsuga menziesii*/*Festuca idahoensis* woodland?

ASPECT: South

TOPOGRAPHIC POSITION: Upper and middle slope

DESCRIPTION: Woodland with tree canopy cover ca. 40%, above scattered low shrubs (1% cover), a herbaceous undergrowth with ca. 30% cover, and a non-vascular (clubmoss) layer of ca. 30%. Bare rock accounts for ca. 50% cover.

Trees: *Pseudotsuga menziesii* 30%, *Pinus contorta* 20%

Shrubs:

Dwarf Shrubs: *Shepherdia canadensis*, *Juniperus communis* (cover <1%)

Graminoids & Forbs: *Carex geyeri*, *Festuca idahoensis*, *Poa nervosa*, *Agrostis scabra* are the main species; also present are *Carex rossii*, *Antennaria umbrinella*, *Penstemon fruticosus*.

Non-vascular: *Selaginella densa* ca. 40%

NOTES: This woodland apparently grows on upper, south-facing slopes at the lower elevations along the southern part of the potential RNA, in the matrix of *Pinus contorta* forest.

Location 7. Southeastern part of area

ASPECT: Flat

TOPOGRAPHIC POSITION: Depressions and kettle ponds between granite outcrops.

DESCRIPTION: *Carex rostrata* dominates in the lowest, wettest parts and often is the only species present. *Calamagrostis canadensis* grows on hummocks and around the margins of kettles. Moss forms a dense carpet in wet areas. *Picea engelmannii* grows around the margin of the wetland.

Trees: *Picea engelmannii*, around the margin

Shrubs:

Dwarf Shrubs:

Graminoids & Forbs: *Carex rostrata* in lowest, wettest part;
Calamagrostis canadensis on hummocks and around margin.

NOTES: These wetlands are small patches (up to ca. 1000 sq. meters) in the matrix of *Pinus contorta* forest.

LOCATION 7.

VEGETATION TYPE: *Pinus contorta/Vaccinium scoparium* forest

ELEVATION: 8400 feet (2560 meters). ASPECT: West

TOPOGRAPHIC POSITION: Upper and middle slope

DESCRIPTION: Lodgepole pine forms the tree overstory with ca. 50% canopy cover. Subalpine fir saplings grow in patches and contribute little cover. Shrubs are present but contribute <5% canopy cover. The herbaceous undergrowth is patchy and strongly dominated by grouse whortleberry.

Trees: *Pinus contorta* 50

Shrubs: *Abies lasiocarpa* saplings 3

Dwarf Shrubs: *Shepherdia canadensis* 3, *Juniperus communis* 1,
Vaccinium globulare 1

Graminoids & Forbs: *Vaccinium scoparium* 30, *Linnaea borealis* 20,
Antennaria racemosa 10, *Poa nervosa* var. *wheeleri* 3, *Carex rossii* 1

NOTES: This is the matrix vegetation in the southern part of the area.

APPENDIX 4. EXPLANATIONS OF RANKS USED BY THE WYOMING NATURAL DIVERSITY DATABASE

As part of the North American network of natural heritage programs, the Wyoming Natural Diversity Database (WYNDD) uses the natural heritage element ranking system developed by The Nature Conservancy. In this system, each element (in this case, species) is assigned a two-part rank that reflects its rarity and security both globally (the G part of the rank) and within a state or province (the S part of the rank). Both the global rank and the state rank can range from 1 (extremely rare or threatened) to 5 (common and secure). Ranks are defined as follows:

Global Ranks

- G1: Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals) or because of some factors making it especially vulnerable to extinction.
- G2: Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals) or because of factors making it very vulnerable to extinction.
- G3: Either very rare and localized throughout its range, or found locally (and perhaps abundantly at some sites) throughout a restricted range, or vulnerable to extinction throughout its range.
- G4: Apparently secure globally, although it may be quite rare in parts of its range, especially at the periphery.
- G5: Demonstrably secure globally and essentially ineradicable under present conditions.
- T: A "T" following the global rank (G#T#) refers to a rank assigned to a subspecific taxon. The number following the "G" is the rank of the species, and the number following the "T" is the rank of the subspecific taxon.
- Q: Taxonomic questions or problems exist about the taxon; more information is needed. A "G#Q" rank implies that the taxonomic distinctiveness of the taxon may be of questionable validity. A "G#T#Q" rank implies that the taxonomic distinctiveness of the subspecific taxon is of questionable validity.

State Ranks

- S1: Critically imperiled in the state or province because of extreme rarity (5 or fewer occurrences or very few remaining individuals) or because of some factors making it especially vulnerable to extinction.
- S2: Imperiled in the state or province because of rarity (6 to 20 occurrences or few remaining individuals) or because of factors making it very vulnerable to extinction.
- S3: Rare or uncommon in the state (on the order of 21 to 100 occurrences).
- S4: Apparently secure in the state or province, with many occurrences.
- G5: Demonstrably secure in the state or province and essentially ineradicable under present conditions.
- SU: Possibly imperiled in the state but status is uncertain; more information needed before a numerical rank can be assigned.
- S?: Status uncertain due to lack of information. The "?" is usually combined with any of the numerical ranks, as in "S3?".

Migratory Ranks

- B: A "B" following a rank (e.g., S3B) indicates that the rank refers to the breeding status of the species within the state. B ranks are usually assigned to birds.
- N: An "N" following a rank (e.g., S3N) indicates that the preceding rank refers to the non-breeding status of the species in the state. N ranks are usually assigned to birds.

