Current Vegetation Map of McGee-Riverland Unit, Hanford Reach National Monument

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INTRODUCTION

This map of current vegetation is intended to provide a tool to understand the landscape and vegetation dynamics of shrub steppe in the McGee-Riverland Unit of the Hanford Reach National Monument. It complements previous work on Hanford vegetation done by Wilderman (1994) on the Fitzner-Eberhardt Arid Lands Ecology Reserve, and by Salstrom and Easterly (1997) on Central Hanford.

The McGee-Riverland Unit of the Hanford Reach National Monument occupies approximately 9,100 acres and is bounded by State Route 24 to the south and east and the Columbia River to the north.

Site Description

The study area is located on and adjacent to eastern Umtanum Ridge, which is composed of numerous basalt flows of the Columbia River Basalt Group. Umtanum Ridge is one of a series of east-west trending anticlines that comprise the Yakima Fold Belt. It is asymmetrical, with a relatively gentle south slope and a steep, intensely folded and faulted north slope. The ridge plunges to the east, becoming buried by sedimentary materials in Pasco Basin.

Between some of the upper basalt flows are sedimentary interbeds. The largest of these, the Vantage Interbed, represents a hiatus in basalt flows that may have lasted up to 500,000 years (Smith, 1988) and consists of materials from both the Cascade Mountain volcanoes and the Rocky Mountain Terrane, the latter of which was carried to the site by ancestral rivers (Reidel and Fecht 1981). On eastern Umtanum Ridge, the Vantage Interbed is exposed along the upper north slope of the ridge; the other smaller interbeds occur nearer the ridgetop. These interbed horizons are the major zones of slippage during folding and faulting (Goff 1981). In addition, the Vantage Interbed is the major water-bearing stratum in the area, expressed by numerous cold springs along the north flank of Umtanum Ridge (Goff 1981). Water in this buried interbed is likely the source of numerous artesian wells on the south flank of the ridge (Goff 1981), such as at the McGee Well.

Eastern Umtanum Ridge is located along the route of many catastrophic floods during the 1.5-2.5 million years of the Pleistocene Epoch (Bjornstad et al. 2001). At it's eastern end (i.e., within the study area), the massive Umtanum Ridge deflected a major trajectory of the floodwaters to the east, scouring the north slope of the ridge. Downstream the floodwaters encountered a major constriction in its path at Wallula Gap, causing hydraulic ponding and the formation of temporary lakes in Pasco Basin. The ponded and surging water dropped large quantities of entrained materials, cloaking much of the south slope of Umtanum Ridge with fine-grained materials and a deposit of ice-rafted gravel on the surface (Lindberg 1994). Also, icebergs loaded with debris became stranded below 350 meters elevation on the south slope of Umtanum Ridge, leaving unsorted deposits (bergmounds) when they melted (Goff 1981). The upper strata of the slack-water deposits were subsequently redistributed and sorted by wind and water during the Quaternary.

On the north slope of the ridge, a large block landslide above Juniper Springs was facilitated by the intense folding and faulting, the incompetence of multiple sedimentary interbeds, its location intersecting with the Olympic-Wallowa Lineament, and the Pleistocene outburst floods that removed materials at the base of the slope (Goff 1981).

On the south side of the ridge, some road cuts expose a carbonate horizon that has developed in the loess and slack-water sediments. This carbonate-cemented sandy-silt occurs throughout the slack-water fine deposits at a depth of 30-60 cm (Lindberg 1994).

North of Umtanum Ridge along the Columbia River are boulders, cobble, gravels and sand from the Pleistocene outburst floods (Reidel and Fecht 1994), which is generally mantled with Quaternary alluvium (Goff 1981).

Land Use History

Overgrazing by livestock occurred in the area as early as 1880-81 (Parker 1979). This long-term grazing pressure undoubtedly suppressed grasses and shifted the balance between shrubs and grasses, a condition that is probably still evident in some of the oldest unburned portions on the site. In addition, the study area has two areas that were under early cultivation and development. As early as 1892, settlers along the Columbia River developed natural springs, dug wells, or irrigated from the river with gasoline engines. By 1908, electricity from Priest Rapids was developed (Parker 1979), providing yet another option to power irrigation. Artesian wells near the McGee Ranch on the south side of Umtanum Ridge provided irrigation water for agriculture and a number of home sites. These activities stopped in 1943, when the site was acquisitioned by the Federal Government for the Hanford Nuclear Facility.

