

Hanford Site Rare Plant Monitoring Report for Calendar Year 2016



Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

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1.0 INTRODUCTION

In 2016, a rare plant monitoring effort occurred on the portion of the Hanford Site (referred to herein as Central Hanford) managed by the U.S. Department of Energy (DOE). The goal of this effort was to revisit known occurrences of upland rare plant populations on Central Hanford to improve baseline information on locations of rare plant populations on the Hanford Site. Additionally, population stability, viability, and threats were recorded and will be used to inform future management of rare plant species.

All known upland rare plant populations located in the central portion of the Hanford Site were visited in 2016, and three riparian species were briefly surveyed. The 2016 status with the Washington State Department of Natural Resources Natural Heritage Program (WNHP) listings are summarized in the bullets below for each monitored species (WNHP 2016). This effort was led by Mission Support Alliance (MSA) and subcontracted personnel from SEE Botanical Consulting. Species canvassed as a part of this study include the following:

- *Aliciella leptomeria* (**Great Basin gilia**), Washington State Threatened
- *Astragalus columbianus* (**Columbia milkvetch**), Washington State Sensitive; Federal Species of Concern
- *Calyptidium roseum* (**rosy pussypaws**), Washington State Threatened¹
- *Cryptantha leucophaea* (**gray cryptantha**), Washington State Sensitive²; Federal Species of Concern
- *Eremogone franklinii* var. *thompsonii* (**Thompson's sandwort**), Washington State Sensitive
- *Eremothera minor* (**small-flowered evening-primrose**), Washington State Sensitive
- *Eremothera pygmaea* (**dwarf evening-primrose**), Washington State Sensitive³
- *Erigeron piperianus* (**Piper's daisy**), Washington State Sensitive⁴
- *Erythranthe suksdorfii* (**Suksdorf's monkeyflower**), Washington State Sensitive⁵
- *Lipocarpha aristulata* (**awned halfchaff sedge**), Washington State Threatened
- *Loeflingia squarrosa* var. *squarrosa* (**spreading pygmyleaf**), Washington State Threatened
- *Lomatium tuberosum* (**Hoover's desert parsley**), Washington State Sensitive
- *Nicotiana attenuata* (**coyote tobacco**), Washington State Sensitive
- *Oenothera cespitosa* ssp. *cespitosa* (**tufted evening-primrose**), Washington State Sensitive.⁶
- *Rorippa columbiae* (**Columbia yellowcress**), Washington State Threatened
- *Rotala ramosior* (**lowland toothcup**), Washington State Threatened⁷.

This report summarizes the methodology, results, and conclusions of the monitoring effort carried out during calendar year (CY) 2016.

¹ Listed as Federal Species of Concern in 2019 Washington Natural Heritage Program (WNHP) listings (WNHP 2019).

² Listed as Washington State Threatened in 2019 WNHP listings.

³ Listed as Federal Species of Concern in 2019 WNHP listings.

⁴ Removed from WNHP listings, no longer considered WA State Sensitive.

⁵ Listed as Federal Species of Concern in 2019 WNHP listings.

⁶ Listed as Federal Species of Concern in 2019 WNHP listings.

⁷ Listed as Washington State Sensitive in 2019 WNHP listings.

1.1 Purpose and Need for Rare Plant Monitoring at the Hanford Site

The U.S. Department of Energy, Richland Operations Office (DOE-RL) conducts ecological monitoring on the Hanford Site to collect and track data needed to ensure compliance with an array of environmental laws, regulations, and policies governing DOE activities. Ecological monitoring data provide baseline information about the plants, animals, and habitat under DOE-RL stewardship at the Hanford Site required for decision making under the *National Environmental Policy Act of 1969* (NEPA) and *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*. DOE/EIS-022-F, the *Hanford Site Comprehensive Land Use Plan* (CLUP), is the Environmental Impact Statement for Hanford Site activities that helps ensure that DOE-RL, its contractors, and other entities conducting activities on the Hanford Site are in compliance with NEPA.

DOE/RL-96-32, *Hanford Site Biological Resources Management Plan*, (BRMP) is identified by the CLUP as the primary implementation control for managing and protecting natural resources on the Hanford Site. According to the CLUP, the BRMP

provides a mechanism for ensuring compliance with laws protecting biological resources; provides a framework for ensuring that appropriate biological resource goals, objectives, and tools are in place to make DOE an effective steward of the Hanford biological resources; and implements an ecosystem management approach for biological resources on the site. The BRMP provides a comprehensive direction that specifies DOE biological resource policies, goals, and objectives.

DOE-RL places priority on monitoring those plant and animal species and habitats with specific regulatory protections or requirements; that are rare and/or declining (federal- or state-listed endangered, threatened, or sensitive species); or are of significant interest to federal, state, or Tribal governments or the public.

The BRMP ranks wildlife species and habitats (Level 0-5), providing a graded approach to monitoring biological resources based on the level of concern for each resource. Washington State Endangered and Threatened species are categorized as Level 4 resources and are considered Essential Resources by the BRMP, requiring a high level of status monitoring. Washington State Sensitive Species and Federal Species of Concern are categorized as Level 3 resources and are considered Important Resources by the BRMP, requiring a moderate level of status monitoring.

1.2 Plant Species of Conservation Concern on the Hanford Site

This section provides a brief overview of the rare plant species found on the Hanford Site and their status as of 2016.

1.2.1 Washington State Listed Rare Plant Species

State status of plant species within Washington State is determined by the WNHP. Factors considered in determining plant status include abundance, occurrence patterns, vulnerability, threats, existing protection, and taxonomic distinctness. Values include:

- **Endangered.** In danger of becoming extinct or extirpated from Washington State.
- **Threatened.** Likely to become endangered within the near future in Washington State if the factors contributing to population decline or habitat loss continue.
- **Sensitive.** Vulnerable or declining and could become endangered or threatened in the state without active management or removal of threats.
- **Review Group 1.** Of potential concern but needs more research to assign another rank.

As of 2016, 12 plant species that occur or potentially occur on the Hanford Site are listed as either endangered or threatened by Washington State; an additional 17 plant species are listed as sensitive. A list of these species can be found in DOE-RL-2017-24, *Hanford Site Environmental Report for Calendar Year 2016*, Section 11.2.

1.2.2 Federally-Listed Rare Plant Species

Federally-listed rare plants are protected under the *Endangered Species Act* (ESA). The purpose of the ESA is to protect and recover imperiled species and the habitats upon which they depend. The federal list of endangered and threatened plant species is maintained by the U.S. Fish and Wildlife Service (USFWS) in 50 CFR 17.12, "Endangered and Threatened Plants." Federal classifications for rare plants include the following:

- **Listed Endangered.** The plant is in danger of extinction throughout all or a significant portion of its range.
- **Listed Threatened.** The plant is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
- **Proposed Endangered.** A plant that is proposed to be listed as endangered and is undergoing a review process.
- **Proposed Threatened.** A plant that is proposed to be listed as threatened and is undergoing a review process.
- **Candidate Species.** A plant for which the USFWS or the National Oceanic and Atmospheric Administration Fisheries has on file sufficient information on biological vulnerability and threats to support a proposal to list as endangered or threatened.
- **Species of Concern.** An informal term referring to a species that might be in need of conservation action. Such species receive no legal protection and use of the term does not necessarily imply that a species will eventually be proposed for listing.

Two plant species found on the Hanford Site, Umtanum desert buckwheat (*Eriogonum codium*) and White Bluffs bladderpod (*Physaria douglasii* ssp. *tuplashensis*), were listed as threatened species under the ESA in April 2013; the rule was reaffirmed late in 2013 and was effective as of December 20, 2013 (78 FR 23984). White Bluffs bladderpod is located on land owned by DOE and managed by the USFWS and USFWS is responsible for monitoring the status of the species. Umtanum desert buckwheat is routinely surveyed by USFWS and WNHP and was not included in this effort. No other plants found on

the Hanford Site are currently on the federal list of endangered and threatened species; however, as of 2016 there are four plant “Species of Concern” on the Hanford Site: *Astragalus columbianus* (Columbia milkvetch), *Rorippa columbiae* (Columbia yellowcress), *Cryptantha leucophaea* (grey cryptantha), and *Lomatium tuberosum* (Hoover’s desert parsley). All four of these species were at least partially surveyed in 2016.

1.3 Report Scope

The remainder of the report is organized as follows:

- **Section 2.0** discusses the methods, results, and conclusions reached during the monitoring of upland plants on Central Hanford.
- **Section 3.0** lists the literature cited in this report.

2.0 MONITORING UPLAND PLANTS OF CONSERVATION CONCERN

2.1 Background

The goal of the 2016 monitoring effort was to build on fieldwork done in the mid-1990s and in 2015 (TNC 1995, TND 1996, TNC 1997, TNC 1999, HNF-64625) in order to facilitate a broader understanding of the distribution, abundance, and inter-year variability of plants of conservation concern on the DOE-managed portion of the Hanford Site. Figure 1 shows the area of the Hanford Site managed by DOE and referred to as Central Hanford throughout this report.

