

# Hanford Site Revegetation Monitoring Report for Fiscal Year 2019



Prepared for the U.S. Department of Energy  
Assistant Secretary for Environmental Management  
Contractor for the U.S. Department of Energy  
under Contract DE-AC06-09RL14728



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# Hanford Site Revegetation Monitoring Report for Fiscal Year 2019

September 2019

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Release Approval

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## INTRODUCTION

This report describes the monitoring of areas revegetated by the River Corridor Closure Contractor (RCCC) and CH2M Hill Plateau Remediation Company (CHPRC) that were transitioned to and monitored by Mission Support Alliance (MSA) in 2019, along with sites revegetated by MSA. Site monitoring is a continuance of efforts performed by the RCCC from fiscal year (FY) 2004 through FY 2019. This report contains data collected in 2019 documenting the recovery of revegetation areas associated with the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* cleanup of National Priorities List waste sites and restoration of lands disturbed by ongoing site mission activities at the Hanford Site in Richland, Washington. It contains vegetation monitoring data for 55 sites selected to be representative sites for areas planted between the years of FY 2004 through FY 2019. Two revegetation site monitoring efforts occurred in 2019. The first effort was traditional revegetation monitoring, which analyzes the plant composition of representative revegetated sites for 5 years after they were planted. This monitoring is summarized in Section 3.0. The second effort evaluated the long-term trends of revegetated sites that were past their fifth year of growth. This monitoring is a continuation on the long-term trend monitoring that occurred in 2018 and is summarized in Section 4.0.

Five-year monitoring efforts analyze the structure and composition of native and non-native plant species on representative revegetated sites over a 5-year period. This provides a timeline over which to evaluate restoration success and provides insight into which planting methods are most effective. Revegetation sites are considered successful if after 5 years they have a native shrub density of 600 plants/ha (240 plants/ac) and total canopy cover of 25% or greater for native plants as specified in the DOE/RL-2011-116, *Hanford Site Revegetation Manual*, and area specific revegetation plans (DOE/RL-96-17, Rev. 6, Appendix H; DOE/RL-2005-93, Rev. 1, Appendix G, and DOE/RL-2001-47, Rev. 3, Appendix C). If the structure and composition of a monitored revegetation site are determined to meet these success criteria by the fifth year, the site is considered “successful.” In addition to monitoring the representative sites, sites that were not originally monitored but are in the same area as unsuccessful representative sites may be monitored to evaluate the need for additional revegetation efforts. Sites where five-year monitoring occurred in 2019 are discussed in Section 3 of this report. For each site, Section 3.0 contains a brief summary of the revegetation activities, monitoring efforts, and tabulated species data.

This report provides fifth-year monitoring results for Pit 24, 120-N-1:1, 100-D-30/104, and 600-379; fourth-year monitoring results for 100-B-35, 100-N-96, 100-D-100, 100-H-28:2, and 600-358; third-year monitoring results for 100-N-83, 100-N-CTA, 100-D-Trailer Village, 600-385, 300-288:2, L-840 and L-525; second-year monitoring results for 100-N-CTA, 100-D-48:2, 100-D-49:2, 100-H-24, 116-H-1, 100-F-47, 118-F-1, 118-F-6, 100-F-26, 118-F-3, 100-F-57, 100-F-CTA, 100-F-Trailer Village, 118-F-5, 300-North A-D, 618-2 & 3, and L-419; and first-year monitoring results for 116-C-5, 100-K-95, 100-K-CTA, 128-D-2, 628:3, 600-301, 600-100, 600-120, 600-356, 618-10, L-853/854, and L-894. Sixth-year monitoring results are provided for 100-C-7, which was seeded after the fifth year of monitoring, and 600-370, which was planted with seedlings after the fifth year of monitoring; and seventh-year monitoring results

are provided for 128-K-2 SSA, which was planted with seedlings 2 years after the fifth year of monitoring.

Seven sites (100-N-61:1, 100-D-48:2, 100-D-49:2, 100-H-24, 116-H-1, 300-North A-D, and 618-2 & 3) in the list above were not initially monitored after planting but were monitored in 2018 and 2019. These sites were planted over 5 years ago and are located in an area where other representative sites that were monitored over the 5-year period failed to meet the prescribed success criteria. These sites were monitored to determine if they meet the success criteria noted above and, if not, to provide data that will be used to determine future revegetation strategies for the sites.

Selected sites that were determined to need additional revegetation actions in order to meet success criteria were either re-worked or had additional plugs planted in FY 2019. Sites that were re-worked in 2019 were seeded with the FY 2019 seed mix; these sites include 116-C-5, 100-K-95, 100-K-CTA, 128-D-2, 628-3 Outer, and 600-356 (Table 1). These sites also had shrub and/or forb plugs planted after seeding. Sites that only had additional plugs planted were 128-K-2, 628-3-Outer, 600-301, 600-120, 600-100, 600-370, and 600-358. First year monitoring took place at these sites in 2019.