Several power transmission lines cross the area, in addition to a power substation at the base of Umtanum Ridge below Juniper Springs. Roads, many which are associated with powerline construction and maintenance, provide access to much of the site. In the upper portion of the site, vehicle access is currently regulated with locked gates. The Riverland portion of the site near the Columbia River is open to the public, with a paved road through the middle. Some of the primitive roads in this section are closed to vehicles.

In the early 1950s, several Anti-Aircraft Artillery sites were established around Hanford's nuclear production facilities, one of which was situated on Umtanum Ridge in the eastern portion of the study site. These AAA sites, approximately 20 acres each, were decommissioned during the early 1960s. Although the Umtanum facility has been razed, its footprint can be seen near the east end of the study area and is presumably responsible for some ground disturbances along the ridge. In addition to the AAA site, a railway depot was located in the Riverland Area, where some contamination may have occurred. Both facilities have since been dismantled and the railway removed.

Management of the site is currently by the US Department of Energy, although it is part of the Hanford Reach National Monument and management is slated for transfer to the US Fish and Wildlife Service. Management of adjacent land include a fenced buffer area for the Hanford Nuclear Reservation to the east (including natural habitat and a former homestead and orchard); unconverted land of other units of the Hanford Reach National Monument to the north and south; highway corridors with a developed rest area to the east and south; and a vineyard, land formerly cultivated for dryland wheat and unconverted habitat providing a corridor to the Yakima Training Center to the west.

Livestock grazing has presumably been prohibited on the unit since about 1950, although active enforcement was apparently sporadic until the 1970s. Some trespass grazing by sheep continues to occur along the western edge of the site. Currently, large mammals on the site are elk, mule deer and coyotes.

METHODS

Mapping methodology were the same as we used on the Yakima Training Center (Easterly and Salstrom 1999), the East Satus Area of the Yakama Reservation (Easterly and Salstrom 2002a), the Ginkgo-Wanapum State Park (Easterly and Salstrom, 2002b), and with some adaptations, the central portion of the Hanford Nuclear Reservation (Easterly and Salstrom 1997).

Before fieldwork, we reviewed available information regarding the geology and ecology of the region and made a reconnaissance visit to the study site. Then, aerial photos[1] were examined and visible changes in shrub type or density were drawn as preliminary polygons on 1:24,000 USGS topographic map quadrangles.

Fieldwork was done between May and September 2002. During field visits, a site's vegetation was named (see below for identification methods) and the accuracy of the preliminary polygons was assessed. Adjustments to the preliminary polygons and additional polygons were drawn as necessary.

Plant species[2] whose distributions were used to delineate polygon boundaries are listed in Table 1. Criteria were different depending on factors such as the species priority for the project[3], predictability of habitat, and visibility on aerial photos and from a distance. Only distributions of high and medium priority species were used to delineate polygon boundaries. With some exceptions, each of these species names was included in the mapping-unit name when they were observed in the polygon.

However, some low and medium priority species were included in the mapping-unit name only when high priority species were not present in the polygon. For example, when the high priority *Artemisia rigida* was present, *Eriogonum thymoides* and *E. douglasii* were not consistently named. Likewise, *Poa secunda* was not included in the mapping unit name if a higher-ranking bunchgrass was present. This methodology was also used when including *Chrysothamnus nauseosus* and *C. viscidiflorus* in mapping-unit names.

Polygon boundaries were drawn to reflect changes in cover of high priority species when trends were observed at a level that could be mapped. Three cover class levels were indicated in the mapping-unit name. A species with irregular or clumpy distribution within a polygon was indicated with brackets, [...]; low cover (1-5%) was shown with parentheses, (...); and the species name without a modifier indicated moderate to

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[1] 1:19,900 infrared aerial photos, flown 5-06-87; excellent quality, high resolution photos provided by Battelle PNNL (contact Dr. Janelle Downs). Downs also provided computer printouts of digital photos taken after the 1996 fire.

