MOTORIZED TRAVEL MANAGEMENT PROJECT

DRAFT BOTANY REPORT

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For
Okanogan-Wenatchee National Forest

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Introduction

The purpose of this analysis is to identify potential effects of Motorized Travel Management Project alternatives on threatened, endangered, sensitive, proposed (TESP), and survey and manage plants within the project area. The Forest supports a highly diverse botanical community. The variation in habitats and elevation supports numerous plant species, many of which are considered rare and/or unique to the area. This analysis focuses on how the actions affect known TESP and survey and manage plant populations as well as the habitats most associated with those plants (i.e., late successional or old growth and riparian areas).

Regulatory Framework

Relevant Laws and Regulations

Endangered Species Act of 1973

Section 7 of the Endangered Species Act requires federal agencies to insure that any action authorized, funded, or carried out by agencies is not likely to jeopardize the continued existence of listed species or modify their critical habitat.

NFMANational Forest Management Act (NFMA)

NFMA requires the Forest Service to manage plant habitat to maintain viable populations of all native and desirable non-native plant species and conserve all listed threatened or endangered species populations (36CFR219.19). Sensitive species are identified to meet requirements of this act.

Departmental Regulation 9500-4

This regulation directs the Forest Service to:
Manage "habitats for all existing native and desired nonnative plants, fish, and wildlife species in order to maintain at least viable populations of such species."
Avoid actions "which may cause a species to become threatened or endangered."

Forest Plan Direction

Okanogan Forest Plan (Forest Plan, 1989).

The following Forestwide standards and guidelines apply to proposed, threatened, endangered or sensitive plants:

- 6-17 requires that threatened and endangered species be managed according to recovery plans, and that management be coordinated with U.S. Fish and Wildlife Service and Washington State Departments of Fish and Wildlife (p. 4-36).
- 6-18 requires that consultation be initiated with U. S. Fish and Wildlife Service when threatened or endangered species may be affected by resource proposals (p. 4-36), and
- 6-19 directs that sensitive plants be protected (p. 4-36).

Wenatchee Forest Plan (Forest Plan, 1990).

The following Forest-wide standards and guidelines apply to proposed, threatened, endangered or sensitive plants:

- Threatened, endangered and sensitive species will be identified and managed in cooperation with Washington Department of Natural Resources and Washington Natural Heritage Program (p. IV-78).

- All project environmental analysis will evaluate the effects of the project on threatened, endangered or sensitive species (p. IV-78).

Northwest Forest Plan (Northwest Forest Plan, 1994, 2001, 2003, 2011)

The NWFP sets up standards and guidelines for a group of late-successional and old-growth related species. These are termed survey and manage (S&M) species in the NWFP. The following standards and guidelines apply to survey and manage species (p. C-4 to C-6, 2011 S/M Settlement Agreement): Current and future known sites will be managed according to the management recommendations for the species.

Most species analyzed are in Category B in the table below. The six categories are based on level of relative rarity, ability to reasonably and consistently locate occupied sites during surveys prior to habitat disturbing activities, and the level of information known about the species or group of species.

Table 1–Standards and guidelines for survey and manage plant species

Relative rarity	Pre-disturbance surveys practical	Pre-disturbance surveys not practical	Status undetermined
Rare	Category A - 57 species • Manage all known sites • Pre-disturbance surveys • Strategic surveys	Category B - 222 species • Manage all known sites • N/A • Strategic surveys	Category E - 22 species • Manage all known sites • N/A • Strategic surveys
Uncommon	Category C - 10 species • Manage high-priority sites • Pre-disturbance surveys • Strategic surveys	Category D - 14 species • Manage high-priority sites • N/A • Strategic surveys	Category F - 21 species • N/A • N/A • Strategic surveys

Forest Service Policy

Management for threatened, endangered, sensitive plant (TESP) species follows Forest Service policy as identified in Section 2670 of the Forest Service Manual, which prohibit adverse effects to threatened and endangered species, and require the maintenance of species viability for sensitive species.

Best Available Science and Rationale

A review of scientific literature related to effects to vegetation and botanical resources from vehicle use and recreational activities was conducted. No conflicting literature sources for analyzing effects to botanical resources were found. The studies and information discussed in the existing condition below are the best and most current data available.

Methods

Plant species selected for this analysis are composed of species that are listed as threatened, endangered, or proposed under the Endangered Species Act (USDI 2005); sensitive species listed on the Regional Forester's Special Status Species list (USDA 2011); and survey and manage (S&M) species listed in the January 2001 ROD Standards and Guidelines and the December 2003 species list (USDA 2014).

The pre-field review consisted of checking existing records for documented occurrences of any proposed, endangered, threatened, sensitive, or survey and manage plant species on the Forest. The pre-field and field review incorporated the following data sources:

- U.S. Forest Service Region 6 Interagency Special Status/Sensitive Species Program (ISSSSP) Plant List (December 1, 2011)
- Washington Natural Heritage Program (WNHP): Rare, Threatened and Endangered Species List (2014)
- NRIS (Natural Resource Inventory System) database for the Okanogan-Wenatchee National Forest: Element Occurrence records for TESP and S&M plants
- Travel Management Survey Records, Okanogan-Wenatchee National Forest

The review indicated that 2 federally listed endangered plant species, 69 sensitive plant species and 79 survey and manage plant species are found within the project area, which is the Forest boundary (outside of wilderness). A list of those 150 species can be found in the project record. Those potentially affected by the Motorized Travel Management Project are analyzed in this report.

The botanical resources are analyzed in four different ways using GIS overlays of known sites across the Forest outside wilderness, and project activities near known sites, within riparian allocations, and within modeled late successional and old-growth habitat. The analysis indicates that the majority of known sites are located in either riparian or late successional/old growth habitats. Those known sites in other habitats were included in the Forest-wide numbers outside wilderness and project activities near known sites analyses. However, plants associated with other habitats on the Forest do not have any known models to predict the associated habitat, so plants associated with riparian and late-successional and old growth habitats are the only plant habitats discussed.

Existing Condition

Analysis Area and Boundary Rationale

The Motorized Travel Management Project area covers the entire Forest outside the wilderness boundaries because this is the area currently open for motorized vehicle use (outside Wilderness and other management areas specifically prohibiting motorized vehicles). The boundary for the analysis is the Forest boundary because effects to plants are limited to their nearby area as described below.