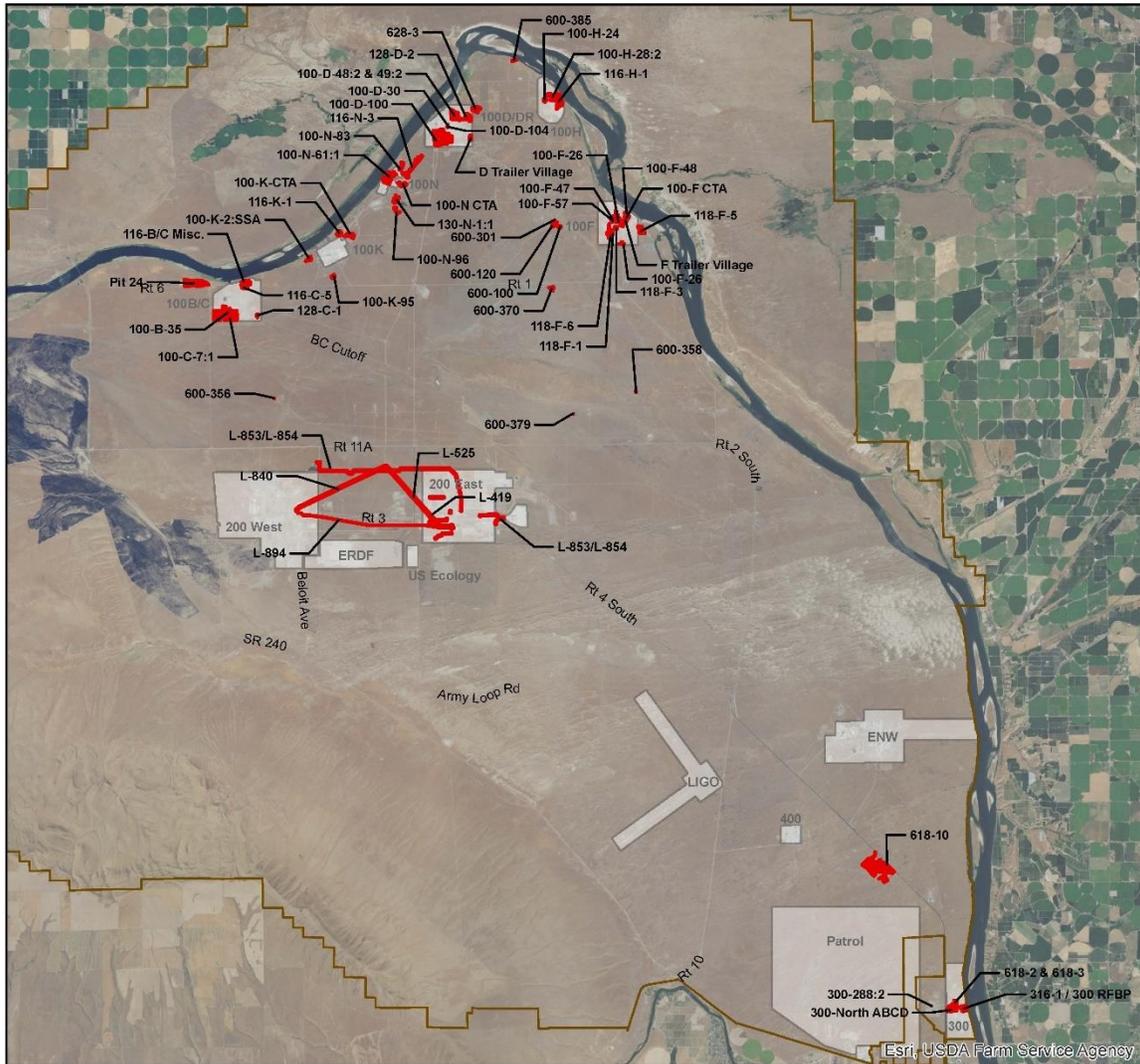
**Table 1. FY 2019 Seed Mix Used at Re-Worked Sites.**

<b>Species</b>	<b>Pounds per Acre</b>
Gray rabbitbrush ( <i>Ericameria nauseosa</i> )	0.14
Green rabbitbrush ( <i>Chrysothamnus viscidiflorus</i> )	0.14
Blue Mountain buckwheat ( <i>Eriogonum strictum</i> )	0.14
Snow buckwheat ( <i>Eriogonum niveum</i> )	0.18
Munro's globemallow ( <i>Sphaeralcea munroana</i> )	0.18
Carey's balsamroot ( <i>Balsamorhiza careyana</i> )	0.18
Crouching milkvetch ( <i>Astragalus succumbens</i> )	0.18
Cushion fleabane ( <i>Erigeron poliospernus</i> )	0.16
Threadleaf fleabane ( <i>Erigeron filifolius</i> )	0.16
Hoary falseyarrow ( <i>Chaenactis douglasii</i> )	0.16
Sandberg's bluegrass ( <i>Poa secunda</i> )	9.8
Needle-and-thread grass ( <i>Hesperostipa comata</i> )	7.0
Indian ricegrass ( <i>Oryzopsis hymenoides</i> )	5.6
Bottlebrush squirreltail ( <i>Elymus elymoides</i> )	5.6