[2] To be consistent with previous reports, taxonomy in this report follows Hitchcock and Cronquist (1973), with three exceptions. Updated taxonomy is used in referring to *Atriplex spinosa* (Hook.)Collotzi (=*Grayia spinosa* (Hook.)Moq. *Agropyron spicatum* Pursh (=*Pseudoroegnaria spicata* (Pursh) A. Love) and to the *Poa secunda* complex, which formerly included *Poa nevadensis* Vasey ex Scribn., *Poa sandbergii* Vasey, and *Poa scabrella* (Thurb.) Benth. ex Vasey, among others.

[3] Initially, our vegetation mapping projects in the region were undertaken to delineate some habitat requirements for sage grouse, primarily the distribution of species of *Artemisia* and bunchgrasses. We have incorporated additional species to aid finer-scale analysis of the habitat that may be useful for management. These secondary species were chosen because they occur with some regularity across the landscape, were species included by Daubenmire's (1970) vegetation classification for the region, and/or were thought to possibly be important for wildlife distribution. With two exceptions (*Grayia spinosa* and *Purshia tridentata*), these additional species were a lower priority for mapping than those thought to be required by sage grouse. Species priorities for this project were consistent with those for our previous mapping projects (Easterly and Salstrom 1997, 1998, 1999, 2002a and 2002b).
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dense cover and a relatively even distribution in the polygon. This system captures information about cover types that occur as fine-scale mosaics and may indicate ecotonal conditions.

Table 1. List of species used to define polygon boundaries and generate mapping-unit names in the McGee-Riverland Unit of the Hanford Reach National Monument.

Vegetation layer *Species*	**Priority for mapping polygon boundary**	**Presence in polygon always named in mapping unit**
Shrubs		
Artemisia rigida	High	Yes
Artemisia tridentata	High	Yes
Chrysothamnus nauseosus	Low	No[a,b]
Chrysothamnus viscidiflorus	Low	No[a,b]
Eriogonum douglasii	Medium	Yes
Eriogonum niveum	Low	No[b]
Eriogonum sphaerocephalum	Low	No[b]
Eriogonum thymoides	Medium	No[b]
Eurotia lanata	High	Yes
Grayia spinosa	High	Yes
Purshia tridentata	High	Yes
Salvia dorrii	Medium	No
Grass		
Agropyron cristatum	Low	Yes
Agropyron dasytachyum	Low	No
Bromus tectorum	Medium	No
Distichlis spicata	High	Yes
Elymus cinereus	Medium	Yes
Elymus lanceolatus	Low	No
Poa bulbosa	Medium	No
Poa secunda	Low	No[c]
Pseudoroegnaria spicata	High	Yes
Sporobolus cryptandrus	Medium	Yes
Stipa comata	High	Yes
Forb		
Balsamorhiza careyana	Low	No[b]
Helianthus cusickii	Low	No

[a] *Chrysothamnus nauseosus* and *C. viscidiflorus* were generally named only when other shrubs were absent from, or had patchy distribution in, polygon.
[b] Included in mapping unit name only at the level of bracket or more; lower densities were not noted.
[c] *Poa secunda* is widespread in most of the drier cover types within shrub-steppe. This species was included in the mapping-unit name only when other tracked bunchgrasses were not present; we therefore did not document sites where this species did not occur. Sites with extreme disturbance were named *Bromus tectorum*, although the presence or absence of *P secunda* was not determined.

Because accurate representation of complex margins may aid understanding wildlife use patterns, fire behavior, etc., polygon boundaries were drawn to reflect the sinuosity of vegetation boundaries as much as possible.

RESULTS and DISCUSSION

Products of this study are the following.

USGS 7.5' topographic maps[4] with 245 numbered polygons representing existing vegetation for the McGee-Riverland study area. Two sets of maps were submitted: one with polygon boundaries, the other a photocopy of the first with polygon numbers assigned to each polygon.

Polygon spreadsheet, in which each polygon number was assigned a mapping-unit name. There were 121 mapping-unit types. As an example of how the types can be grouped, the mapping units were combined into three nested groups containing 58, 38 and 17 types based on dominant and secondary shrub and grass species. Considering these varying levels of detail in species' distribution pattern allows for finer and coarser interpretation of the landscape matrix.

Spreadsheet indicating individual species' densities, in which each tracked species is given a relative value to show its density within the polygon. From this spreadsheet, maps can be created that show the distribution and concentration of individual species.