Existing Condition

The Forest lies within the East Cascade Range and Okanogan eco-regions with considerable diversity from north to south and from the Cascade Crest eastward. Elevations range from over 8,000 feet at the crest, to below 1,000 feet along the Columbia River. Similarly, precipitation varies greatly over the Forest. Gradients along the Cascade Crest of the Forest are typical of a maritime climate regime with a large rain shadow provided by the Cascade Range. Precipitation ranges from over 120 inches per year at the Crest, to below 10 inches along the Columbia River. On the northeastern portion of the Forest, the climate transitions into one more typical of the continental climate regime with precipitation around 10 inches per year along the Okanogan River, and about 20 inches per year in the Okanogan Highlands. Not only does the climate vary from north to south, so does the underlying geology. The northeast portion of the Forest is located on the Okanogan Highlands, the central and northern portions of the Forest are in the North Cascades geologic province, while the very southern part of the Forest is located in the Southern Cascades province.

Due to this diversity, the Forest supports a highly diverse botanical community. The variation in habitats and elevation supports numerous plant species, many of which are considered rare and/or unique to the area. Many of these plant species occur most often within small areas of microhabitat within the larger general habitat types. Theses microhabitats include riparian habitat, such as streamside, wet meadow, marsh, lakeshore, seep, fen, bog, hummock, and seasonally moist areas. Riparian habitats are particularly susceptible to disturbance from recreational activities, including motorized vehicle use. . Riparian reserves and riparian habitat conservation areas will collectively be referred to as riparian allocations in this section. Other microhabitats include talus field; alpine and sub-alpine meadows; and serpentine soils (serpentine soil is derived from rocks with low silica content, in particular serpentinite, a rock formed by the hydration and metamorphic transformation of rock from the Earth's mantle). The soils derived from low silica bedrock give rise to unusual and sparse associations of edaphic, or soil-dependent and often endemic, or unique to one location) plants that are tolerant of extreme soil conditions. By definition, S&M species are closely associated with late successional or old growth forest habitat.

Two listed endangered plant species are found within the project area; *Hackelia venusta* (showy stickseed) and *Sidalcea oregana* var. *calva* (Wenatchee Mountains checkermallow) and its designated critical habitat. Even though *Hackelia venusta* is located within the project area, it occupies a very small area that is only accessible by foot. Therefore, *H. venusta* will not be affected by project activities and will not be analyzed further.

S. oregana var. *calva* is restricted to wetlands and moist meadows of the Wenatchee Mountains of central Washington on the east side of the Cascade Range. This species is found at mid-elevations, ranging from 488 to 1,000 meters (1,600 to 3,300 feet). Populations of *S. oregana* var. *calva* are generally concentrated in the wetter portions of open forest-moist meadow habitats, in slight topographic depressions. The plant may also be found in open conifer forests dominated by *Pinus ponderosa* (ponderosa pine) and *Pseudotsuga menziesii* (Douglas-fir), on the perimeter of shrub and hardwood thickets dominated by quaking aspen (*Populus tremuloides*), along permanent or intermittent streams in sparsely forested draws, and near seeps, springs, or small drainages. The presence of surface water or saturated upper soil profiles in the spring and early summer is the feature common to the variety of habitats where the species is found. The recovery plan for *Sidalcea oregana* var. *calva* designates 6,135 acres of critical habitat, all located in Chelan County, Washington. The primary constituent elements found in the areas designated as critical habitat for *S. oregana* var. *calva* include surface water or saturated upper soil profiles; a wetland community dominated by native grasses and forbs and generally free of woody shrubs and conifers that produce shade and competition for the species; seeps and springs on fine-textured soils (clay loams and silt loams), which contribute to the maintenance of hydrologic processes necessary to support meadows that remain moist into early summer; and elevations of 488 to 1,000 meters (1,600 to 3,300 feet). (USFWS 2004)

The primary threats to *Sidalcea oregana* var. *calva* include habitat fragmentation and destruction due to alterations of hydrology, competition from native and non-native plants, and recreation (USFWS 2004).

The following table lists the sensitive and S&M species known to be growing within the analysis area (Forest-wide outside wilderness). There are 1,163 known sites of sensitive species, and 400 of S&M species.

Table 2–Sensitive and Survey & Manage plant species

Scientific Name	Common Name	Scientific Name	Common Name
Sensitive Species			
Allium campanulatum	dusky onion	*Heterotheca oregona var. oregona*	Oregon false goldenaster
Astragalus arrectus	Palouse milkvetch	Iliamna longisepala	longsepal wild hollyhock
Botrychium ascendens	trianglelobe moonwort	Mimulus pulsiferae	candelabrum monkeyflower
Botrychium crenulatum	scalloped moonwort	Penstemon eriantherus var. whitedii	Whited's penstemon
Botrychium paradoxum	peculiar moonwort	*Phacelia minutissima*	small phacelia
Carex comosa	longhair sedge	*Pinus albicaulis*	whitebark pine
Carex heteroneura var. epapillosa	different-nerve sedge	*Platanthera obtusata*	bluntleaved orchid
Carex magellanica ssp. irrigua	boreal bog sedge	*Polytrichum strictum*	polytrichum moss
Carex media	closedhead sedge	*Pulsatilla patens ssp. multifida*	cutleaf anemone
Carex scirpoidea ssp. scirpoidea	northern singlespike sedge	*Pyrrocoma hirta var. sonchifolia*	tacky goldenweed
Carex sychnocephala	manyhead sedge	*Rubus arcticus ssp. acaulis*	dwarf raspberry
Carex tenuiflora	sparseflower sedge	*Sanicula marilandica*	Maryland sanicle
Carex vallicola	valley sedge	*Sidalcea oregana var. calva*	Oregon checkerbloom
Chaenactis thompsonii	Thompson's pincushion	*Silene seelyi*	Seely's catchfly
Chrysosplenium tetrandrum	northern golden saxifrage	*Spiranthes porrifolia*	creamy lady's tresses
Cicuta bulbifera	bulblet-bearing water hemlock	*Trifolium thompsonii*	Thompson's clover
Delphinium viridescens	Wenatchee larkspur	*Utricularia minor*	lesser bladderwort
Draba aurea	golden draba	*Vaccinium myrtilloides*	velvetleaf huckleberry
Geum rossii var. depressum	Ross' avens	*Viola renifolia*	white violet
Survey & Manage Species			
Scientific Name / Survey and Manage Category			
Albatrellus flettii B	*Cladonia norvegica B*	*Gyromitra californica B*	*Ptilidium californicum A*
Boletus piperatus D	*Clavariadelphus sachalinensis B*	*Helvella crassitunicata B*	*Ramaria amyloidea B*
Buxbaumia viridis D	*Clavariadelphus truncates B*	*Hygrophorus caeruleus B*	*Rhizomnium nudum B*
Cantharellus subalbidus D	*Cortinarius cyanites B*	*Leucogaster citrinus B*	*Tholurna dissimilis B*
Chaenotheca chrysocephala B	*Cudonia monticola B*	*Lobaria linita A*	*Tremiscus helvelloides B*
Chaenotheca furfuracea	*Cypripedium fasciculatum*	*Mycena overholtsii B*	

F	*C*		
Chaenotheca subroscida E	*Cypripedium montanum C*	*Nephroma bellum F*	
Chaenothecopsis pusilla E	*Gomphus bonarii B*	*Polyozellus multiplex B*	

Table 3 shows species that are associated with either riparian or late successional/old growth habitats.