2.2 Methods

This survey continues the effort to collect baseline data on upland rare plant populations on the Hanford Site. The 2016 surveys described in this report build on the data that were collected in 2015 and provide insight regarding population viability and threats. The surveys also updated rare plant population mapping data, some of which had not been updated since the late-1990s and were originally recorded with less accurate devices. Due to the sensitive nature of rare plant mapping data, point locations and population boundaries are not available in this report but may be requested from WNHP.

Surveys were timed to prioritize known occurrences of rare species and their habitats. Other rare species with the potential to occur on the Hanford Site were searched for in conjunction with the 2016 surveys but were not targeted. Resurveys for high priority species included searches for additional subpopulations in the surrounding appropriate habitats and as time allowed. During surveys, rare plants in small occurrences were counted completely. More extensive rare plant occurrences were counted at representative portions of the population. In both cases, Global Positioning System (GPS) readings were made at point(s) and locations were recorded along with the documented information. Prior to surveys,

rare plant records from the study area in the DOE Information System were reconciled with records on file with the Washington State Department of Natural Resources.

Habitats in which rare plants occur were assessed in order to identify factors that could threaten the viability of the population (e.g. invasive species, stabilization). Sites were documented by means of GPS-referenced photo-points and vegetative species lists from selected observation points within the habitat. Areas where rare plants have been previously observed but where no plants were found during the survey were characterized and photo-documented.

Four field visits were made in 2016 to coincide with the timing of phenology of high priority species. These visits were made March 29 through April 6, April 20 through May 13, May 23 through June 13, and September 19 through September 22.

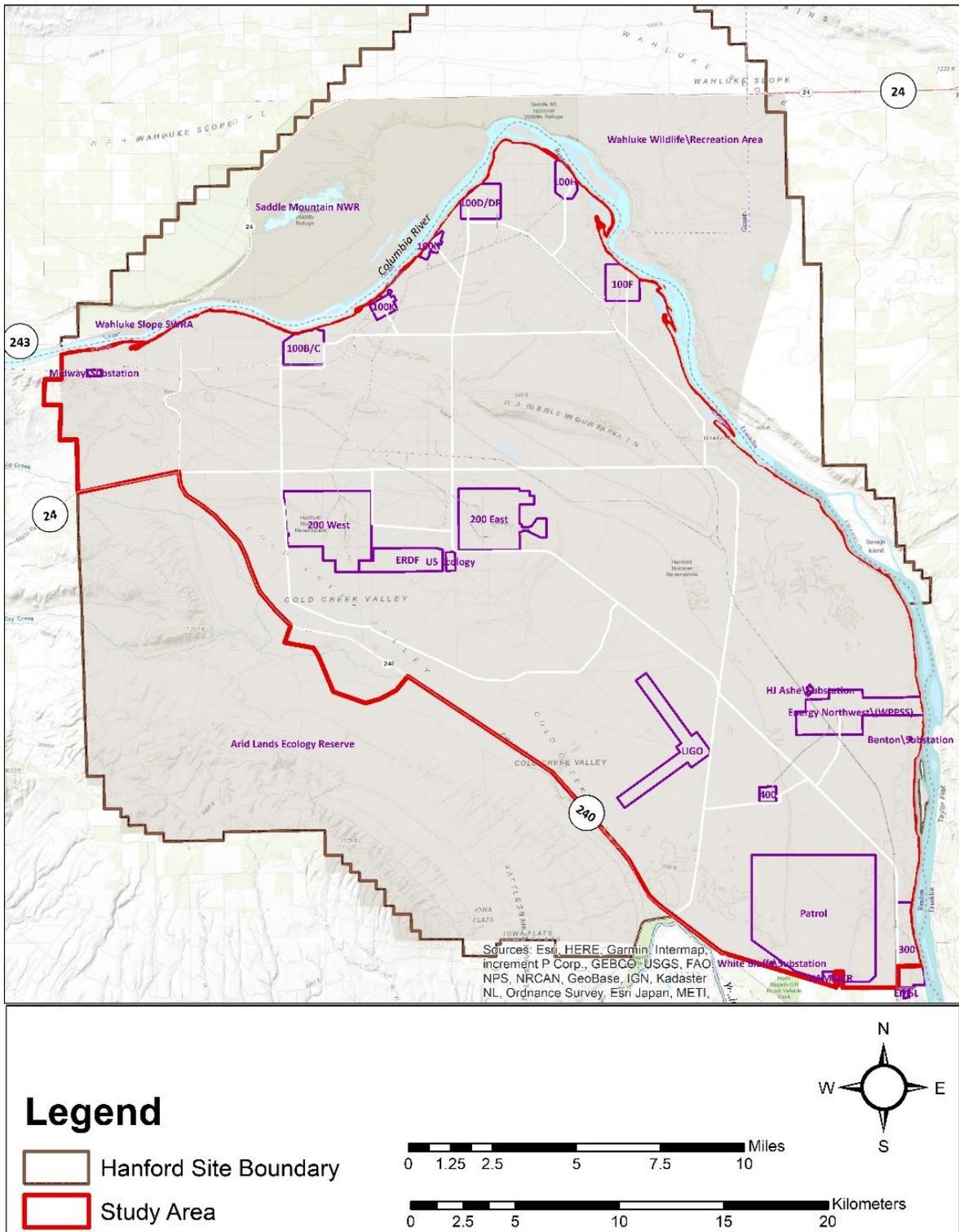


Figure 1. Central Hanford Study Area (in Red) for the 2016 Rare Plant Survey

2.3 Results

Survey results from 2016 monitoring are summarized in the species-specific sections below. Specific locations in the form of coordinate data or maps are not provided in this report due to the sensitive nature of these plant populations. To obtain coordinate data for conservation purposes, contact WNHP.

Survey data from 1994, 1995, and 1997 are from The Nature Conservancy's Rare Plant Surveys of the Hanford Site (TNC 1995, TNC 1996, TNC 1997). Survey data of riparian species from 2011, 2012, and 2013 are from riparian rare plant monitoring performed by Hanford Site contractors (HNF-52260, HNF-54686, HNF-56799). Survey data of upland species from 2013 are from Site surveys associated with the Midway-Moxee Rebuild and Midway-Grandview Upgrade Transmission Line Project Environmental Assessment (DOE/EA-1912). Survey data from 2015 is from the Hanford Site Rare Plant Monitoring Report for Calendar Year 2015 (HNF-64625).

2.3.1 *Aliciella leptomeria*

Species Description

Known as sand gilia or Great Basin gilia, *Aliciella leptomeria* is listed as a Threatened Species in Washington State. This annual has between one and several thin spreading branches and is generally 7 to 23 cm (3 to 9 in.) in height. The stems are covered with glands and tiny hairs and a rosette of strap-shaped leaves with lobes rounded with sharp points are found at the base of the plant. Tube-shaped flowers with white lobes, purple tubes, and yellow throats extending beyond the calyx generally appear in May. Figure 2 shows an *Aliciella leptomeria* individual in bloom.

Occurrences on Central Hanford

Aliciella leptomeria was first identified on the Hanford Site in 1995, and at the time it represented the first known occurrence of the species in Washington State. Four new populations were recorded by The Nature Conservancy in 1995, two of which were located within Central Hanford near Federal Avenue and Umtanum Ridge (west of State Route 24). Populations were relatively small, averaging 50 plants per population (TNC 1996). An additional population within Central Hanford was identified in 1997, located on the eastern end of Umtanum Ridge (east of State Route 24) in an area associated with vernal pools and an alkali spring; this population is now referred to as Vernita Grade (TNC 1997). In 2015 monitoring, two additional populations of *Aliciella leptomeria* were identified, one on the northern side of Gable Mountain and one near Army Loop Road. Additionally, the boundaries of the known Federal Avenue population were expanded in 2015 (HNF-64625). In 2016, all known occurrences of *Aliciella leptomeria* were surveyed and only the Federal Avenue population was detected. Occurrences of *Aliciella leptomeria* detected during formal rare plant surveys of Central Hanford are summarized in Table 1. Monitoring efforts for *Aliciella leptomeria* will be most successful if focused on years with abundant moisture.

Population Stability and Threats

Aliciella leptomeria is difficult to detect except when in peak bloom; there is high potential for additional occurrences within Central Hanford given the extensive amount of potential habitat suitable to the species. Occurrences not detected in 2015 or 2016 are likely extant but only occur after certain patterns of favorable precipitation similar to those seen in the late 1990s.

Populations of *Aliciella leptomeria* appear to be stable and viable. Threats vary based on location but generally include the threat of stabilization of sites by perennial species or aggressive weedy annuals,

along with competition with other spring ephemerals and an increased cover of sagebrush and other species. Canopy closure and shrinking openings reduce the ability of *Aliciella leptomeria* populations to emerge after high precipitation. Occurrences near roads (Umtanum Ridge and Federal Avenue) are threatened by road maintenance activities like road hardening or herbicide drift. Fire is generally a threat to native plant species; however, the long-term impacts of fire on *Aliciella leptomeria* are uncertain. Openings required for survival may be enhanced by fire, while weed seed and soil mobilization may degrade the specialized habitat needs of certain rare species.