Additional monitoring efforts took place in 2019 to evaluate the long-term trends of revegetation sites past their fifth year of growth. In 2018, 12 revegetation sites planted from 2002 to 2007 were monitored to determine revegetation success after 10 to 16 years. Five of these sites were revisited in 2019 in order to collect more canopy cover data and to track site changes. Data collected from older revegetation sites may show that sites trend towards success in the long-term, or may indicate that without intervention unsuccessful sites will not improve in this time-period. These data will be used to inform future revegetation efforts, especially intervention efforts at unsuccessful sites. See Section 4.0 for the results from this monitoring effort.

This report provides long-term trend data for the following sites with the year planted in parentheses: 116-B/C Misc. (FY 2007), 128-C-1 (FY 2006), 116-K-1 (FY 2006), 116-N-3 (FY 2005), and 316-1/300 Retired Filter Backwash Pond (RFBP) (FY 2004).

The locations of the 55 sites monitored in 2019 are shown in Figure 1.



- Legend**
- FY2019 Revegetation Monitoring Sites
  - Management Areas
  - Hanford Site Boundary

NOTE: Aerial Imagery, 2017, NAIP.



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**Revegetation Monitoring Sites, 2019**

Hanford Site, Benton County, WA

**Figure 1. Map of Revegetation Sites Monitored in 2019.**

## METHODS

The 2019 revegetation monitoring of 5-year monitoring sites consisted of two quantitative measurements taken at all sites. The first consisted of repeated measurements to estimate canopy cover and frequency of occurrence of all plant species observed within a series of plot frames. The second included the counting of transplanted shrubs/trees within an established transect area to estimate overstory density (plants/ha) for the site. Shrub and tree species include big sagebrush (*Artemisia tridentata*), spiny hopsage (*Grayia spinosa*), and antelope bitterbrush (*Purshia tridentata*) in upland areas; and Wood's rose (*Rosa woodsii*), golden currant (*Ribes aureum*), black cottonwood (*Populus balsamifera*), narrowleaf willow (*Salix exigua*), peachleaf willow (*Salix amygdaloides*), and redosier dogwood (*Cornus sericea*) in riparian areas. In FY 2019, select revegetation sites were planted with forb plugs, including snow buckwheat (*Eriogonum niveum*), Munro's globemallow (*Sphaeralcea munroana*), and cushion fleabane (*Erigeron poliospermus*). The data collected using these methods allows the analysis of relative seral stages, general site progression, as well as site trends and provides a way to analyze the long-term achievement of management objectives.

Frequency of occurrence and canopy cover measurements were obtained using the methods described in *Steppe Vegetation of Washington* (Daubenmire 1970). Canopy coverage is defined in Daubenmire (1970) as "the percentage of ground surface included in the vertical projection of a polygon drawn around the extremities of undisturbed foliage of a plant." The plot frame encompasses a 0.5-m<sup>2</sup> (5.4-ft<sup>2</sup>) area. The name and relative amount of ground cover for each rooted species within the confines of the plot frame is documented for each plot-frame measurement. The total vegetation can exceed 100% with this method due to species overlapping when plot measurements are taken in densely vegetated areas. Depending on the size of the restoration site, a number of plot-frame measurements were collected and analyzed to estimate canopy cover for each species present. Frequency was represented as the percentage of occurrences a species was observed within the given number of plot frames measured. For example, if a species was represented in 10 out of 25 plot frames, its frequency would be  $10/25 \times 100 = 40\%$ . The relative magnitude of a frequency rating in comparison to a canopy coverage rating provides an index of species distribution and its influence within a vegetation community. Species that were observed within a revegetated area but were not counted in a plot frame were recorded as occurrences and denoted as an "X" in the tables. Frequency of occurrence and canopy cover measurements were taken between April 1 and May 16, 2019. Listed Washington State noxious weed species identified within the monitoring areas are identified in the site monitoring result tables with their state class designation (e.g., A, B, or C). Washington State noxious weed classes are defined as:

*"Noxious weed" is the traditional, legal term for invasive, non-native plants that are so aggressive they harm ecosystems or disrupt agricultural production. These plants crowd out the native species that fish and wildlife depend on. Washington State separates noxious weeds into three classifications. Class A noxious weeds are usually newcomers to Washington, and are generally rare. The goal is to completely eradicate them before they gain a foothold. Class B noxious weeds are widespread in some areas of the state, but limited or absent in other parts of the state. The goal is to prevent them from spreading into new areas, and to contain or reduce their population in already infested areas. Class C Noxious*

*weeds are often widespread, or are of special interest to the agricultural industry.* (NWCB 2017).