Table 3–Riparian and old growth habitat associated species

Riparian Associated Species	
Scientific Name	**Common Name**
Botrychium crenulatum	scalloped moonwort
Botrychium *paradoxum*	peculiar moonwort
Carex comosa	longhair sedge
Carex heteroneura var. epapillosa	different-nerve sedge
Carex sychnocephala	manyhead sedge
Carex tenuiflora	sparseflower sedge
Chrysosplenium tetrandrum	northern golden saxifrage
Cicuta bulbifera	bulblet-bearing water hemlock
Delphinium viridescens	Wenatchee larkspur
Mimulus pulsiferae	candelabrum monkeyflower
Platanthera obtusata	bluntleaved orchid
Rubus arcticus ssp. acaulis	dwarf raspberry
Sanicula marilandica	Maryland sanicle
Sidalcea oregana var. calva	Oregon checkerbloom
Spiranthes porrifolia	creamy lady's tresses
Late Successional/Old Growth Associated Species	
Scientific Name	**Scientific Name**
Albatrellus flettii	*Cypripedium montanum*
Boletus piperatus	*Gomphus bonarii*
Botrychium montanum	*Gyromitra californica*
Buxbaumia viridis	*Helvella crassitunicata*
Cantharellus subalbidus	*Hygrophorus caeruleus*
Chaenotheca chrysocephala	*Leucogaster citrinus*
Chaenotheca furfuracea	*Lobaria linita*
Chaenotheca subroscida	*Mycena overholtsii*
Chaenothecopsis pusilla	*Nephroma bellum*
Cladonia norvegica	*Polyozellus multiplex*
Clavariadelphus sachalinensis	*Ptilidium californicum*
Clavariadelphus truncatus	*Ramaria amyloidea*
Cortinarius cyanites	*Rhizomnium nudum*
Cudonia monticola	*Tremiscus helvelloides*
Cypripedium fasciculatum	

Cross Country Motorized Travel and Unauthorized Routes

Cross country motorized travel has damaged botanical resources across the analysis area. The impacts are concentrated on unauthorized routes that have developed over time scattered across the 675,000 acres currently open to motorized cross country travel, and flat and open enough for the activity. The impacts include reduced vegetation cover and growth rates, reduced perennial and annual plant cover and density, as well as overall above ground biomass. Additional direct impacts include increased potential for non-native grasses and pioneering species to become established, thus altering vegetation communities (Taylor 2010). Some indirect effects of cross country motorized travel on botanical resources are tied to soil properties altered by motorized vehicles, as soil properties typically influence vegetation growth.

Known locations of *S. oregana* var. *calva* and critical habitat occur in areas currently open to cross-country travel, along roads open to motorized vehicles. The risk of degradation and decline of these populations and critical habitat increases where existing locations of *S. oregana* var. *calva* are within areas open to cross-country travel and along routes that have motorized vehicle use. The primary constituent elements (PCE's) found in the areas designated as critical habitat for *S. oregana* var. *calva* include surface water or saturated upper soil profiles; a wetland community dominated by native grasses and forbs and generally free of woody shrubs and conifers that produce shade and competition for the species; seeps and springs on fine-textured soils (clay loams and silt loams), which contribute to the maintenance of hydrologic processes necessary to support meadows that remain moist into early summer; and elevations of 488 to 1,000 meters (1,600 to 3,300 feet) (USDI 2004). Those PCE characteristics are particularly vunerable to resource damage from motorized use. Examples of damage to the species' habitat were documented in a location where allowed motorized activity was occurring in areas occupied by *S. oregana* var. *calva* (Figure 1).

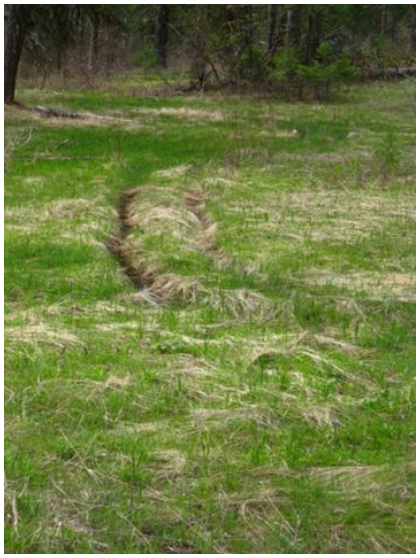
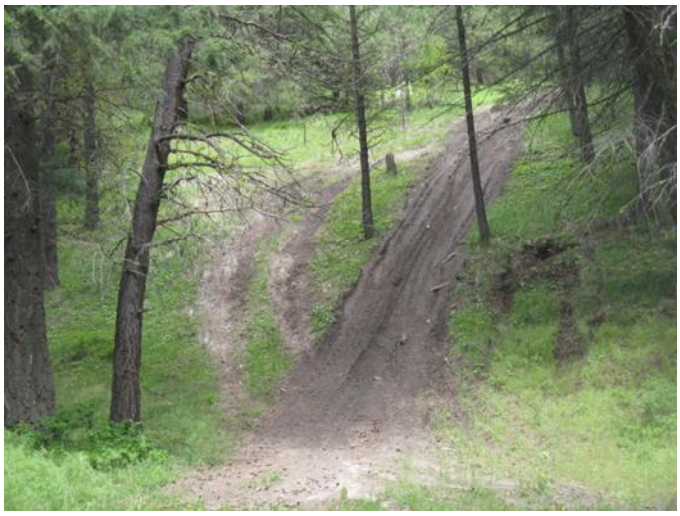


Figure 1. Vehicle tracks two years after encroachment into *S. oregana var. calva habitat*

Unrestricted cross-country motorized use has resulted in areas of progressive damage over several years as show in Figure 2 below which compares the damage progression from 2007 to 2009 from the activity.



a **b**

Figure 2. Vehicle tracks from cross country motorized travel in 2007 (a) and same vehicle tracks two years later (b)

The comparative photos clearly show the reduction of vegetative cover and density, and damage to soils on cross country motorized travel routes.

Road and Motorized Trail Network

Motorized vehicle use on roads and trails is impacting plants in the vicinity. There are 7,923 miles of Forest Service system road on the Forest, and 998 miles system motorized trails. Maintenance level 1 roads (2,557 miles of the total 7,923 miles) are closed by definition, but most are currently open to motorized vehicles[1]. The Okanogan National Forest Travel Plan map specifically states that unlicensed OHVs are allowed on roads closed with berms (a typical closure method for maintenance level 1 roads). The Wenatchee Forest Plan does not specifically address motorized vehicle use on maintenance level 1 roads, but once a road is closed (put into maintenance level 1 status) is becomes part of the cross country landscape, and is therefore open as long as it falls within areas currently open to cross country motorized travel. Despite not being officially closed, many maintenance level 1 roads receive no motorized use because they have revegetated, blocking motorized vehicles, or because they do not provide access to a desirable location or are not part of an unauthorized trail.