Figure 2. *Aliciella leptomeria* (Great Basin Gilia) in Bloom.

Table 1. Results of CY 2016 Survey for *Aliciella leptomeria* (Great Basin Gilia).

Site name	Survey Year	Plants Present (Year)	2016 Notes
Army Loop Road	2015 2016	Yes (2015), No (2016)	Population first documented in 2015, not found in 2016.
North of Gable Mt.	2015 2016	Yes (2015), No (2016)	Population first documented in 2015, not found in 2016.
Federal Ave.	1995 1997 2011 2015 2016	Yes (1995), Yes (1997), No (2011), Yes (2015), Yes (2016)	Plants with characteristics intermediate with <i>Aliciella lottiae</i> were found east of the known site at Federal Way in 2015. Intermediates between the two species are known to occur in some areas (Porter 1998).
Umtanum Ridge	1995 2016	Yes (1995), No (2016)	Population presumed to be stable, not present due to low rainfall.
Vernita Grade	1997 2016	Yes (1997), No (2016)	Population presumed to be stable, not present due to low rainfall.

2.3.2 *Astragalus columbianus*

Species Description

Astragalus columbianus, commonly called Columbia milkvetch, is considered Sensitive in the state of Washington and is a Federal Species of Concern. Its range is restricted to Yakima, Kittitas, and Benton Counties and it is a local endemic that was once believed to be extinct. *Astragalus columbianus* is a short-lived (2 to 4 years) perennial with white to cream colored flowers that normally appear in April (Figure 3). It is found on gravelly and rocky silt loams, silts, and lithosols. The seedpods are distinctive, turning red when exposed to direct sun, and allow the plant to be recognized for several months after flowering.

Occurrences on Central Hanford

Columbia milkvetch is local endemic whose distribution is limited to an area approximately 8 by 40 kilometers (5 by 25 mi) along the Columbia River. The eastern end of this species range extends into the western portion of Central Hanford along Umtanum Ridge. Like many locally endemic species it can be relatively abundant within its habitat. Three occurrences of *Astragalus columbianus* are known on Central Hanford. One historic occurrence is found on Umtanum Ridge and was revisited during The Nature Conservancy's 1990s rare plant surveys. The Riverland occurrence was discovered in a 1994 rare plant survey (TNC 1995) and the Vernita Grade occurrence was discovered in 1997 (TNC 1997). The Umtanum Ridge population was expanded to the south after 2015 monitoring.

Astragalus columbianus individuals were found at all three occurrences in 2016. The species was widespread and appeared vigorous at the Umtanum Ridge site; representative areas were sampled and plants were counted. The Vernita Grade and Riverland populations were both completely mapped. Occurrences of *Astragalus columbianus* detected during formal rare plant surveys of Central Hanford are summarized in Table 2.

Population Stability and Threats

The species occurs within a variety of substrates and habitats on both relatively undisturbed and disturbed areas, including two-track roadways and occurrence in a firebreak that is disked annually. This species is also present in areas dominated by cheatgrass (*Bromus tectorum*) and bulbous bluegrass (*Poa bulbosa*) in the Riverland area. The Umtanum Ridge and Vernita Grade occurrences appear to be stable, while the Riverland occurrence may be in decline due to cover competition from invasive species. Juveniles at the Riverland site were sparse but difficult to detect due to high cover of cheatgrass.

This species is potentially threatened by increased cover of vegetation, especially weedy species such as bulbous bluegrass, cheatgrass, *Sisymbrium altissimum* (Jim Hill's tumbled mustard), *Sisymbrium loeselii* (tall hedge mustard), *Centaurea repens* (Russian knapweed), and *Descurainia sophia* (flixweed). *Astragalus columbianus* appears to do well in the years following fire. Though it may increase after some disturbance, the long-term effects of disturbance on this species is unknown.



Figure 3. *Astragalus columbianus* (Columbia Milkvetch) in Flower.

Table 2. Results of CY 2016 Survey for *Astragalus columbianus* (Columbia Milkvetch).

Site name	Survey Year	Plants Present (Year)	2016 Notes
Umtanum Ridge ^a	1994 1995 2010 2013 2015 2016	Yes (1994), Yes (1995), Yes (2010), Yes (2013), Yes (2015), Yes (2016)	Historic occurrence found pre-1994. Occurrence expanded in 2015. Large, vigorous occurrence.
Riverland	1994 2015 2016	Yes (1994), Yes (2015), Yes (2016)	Population may be declining due to cover competition from invasive species.
Vernita Grade	1997 2015 2016	Yes (1997), Yes (2015), Yes (2016)	Majority in area maintained as firebreak.

^a This site has been surveyed before 1994, only survey data from 1994 and on are included on this table.

2.3.3 *Calyptridium roseum*

Species Description

Calyptridium roseum, also known as rosy pussypaws, is a Washington State Threatened species⁸. In Washington State, this species is known only from two occurrences on Central Hanford and one occurrence across the river on the Hanford Reach National Monument. *Calyptridium roseum* is a tap-rooted annual forb with two or more spreading stems. The fleshy leaves of this plant form a basal rosette. The small flowers consist of two almost-circular sepals, two white petals, two stigmas, and one stamen located on a coiled inflorescence. The entire plant is generally only a few inches in width. Figure 4 shows a *Calyptridium roseum* plant in bloom.

Occurrences on Central Hanford

Calyptridium roseum is known from two locations on Central Hanford that were discovered in 1995, with about 80 total plants found (TNC 1996). The occurrences have been visited multiple times since the initial discovery and *Calyptridium roseum* has not been found. These two occurrences, Federal Avenue and Black Sands, were revisited in 2016. Five plants were found at the Federal Avenue occurrence in 2016 and no plants were found at the Black Sands occurrence. Potential habitat on Central Hanford is extensive but it is likely that this species will only be found in years with optimal moisture. Occurrences of *Calyptridium roseum* detected during formal rare plant surveys of Central Hanford are summarized in Table 3.

Population Stability and Threats

Though these populations have not been detected or have not been as vigorous as they were in 1995, it is suspected that the populations are extant and only appear after optimal precipitation. Determining the viability of the *Calyptridium roseum* populations on Central Hanford is difficult without recent data from a high precipitation year.

Threats to this species may include stabilization of sites by perennial species or aggressive weedy annuals and competition with other spring ephemeral species. The long-term effects of fire are uncertain for *Calyptridium roseum*, openings required for germination may be enhanced by fire while increased invasive cover after fire may degrade the habitat. The Federal Avenue population is vulnerable to herbicide drift from routine maintenance of Route 1 and Federal Avenue.

⁸ *Calyptridium roseum* is also listed as a Federal Species of Concern in 2019 WNHP listings.



Figure 4. *Calyptridium roseum* (rosy pussypaws).

Table 3. Results of CY 2016 Survey for *Calyptridium roseum* (rosy pussypaws).

Site name	Survey Year	Plants Present (Year)	2016 Notes
Federal Avenue	1995, 2011, 2015, 2016	Yes (1995), No (2011), No (2015), Yes (2016)	Small occurrence of five individuals recorded in 2016.
Black Sands	1995, 2011, 2015, 2016	Yes (1995), No (2011), No (2015), No (2016)	Population not found, likely due to low precipitation.

2.3.4 *Cryptantha leucophaea*

Species Description

Cryptantha leucophaea, or gray cryptantha, is a Washington State Sensitive Species⁹ and a Federal Species of Concern. A regional endemic from the western Columbia Basin, *Cryptantha leucophaea* is found in sandy areas, especially dunes that have not completely stabilized. As shown in Figure 5, *Cryptantha leucophaea* is a large, showy perennial forb with distinctive white flowers and herbage covered with stiff appressed hairs.

Occurrences on Central Hanford

This species is believed to have been extirpated in the state of Oregon, and the occurrence of this species on Central Hanford is the largest, most dynamic extant occurrence currently known. Five distinct

⁹ *Cryptantha leucophaea* is listed as a Washington State Threatened Species in 2019 WNHP listings.

occurrences of *Cryptantha leucophaea* are found on Central Hanford. One historic occurrence, south of 100-D Area, was documented before The Nature Conservancy's 1994 survey. The Hanford Dune population was documented by The Nature Conservancy in 1994 (TNC 1995). Two of the five occurrences on Central Hanford found after 1994 are believed to be extirpated, including the Army Loop Road East occurrence and the Northwest of Fast Flux Test Facility (northwest of the Fast Flux Test Facility [FFTF]) occurrence. Lastly, a new occurrence was first observed in 2015 and named Old Irrigated Homestead (HNF-64625). There is potential for additional occurrences at remote locations, particularly between the 200 Area plateau and the Hanford Dunes, as well as in the northeast area of Central Hanford. In 2016, all occurrences but the NW of FFTF occurrence were surveyed. Plants were present at all sites except the Army Loop Road East site. A partial survey was performed at the Hanford Dune site since an extensive survey had been performed in 2015 (HNF-64625). The 100-D Area site was expanded after 2016 monitoring. Occurrences of *Calyptridium roseum* detected during formal rare plant surveys of Central Hanford are summarized in Table 4.