Ground cover type was factored into the vegetative cover calculation for each site. The measurement “Unavailable Space” used the Daubenmire method to calculate the percentage of each site where vegetation was unable to grow. An example of this would be a large boulder or area with large rocks or concrete pads within the revegetation area. The amount of space considered unavailable is subtracted from 100% to represent the available growing space. Vegetative cover is then divided by the available growing space to represent the actual vegetative cover in a revegetation site. For example, if a site had 5% unavailable space and 20% vegetative cover, the adjusted vegetative cover to represent plants growing in the available growing space would be:

$$\frac{\% \text{ vegetative cover}}{\% \text{ available growing space}} * 100\% = \frac{20\%}{95\%} * 100\% = \mathbf{21\%}$$

Changes in native and invasive cover are reported based on the unadjusted vegetative cover data, as data collected in 2018 was not adjusted to represent available growing space.

The evaluation of shrub density was determined through the establishment of stationary transect areas that are monitored annually over a 5-year period. In most cases, transects are 100 m (328 ft) in length with offsets to either side of up to 5 m (16.4 ft); shorter (25 to 75 m [82 to 246 ft]) transects have been established at sites too small to support a 100-m (328-ft) transect. The number of live shrubs within the established transect area (typically a 1,000-m<sup>2</sup> [10,764-ft<sup>2</sup>] area) was extrapolated to derive the shrub density for the site each year. For example, the 100-B-35 site in B Area has a 100-m (328-ft) transect with 5-m (16.4-ft) offsets that equates to a 1,000-m<sup>2</sup> (10,764-ft<sup>2</sup>) transect area. A total of 69 native shrubs were recorded within the transect area in 2019. Using the conversion factor of 1 hectare = 10,000 m<sup>2</sup>, (1 acre = 4,047 m<sup>2</sup>), we can derive that the shrub density for the site in 2019 was 690 plants/ha (279 plants/ac), meeting the shrub cover success criteria of 600 plants/ha (240 plants/ac). Using the same methods, planted forbs were monitored for survival at representative sites in 2019. Transect data were collected between May 20 and July 8, 2019.

Long-term trend monitoring sites were monitored only using frequency of occurrence and canopy cover measurements described in the report *Steppe Vegetation of Washington* (Daubenmire 1970). Shrub density transects were not established for these sites.

Plant identifications in the 2019 monitoring efforts use the current nomenclature from the United States Department of Agriculture (USDA) PLANTS Database (USDA 2019). Appendix A of this report lists the current scientific and common names from the USDA database along with synonyms possibly used in previous revegetation monitoring reports from *Flora of the Pacific Northwest* (Hitchcock and Cronquist 1973) and/or *Vascular Plants of the Hanford Site* (Sackschewsky and Downs 2001).

As of September 2019, the Hanford Site Revegetation Monitoring Reports for FY 2016, 2017, and 2018 are available online at <https://www.hanford.gov/page.cfm/EcologicalMonitoring>.

## MONITORING RESULTS – 5-YEAR MONITORING SITES

This section describes the revegetation site data collected during the 2019 revegetation monitoring efforts. See Section 4.0 for long-term trend data.

### 1.1 100 B/C AREA SITES

Four sites were monitored in the 100 B/C Area: Pit 24, 100-B-35, 100-C-7, and 116-C-5. The Pit 24 and 100-B-35 sites were revegetated in FY 2015 and FY 2016, respectively. The 100-C-7 site was originally revegetated in FY 2014 and seed was added to the site in FY 2019 in an effort to increase native canopy cover. The 116-C-5 site was re-worked in FY 2019 and first year monitoring took place in 2019. These sites were remediated to meet the objectives for interim closure as established in DOE/RL-96-17, *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, (100 Area RDR/RAWP) and in the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 10-DR-2, 100-FR-1, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Interim Action ROD) (EPA 1999).

Revegetation efforts at the upland area of Pit 24 and 100-B-35 entailed broadcast seeding at approximately 16.8 kg/ha (15 lbs/ac) with a mixture of native grasses including Sandberg bluegrass (*Poa secunda*), Indian ricegrass (*Achnatherum hymenoides*), bluebunch wheatgrass (*Pseudoroegneria spicata*), squirreltail (*Elymus elymoides*), needle-and-thread grass (*Hesperostipa comata*), and prairie junegrass (*Koeleria macrantha*) topped with a straw mulch that was crimped into the soil surface. Shrub species including big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), and spiny hopsage (*Grayia spinosa*) were transplanted on the sites at approximately 1,235 to 1,600 plants/ha (500 to 650 plants/ac) with a mix of approximately 75% sagebrush, 15% bitterbrush, and 10% spiny hopsage.