Motorized use that is occurring on maintenance level 1 roads is contributing to the overall impacts from roads and trails. Roads and motorized trails create edge habitats, which can generate conditions that promote the encroachment of non-native and invasive plant species. Motorized vehicle traffic on these roads and trails creates airborne pollutants and dust. A blanket of fugitive dust on plant foliage can inhibit plant growth rate, size, and survivorship (Ouren 2007).

Motorized Access for Dispersed Camping

[1] A few maintenance level 1 roads have been officially closed to motorized vehicles with specific closure orders.

Motorized access for dispersed camping has damaged or destroyed vegetation in several places across the Forest. The popularity of dispersed camping has led to the creation of numerous unauthorized routes, compacted earth, lack of vegetation and bank erosion caused by vehicles and heavy use at within 100 feet of the water's edge (USDA 2012.).. The Forest is generally managed as "open" to dispersed camping, meaning motorized access for dispersed camping is allowed anywhere on the Forest unless specific restrictions are in place. The access routes and dispersed campsites were generally created by users as they gradually encroached into vegetated areas. Many of these routes are in riparian areas, so are potentially impacting the sensitive and S&M species that depend on that habitat, especially at those sites and access routes located within 100 feet or less of the water's edge.

The resource damage caused by the motorized access is having direct and indirect effects on vegetation. These include vehicles driving onto stream banks or wetlands, killing vegetation and compacting soil; numerous social trails to the water causing loss of riparian vegetation; high-use at campsites causing large compacted browned-out areas and trails and unauthorized routes devoid of vegetation (USDA 2012). Motorized access for dispersed camping is also creating fugitive dust that, depending on particle size, can affect plants a distance of 8 meters to 1 kilometer away from the road or trail (Farmer, 1991).

The number of motorized access routes to dispersed campsites, and the footprint of the campsites themselves, and been increasing over the past decades. In some areas, particularly on the Naches and Cle Elum districts, the boundaries of some dispersed sites have grown due to increasing and heavier use. Such growth in the number and size of dispersed sites has led to loss of vegetation not just in the campsites or access routes, but also in the vicinity of the campsites as people walk in the forest around the campsites. This is especially true in the Little Naches River drainage, in the Icicle River drainage, and along the Cle Elum River.

During the past two to three decades, the Forest Service has taken some actions to reduce the impact of dispersed camping and the associated motorized access to the campsites. Some areas, such as the along the Icicle River on the Wenatchee River Ranger District, and along portion of the Cle Elum River on the Cle Elum Ranger District, were closed to dispersed camping. The "Respect the River" program was developed in the 1990s, and has been used at dispersed sites on most districts. It targets some popular dispersed recreation sites that were causing unacceptable impacts to vegetation and other resources. The restoration efforts included using rock or wood barriers to limit the size and area of disturbance at the sites, and to limit motorized vehicle access within riparian areas. The soil in blocked areas was de-compacted in some cases, and native vegetation replanted or reseeded. These sites are referred to as "Improved Sites" in this analysis.

While these efforts have been largely effective at reducing impacts at some locations, continued use, and increases in the size and number of sites in other areas are perpetuating impacts to vegetation within the riparian areas, potentially including sensitive and S&M species.

Environmental Consequences

Direct and Indirect Effects

Effects of WATV Routes from Alternative B and D

WATVs would be allowed on 350 miles of open Forest Service roads in alternatives B and D. An engineering safety analysis has been completed on these roads, and determined they meet safety standards for this new class of licensed motorized vehicles. An initial analysis by each District determined routes that would be appropriate for the addition of this type of mixed motorized use. Fugitive dust may increase on 350 miles of WATV designated roads but, in initial analysis, routes with potential for affecting resources were designated as such and dropped from consideration. The 350 miles of roads are already in use and included in the motorized access analysis. These roads are currently receiving use, and the additional use is not predicted to result in a measureable change in traffic levels.

Alternative A

Cross Country Motorized Travel

Alternative A would allow cross country travel to continue on 2.4 million acres of the Forest, of which about 675,000 acres are flat and open enough for motor vehicle use in land allocations that currently allow motorized use. All plant species and their habitat, including the sensitive species, located in these areas open to cross country travel would continue to be at risk of destruction from motorized travel, which could damage, dislodge or crush plants, and degrade habitat. Motorized cross-country travel could also contribute to noxious weed and invasive species introduction into un-infested areas and contribute to expanding existing populations. Invasive species can out-compete native species and create monocultures that are prone to fire and that degrade wildlife habitat (WDFW 2003) (see Invasives Plants section).

The areas likely to receive to cross-country motorized travel encompass habitat and known populations of 147 sensitive or S&M species and one endangered species, *Sidalcea oregana* var. *calva*, (Wenatchee Mountains checker-mallow) and its critical habitat. The primary constituent elements (PCE's) found in the areas designated as critical habitat for *S. oregana* var. *calva* include surface water or saturated upper soil profiles; a wetland community dominated by native grasses and forbs and generally free of woody shrubs and conifers that produce shade and competition for the species; seeps and springs on fine-textured soils (clay loams and silt loams), which contribute to the maintenance of hydrologic processes necessary to support meadows that remain moist into early summer; and elevations of 488 to 1,000 meters (1,600 to 3,300 feet) (USDI 2004).

Alternative A poses the greatest potential risk to *S. oregana* var. *calva* due to the potential degradation to the species and its critical habitat and potential adverse effect on the populations from cross-country motorized travel. Over time, the habitat for this species may begin to erode and compromise the unique nature of this ecosystem.

Road and Motorized Trail Network

The existing impacts to vegetation from motorized vehicle use on the Forest Service system roads and motorized trails would continue. The 2,557 miles of maintenance level 1 roads would still be open to motorized vehicles, with the exception of the few that are currently officially closed. Motorized use on these roads would continue, or potentially increase the impact on plants in the vicinity of the roads. The edge habitat along the maintenance level 1 roads receiving motorized use would perpetuate conditions that promote the encroachment of non-native and invasive plant species. The motorized vehicle traffic would also create airborne pollutants and dust, potentially blanketing plant foliage and inhibiting plant growth rate, size and survivorship (Ouren 2007).