Population Stability and Threats

The remaining Central Hanford *Cryptantha leucophaea* populations appear to be stable but are dependent on the protection of their natural dune habitat. Throughout Washington State, *Cryptantha leucophaea* populations appear to be less stable. An extensive 2015 survey of *Cryptantha leucophaea* in Washington State that included the Hanford Dunes occurrence found that about 26% of the known occurrences of *Cryptantha leucophaea* could not be relocated. At 30% of the known occurrences that were relocated, populations had declined by 75% or more. Additionally, 26% of the known occurrences that were relocated had populations of fewer than 50 individuals (Rare Care 2015).

Two of the five known occurrences of *Cryptantha leucophaea* have been extirpated due to stabilization of sands by natural processes. Stabilization of open sands within dunes presents a threat to the remaining *Cryptantha leucophaea* populations. This can occur from natural causes or as a result of management actions that limit natural dune processes.



Figure 5. *Cryptantha leucophaea* (gray cryptantha).

Table 4. Results of CY 2016 Survey for *Cryptantha leucophaea* (gray cryptantha).

Site name	Survey Year	Plants Present (Year)	2016 Notes
South of 100-D ^a	1994 2011 2015 2016	Yes (1994), Yes (2011), Yes (2015), Yes (2016)	Historic occurrence found pre-1994. Occurrence is relatively large; stability depends on management of intersecting two-track.
Old Irrigated Homestead	2015 2016	Yes (2015), Yes (2016)	Population appears stable.
Army Loop Road East	2016	No (2016)	Population extirpated by stabilization of dune.
Hanford Dunes	1994 2015 2016	Yes (1994), Yes (2015), Yes (2016)	Population appears stable.

^a This site has been surveyed before 1994, only survey data from 1994 and on are included on this table.

2.3.5 *Eremogone franklinii* var. *thompsonii*

Species Description

Eremogone franklinii var. *thompsonii* (formerly *Arenaria franklinii* var. *thompsonii*), also known as Thompson's sandwort, is a Washington State Sensitive Species. *Eremogone franklinii* var. *thompsonii* is a tufted perennial with white flowers that grows from a taproot (Figure 6). It is often found growing in the same sandy environments as *Cryptantha leucophaea* and is locally common within Central Hanford. *Eremogone franklinii* var. *thompsonii* is only found in Central Hanford and Gilliam County, Oregon.

Occurrences on Central Hanford

Seven occurrences of *Eremogone franklinii* var. *thompsonii* are known on Central Hanford. This species was not a focus of The Nature Conservancy surveys of the late 1990s as the taxa was integrated with *Eremogone franklinii* var. *franklinii* during monitoring. Of the seven known occurrences on Central Hanford, one was discovered in 2016 (Old Irrigated Homestead) and one was discovered in 2015 (Black Sands). There is a high potential for additional occurrences of this species in sand dune areas that have not been heavily surveyed. In 2016, four of the known *Eremogone franklinii* var. *thompsonii* occurrences were surveyed. The southeast of 200-East Area occurrence was not surveyed in 2015 or 2016 and is not included in the table below. Occurrences of *Eremogone franklinii* var. *thompsonii* monitored during the 2016 survey are summarized in Table 5.

Population Stability and Threats

The known *Eremogone franklinii* populations on Central Hanford appear to be stable and viable, as seedlings were found at some occurrence during 2016 surveys. Similar to *Cryptantha leucophaea*, stabilization of open sands within dunes presents a threat to the existing *Eremogone franklinii* var. *thompsonii* populations. This can occur from natural causes or as a result of management actions that limit natural dune processes.



Figure 6. *Eremogone franklinii* var. *thompsonii* (Thompson's sandwort).

Table 5. Results of CY 2016 Survey for *Eremogone franklinii* var. *thompsonii* (Thompson's sandwort).

Site name	Survey Year	Plants Present (Year)	2016 Notes
Old Irrigated Homestead	2016	Yes (2016)	Occurrence discovered in 2016, <i>Eremogone franklinii</i> var. <i>franklinii</i> also present at this site.
Black Sands	2015, 2016	Yes (2015), Yes (2016)	Occurrence discovered in 2015. Population appears stable.
Goose Egg Hill	2016	Yes (2016)	Population appears stable.
SE of Wye Barricade	2015	Yes (2015)	Population appears stable.
Cold Creek Sandslope	2014	Yes (2014)	Population appears stable.
Hanford Dunes	2015, 2016	Yes (2015), Yes (2016)	Occurrence area expanded after 2015 monitoring. Population appears stable.

2.3.6 *Eremothera minor*

Species Description

Eremothera minor, also known as small-flower evening-primrose, is a Washington State Sensitive Species that is generally found on gravelly basalt slopes; sandy and alkaline soils; and dry, rocky hillsides. *Eremothera minor* is recognizable in May through August, with flowers and fruit present on plants throughout the growing season. As shown in Figure 7, this annual is hairy with small white to pink sessile flowers and is fairly short, ranging from 3 to 30 cm (1.2 to 12 in.) tall. *Eremothera minor* grows in conjunction with other rare plant species, including *Eremothera pygmaea*, *Eriogonum codium*,

Astragalus columbianus, *Oenothera cespitosa* ssp. *cespitosa*, *Aliciella leptomeria*, *Loeflingia squarrosa* var. *squarrosa*, and *Calyptidium roseum*.

Occurrences on Central Hanford

Five distinct occurrences of *Eremothera minor* are located on Central Hanford. Three of these occurrences were discovered during 1997 rare plant surveys (recorded as Umtanum Ridge, Black Sands, and South Slope of Gable Mountain) (TNC 1997). The Umtanum Ridge occurrence had around 100 plants, the Black Sands occurrence had around 200 plants, and the South Slope of Gable Mountain occurrence had less than 100 plants. The East Army Loop Road occurrence was discovered during 2015 rare plant monitoring and contained approximately 2,000 individuals (HNF-64625). The Environmental Restoration Disposal Facility (ERDF) occurrence was not revisited in 2016 and is presumed to have low stability due to continuing site disturbance in the ERDF area. Occurrences of *Eremothera minor* detected during 2016 rare plant surveys of Central Hanford are summarized in Table 6.

Population Stability and Threats

Eremothera minor populations on Central Hanford are generally stable and viable, with the exception of the ERDF occurrence, which is threatened by ongoing site disturbance and soil capping of the waste site. Threats to the Central Hanford *Eremothera minor* populations are mainly disturbance that would cause an increase in cover of other species, particularly invasive species such as cheatgrass. Increasing cover of cheatgrass would limit openings in the canopy that allow *Eremothera minor* individuals to germinate.



Figure 7. *Eremothera minor* (small-flowered evening-primrose).

Table 6. Results of CY 2016 Survey for *Eremothera minor* (small-flowered evening primrose).

Site name	Survey Year	Plants Present (Year)	2016 Notes
Umtanum Ridge	1997 2016	Yes (1997), Yes (2016)	Population appears stable.
Black Sands	1997 2016	Yes (1997), No (2016)	Population appears stable.
South Slope of Gable Mountain	1997 2015	Yes (1997), No (2015)	Population appears stable and was partially burned in 2008.
East Army Loop Road	2015 2016	Yes (2015), Yes (2016)	Occurrence discovered in 2015. Population appears stable.

2.3.7 *Eremothera pygmaea*

Species Description

Eremothera pygmaea, or dwarf evening-primrose, is a Washington State Sensitive Species¹⁰ that is a regional endemic in eastern Washington and is also found in Oregon and potentially Idaho. This diminutive annual species is generally found on unstable soil or gravel within sagebrush steppe communities. As seen in Figure 8, *Eremothera pygmaea* plants often have small white to light pink flowers and fruits (capsules) on the plant at the same time and are most recognizable between June and August.

Occurrences on Central Hanford

There are three known occurrences of *Eremothera pygmaea* on Central Hanford. One was located in a gravel pit (now called Gravel Pit 9) before The Nature Conservancy surveys in the 1990s. The other two occurrences were discovered in 1995, both on the south facing slope of Gable Mountain (TNC 1996). The Pit 11 site was the only occurrence surveyed in 2016. The South Slope of Gable Mountain Site 1 has not been surveyed since 1995 but is presumed to be a stable population due to low potential threats. The South Slope of Gable Mountain Site 2 was last surveyed in 2015 and no plants were found; it is possible that the field visit was too early to detect the plants. Occurrences of *Eremothera pygmaea* detected during formal rare plant surveys of Central Hanford are summarized in Table 7.