A state rank of S2BS5N indicates that the species is rare in the state as a breeder, but abundant as a non-breeder.

APPENDIX 5. PLANT COMMUNITY TYPES IN THE POTENTIAL LAKE CREEK RESEARCH NATURAL AREA.

The vegetation types are listed by the names used for them in the national vegetation classification (Anderson et al. 1998). The code in parentheses following the name is the last four digits of the element code from the national classification. Citations refer to these sources:

- Johnston (1987): equivalent plant association from the list for USDA Forest Service Region 2;
- Steele et al. (1983): equivalent forest habitat type (if any);
- Federal Geographic Data Committee (1997): type in the hierarchy of the National Vegetation Classification Standard to which the association belongs;
- Kuchler (1966): Kuchler vegetation type to which the association belongs;
- Eyre (1980): Society of American Foresters forest cover type to which the association belongs (if any).

Calamagrostis canadensis Western Herbaceous Vegetation (1559)

- Johnston (1987): Unknown
- Steele et al. (1983): None
- Federal Geographic Data Committee (1997): V.A.5.N.k.;
Seasonally flooded, temperate or subpolar grassland
- Kuchler (1966): None
- Eyre (1980): None

Carex rostrata Herbaceous Vegetation (1562)

- Johnston (1987): *Carex aquatilis*/*Carex utriculata* plant association
- Steele et al. (1983): None
- Federal Geographic Data Committee (1997): V.A.5.N.k.;
seasonally flooded, temperate or subpolar grassland
- Kuchler (1966): None
- Eyre (1980): None

Spikemoss and Herbaceous (code unknown)

- Johnston (1987): none
- Steele et al. (1983): none
- Federal Geographic Data Committee (1997): V.B.2; Temperate or subpolar perennial forb vegetation?
- Kuchler (1966): none
- Eyre (1980): none

Sphagnum sp. (code unknown)

- Johnston (1987): none
- Steele et al. (1983): none

- Federal Geographic Data Committee (1997): VI.A.1.; Temperate or subpolar bryophyte vegetation OR VI.A.1.N.c.; Temperate or subpolar, saturated bryophyte vegetation.
- Kuchler (1966): none
- Eyre (1980): none

SHRUBLANDS

Salix planifolia/Carex aquatilis Shrubland (1227)

- Johnston (1987): *Salix phylicifolia* var. *planifolia*/*Carex aquatilis* Plant Association
- Steele et al. (1983): None
- Federal Geographic Data Committee (1997): III.B.2.N.e.; Seasonally flooded, cold deciduous shrubland
- Kuchler (1966): None
- Eyre (1980): None

Salix wolfii/Carex aquatilis Shrubland (1234)

- Johnston (1987): *Salix wolfii*/*Carex aquatilis* Plant Association
- Steele et al. (1983): None
- Federal Geographic Data Committee (1997): III.B.2.N.e.; Seasonally flooded, cold deciduous shrubland
- Kuchler (1966): None
- Eyre (1980): None

FORESTS

Abies lasiocarpa/Vaccinium scoparium Forest (344)

- Johnston (1987): *Abies lasiocarpa*-*Picea engelmannii*/*Vaccinium scoparium* Plant Association
- Steele et al. (1983): *Abies lasiocarpa*/*Vaccinium scoparium* Habitat Type
- Federal Geographic Data Committee (1997): I.A.8.N.d.; Cylindrical crowned, temperate or subpolar, needle-leaved, evergreen forest
- Kuchler (1966): Western spruce-fir forest (14)
- Eyre (1980): Engelmann spruce-subalpine fir (206)

Picea engelmannii/Linnaea borealis Forest (370)

- Johnston (1987): *Picea engelmannii*/*Linnaea borealis* Plant Association
- Steele et al. (1983): *Picea engelmannii*/*Linnaea borealis* Habitat Type
- Federal Geographic Data Committee (1997): I.A.8.N.c.; Conical crowned, temperate or subpolar, needle-leaved, evergreen forest
- Kuchler (1966): Western spruce-fir forest (14)
- Eyre (1980): Engelmann spruce-subalpine fir (206)

Pinus contorta/Vaccinium scoparium Forest (172)

-- Johnston (1987): *Pinus contorta/Vaccinium scoparium* Plant Association
-- Steele et al. (1983): *Abies lasiocarpa/Vaccinium scoparium* Habitat Type
-- Federal Geographic Data Committee (1997): I.A.8.N.b.; Rounded crowned, temperate or subpolar, needle-leaved, evergreen forest
-- Kuchler (1966): Western spruce-fir forest (14)
-- Eyre (1980): Lodgepole pine (206)

Pseudotsuga menziesii/Festuca idahoensis Woodland? (0900?)

-- Johnston (1987): *Pseudotsuga menziesii/Festuca idahoensis* Plant Association
-- Steele et al. (1983): *Pseudotsuga menziesii/Festuca idahoensis* Habitat Type
-- Federal Geographic Data Committee (1997): II.A.4.N.b.; Conical crowned, temperate or subpolar, needle-leaved, evergreen woodland
-- Kuchler (1966): Western spruce-fir forest(14)?
-- Eyre (1980): Interior Douglas-fir (210)

APPENDIX 6. ELEMENT OCCURRENCE RECORDS FOR PLANT SPECIES OF
SPECIAL CONCERN IN THE POTENTIAL LAKE CREEK RNA.