Attribute files, in which spreadsheet attributes are defined.

WNHP forms and slides for 8 vegetation plots.

WNHP forms for potential Element Occurrences.

Aerial photos were useful to delineate dramatic soil changes, such as between bare lithosols and sites with deeper soil. For more subtle changes, the aerial photos were helpful to identify some trends, such as shrub density changes. However, except for lithosols dominated by *Artemisia rigida*, they were not useful to delineate changes in shrub or grass species. In addition, fire burned irregularly across some of the site in 1996, after the available aerial photos were taken. The computer printout of post-fire digital images had insufficient resolution to consistently see the pattern of surviving shrubs. As a result, many of the polygons delineating post-fire shrub patterns were redrawn in the field and may be distorted due to the angles from which they were viewed.

The complexity of the data set can be greatly reduced when the secondary species (e.g., *Grayia spinosa, Purshia tridentata, Eriogonum sphaerocephalum, Salvia dorrii, E. nivium* and *Balsamorhiza careyana*) are eliminated from the polygon names. Alternatively, individual species in the mapping units can be grouped to highlight various aspects of the site's vegetation.

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[4] Vernita Bridge, Riverland, Priest Rapids NE and Emerson Nipple USGS 7.5' topographical map quadrangles

General Vegetation Description

Vegetation patterns in the study area frequently reflect the geomorphic surface on which they occur, including basalt outcrops, lithosols, Pleistocene outburst flood deposits (cobble, gravel and sand), and fine slack-water sediments.

The historic floodplain of the Columbia River north of Umtanum Ridge is gravel and cobble with occasional sandy areas and some secondary flood channels. The dominant cover type in this area is *Artemisia tridentata*/*Poa secunda*, commonly with *Grayia spinosa* on substrate that appears to be coarser in texture and/or shallower. *Eriogonum niveum* is common and sometimes dominant on sandy sites. The grass layer is frequently dominated by *Poa secunda* (which is sometimes vigorous), sometimes with high densities of *Bromus tectorum*. *Poa bulbosa* replaces *P. secunda* in at least some of the most heavily disturbed areas.

Closer to the river, the vegetation grades into riparian communities mapped in previous studies (Salstrom and Easterly 1995, Easterly and Salstrom 2001), which include *Agropyron dasytachyum, Elymus triticoides* and *Sporobolus cryptandrus.* The latter species also occurs intermittently in some historic flood channels and along some roads. Some of the old flood channels that were intensely disturbed (possibly historically used as livestock bedding areas) are infested with *Centaurea repens*.

Along the top of Umtanum Ridge, lithosols occur repeatedly, and support *Artemisia rigida*/*Poa secunda*, with and without *Eriogonum thymoides* and *Eriogonum douglasii*. These lithosols generally served as firebreaks for the 1996 fire.

On the north slope of Umtanum Ridge substrates include basalt outcrops, lithosols, sedimentary interbeds and loess. On much of this area, the substrates (and accompanying vegetation) recur on a relatively small-scale. Lithosols along spur ridges support *Artemisia rigida*/*Poa secunda*, frequently with *Salvia dorrii* and *Eriogonum sphaerocephalum*. Elsewhere, *Pseudoroegneria spicata* is common, especially on soils with a loess component. *Bromus tectorum* is a frequent component of the vegetation on the south aspects of secondary ridges. *Stipa comata* occurs sporadically along the slope, usually in areas with a relatively higher percentage of sand sorted from the slack-water Pleistocene sediments. Portions of the slope, especially in the western part of the study, burned in 1996. There, as in most other burned sites within the study area, *Artemisia tridentata* reproduction was often abundant. *Chrysothamnus nauseosus* and *C. viscidiflorus* occur sporadically, especially on upper slopes in the burned areas where they have resprouted. Small areas with *Eurotia lanata* occur along the slope, apparently associated with soils derived from the sedimentary interbed materials.