Population Stability and Threats

The primary threats to *Eremothera pygmaea* appear to be increased cover of other species, especially invasive species like cheatgrass, resulting in canopy closure of its habitats. Fire may be a potential threat to this species, but the long-term influence of fire on *Eremothera pygmaea* and its habitat is unknown. Occurrences in Pit 9 and Pit 11 are threatened by a potential reactivation of activities within the pits.

¹⁰ *Eremothera pygmaea* is listed as a Federal Species of Concern in 2019 WNHP listings.



Figure 8. *Eremothera pygmaea* (Dwarf Evening-Primrose).

Table 7. Results of CY 2016 Survey for *Eremothera pygmaea* (Dwarf Evening-Primrose).

Site name	Survey Year	Plants Present (Year)	2016 Notes
South Slope of Gable Mountain Site 1	1995	Yes (1995)	Population presumed stable.
South Slope of Gable Mountain Site 2	1995 2015	Yes (1995), No (2015)	Population appears stable and was partially burned in 2008, long-term influence of fire is unknown.
Gravel Pit 9	2012 2015	Yes (2012), No (2015)	Vigorous in 2012, not found in 2015.
Pit 11	2016	Yes (2016)	Reactivation of quarry poses a threat to population.

2.3.8 *Erigeron piperianus*

Species Description

Endemic to the Columbia Basin of Washington State, *Erigeron piperianus*, also known as Piper's daisy, is found in dry, open places where the soil is somewhat alkaline. A Washington State Sensitive Species¹¹, *Erigeron piperianus* is a small yellow-flowered perennial in the sunflower family that generally blooms from May through June (Figure 9). Hybrids between this species and *Erigeron poliospermus* (cushion fleabane), which has purple-tinted, white ray flowers, are found where the species co-occur on the Hanford Site.

¹¹ WNHP has since changed this designation and Piper's daisy is no longer a listed species in Washington State (2020).

Occurrences on Central Hanford

Multiple populations of *Erigeron piperianus* occur on Central Hanford and have been separated into three large occurrences for the purpose of monitoring. The 200-East and 200-West occurrences in the Central Plateau of the Hanford Site are located in an area heavily impacted by human activities. These populations have been tracked periodically as part of ecological compliance activities and were last heavily surveyed in 2011 and 2015 (HNF-52260, HNF-64625). The other known populations are located on and near Umtanum Ridge and have been consolidated into a single Umtanum Ridge occurrence that is located near other rare plants such as *Eriogonum codium*, *Eremothera minor*, and *Astragalus columbianus*. Table 8 summarizes the occurrences of *Erigeron piperianus* on Central Hanford.

Population Stability and Threats

The 200 Area Plateau occurrences of *Erigeron piperianus* are threatened by human disturbance in the form of infrastructure development. Despite heavy human activity in the areas surrounding the 200 Area occurrences, these two populations appear to be stable and many seedlings were noted within the occurrences in both 2015 and 2016. Habitat stabilization and cover competition from invasive species like cheatgrass present a threat to all *Erigeron piperianus* occurrences. The Umtanum Ridge occurrence is potentially threatened by increasing fire frequency and subsequent habitat conversion but the long-term effects of fire on *Erigeron piperianus* are unknown.



Figure 9. *Erigeron piperianus* (Piper's daisy).

Table 8. Results of CY 2016 Survey for *Erigeron piperianus* (Piper’s daisy).

Site name	Survey Year	Plants Present (Year)	2016 Notes
Umtanum Ridge	1994, 1995, 2015, 2016	Yes (1994), Yes (1995), Yes (2015), Yes (2016)	Occurrence expanded in 2015, population appears to be stable with abundant seedlings present.
200-West Area Plateau ^a	2011, 2015, 2016	Yes (2011), Yes (2015), Yes (2016)	Population may be shrinking, more monitoring required. Abundant seedlings present.
200-East Area Plateau ^a	2011, 2015, 2016	Yes (2011), Yes (2015), Yes (2016)	Population may be shrinking, more monitoring required. Abundant seedlings present.

^a These occurrences have been surveyed many times, only 2011, 2015, and 2016 rare plant surveys performed by Mission Support Alliance are included in this report.

2.3.9 *Erythranthe suksdorfii*

Species Description

Erythranthe suksdorfii (formerly *Mimulus suksdorfii*), or Suksdorf’s monkeyflower, is a Washington State Sensitive Species¹². This annual occurs seasonally in moist swales, drainages, or vernal pools within sagebrush steppe vegetation. Shown in Figure 10, *Erythranthe suksdorfii* is a slender plant with small yellow, faintly spotted flowers that are slightly two-lipped and have a hairy throat. It is typically found in open habitat and plants may only attain a few millimeters of height in dry years, or not germinate at all.

Occurrences on Central Hanford

There are 34 known occurrences of *Erythranthe suksdorfii* in Washington State and there are currently six occurrences of *Erythranthe suksdorfii* on Central Hanford. Prior to 1995, no occurrences of *Erythranthe suksdorfii* were known on the Hanford Site. Six occurrences were discovered during the 1990s rare plant surveys: North of Gable Mountain, Federal Avenue, South of Gable Mountain, Vernita Grade, Gable Butte Complex, and East Gable Mountain. The North of Gable Mountain and Federal Avenue occurrences were surveyed as one occurrence in 1995 and 1997 and, together, were estimated to have approximately 10,000 plants (TNC 1997). The South of Gable Mountain site was estimated to have many hundreds of plants, and the Vernita Grade site was estimated to have 3,000 to 4,000 plants (TNC 1997). The Gable Butte Complex site was estimated to have many thousands of plants, and the East Gable Mountain site was estimated to have several hundred plants (TNC 1997).

Since the plants on Central Hanford were originally recorded in the late-1990s, they have only been detected a few times and are believed to require patterns of high precipitation to germinate. All known occurrences were surveyed in 2015, but no plants were found. *Erythranthe suksdorfii* was detected in 2016 monitoring at every occurrence but East Gable Mountain but was recorded in small numbers compared to those found in the late 1990s (Table 9).

¹² *Erythranthe suksdorfii* is listed as a Federal Species of Concern in 2019 WNHP listings.

Population Stability and Threats

Threats to *Erythranthe suksdorfii* populations are similar to those of other rare annuals on Central Hanford. Two of the six occurrences found on Central Hanford are near roads and are threatened by road hardening and herbicide use. Other threats include fire and increasing cover of annual species. The Gable Butte occurrence appears to be stable, mainly due to its isolation from human disturbance and low invasion from non-native species. Other occurrences such as Vernita Grade and East of Gable Mountain are vulnerable to increases in cheatgrass litter overtaking the habitat.



Figure 10. *Erythranthe suksdorfii* (Suksdorf's monkeyflower).

Table 9. Results of CY 2016 Survey for *Erythranthe suksdorfii* (Suksdorf's monkeyflower).
(2 Pages)

Site name	Survey Year	Plants Present (Year)	2016 Notes
Vernita Grade	1997 2015 2016	Yes (1997), No (2015), Yes (2016)	Few plants in 2016 compared to historic data.
Gable Butte Complex	1997 2015 2016	Yes (1997), No (2015), Yes (2016)	Found at some new locations, population appears stable.
Federal Avenue	2015 2016	No (2015), Yes (2016)	Few plants at one site.
North of Gable Mt.	1995 1997 2011 2015 2016	Yes (1995), Yes (1997), Yes (2011), No (2015), Yes (2016)	Few plants at one site, thousands of plants were reported at this occurrence in 1996. 2011 sighting was of desiccated plants.
South of Gable Mt.	1995 1997 2015	Yes (1995), Yes (1997), No (2015),	Roadside sites potentially threatened, plants present along dirt road.

	2016	Yes (2016)	
East of Gable Mt.	1997 2015 2016	Yes (1997), No (2015), No (2016)	No plants found, site filled with cheatgrass litter.

2.3.10 *Lipocarpha aristulata*

Species Description

Lipocarpha aristulata, also known as awned halfchaff sedge, is a Washington State Threatened Species found on Central Hanford along the Columbia River. It occurs in riparian areas, growing in wet and muddy soils that are completely submerged during the early portions of the growing season and submerged periodically during the later portions of the growing season (TNC 1995). In Washington, this species grows below the high water mark, often in association with rushes (*Juncus* sp.) and spike rushes (*Eleocharis* sp.) (WADNR 2020). *Lipocarpha aristulata* grows from 3 to 15 cm (1.2 to 6 in.) tall and has slender leaves that can resemble stems. It is most easily identifiable by its tufted inflorescence. Figure 11 shows the characteristic growth form of *Lipocarpha aristulata* with multiple tufted inflorescences.

Occurrences on Central Hanford

Lipocarpha aristulata occurs within sand, silt, and muddy soil along the Columbia River. This species was not known to occur on Central Hanford before botanical surveys in 1994, when three locations were discovered and mapped within the current Vernita Grade occurrence. There are currently eight documented occurrences of *Lipocarpha aristulata* on Central Hanford, all of which were detected during the most recent riparian monitoring effort in 2013. Riparian species were not a focus of the 2016 rare plant survey and only three of these occurrences were revisited (west of 100-B/C, White Bluffs Boat Launch Slough, and Hanford Townsite Slough). Plants were found at all three locations (Table 10).