#### 1.1.1 Pit 24 Site (600-253, Gravel Pit #24)

The Pit 24 site was revegetated in FY 2015 and monitoring for the site was first conducted in 2015. Remediation efforts at the site included revegetation of the upland areas and creation of wetland habitat with establishment of associated aquatic and riparian vegetation (Figure 2). This provided for three distinct ecological areas (upland, riparian, and wetland). Previous revegetation monitoring has included data collection from 4 upland transects and 10 riparian area transects; data has not been collected from 9 of the riparian areas due to seasonal water fluctuations and in-water hazards. High water levels were present on the site through July 2019, covering the majority of the established transects in the riparian area. One riparian transect, called the Transition Zone, was not submerged and could be monitored. Due to the persistent high water levels, no revegetation monitoring data were collected for the Pit 24 Riparian Area. In 2017, no revegetation monitoring data were collected for the riparian areas or Upland Transect 3 and Upland Area 3 due to high water levels that covered the area. In 2018, Upland Transect 3 and Upland Area 3 were monitored; Upland Transect 3 saw significant dieoffs.



**Figure 2. Mule Deer (*Odocoileus hemionus*) Using the Wetland Area of the Pit 24 Site in 2019.**

Upland shrub transects were established in 2015. Fifth-year monitoring of the upland transects was conducted in May 2019; the results show an overall shrub density of 619 plants/ha (251 plants/ac) for Upland Transects 1, 2, and 4, currently meeting the shrub density success criteria of 600 plants/ha (240 plants/ac). Shrub survival for the upland areas was 98% of that observed in 2018. Upland Transect 3 was excluded from this calculation due to 80% of the shrubs dying after summer 2017, likely due to being submerged under water for a prolonged period. Average sagebrush (*Artemisia tridentata*) size was 0.17 m (0.56 ft) high by 0.18 m (0.59 ft) wide, and average bitterbrush (*Purshia tridentata*) size was 0.16 m (0.52 ft) high by 0.30 m (0.98 ft) wide.

The transition zone shrub transect (Transect 10 in previous reports) had not been monitored since 2016 and had been planted with supplemental upland forbs since the original monitoring. This transect included sagebrush, bitterbrush, and black cottonwood (*Populus balsamifera*). Shrub density at this transect was 580 plants/ha (235 plants/ac). This is below success levels, likely because the transect was submerged in 2017.

Canopy cover data for the upland areas was collected in April 2019 (Figure 3). The upland canopy cover averaged 40.0% with native cover representing 22.1% and invasive cover representing 17.9% (Table 1). This represents an increase of 8.1% in native cover and an increase of 4.4% in invasive cover from 2018. Cheatgrass (*Bromus tectorum*) was the dominant species with 9.5% canopy cover and occurrence in 99% of the plot frames. Native grasses including Sandberg bluegrass (*Poa secunda*) and bluebunch wheatgrass (*Pseudoroegneria spicata*) were the dominant native species with 9.3% and 5.4% canopy cover, respectively. Eighteen native species were recorded growing in the upland area of this site.

Diffuse knapweed (*Centaurea diffusa*), common reed (*Phragmites australis*), kochia (*Bassia scoparia*), and saltcedar (*Tamarix ramosissima*), all Washington State Class B noxious weeds, as

well as reed canarygrass (*Phalaris arundinacea*), a Washington State Class C noxious weed, were present on the site. Diffuse knapweed was the most widespread with 2.3% cover and occurrence in 26% of the plot frames, increasing from last year. Herbicidal treatment of diffuse knapweed, common reed, saltcedar, and reed canarygrass occurred in summer 2018; continual treatment is planned.

As in previous years, evidence of wildlife use of the area was observed. Frogs and mule deer are commonly observed at the site and multiple birds (e.g., red-winged black birds, yellow-headed black birds, American pelicans, northern harriers, magpies, blue herons, kill deer, and swallows) were all observed using the site during 2019 monitoring.

This is the last year of routine monitoring for the Pit 24 site. Upland shrub cover is successful and upland native plant cover is nearing success levels and is trending positively. No further interventions to increase upland native plant cover are recommended at this site, as it will likely reach 25% native cover independently as plants continue to grow and reproduce. Continued maintenance of noxious weeds is recommended at this site.

**Table 2. Percent Canopy Cover and Frequency of Occurrence at Pit 24 Site (Upland Areas) in 2019 (2 Pages).**

Species	Combined Upland Areas	
	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.03	1.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	2.1	17.8
<i>Artemisia tridentata</i> (big sagebrush)	1.4	8.0
<i>Artemisia tridentata</i> (recruits)	X	X
<i>Bassia scoparia</i> (kochia) (B) <sup>(b)</sup>	X	X
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	9.5	98.8
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	2.3	26.3
<i>Chaenactis douglasii</i> (Douglas' dustymaiden)	0.1	3.0
<i>Descurainia pinnata</i> (western tansymustard)	0.1	3.0
<i>Elymus elymoides</i> (squirreltail)	X	X
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.1	2.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.7	9.0
<i>Eriogonum vimineum</i> (wickerstem buckwheat)	0.5	27.5
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	0.3	19.4
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.2	6.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	1.0	40.6
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.7	15.6
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.03	0.03
<i>Melilotus officinalis</i> (sweet clover) <sup>(a)</sup>	X	X
<i>Phalaris arundinacea</i> (reed canarygrass) <sup>(b)</sup> (C)	X	X
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	0.1	4.0
<i>Poa secunda</i> (Sandberg bluegrass)	9.3	95.7
<i>Populus baslamifera</i> (black cottonwood)	X	X