Motorized Access for Dispersed Camping

Motorized access for dispersed camping would continue in the current, largely unregulated pattern. Motorized vehicles would continue to be used on established access routes, with new ones likely created over time in the areas most popular for dispersed camping. This would increase the potential impacts to *S. oregana* var. *calva*, compounding the potential impacts from cross country motorized travel. There could be a degradation to the species and its critical habitat and potential adverse effect on the populations from cross-country motorized travel and motorized access for dispersed camping. Over time, the habitat for this species may begin to erode and compromise the unique nature of this ecosystem.

There would also be a continued and potentially increasing impact to sensitive and S&M species dependent on riparian habitats. Motorized vehicles would continue to compact earth, damage vegetation, and cause bank erosion since there would be no limitation on how close vehicles could be drive to the water's edge. The motorized access would also continue to create fugitive dust that, depending on particle size, could affect plants a distance of 8 meters to 1 kilometer away from the access routes (Farmer, 1991).

Effects Common to Alternatives B, C, and D

Cross Country Motorized Travel

All plant species and their habitat, including the sensitive species, located in these areas open to cross country travel would benefit from implementation of Alternative B, C, or D because cross country motorized travel would no longer be permitted, except on the 33 acres of currently open Moon and Funny Rocks. Moon and Funny Rocks contain no habitat for *S. oregana var. calva*, and no riparian or old growth habitat, therefore the motorized use of these areas would have no effect on any threatened or endangered, sensitive, proposed, or S&M plant species.

Cross country motorized travel would no longer be allowed in riparian or late successional/old growth habitat, so all sensitive and S&M species associated with this habitat would benefit from the closure. The acres open to cross country travel in each alternative are displayed in the following table.

Table 4. Total Acres Open to Cross Country Motorized Travel, And Acres of Riparian and Late Successional/Old Growth (LS/OG) Habitat Open to Motorized Travel, by Alternative

Alternative	Acres open to cross-country travel	Acres of Riparian Habitat Open to Cross Country Travel	Acres of LS/OG Habitat Open to Cross Country Travel
Alternative A	675,000*	79,261**	140,390**
Alternative B	33	0	0
Alternative C	33	0	0
Alternative D	33	0	0

* Although about 2.4 million acres of the Forest lies outside wilderness, only about 675,000 are within areas amenable to motorized use (relatively flat, open topography) in allocations that are currently open to motorized use.

** These are the number of acres of this habitat amenable to motorized use (relatively flat, open topography).

All impacts to plants from motorized cross country travel would cease, and damage to plants that has occurred over time, such as dislodged or crushed plants and degraded habitat, would gradually repair. There would be no spread of noxious weeds by motorized vehicles into these areas closed by Alternatives B, C, or D, and species introduction, or contributions to the spread of existing populations would no longer occur.

Populations of *S. oregana var. calva* would benefit from Alternative B, C, or D over time due to the elimination of motorized cross country travel in its habitat.

Road and Trail Network

Implementation of Alternative B, C, or D would close all maintenance level 1 roads to motorized use, decreasing the miles of road open to motorized use by 2,557 miles, or a 32.3% reduction in open roads. This would reduce the existing road-related impacts to plants, including edge habitat perpetuating conditions that promote the encroachment of non-native and invasive plant species, and airborne pollutants and dust. This would benefit all plant species in the vicinity of the maintenance level 1 roads, including *S. oregana var. calva*, and sensitive and S&M species. The ongoing effects to plants from use of the maintenance level 2 through 5 roads and the motorized system trails would continue.

Effects of Motorized Access for Dispersed Camping from Alternative B, C, or D[2]

Alternatives B, C, and D would reduce impacts to plants from motorized access for dispersed camping, compared to the existing condition or Alternative A. Motorized use within corridors would be restricted to existing access routes only. Vehicles would not be allowed more than 300 feet from the road, and not closer than 100 feet to water. Direct effects to plants would be minimal because of these restrictions. No new ground-disturbing activities are included in any of the alternatives.

When comparing the three action alternatives, the effect to plants, such as fugitive dust; damaging, dislodging, or destroying plants; and habitat alteration, would change in proportion to the number of acres of corridors. The actual acres where the motorized use would be likely to occur was estimated by determining the number of acres with slopes less than 20%, and areas with less than 50% vegetation cover within corridors. The actual area of impact would be much smaller than this, however, since no new access routes would be allowed.

The following table includes details about the size of corridors and the number of acres within corridors by alternative.

Table 5–Size and Acres of Corridors, and Acres Where Motorized Use Would Likely Occur, by Alternative B, C, and D

	Alt B	Alt C	Alt D
Corridor width (feet), on both sides of the road	300 feet	300 feet	300 feet
Setback From Water	100 feet	100 feet	100 feet
Total corridor acres	117,625 acres	103,533 acres	327,558 acres
Corridor acres Where Motorized Use is likely to Occur	43,124 acres	37,408 acres	92,611 acres

Riparian habitats, such as streamsides, wet meadows, marshes, lakeshores, seeps, fens, bogs, hummocks, and seasonally moist areas, are especially susceptible to the effects of motorized vehicle use within corridors because many routes for access to dispersed camping are within riparian habitat. By definition, all S&M species are closely associated with late-successional or old-growth forest habitat and

[2] This analysis assumes that most users would stay on existing routes within corridors with motorized vehicles as a result of public education and enforcement of the regulations published in the motor vehicle use map. Although some illegal use is still expected to occur, the exact location and extent cannot be predicted (see Assumptions in Chapter 3). However, encroachment into vegetated areas could occur adjacent to these routes when users leave their vehicles to pursue recreational activities such as hiking, fishing, camping, hunting, firewood gathering, etc.

also susceptible to the effects of motorized vehicle use within corridors for access to dispersed camping. Sensitive and S&M species were analyzed for effects to those habitats and known populations within corridors.

The table below compares acres of those habitats in Alternatives B, C, and D. .

Table 6–Comparison of Acres of Riparian and Late Successional Habitat in Corridors by Alternative*.

Alternative	Acres of corridors in riparian habitat	Acres of corridors designated in LS/OG habitat
B	20,457	29,847
C	14,401	22,975
D	53,744	91,927

Table 7 displays endangered and sensitive species that would occur in riparian habitats within the corridors designated by Alternatives B, C, and D.

Table 7–Endangered and Sensitive species found in riparian habitat within corridors

Riparian Associated Species	
Scientific Name	**Common Name**
Botrychium crenulatum	scalloped moonwort
Botrychium paradoxum	peculiar moonwort
Carex comosa	longhair sedge
Carex heteroneura var. epapillosa	different-nerve sedge
Carex sychnocephala	manyhead sedge
Carex tenuiflora	sparseflower sedge
Chrysosplenium tetrandrum	northern golden saxifrage
Cicuta bulbifera	bulblet-bearing water hemlock
Delphinium viridescens	Wenatchee larkspur
Mimulus pulsiferae	candelabrum monkeyflower
Platanthera obtusata	bluntleaved orchid
Rubus arcticus ssp. acaulis	dwarf raspberry
Sanicula marilandica	Maryland sanicle
Sidalcea oregana var. calva	Oregon checkerbloom
Spiranthes porrifolia	creamy lady's tresses

The following twenty-nine S&M species would be located within corridors.