On the upper slope south of Umtanum Ridge in the western portion of the study area, *Eurotia lanata*/*Stipa comata* occurs on slack-water flood sediments and associated loess. Parts of this area burned in 1996, after which the *Eurotia lanata* resprouted[5]. Within this zone, *Stipa comata* generally occurs intermittently, creating a mosaic of *Eurotia lanata/Stipa comata* and *E. lanata/Poa secunda.* Occasional *Artemisia tridentata* shrubs also occur, although the fire eliminated most established *Artemisia tridentata* plants. *A. tridentata* seedlings are present. *Pseudoroegneria spicata* occurs with *Eurotia lanata* along the western margin of the study area, a cover type that continues upslope to the west off the site. To the east and south, the elevation drops, the substrate becomes coarser and *Eurotia lanata* drops out. *Stipa comata* and *Pseudoroegneria spicata* continue along the ridge to the east, with the latter species becoming confined to

[5]This species' response to fire is variable, depending on the severity of the fire and whether the buds near the base of the plant are damaged (U.S. Department of Agriculture 2003). *Eurotia lanata* did not resprout in the first year following the 2000 fire on Horse Heaven Hills, Yakama Nation (personal observation).

north aspects as the elevation continues to drop. *Artemisia tridentata* seedlings are abundant in much of the burned area.

The south flank of Umtanum Ridge burned irregularly in 1996. On the lower to mid portion of the slope, unburned sites support *Artemisia tridentata*/*Poa secunda*. *Grayia spinosa* is frequently present at relatively high concentrations, especially at lower elevations. Large patches of *Stipa comata* occur regularly at mid-elevations, especially on sandier sites where the shrub cover has been reduced by fire. Adjacent burned and unburned sites often seem to indicate an inverse relationship between *Stipa comata* and shrub cover that is evidently not due to substrate variation. At lower elevations within the study area, *Stipa comata* drops out as it's distributional ecotone, apparently a combination of elevation and soil, is crossed. As elsewhere on the site, reproduction of *Artemisia tridentata* is generally abundant, although uneven, in the burned area.

On the south flank of Umtanum Ridge, *Astragalus caricinus* and *Machaeranthera canescens* are common and sometimes abundant. Large patches of *Helianthus cusickii* occur throughout the lower south slope, usually where shrub cover is low. Other forbs include *Sphaeralcea munroana, Phlox longifolia, Erigeron linearis, E. filifolius, Castilleja thompsonii, Descurainia richardsonii, Astragalus purshii, Astragalus columbianus, Chaenactis douglasii, Astragalus succumbens* and *Townsendia florifer. Balsamorhiza careyana* occurs throughout much of the entire area, sometimes in high concentration. Likewise, *Salsola kali* also occurs sporadically, sometimes in high concentrations. *Centaurea repens* occurs near McGee Well.

In and around McGee Ranch on the lower south slope, the vegetation is dominated by *Bromus tectorum.* This is presumably a result of historic cultivation, livestock grazing, repeated fire in recent years,[6] and it's landscape setting (i.e., soil and aspect). *Artemisia tridentata* seedlings are present in much of the area.

Vegetation Condition and Natural Heritage Element Occurrences

Except sites that were cultivated historically or otherwise heavily impacted, much of the study area is in relatively good ecological condition. At lower elevations, however, the potential for recovery from past disturbances is likely slowed or reduced because of the lower productivity and resilience in these harsher physical settings. These areas are apparently below the ecotone for *Stipa comata* and *Pseudoroegneria spicata,* and the initial diversity was probably low relative to sites at higher elevations. Although *Bromus tectorum* is a component of the vegetation in much of the site, it is seldom dominant above the low elevation areas.

In some portions of the site, dense shrub cover likely reflects a response to historical overgrazing. This artifact of grazing may have been reset in some areas where recent fire (1996) removed shrubs. It remains to be seen to what extent those areas will recover the grass component of the vegetation, but initial observations frequently indicate higher bunchgrass cover where the shrub cover has been reduced, especially at mid to upper elevations. The structure of the community will continue to be modified as the shrub seedling, present at many of these sites, mature.

According to Natural Heritage methodology, 'element occurrence ranks provide a succinct assessment of . . . probability of persistence (based on condition, size, and landscape context) of occurrences of a given Element' (NatureServe 2002, page 35). Element ranks are established by equally ranking condition, size and landscape context.

[6] Approximately 80% of this area burned in the 1996 fire; 40-50% burned before the 1987 aerial photos were taken.

The extensive, unconverted, natural landscape of most the area, some of which is managed for conservation, gives a high landscape rank for all elements that can be identified on the site.