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<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	5.4	45.7
<i>Purshia triedntata</i> (antelope bitterbrush)	X	X
<i>Rosa woodsii</i> (Woods' rose)	X	X
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	2.5	72.2
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	0.1	3.1
<i>Sporobolus cryptandrus</i> (sand dropseed)	0.3	2.2
<i>Tamarix ramosissima</i> (saltcedar) <sup>(b)</sup> (B)	X	X
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X
<i>Verbascum thapsus</i> (common mullein) <sup>(a)</sup>	X	X
<i>Vulpia microstachys</i> (desert fescue)	0.6	20.0
Crust	0.5	20.5
Soil	26.8	106.7
Litter	14.9	72.2
Rock/Cobble	61.7	125.6
Unavailable Space	6.8	97.7
<b>Total Canopy Cover</b>	<b>40.0</b>	
<b>Native % Cover</b>	<b>22.1</b>	
Invasive % Cover	17.9	
Unadjusted Canopy Cover (excludes ground cover)	37.3	
Unadjusted Native % Cover	20.6	
Change in Native % Cover from 2018	8.1	
Unadjusted Invasive % Cover	16.6	
Change in Invasive % Cover from 2018	4.4	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 3. An Upland Area of Pit 24 in April 2019, Showing Native Shrubs and Bunchgrasses.**

### **1.1.2 100-B-35 Site (Electrical Substation)**

The 100-B-35 site (Figure 4) was revegetated in FY 2016 and monitoring for the site was first conducted in 2016. The substrate for the site consists predominantly of cobbles with varying amounts of sandy loam.

A shrub monitoring transect was established for the site in 2016. Fourth-year monitoring was conducted in May 2019; the results show a shrub density of 690 plants/ha (279 plants/ac), above the shrub density success criteria of 600 plants/ha (240 plants/ac). Shrub survival was 73.6% of that observed in 2018. Average shrub size was 0.32 m (1.05 ft) high by 0.23 m (0.75 ft) wide.

Canopy cover data for the site was collected in April 2019. Canopy cover for the site was 31.2% with native cover representing 17.8% and invasive cover representing 13.4% (Table 2). This represents an increase of 7.2% in native cover and an increase of 2.1% in invasive cover from 2018. Native cover was dominated by Sandberg's bluegrass (*Poa secunda*) with 8.4% cover and bluebunch wheatgrass (*Pseudoroegneria spicata*) with 3.7% cover. Cheatgrass (*Bromus tectorum*) was the dominant species at the site with a coverage of 6.8%. Twelve native species were recorded at this site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed on the site and had less than 1% cover.

**Table 3. Percent Canopy Cover and Frequency of Occurrence at the 100-B-35 Site in 2019.**

Species	% Cover	% Frequency of Occurrence
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.8	32.0
<i>Artemisia tridentata</i> (big sagebrush)	2.8	16.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	6.8	100.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	0.7	8.0
<i>Chorispora tenella</i> (crossflower) <sup>(a)</sup>	X	X
<i>Chrysothamnus viscidiflorus</i> (yellow rabbitbrush)	X	X
<i>Descurcainia pinnata</i> (western tansymustard)	0.2	8.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.5	20.0
<i>Elymus elymoides</i> (squirreltail)	0.1	4.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.2	8.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	0.1	4.0
<i>Grayia spinosa</i> (spiny hopsage)	0.2	8.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.7	28.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.4	16.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.3	12.0
<i>Melilotus officinalis</i> (sweet clover) <sup>(a)</sup>	X	X
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	8.4	96.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	3.7	68.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	1.6	64.0
<i>Sisymbrium altissimum</i> (tall tumbledustard) <sup>(a)</sup>	1.7	68.0
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X
Crust	0.6	4.0
Soil	3.3	56.0
Litter	18.9	100.0
Rock/Cobble	71.1	100.0
Unavailable Space	6.4	60.0
<b>Total Canopy Cover %</b>	<b>31.2</b>	
<b>Native Cover %</b>	<b>17.8</b>	
Invasive Cover %	13.4	
Unadjusted Canopy Cover	29.2	
Unadjusted Native % Cover	16.7	
Change in Native Cover from 2018	7.2	
Unadjusted Invasive % Cover	12.5	
Change in Invasive % Cover from 2018	2.1	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 4. The 100-B-35 Site in 2019.**

### 1.1.3 100-C-7 Site (183-C Water Treatment Facility Head House Foundation)

The 100-C-7 site (Figure 5) was revegetated in FY 2014 and monitoring for the site was first conducted in 2014. Fifth year monitoring for this site was completed in 2018, reporting 10.4% native cover and 21.3% invasive cover. Shrub transects reported successful shrub cover. In an effort to increase native cover this site was seeded in December 2018 with native forb and shrub seed (Table 4). Seed was broadcast over 297 ha (120 ac) using a broadcast seeder mounted on an ATV. Species seeded at 100-C-7 were chosen specifically to support pollinator populations in the surrounding area in an effort to increase pollinator habitat and to increase the health of the native plant population at this site.