Population Stability and Threats

A main threat to the Central Hanford populations of *Lipocarpha aristulata* is habitat invasion by invasive species such as purple loosestrife (*Lythrum salicaria*), reed canary grass (*Phalaris arundinacea*), and yellow flag iris (*Iris pseudacorus*). Changing hydraulic cycles also threaten this species, as inundation of the plants during the growing season inhibits their ability to reproduce. The Central Hanford populations of *Lipocarpha aristulata* appear to be stable.



Figure 11. *Lipocarpus aristulata* (awned halfchaff sedge).

Table 10. Results of CY 2016 Survey for *Lipocarpus aristulata* (awned halfchaff sedge).

Site name	Survey Year	Plants Present (Year)	2016 Notes
Vernita Grade	1994 2013	Yes (1994), Yes (2013)	Not recently surveyed.
China Bar Slough	2013	Yes (2013)	Not recently surveyed.
West of 100-B/C Area	2013 2016	Yes (2013), Yes (2016)	Population appears stable.
100-D Area	2013	Yes (2013)	Not recently surveyed.
White Bluffs Horn Area	2013	Yes (2013)	Not recently surveyed.
100-H Area	2013	Yes (2013)	Not recently surveyed.
White Bluffs Boat Launch Slough	2013 2016	Yes (2013), Yes (2016)	Population appears stable.
100-F Area Slough	2013	Yes (2013)	Not recently surveyed.
Hanford Townsite Slough	2013 2016	Yes (2013), Yes (2016)	Population appears stable.

2.3.11 *Loeflingia squarrosa* var. *squarrosa*

Species Description

Loeflingia squarrosa var. *squarrosa*, or spreading pygmyleaf, is classified as a Threatened Species in the state of Washington. It is widespread in the western and southwestern United States, but the Hanford Site populations are separated from the typical range of the species by at least 483 kilometers (300 mi)

(TNC 1996). This plant is only 1 to 12 cm (0.4 to 4.7 in.) in height and can be easily overlooked (Figure 12). It forms small mats that appear somewhat spikey and is found in the dark basalt sand dunes north and south of Gable Mountain.

Occurrences on Central Hanford

Loeflingia squarrosa var. *squarrosa* is typically found in low swales and shallow vernal pools. The first known occurrences of this species in Washington State were found by The Nature Conservancy in 1995, a year with unusually high precipitation (TNC 1996). The discovered populations are restricted to a very small geographic area and are at risk of being extirpated in the state. Central Hanford is home to all of the known occurrences of *Loeflingia squarrosa* var. *squarrosa* in Washington State except for one occurrence on the Hanford Reach National Monument. These occurrences are categorized into six geographic areas, three were discovered by The Nature Conservancy in 1995, two were discovered in 1997, and one has been discovered since. The Federal Avenue and North of Gable Mountain occurrence were surveyed together in 1995 and 1997 and estimated to have over 10,000 plants. The South of Gable Mountain occurrence was surveyed in 1995 and 1997 and estimated to have 1,000 plants. The Umtanum Ridge and Gable Butte occurrences were discovered in 1997 and estimated to have less than 100 plants and several hundred plants, respectively (TNC 1997). All six occurrences were surveyed in 2015 and no plants were found. The 2016 surveys found small numbers of plants at the Federal Avenue, North of Gable Mountain, and South of Gable Mountain sites (Table 11). These plants likely only occur in large numbers after favorable spring precipitation, as was seen in the late-1990s when these populations were first discovered.

Population Stability and Threats

The *Loeflingia squarrosa* var. *squarrosa* populations on Central Hanford likely require high spring precipitation to be present in the numbers seen in the late-1990s. As of 2016, population viability and stability appears to be mixed among occurrences, but more data are needed to determine the status of this elusive species. Threats to *Loeflingia squarrosa* var. *squarrosa* are mainly related to habitat loss. Competition from perennial and weedy annual species may reduce the available growing space for this plant. Some of the Central Hanford populations are located near roads; road hardening or herbicide application threatens their habitat. The effects of fire on *Loeflingia squarrosa* var. *squarrosa* are largely unknown.



Figure 12. *Loefflingia squarrosa* (spreading pygmyleaf).

Table 11. Results of CY 2016 Survey for *Loefflingia squarrosa* var. *squarrosa* (spreading pygmyleaf).

Site name	Survey Year	Plants Present (Year)	2016 Notes
Vernita Grade	1997, 2015, 2016	Yes (1997), No (2015), No (2016)	Population appears stable.
Gable Butte Complex	1997, 2015, 2016	Yes (1997), No (2015), No (2016)	Population appears stable.
Federal Avenue	1995, 1997, 2015, 2016	Yes (1995), Yes (1997), No (2015), Yes (2016)	Population appears stable.
North of Gable Mountain	1995, 1997, 2011, 2015, 2016	Yes (1995), Yes (1997), No (2011), No (2015), Yes (2016)	Population near road, potential threat.
South of Gable Mountain	1995, 1997, 2015, 2016	Yes (1995), Yes (1997), No (2015), Yes (2016)	Population near road, potential threat. Part of population appears to have been eliminated by road improvements.
East of Gable Mountain	2015, 2016	No (2015), No (2016)	Population near road, potential threat.

2.3.12 *Lomatium tuberosum*

Species Description

Lomatium tuberosum, or Hoover's desert parsley, is classified as a Sensitive Species in Washington State. This plant is a low-growing perennial that grows from a thick tube-like taproot in loose talus slopes. *Lomatium tuberosum* has finely dissected, hairless leaves and showy flowers that range from light purple to creamy yellow (Figure 13). Within Washington State, *Lomatium tuberosum*'s range is confined to the Columbia Basin. Though it is a local endemic, the local populations of *Lomatium tuberosum* can be quite vigorous.

Occurrences on Central Hanford

The populations of *Lomatium tuberosum* found on Central Hanford are categorized as two occurrences, one on the basalt scree slopes of Umtanum Ridge and one along the same latitude along Umtanum Ridge but east of Juniper Springs. Populations of *Lomatium tuberosum* were known on Central Hanford before The Nature Conservancy's surveys in the 1990s and an additional population was discovered during the 1995 surveys (TNC 1996). Both occurrences are found on Umtanum Ridge and were visited in 2016. The Umtanum Ridge Scree Slope occurrence was only partially surveyed due to difficulty safely accessing the entire population, while the Umtanum Ridge East of Juniper Springs occurrence was surveyed entirely. Vigorous plant populations were found at both locations. Due to difficulty accessing the talus slopes where *Lomatium tuberosum* is found and limited human activity on those slopes, there is a high probability that there are additional occurrences of *Lomatium tuberosum* that have not yet been recorded.

Population Stability and Threats

Both known populations of *Lomatium tuberosum* appear stable and have minimal threats. There is low cover of other plant species within the talus slope habitat, reducing the threat of competition from other species. There is also a low chance of disturbance from human activity due to the difficulty accessing the basalt talus slope habitat, and less threat from wildfire as there is less fuel in talus slope areas.



Figure 13. *Lomatium tuberosum* (Hoover's desert parsley).

Table 12. Results of CY 2016 Survey for *Lomatium tuberosum* (Hoover's desert parsley).

Site name	Survey Year	Plants Present (Year)	2016 Notes
Umtanum Ridge Scree Slope	1995 2016	Yes (1995), Yes (2016)	Population appears stable and is vigorous.
Umtanum Ridge East of Juniper Springs	1995 2016	Yes (1995), Yes (2016)	Population appears stable, original location updated.

2.3.13 *Nicotiana attenuata*

Species Description

Nicotiana attenuata, or coyote tobacco, is a showy annual that is a Washington State Sensitive Species. It can be identified by its white, tubular flowers that bloom from June to September (Figure 14) or by its glandular leaves. This species is found in areas that are prone to disturbance and germination often increases after disturbances. *Nicotiana attenuata* is apparently secure globally but is considered imperiled throughout its range in Washington State.

Occurrences on Central Hanford

Natural disturbances from sand dune movement and human disturbances from construction have both contributed to the creation of habitat for *Nicotiana attenuata* on Central Hanford. This plant is illusive and tends to not appear in the same place year after year. Despite searching for this species, *Nicotiana attenuata* was not detected during The Nature Conservancy's rare plant surveys in 1994, 1995, or 1996 (TNC 1997). There is currently one documented occurrence of *Nicotiana attenuata* on Central Hanford, located within the 618-10 waste site and in the surrounding sand dunes. This occurrence has been opportunistically surveyed a number of times during development and closure of the 618-10 waste site. This occurrence was revisited in 2016 and plants were found within the 618-10 waste site boundary but not in the surrounding area (Table 13).