Table 8–Survey and Manage species within corridors

Scientific Name	
Albatrellus flettii	*Cypripedium montanum*
Boletus piperatus	*Gomphus bonarii*
Buxbaumia viridis	*Gyromitra californica*
Cantharellus subalbidus	*Helvella crassitunicata*

Chaenotheca chrysocephala	*Hygrophorus caeruleus*
Chaenotheca furfuracea	*Leucogaster citrinus*
Chaenotheca subroscida	*Lobaria linita*
Chaenothecopsis pusilla	*Mycena overholtsii*
Chamonixia caespitosa	*Nephroma bellum*
Cladonia norvegica	*Polyozellus multiplex*
Clavariadelphus sachalinensis	*Ptilidium californicum*
Clavariadelphus truncatus	*Ramaria amyloidea*
Cortinarius cyanites	*Rhizomnium nudum*
Cudonia monticola	*Tremiscus helvelloides*
Cypripedium fasciculatum	

Table 9 shows the species and number of known sites found in corridors under each alternative. The table compares the total number of known sites in the alternative to the total number of known sites on the Forest for context because all known sites could potentially be affected by cross-country use under Alternative A. This determines the percentage of known sites that could be potentially affected in each alternative. Any sites that are within 100 feet of water within corridors would not be affected by motorized access for dispersed camping since motorized vehicles would not be allowed closer than 100 to water, except at improved sites.

Any species at five percent or higher is considered at risk for the direct and indirect effects described above. This percentage derives from the literature that describes a common rule-of thumb, the "1 in 20 rule", for mitigating the effects of plant collection on plant populations (Norton, et al, 1994; Wagner, 1995). The viability of a population is not necessarily at risk just because the population may have indirect or direct effects from motorized use.

Motorized access for dispersed camping within corridors in each action alternative would potentially cause direct and indirect effects to the species shown in Table *. However, the limitation on motorized vehicles within corridors in Alternatives B, C, and D, including restricting them to existing routes and prohibiting them within 100 feet of water and the mitigation measures that would be implemented if monitoring discovers unacceptable impacts, coupled with closing the forest to motorized cross country travel would result in not reducing the viability of any of the species.

Table 9–Number of known sites found within corridors by species by Alternative

Species	Forest total of known sites (Alternative A)	Alternative B		Alternative C		Alternative D	
		Sites in corridors	% of total known sites	Sites in corridors	% of total known sites	Sites in corridors	% of total known sites
Albatrellus flettii	3	0	0	0	0	1	33
Boletus piperatus	2	0	0	0	0	1	50
Buxbaumia viridis	11	0	0	0	0	3	27
Cantharellus subalbidus	5	0	0	0	0	4	80
Chaenotheca chrysocephala	16	6	38	5	31	6	38

Chaenotheca furfuracea	9	0	0	0	0	5	56
Chaenotheca subroscida	28	2	7	1	4	5	18
Chaenothecopsis pusilla	6	3	50	2	33	4	67
Cladonia norvegica	3	1	33	1	33	1	33
Clavariadelphus sachalinensis	1	0	0	0	0	1	100
Clavariadelphus truncatus	3	0	0	0	0	2	67
Cortinarius cyanites	1	0	0	0	0	1	100
Cudonia monticola	2	1	50	0	0	1	50
Cypripedium fasciculatum	147	18	12	17	12	42	29
Cypripedium montanum	45	13	29	12	27	21	47
Gomphus bonarii	3	0	0	0	0	2	67
Gyromitra californica	6	1	17	0	0	3	50
Helvella crassitunicata	3	0	0	0	0	2	67
Hygrophorus caeruleus	1	0	0	0	0	1	100
Leucogaster citrinus	1	1	100	1	100	1	100
Lobaria linita	11	1	9	0	0	6	55
Mycena overholtsii	33	10	30	5	15	16	49
Nephroma bellum	2	1	50	0	0	1	50
Polyozellus multiplex	15	1	7	0	0	2	13
Ptilidium californicum	16	0	0	0	0	1	6
Ramaria amyloidea	2	0	0	0	0	1	50
Rhizomnium nudum	21	0	0	0	0	2	10
Tholurna dissimilis	2	0	0	0	0	2	100
Tremiscus helvelloides	2	0	0	0	0	1	50
Allium campanulatum	1	1	100	1	100	1	100
Astragalus arrectus	4	0	0	0	0	2	50
Botrychium ascendens	6	1	17	1	17	2	33
Botrychium crenulatum	43	9	21	8	19	21	49
Botrychium paradoxum	5	0	0	0	0	1	20
Carex comosa	1	0	0	0	0	1	100
Carex heteroneura var. epapillosa	7	0	0	0	0	3	43
Carex magellanica ssp. irrigua	15	0	0	0	0	4	27
Carex media	1	1	100	1	100	1	100
Carex scirpoidea ssp. scirpoidea	4	1	25	0	0	1	25
Carex sychnocephala	2	0	0	0	0	1	50
Carex tenuiflora	3	0	0	0	0	1	33
Carex vallicola	14	2	14	2	14	7	50
Chaenactis thompsonii	33	2	6	2	6	2	6
Chrysosplenium tetrandrum	14	4	29	4	29	5	36
Cicuta bulbifera	1	0	0	0	0	1	100
Delphinium viridescens	19	7	37	7	37	9	47

Draba aurea	2	0	0	0	0	2	100
Geum rossii var. depressum	2	0	0	0	0	1	50
Heterotheca oregona var. oregona	1	1	100	0	0	1	100
Iliamna longisepala	83	9	11	8	10	33	40
Mimulus pulsiferae	2	1	50	1	50	2	100
Penstemon eriantherus var. whitedii	2	0	0	0	0	1	50
Phacelia minutissima	2	2	100	2	100	2	100
Pinus albicaulis	675	67	10	67	10	110	16
Platanthera obtusata	60	28	47	28	47	32	53
Polytrichum strictum	2	0	0	0	0	1	50
Pulsatilla patens ssp. multifida	6	3	50	3	50	3	50
Pyrrocoma hirta var. sonchifolia	11	5	45	5	45	6	55
Rubus arcticus ssp. acaulis	2	0	0	0	0	1	50
Sanicula marilandica	14	9	64	0	0	13	93
*Sidalcea oregana var. calva**	4	1	25	1	25	1	25
Silene seelyi	18	0	0	0	0	4	22
Spiranthes porrifolia	7	0	0	0	0	1	14
Trifolium thompsonii	5	0	0	0	0	3	60
Utricularia minor	8	0	0	0	0	2	25
Vaccinium myrtilloides	2	0	0	0	0	2	100
Viola renifolia	10	5	50	5	50	7	70

*Alternative D includes corridors on all open roads, however motorized access for dispersed camping would not be allowed on roads gated closed. Three of the known sites of *Sidalcea oregana* var. *calva* are located on two of those gated roads; therefore they would not be at high risk for the direct or indirect effects described.