Elements that meet minimum size standards for regional importance are *Artemisia tridentata/Stipa comata, Artemisia tridentata/Pseudoroegneria spicata, Artemisia rigida/Poa secunda, Artemisia tridentata-Grayia spinosa/Poa secunda,* and *Eurotia lanata/Stipa comata-Poa secunda*. The latter two types are not currently recognized as elements by the Washington Natural Heritage Program: *Artemisia tridentata-Grayia spinosa/Poa secunda* is a subset of *A. tridentata/Poa secunda*, and *Eurotia lanata/Stipa comata-Poa secunda* is a subset of *Eurotia lanata/Poa secunda*. Many of these elements occur within a landscape matrix rather than as continuous polygons.

Assigning the condition rank is problematic because the criteria continue to evolve, as more is understood about vegetation dynamics. In addition, vegetation classification has not yet reached the level of detail required to be certain of comparing like types. While this ranking system works well under some conditions, natural variations of landscape and vegetation exceeds the parameters that are allowed by narrow criteria ranges. While Crawford (1999) made strides towards incorporating these additional factors, more comprehensive specification criteria are still needed.

For the project at hand, all identifiable elements large enough to meet size criteria for element occurrences in this intact landscape will be considered eligible for entry into the WNHP Information System. As mentioned above, we have included two elements that are more specific than those currently in the Natural Heritage system. In addition, some of the polygons drawn on the north slope of Umtanum Ridge represent vegetation that is ecotonal between *Artemisia tridentata/Pseudoroegneria spicata* and *A. rigida/Poa secunda*, often including *Eriogonum sphaerocephalum* and *Salvia dorrii.* These polygons are included in the records for *A. tridentata/Pseudoroegneria spicata* and *A. rigida/Poa* secunda, depending on which type it was most like. A list of element occurrences and ranks is presented in Table 2. Ecosystem Element Occurrence Survey Forms describing each occurrence are attached to this report as Appendix 1.

Table 2. Ecosystem Element Occurrences on the McGee-Riverland Unit, Hanford Reach National Monument, with tentatively assigned ranks.

Element	Landscape Rank	Size Rank	Condition Rank	Overall Rank	Acreage Total
Artemisia tridentata-Grayia spinosa/Poa secunda[a]	A	B	BC	B	884
Artemisia tridentata/Pseudoroegneria spicata	A	CB	C	B	793
Artemisia tridentata/Stipa comata	A	CB	CB	B	394
Eurotia lanata/Stipa comata-Poa secunda[b]	A	CB	CB	B	401
Artemisia rigida/Poa secunda	A	C	CD	BC	151

[a] This community type is not currently recognized as an element by the WA Natural Heritage Program. It is a subset of the *Artemisia tridentata/Poa secunda* type.
[b] This community type is not currently recognized as an element by the WA Natural Heritage Program. It is a subset of the *Eurotia lanata/Poa secunda* type.

MANAGEMENT RECOMMENDATIONS

Restoration: Any attempted restoration should be limited to sites that were heavily impacted historically and don't appear to have the potential to recover without interference. This includes disturbed sites near McGee Ranch and formerly cultivated sites at Riverland. Unless specific management objectives are identified, other areas of the unit should be allowed to continue recovering without interference.

Wildfire: The site is susceptible to recurring wildfire. Several of the recent fires in the area were human-caused, and most originated from vehicles. To reduce risk of unintended ignition, highway rights-of-way in the area should be maintained with controlled fires to maintain them free of weeds and fuel. In addition, firebreaks could be maintained along some secondary roads within the site by using truck-mounted propane burners. All vehicles with back–road access should be equipped with a fire extinguisher and shovel, and drivers should be informed of fire-prevention behavior.

Noxious Weeds: Several relatively localized areas within the study site are infested with noxious weeds, primarily *Centaurea repens.* These infestations should be treated as soon as possible. Roads through untreated areas should be closed to all vehicles.

Signage: The signs indicating that some of the secondary roads in the Riverland section are closed to vehicles are unclear until one drives close to them. We recommend that the signs be modified to make them more clearly understood from a distance, for example by placing a strip of red tape diagonally across the car figure.

Data gaps: Although not currently included in the vegetation classification criteria for Washington, additional information regarding the ecology of the site could be gleaned by adding *Stipa thurberiana* to the list of species tracked in the mapping units.

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