Population Stability and Threats

Stabilization of habitats by other plant species or other factors that reduce the ability of sand dunes to naturally shift present a threat to *Nicotiana attenuata* populations. Increased vegetative coverage reduces the ability of *Nicotiana attenuata* to germinate opportunistically and also presents a threat to the species. Human activity at the 618-10 waste site has decreased significantly and will lessen once the site is revegetated. Reduced disturbance may decrease the size and viability of the occurrence at 618-10. Due to the difficulty tracking population sizes and boundaries of *Nicotiana attenuata*, this species is difficult to protect during habitat disturbing projects.



Figure 14. *Nicotiana attenuata* (coyote tobacco).

Table 13. Results of CY 2016 Survey for *Nicotiana attenuata* (coyote tobacco).

Site name	Survey Year	Plants Present (Year)	2016 Notes
618-10 Waste Site	2016	Yes (2016)	Population appears stable and is vigorous.

2.3.14 *Oenothera cespitosa ssp. cespitosa*

Species Description

Commonly known as cespitose or tufted evening-primrose, *Oenothera cespitosa ssp. cespitosa* is a Washington State Sensitive Species¹³. This perennial species is easily recognized by its tufted habit and large white flowers that open at sunset and become pinkish with age (Figure 13). *Oenothera cespitosa ssp. cespitosa* is found in open sagebrush areas on sandy or gravelly slopes, the flat terrace of the Columbia River, road cuts, and other exposed sites.

¹³ *Oenothera cespitosa ssp. cespitosa* is listed as a Federal Species of Concern in 2019 WNHP listings.

Occurrences on Central Hanford

Three occurrences of *Oenothera cespitosa* ssp. *cespitosa* are currently known. One small population was first recorded in The Nature Conservancy's 1994 report (Vernita Bar Rock House) and has not been detected since (TNC 1995). One occurrence of *Oenothera cespitosa* ssp. *cespitosa* was detected within an old channel of the Columbia River in 2015, named Riverland Abandoned Channel. This occurrence appears to be stable and vigorous. A third occurrence consisting of one plant was found during 2016 monitoring at Vernita Bar and named Vernita Bar River Mile 2. Table 14 summarizes 2016 and historic monitoring efforts that surveyed this species.

Population Stability and Threats

Oenothera cespitosa ssp. *cespitosa* tends to occur adjacent to the Columbia River and, like other rare riparian species, are potentially threatened by changes in hydrology and river management. As with other native plant species, prominent threats to *Oenothera cespitosa* ssp. *cespitosa* are habitat invasion from weedy species like cheatgrass, knapweed species (*Centaurea* sp.), and white mulberry (*Morus alba*) (TNC 1995). Fire and the associated threat of habitat conversion to a cheatgrass dominated habitat also presents a threat to *Oenothera cespitosa* ssp. *cespitosa*. Additionally, the Riverland Abandoned Channel occurrence is accessible to the public, making collection of the showy flowers a potential threat to the species.



Figure 15. *Oenothera cespitosa* (tufted evening-primrose).

Table 14. Results of CY 2016 Survey for *Oenothera cespitosa* ssp. *cespitosa* (tufted evening-primrose).

Site name	Survey Year	Plants Present (Year)	2016 Notes
Riverland Abandoned Channel	2015 2016	Yes (2015), Yes (2016)	Population appears stable and is vigorous.
Vernita Bar Rock House	1994 2011 2015 2016	Yes (1994), No (2011), No (2015), No (2016)	Population not detected since initial monitoring effort.
Vernita Bar River Mile 2	2016	Yes (2016)	Occurrence consists of 1 individual.

2.3.15 *Rorippa columbiana*

Species Description

Rorippa columbiana, or Columbia yellowcress, is classified as a Threatened Species in Washington State. This species occurs in open cobble in the lower-most vegetative zone along the Columbia River within Central Hanford and has evolved to tolerate periodic flooding (HNF-56799). The Hanford Reach is home to the most extensive *Rorippa columbiana* population. *Rorippa columbiana* is a rhizomatous perennial species with partially dissected leaves and bright yellow flowers, as shown in Figure 16. This species can flower from April to September and bears characteristically hairy fruits.

Occurrences on Central Hanford

As the Hanford Reach is home to the most extensive *Rorippa columbiana* population, there are a large number of clusters of *Rorippa* along the Columbia River within the Central Hanford Area. In The Nature Conservancy's 1994 surveys, all *Rorippa columbiana* individuals along the Hanford Reach were considered one occurrence (TNC 1995). As such, in Table 15 all occurrences are listed as present from 1994. The Hanford Reach population has since been divided into nine distinct geographic occurrences, starting west of State Route 24 at China Bar and following the river east until the ninth occurrence north of the 300 Area. Riparian rare plants were not a focus of 2016 surveys and only one occurrence was surveyed in 2016, the White Bluffs Boat Launch, where one point was surveyed and *Rorippa columbiana* was recorded (Table 15). All known occurrences of *Rorippa columbiana* were surveyed extensively in 2011, 2012, and 2013. See HNF-52260, HNF-54686, and HNF-56799 for data on the other eight known occurrences of *Rorippa columbiana*.

Population Stability and Threats

When *Rorippa columbiana* was surveyed in 2011 to 2013, the study found that it was relatively stable in the upper half of its riparian habitat. The viability of *Rorippa columbiana* is unknown but observers noted that the plants were producing few flowers and were not producing viable seed (HNF-56799). The main threat to *Rorippa columbiana* is the management of the Columbia River water levels and flow. Inundation by current river management has shortened the growing season of this species by completely inundating the habitat until late summer and resuming inundation before *Rorippa columbiana* produces viable seeds.



Figure 16. *Rorippa columbiae* (Columbia yellowcress).

Table 15. Results of CY 2016 Survey for *Rorippa columbiae* (Columbia yellowcress). (2 Pages)

Site name	Survey Year ^a	Plants Present (Year)	2016 Notes
China Bar	1994 2011- 2013	Yes (1994) Yes (2011- 2013)	Not recently monitored.
Vernita Bar	1994 2011- 2013	Yes (1994) Yes (2011- 2013)	Not recently monitored.
100-B/C and 100-K	1994 2011- 2013	Yes (1994), Yes (2011- 2013)	Not recently monitored.
White Bluffs Horn	1994 2011- 2013	Yes (1994), Yes (2011- 2013)	Not recently monitored.
100-H to White Bluffs Boat Launch	1994 2011- 2013	Yes (1994), Yes (2011- 2013)	Not recently monitored.
White Bluffs Boat Launch to 100-F	2016	Yes (2016)	Occurrence first detected in 2016.
Hanford Townsite	1994 2011- 2013	Yes (1994), Yes (2011- 2013)	Not recently monitored.
South of Hanford Dunes	1994 2011- 2013	Yes (1994), Yes (2011- 2013)	Not recently monitored.
North of 300 Area	1994 2011- 2013	Yes (1994), Yes (2011- 2013)	Not recently monitored.

Table 15. Results of CY 2016 Survey for *Rorippa columbiae* (Columbia yellowcress). (2 Pages)

^a Multiple surveys performed over the last 20 years have detected *Rorippa columbiae* along the Hanford Reach. Reported in Table 15 are results from the 1994 TNC surveys and 2011 through 2016 Mission Support Alliance rare plant monitoring (TNC 1995, HNF-52260, HNF-54686, HNF-56799).

2.3.16 *Rotala ramosoir*

Species Description

Rotala ramosoir, also known as lowland toothcup, is a riparian annual found along the shore of the Columbia River. It is widely distributed but considered rare in large portions of its range and, as of 2016, is a Washington State Threatened Species¹⁴. This species can be dominant where present and is relatively small with hairless leaves and stems up to 15 cm (5.9 in.) tall (Figure 17). *Rotala ramosoir* is characterized by small, inconspicuous flowers with four white petals visible from June to August. This species is an emergent annual that grows below the high water line in free-flowing river reaches.

Occurrences on Central Hanford

There are a number of occurrences of *Rotala ramosoir* along the Columbia River following the boundary of Central Hanford. Five locations were recorded with *Rotala ramosoir* populations in 1994 (TNC 1995). In 1995 monitoring, it was found in 29 locations, which were recorded as one occurrence. As such, all occurrences in Table 16 are listed as present for 1995 (TNC 1996). The large, single occurrence of *Rotala ramosoir* documented by The Nature Conservancy has since been grouped into eight distinct occurrences for the purposes of data collection. These occurrences have been monitored on a rotating basis since 2011 riparian rare plant monitoring efforts. In 2011, *Rotala ramosoir* populations were surveyed as encountered during *Rorippa columbiae* surveys (HNF-52260). In 2013, *Rotala ramosoir* populations were surveyed along with other rare riparian species at five locations (HNF-56799). Three occurrences of *Rotala ramosoir* were surveyed in 2016 and plants were found at all three locations.

Population Stability and Threats

The Hanford Reach populations of *Rotala ramosoir* are believed to be stable. The main threat to the Hanford Reach populations of *Rotala ramosoir* is the management of the Columbia River water levels and related habitat flooding. Similar to *Rorippa columbiae*, inundations and daily flooding during the growing season can prevent the plant from producing viable seed and reproducing.

¹⁴ Listed as a WA State Sensitive Species in 2019 WNHP Listings.