The information in Table 9 is totaled in Table 10 to show the number of species and known sites within corridors in Alternatives B, C, and D.

Table 10–Endangered, Sensitive and S&M known sites within proposed corridors by Alternative

Alternative	Number of ES and S&M species	Total number of known sites
B	33	218
C	25	190
D	67	430

Some species would be at elevated risk of impact because 100% of their known sites would be located within corridors. These are listed below, by alternative.

- Alternative B: *Leucogaster citrinus, Allium campanulatum , Carex media, Heterotheca oregona var. oregona and Phacelia minutissima*
- Alternative C: *Leucogaster citrinus, Allium campanulatum and Phacelia minutissima*

- Alternative D: *Cortinarius cyanites, Hygrophorus caeruleus, Leucogaster citrinus, Allium campanulatum, Carex comosa, Carex media, Cicuta bulbifera, Draba aurea, Heterotheca oregona var. oregona, Mimulus pulsiferae, Phacelia minutissima, Sidalcea oregana var. calva, Tholurna dissimilis, and Vaccinium myrtilloides*

No new damage from motorized vehicles to these species, or any listed in Table 9 would be anticipated since the vehicles would be restricted to existing access routes. There would be a risk of impact, however, since illegal use or creation of new access routes could damage or destroy sites if a motorized vehicle is driven through the site. The risk would increase with the number of known sites within corridors in the different alternatives. Given this possibility, the risk of impacts to the species would be greatest with Alternative D, followed by Alternative B. Alternative C would have the lowest risk of impacts. Even in Alternative D, the prohibition on driving a motorized vehicle off an existing route would reduce the risk of new damage to known populations.

The mitigation measure of modifying access routes if unacceptable or unanticipated impacts occur would further reduce the risk to these plant species. The monitoring plan included in Alternatives B, C, and D would ensure that the populations within corridors are protected. If unacceptable impacts to these and other plant species are found, the impacts would be mitigated by modifying the access route. Monitoring would be done to validate the projected effects of corridors on botanical resources. Populations of threatened, endangered, or sensitive species and survey and manage species would be targeted, in addition to known or discovered populations of invasive species. Implementation monitoring would focus on direct effects of motorized vehicle use in corridors. It would document if vehicles are staying on existing access routes, and remaining 100 feet away from waterways except at defined sites. Effectiveness monitoring would focus on a more thorough inventory of the impacts from any particular access route and offer a clearer picture of use patterns and impacts. The questions below are examples of the data that would be collected within corridors to determine whether motorized use is adversely affecting vegetation or contributing to the introduction or spread of invasive species, and if mitigation is needed to reduce impact to acceptable levels.

If motorized use on access routes within corridors for access to dispersed camping (corridors) is impacting *Sidalcea oregana var. calva* populations, sensitive or S&M species, the access route would be modified to minimize or eliminate the impact. Some of the possible actions could include, but are not limited to:

- using boulders, fences, or other barriers to keep vehicles to an acceptable location;
- decommissioning and blocking the access route.

This would mitigate potential impacts to these plant species, and avoid adverse impacts.

Motorized access in corridors could have indirect effects on all plant species, including endangered, sensitive, and survey and manage species, when motorized users leave their vehicles and travel on foot off existing routes within corridors. Effects of traveling on foot would consist of damaging, dislodging, or destroying the plants and altering habitat. Habitat alteration includes changes in soil conditions (compaction and erosion), moisture regime, vegetation coverage, and species composition. Compacted soil inhibits infiltration of precipitation, and soil moisture available to vegetation is diminished. Additionally, soil compaction may inhibit root growth among plants, in which case organic matter, litter, soil fertility, and vegetative cover are diminished (Ouren 2007). Other indirect impacts to vegetation from people leaving their vehicles and traveling on foot include reduced growth rates, and increased

potential for non-native grasses and pioneering species to become established by people carrying seed or plant parts on their clothes or equipment, thus altering vegetation communities.

Cumulative Effects

Analysis Area and Boundary Rationale

The analysis area for cumulative effects of the Motorized Travel Management Project is the Forest boundary since the known sites analyzed are located across the Forest outside wilderness, and Motorized Travel Management actions cannot affect plants beyond the Forest boundary. The temporal boundary begins with European settlement and disturbance from the extraction economy of mining, grazing, and logging in the late 1800s. Motorized travel is expected to continue in perpetuity on the Forest. However, future decisions that affect motorized travel management, such as Forest Plan revision, are likely to change management direction within about 10 years, which is used as the outer boundary of this analysis.

Past Actions

The aggregate effects of past actions are displayed under the affected environment and Alternative A above. All ground disturbing activities (trapping, mining, sheep grazing, logging, road and trail construction, house building, activities associated with the railroad, fire suppression, construction and maintenance of power-line corridors and electronic communication sites) in the past, starting with Euro-American settlement in the 1880s, have possibly affected TESP and S&M species. Past actions have resulted in the environmental conditions described in the affected environment above, although actual effects to TESP and S&M plants would be difficult to evaluate since inventory and mapping of TESP plant species did not begin systematically until the 1900s, long after much of the disturbing activities associated with European settlement. Fire suppression, which began in the early 1900s, has also led to changes in species composition and population dynamics in fire adapted ecosystems. The effect of past road and trail construction on the potential to impact TESP and S&M plants is described in the existing condition and under Alternative A.

Ongoing (Present) and Reasonably Foreseeable Future Actions

Plant species are, and would continue to be, directly affected by fugitive dust raised by motorized traffic near roads and trails. Processes that may be affected by dust include photosynthesis, respiration, and transpiration due to blocked stomata (a pore found in the leaf and stem external layer that is used for gaseous exchange) and cell destruction (Spellerberg and Morrison, 1998), all of which could result in reduced plant growth, size, productivity, and/or survivorship. Depending on particle size, the fugitive dust can affect plants a distance of 8 meters (26 feet) to 1 kilometer (.6 miles) away from the road or trail (Farmer, 1991).

The Swauk Pine, South Summit, Little Crow, Annie and Light restoration projects are currently being planned or implemented across the Forest. These projects are designed to create landscapes that are more resilient to changing climates and disturbances, enabling landscape results that restore natural processes, patterns, and functions; using treatments such as thinning, prescribed burning, and road

closures. All resources, including botanical resources, benefit when ecosystem function is restored. Therefore the cumulative effect of restoration projects and Alternatives B, C, or D would improve habitat for botanical resources particularly as a result of cross-country motorized vehicle closure, and limitations on motorized vehicle use for dispersed camping.