**Table 4. Species Seeded at 100-C-7 in December 2018 (2 Pages)**

<b>Species</b>	<b>Pounds Seeded</b>	<b>Detected 2019?</b>	<b>Detected 2018?</b>
Blue Mountain buckwheat ( <i>Eriogonum strictum</i> )	2.4	Yes	No
Carey's balsamroot ( <i>Balsamorhiza careyana</i> )	6	Yes	No
Crouching milkvetch ( <i>Astragalus succumbens</i> )	11.5	Yes	Yes
Cushion fleabane ( <i>Erigeron poliospermus</i> )	2.4	Yes	No
Douglas' dustymaiden ( <i>Chaenactis douglasii</i> )	28	Yes	No
Gray rabbitbrush ( <i>Ericameria nauseosa</i> )	30	Yes	Yes
Green rabbitbrush ( <i>Chrysothamnus viscidiflorus</i> )	4.3	No	No
Munro's globemallow ( <i>Sphaeralcea munroana</i> )	28	Yes	No

Sand penstemon ( <i>Penstemon acuminatus</i> )	23	Yes	Yes
Snow buckwheat ( <i>Eriogonum niveum</i> )	13	Yes	No
Threadleaf fleabane ( <i>Erigeron filifolius</i> )	2.6	Yes	No

Due to the large size of the site, it was divided into 10 areas with 25 plot frames per area, totaling 250 plot frames across the site. This is consistent with previous annual monitoring techniques. The site in general has a predominantly cobble substrate; however, areas within the excavation footprint have higher amounts of sand and loamy sand than the surrounding areas (outside of the excavation footprint), which have higher amounts of loam and sandy loam.

Canopy cover data for the site was collected in May 2019. Sitewide canopy cover averaged 40.4% with native cover representing 15.7% and invasive cover representing 24.7% (Table 5). This represents an increase of 3.9% in native cover and an increase of 1.6% in invasive cover from 2018. Thirty native species were recorded at this site, an increase from the seventeen native species found in 2018 monitoring. The dominant native species was Sandberg's bluegrass (*Poa secunda*) at 4.2% followed by bluebunch wheatgrass (*Pseudoroegneria spicata*) at 3.4% (Figure 5). Cheatgrass (*Bromus tectorum*) was the dominant species overall with 15% coverage.

Ten of the eleven native species that were seeded in December 2018 were detected during 2019 plot monitoring (Figure 6). Of these, only three had been detected on the 100-C-7 site in the past. This suggests that the seeding effort in 2018 was successful in increasing native species diversity at the 100-C-7 site. Continued monitoring will be necessary to track the long term success of this seeding effort.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weeds, were observed in both areas of the site. Diffuse knapweed had 1.8% cover in each area and occurrence in about 37% of the plot frames. This is an increase of 10% occurrence from 2018 and of 23% from 2017. Dalmatian toadflax (*Linaria dalmatica*) and kochia (*Bassia scoparia*), both Washington State Class B noxious weeds, were observed in the site but did not occur in any plot frames. Noxious weed control is recommended to ensure the ecological integrity of this site.

**Table 5. Percent Canopy Cover and Frequency of Occurrence at the 100-C-7 Site in 2019 (3 Pages).**

Species	Site Average	
	% Cover	% Freq
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Achnatherum hymenoides</i> (Indian ricegrass)	1.8	27.5
<i>Ambrosia acanthicarpa</i> (flatspine bur ragweed)	0.1	4.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	1.9	10.8
<i>Artemisia tridentata</i> (recruits)	0.4	13.3