Figure 17. *Rotala ramosoia* (lowland toothcup).

Table 16. Results of CY 2016 Survey for *Rotala ramosoia* (lowland toothcup).

Site name	Survey Year	Plants Present (Year)	2016 Notes
China Bar	1995 2011	Yes (1995), Yes (2011)	Not recently monitored.
West of 100-B/C	1995 2011 2013 2016	Yes (1995), Yes (2011), Yes (2013), Yes (2016)	Occurrence expanded in 2013.
100-D & Horn at White Bluffs	1995 2011 2013	Yes (1995), Yes (2011), Yes (2013)	100-D occurrence first detected in 2013.
White Bluffs Boat Launch	1995 2011 2013 2016	Yes (1995), Yes (2011), Yes (2013), Yes (2016)	Occurrence expanded in 2013. Partial survey performed in 2016.
100-F Area	1995 2011 2013	Yes (1995), Yes (2011), Yes (2013)	Not recently monitored.
Hanford Townsite	1995 2011 2016	Yes (1995), Yes (2011), Yes (2016)	Partial survey performed in 2016.
North of Hanford Dunes	1995 2011	Yes (1995), Yes (2011)	Not recently monitored.
Wooded Island Area	1995 2011	Yes (1995), Yes (2011)	Not recently monitored.

2.4 Discussion

The Hanford Site is a unique hotspot of rare habitats and plants within the Columbia Basin. Limited development within Central Hanford and the surrounding Hanford Monument land has essentially created a habitat preserve within an area that has seen the majority of its shrub-steppe habitat converted to agriculture and development. Rare plants have been surveyed throughout the Hanford Site many times since the establishment of the area but no survey has been as thorough as The Nature Conservancy’s rare plant surveys of the 1900s. Additionally, no survey has occurred in years with more precipitation than the 1990s when above-average rainfall undoubtedly led to high numbers of rare plant species, especially opportunistic annuals. Subsequent surveys have targeted both riparian rare plants and upland rare plants, but have rarely found populations as abundant as those found by The Nature Conservancy.

In 2016, an upland rare plant monitoring effort occurred on Central Hanford. The goal of this effort was to revisit known occurrences of upland rare plant populations to improve baseline information on locations of rare plant populations on the Hanford Site. Additionally, population stability, viability, and threats were recorded and will be used to inform future management of rare plant species.

The 2016 upland rare plant survey found rare plants in the same locations reported by The Nature Conservancy, but often in much smaller numbers than those reported in the late-1900s. The abundant occurrence of rare annual plants in the 1990s may be attributed to unusual weather patterns during 1995 and 1996, which included high precipitation for 2 years in a row that changed the water profile (182% and 180% of normal). These conditions have not been experienced on the Hanford Site since then (Hanford Meteorological Station 2020). The next highest precipitation year since 1996 was 2010 (150% of normal), a year in which rare annuals were not surveyed on the Hanford Site. See Table 17 for a comparison of the rainfall totals from 1994 to 1997 and 2014 to 2016.

Table 17. Monthly Rainfall Totals for Rare Plant Survey Years at Hanford (inches).

Year	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1993	1.30	1.17	0.67	0.71	0.60	0.12	1.76	0.24	0.04	0.09	0.19	0.94	7.83
1994	0.44	0.11	0.03	0.61	1.27	0.38	0.15	0.08	0.08	0.93	0.68	1.36	6.12
1995	2.14	0.69	0.95	1.54	0.79	0.77	0.34	0.07	0.79	0.87	1.04	2.32	12.31
1996	1.42	1.22	0.83	0.43	0.62	0.05	0.14	0.02	0.22	0.88	2.67	3.69	12.19
1997	1.51	0.25	0.7	0.33	0.33	0.46	0.19	0.06	0.32	0.92	1.01	0.31	6.39
2014	0.37	1.12	1	0.38	0.24	0.26	0.04	0.88	0.16	0.77	0.38	0.93	6.53
2015	0.67	0.42	0.65	0.09	1.49	0.13	0.05	T	0.06	0.28	0.60	2.04	6.48
2016	1.47	0.27	1.01	0.34	0.20	0.38	0.27	T	0.08	2.59	0.57	0.47	7.65
<i>Average^a</i>	<i>0.94</i>	<i>0.63</i>	<i>0.52</i>	<i>0.47</i>	<i>0.55</i>	<i>0.54</i>	<i>0.19</i>	<i>0.23</i>	<i>0.3</i>	<i>0.57</i>	<i>0.85</i>	<i>1.01</i>	6.81

^a Averages from 1946 through 2018

T = Trace Rainfall

More rare plants were detected during the 2016 rare plant surveys than in the 2015 rare plant surveys (HNF-64625). A potential cause of this is differing rainfall patterns, as shown in Table 18. Annual rainfall

totaled 16.5 cm (6.48 in.) for 2015, which is below average. Winter and spring rainfall, which may play a larger role in determining plant germination, totaled 7.98 cm. (3.14 in.) from November 2014 to April 2015. Annual rainfall in 2016 was higher than 2015 at 19.4 cm. (7.65 in.), and winter and spring rainfall from November 2015 to April 2016 totaled 14.5 cm. (5.73 in.). Average rainfall on the Hanford Site from November to April is 10.0 cm. (3.95 in.). All rare plant survey years (1994, 1995, 1997, 2015, 2016) documented in this report had higher than average rainfall for winter-spring except for 1994, which had little focus on Central Hanford apart from Umtanum Ridge and few riparian areas, and 2015, where the least amount of rare plants were recorded.

Table 18. Rainfall Comparison during Rare Plant Survey Years (inches).		
Year	Previous Winter - Spring Rainfall	Total Rainfall
1994	2.32	6.12
1995	7.36	12.31
1996	7.26	12.19
1997	9.15	6.39
2015	3.14	6.48
2016	5.73	7.65
<i>Average</i> ^a	3.95	6.81

^a Averages from 1946 through 2018 data

All of the rare plants that were not found in 2015 monitoring but were found in 2016 monitoring were annuals (*Calyptidium roseum*, *Eremothera pygmaea*, *Erythranthe suksdorfii*, and *Loeflingia squarrosa* var. *squarrosa*). As annual species germinate each year, the previous winter and spring rainfall totals may have a larger effect on their presence or absence than it does for perennial species. A number of perennials were found in both 2015 and 2016, including *Astragalus columbianus*, *Cryptantha leucophaea*, *Eremogone franklinii* var. *franklinii*, *Erigeron piperianus*, and *Oenothera cespitosa* ssp. *cespitosa*. The remaining rare plants surveyed in both 2015 and 2016 had mixed results and were found at some sites but not others in both years (*Aliciella leptomeria* and *Eremothera minor*). These results support that when monitoring rare upland annuals, surveyors should target years with higher-than-average rainfall.

In summary, of the known rare plant populations on Central Hanford, at least one occurrence for each species was relocated and recorded in 2016. The rare plant populations found in 2016 were found in smaller numbers than those found during the Nature Conservancy rare plant surveys of the 1990s. This is likely due to the above average rainfall seen in 1995, 1996, and the winter/spring of 1997. Rare plant monitoring in 2016 led to some occurrences being expanded to account for changing population boundaries and some being updated to better reflect population locations. These data can be used to track rare plant population movements, especially for rare plants growing in naturally changing environments like active dunes or riparian areas. Continually updating boundary data will assist in future rare plant monitoring efforts.

The threats to rare plants on Central Hanford differ depending on their geographic location. Riparian rare plants such as *Lipocarpa aristulata*, *Oenothera cespitosa* ssp. *cespitosa*, *Rorippa columbiae*, and *Rotala ramosa* are threatened by changes in the management of Columbia River hydraulic cycles. If these plants are submerged during the seasons when they would typically be producing flowers and seeds, their viability is lowered and the populations stability suffers. Upland rare plant species on Central Hanford are threatened by invasive and weedy species, which overtake the habitat openings these plants rely on for germination. Most notable of the weedy species is cheatgrass, which already dominates across large swaths of Central Hanford due to wildfire converting mature shrub steppe into cheatgrass dominated fields. Continued management and protection of Central Hanford from wildfires will help prevent future conversion of rare plant habitat into cheatgrass-dominated areas; however, the long-term effects of wildfire on most rare plant populations is unknown. Herbicide drift and road hardening, both of which can potentially kill populations, threaten upland rare plants that occur near roads.

Continued monitoring of both upland and riparian rare plant species is essential to track their population stability and viability. It is also necessary to know correct boundaries of these populations in order to properly protect them from human disturbance. Though rare plant monitoring should occur on a continual basis, it will be important to assess the winter and early spring rainfall totals to determine ideal monitoring years. Past monitoring data suggests that below-average rainfall for the November to April timeframe may lead to lower germination rates of rare annual species, resulting in less plants being detected during monitoring. Repeated rare plant monitoring efforts, especially in years with relatively high precipitation, are needed to continue protecting and assessing the occurrences of the rare plant species present on Central Hanford.

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