Actions resulting from implementation of minimum roads analysis, such as road closure or decommissioning, may result in decreased access to known sites of sensitive plant species. The Chewuch Transportation Plan would result in closure or decommissioning of 118 miles of system road in the Methow Valley Ranger District. The Peshastin and Chumstick Road Decommissioning Project would close or decommission 51.7 miles of road in the Wenatchee area.

Projects such as the Chewuch River Restoration project and those implemented under the ongoing Respect the River program would continue to modify vehicle access to dispersed campsite when needed and eliminate poorly located roads and dispersed campsites. These actions would restore riparian vegetation and function in areas impacted by dispersed camping. There would be a cumulative improvement for botanical resources from this program and the Motorized Travel Management Project.

The Forest is developing a Forest-wide Invasive Species EIS for invasive species treatment through integrated weed management methods. When implemented, the Forest would have the ability to more effectively and efficiently manage for invasive species. This, along with the elimination of cross-country motorized travel resulting from the Motorized Travel Management Project, would be improve habitat for botanical resources.

Table 11–Summary of Effects of Forest-wide ongoing and foreseeable future actions that may affect botanical resources

Project type	Negative or beneficial effect	Possible effects to botanical resources
Restoration	Beneficial	Botanical resources habitat improves when ecosystem function is restored
Decisions resulting from Minimum roads analysis	Beneficial	Decreased access to known sites of endangered, sensitive and S&M plant species
Respect the River projects	Beneficial	Restores riparian vegetation and functioning plant communities
Invasive species management	Beneficial	Reduces invasive species that can compete with native and sensitive species

Cumulative Effects Summary

Alternative A

The cumulative effect of all past, present, and reasonably foreseeable future actions and Alternative A would be somewhat of an improvement to botanical resources, including threatened, endangered, sensitive, proposed, or S&M species from forest restoration projects, road decommissioning, and invasive species control. Any improvements from these projects would be offset to some degree by the continued cross country motorized travel, and the unmanaged or regulated motorized access for dispersed camping.

Alternatives B, C, and D

The cumulative effect of all past, present, and reasonably foreseeable future actions and Alternative B, C, or D would be a substantial improvement to botanical resources, including threatened, endangered,

sensitive, proposed, or S&M species. Reducing access by eliminating cross-country motorized travel, and limiting motorized access to dispersed camping, combined with a number of other projects to restore biodiversity and manage access, would improve habitat for all plant species across the Forest compared to the existing condition.

Consistency Findings & Determination

All action alternatives reduce the risk for the direct and indirect effects to botanical species by designating corridors where motorized access for dispersed camping would be restricted to existing routes and not allowing vehicles closer than 100 feet to water, except at improved sites, by closing the Forest to cross country motorized travel, and closing maintenance level 1 roads to motorized vehicles. By providing less motorized access across the Forest (both within corridors and eliminating cross-country travel), the action alternatives would not reduce, and may improve, the viability of the population compared to Alternative A and the existing condition. Based on these findings and with implementation of mitigation, this project complies with the provisions outlined in the Forest Service direction detailed above, which requires that activities not result in a loss of species viability across their range or result in a species becoming threatened or endangered, or create trends toward federal listing. Alternatives B, C, and D would meet Okanogan Forest Plan requirements to protect sensitive plants by reducing motorized access and would comply with the Wenatchee Forest Plan analysis requirements. The Forest will consult with the United States Fish and Wildlife Service on compliance with the Endangered Species act once an alternative is selected.

Populations of *S. oregana var. calva* would benefit from Alternative B, C, or D over time due to the substantial reduction of the area where motorized activity would be allowed for dispersed camping, and the elimination of all cross country motorized travel within habitat for these species. These alternatives may effect, but will not likely adversely affect *S. oregana var. calva.* The alternatives will not result in a loss of species viability of any sensitive species.

Determination

Alternative A would may affect, and is likely to adversely affect *Sidalcea oregana* var *calva* and its critical habitat due to the effects of cross country travel. All plant species and their habitat, including the sensitive species, located in these areas open to cross country travel would continue to be at risk of destruction from motorized travel, which could damage, dislodge or crush plants, and degrade habitat.

Alternatives B, C, or D “may affect, but are not likely to adversely affect” *Sidalcea oregana* var *calva* or its critical habitat due to the closure of the forest to cross-country travel. Alternatives B, C, or D “may impact individuals or habitat, but will not likely contribute towards federal listing or cause a loss of viability to the population or species” due to the closure of the forest to cross-country travel .

Cross country motorized travel would no longer be allowed in riparian or late successional/old growth habitat, so all endangered, sensitive and S&M species associated with this habitat would benefit from the closure.

Literature Cited

USDA Forest Service. 2011. Region 6 Regional Forester's Special Status Species list. FSM 2670-1950.

USDA Forest Service. 2001. Record of Decision and Standards for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines and December 2003 Species List.

USDA Forest Service. 2014. Memorandum May 2014: Direction Regarding the Survey and Manage Standards and Guidelines. FSM 2670-1950.

U.S. Fish and Wildlife Service. 2004. Recovery plan for Sidalcea oregana var. calva (Wenatchee Mountains Checker-mallow). U.S. Fish and Wildlife Service, Portland, Oregon. x + 52 pp.

The Effects of Off Road Vehicles on Ecosystems; Taylor, Richard B. Retrieved March 27, 2010, from the Texas Parks and Wildlife Department Web site: http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_rp_t3200_1081.pdf

Ouren, D.S., Haas, Christopher, Melcher, C.P., Stewart, S.C., Ponds, P.D., Sexton, N.R., Burris, Lucy, Fancher, Tammy, and Bowen, Z.H., 2007, Environmental effects of off-highway vehicles on Bureau of Land Management lands: A literature synthesis, annotated bibliographies, extensive bibliographies, and internet resources: U.S. Geological Survey, Open-File Report 2007-1353, 225 p.

Farmer, Andrew M., 1991. The Effects of Dust on Vegetation – A Review. Environmental Pollution 79 (1993) 63-75.

USDA Respect the River; http://www.fs.fed.us/rtr/; USDA Forest Service; April 2012.

Spellerburg, I.F., and Morrison, T., 1998. The ecological effects of new roads—A literature review: Wellington, New Zealand, New Zealand Department of Conservation, Technical Report, 55 p.

Norton, David A., Janice M. Lord, David R. Given and Peter J. De Lange. 1994. Over-Collecting: An Overlooked Factor in the Decline of Plant Taxa. Taxon, Vol. 43, No. 2, pp. 181-185

Wagner, Dr. David H. *1995.* A Rule of Thumb for Botanists: The 1 in 20 Rule. Oregon Flora On-Line Newsletter, Volume 1, Number 3. Oregon State University