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<i>Astragalus purshii</i> (woollypod milkvetch)	X	X
<i>Astragalus succumbens</i> (crouching milkvetch)	0.1	4.0
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	0.1	4.0
<i>Bassia scoparia</i> (kochia) (B) <sup>(b)</sup>	X	X
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	15.0	100.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	1.8	37.2
<i>Chaenactis douglasii</i> (Douglas' dustymaiden)	0.1	5.0
<i>Descurcania pinnata</i> (western tansymustard)	0.6	20.4
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.6	24.8
<i>Elymus elymoides</i> (squirreltail)	0.1	4.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.4	15.1
<i>Ericamerua nauseosa</i> (rubber rabbitbrush)	0.3	8.0
<i>Erigeron filifolius</i> (threadleaf fleabane)	X	X
<i>Erigeron poliospermus</i> (cushion fleabane)	X	X
<i>Erigeron pumilus</i> (shaggy fleabane)	X	X
<i>Eriogonum</i> sp. (snow/Blue Mountain buckwheat)	0.1	4.0
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	1.1	15.5
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.7	9.1
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	1.4	54.4
<i>Hordeum leporinum</i> (hare barley) <sup>(a)</sup>	0.1	2.7
<i>Koeleria macrantha</i> (prairie junegrass)	0.1	4.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	1.1	44.0
<i>Lamium amplexicaule</i> (henbit deadnettle) <sup>(a)</sup>	0.4	16.0
<i>Layia glandulosa</i> (white-daisy tidytips)	0.1	4.0
<i>Linaria dalmatica</i> (dalmatian toadflax) (B) <sup>(b)</sup>	X	X
<i>Linum perenne</i> (wild blueflax) <sup>(a)</sup>	X	X
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.1	4.0
<i>Melilotus officinalis</i> (sweet clover) <sup>(a)</sup>	1.3	12.0
<i>Microsteris gracilis</i> (slender phlox)	0.1	4.0
<i>Oenothera pallida</i> (pale-evening primrose)	X	X
<i>Penstemon acuminatus</i> (sharpleaf penstemon)	0.1	4.0
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	0.4	10.7
<i>Poa secunda</i> (Sandberg bluegrass)	4.2	64.4
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	3.4	34.8
<i>Purshia tridentata</i> (antelope bitterbrush)	1.2	5.3
<i>Ranunculus testiculatus</i> (burr buttercup) <sup>(a)</sup>	0.1	4.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	1.6	60.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	0.3	11.3
<i>Sphaeralcea munroana</i> (Munro's globemallow)	0.1	4.0
<i>Sporobolus cryptandrus</i> (sand dropseed)	X	X

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<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X
<i>Vulpia microstachys</i> (desert fescue)	0.9	37.6
Crust	2.5	38.0
Soil	6.4	42.8
Litter	23.4	89.2
Rock/Cobble	37.1	89.2
Unavailable Space	7.3	87.2
<b>Total Canopy Cover</b>	<b>40.4</b>	
<b>Native % Cover</b>	<b>15.7</b>	
Invasive % Cover	24.7	
Unadjusted Canopy Cover	37.4	
Unadjusted Native % Cover	14.5	
Change in Native % Cover from 2018	3.9	
Unadjusted Invasive % Cover	22.9	
Change in Invasive % Cover from 2018	1.6	

<sup>a</sup> = Invasive species

<sup>b</sup> = Washington State Classified Noxious Weed (class)

X = present but not counted in plots





**Figure 5. The 100-C-7 Site in 2019. Top: Shrub and Bunchgrass Coverage in a Rockier Portion of the 100-C-7 Site. Bottom: Increased Cheatgrass Coverage in a Loamier Portion of the 100-C-7 Site.**



**Figure 6. Left: Carey's Balsamroot Sprouting in an Area with Heavy Cheatgrass Coverage at the 100-C-7 Site. Right: Munro's Globemallow Sprouting in a Cobble-Heavy Area of the 100-C-7 Site.**

#### 1.1.4 116-C-5 Site (107-C Retention Basin)

The 116-C-5 Site was planted in FY 2007. Routine monitoring did not take place at this site after it was originally planted. The substrate at this site is a high amount of cobble and rock mixed with loam. This site was identified as an area within the larger 116-B/C-Misc. Site where native species cover was significantly lower and that needed additional revegetation work to bring it up to success levels. This site was re-done in FY 2019 and seeded with shrub, forb, and grass species (Table 6). Sagebrush (*Artemisia tridentata*) and snow buckwheat (*Eriogonum niveum*) seedlings were planted at this site (Figure 7).

**Table 6. Species seeded at the 116-C-5 Site in 2019.**

Species	Detected in 2019?	Pounds per Acre
Gray Rabbitbrush ( <i>Ericameria nauseosa</i> )	Yes	0.14
Green Rabbitbrush ( <i>Chrysothamnus viscidiflorus</i> )	No	0.14
Blue Mountain Buckwheat ( <i>Eriogonum strictum</i> )	No	0.14
Snow Buckwheat ( <i>Eriogonum niveum</i> )	Yes	0.18
Munro's globemallow ( <i>Sphaeralcea munroana</i> )	No	0.18
Carey's balsamroot ( <i>Balsamorhiza careyana</i> )	Yes	0.18
Crouching milkvetch ( <i>Astragalus succumbens</i> )	No	0.18
Cushion fleabane ( <i>Erigeron poliospernus</i> )	Yes	0.16
Threadleaf fleabane ( <i>Erigeron filifolius</i> )	No	0.16
Hoary falseyarrow ( <i>Chaenactis douglasii</i> )	No	0.16
Sandberg's bluegrass ( <i>Poa secunda</i> )	Yes	9.8
Needle-and-thread grass ( <i>Hesperostipa comata</i> )	Bunchgrasses	7.0
Indian ricegrass ( <i>Oryzopsis hymenoides</i> )	Bunchgrasses	5.6
Bottlebrush squirreltail ( <i>Elymus elymoides</i> )	Bunchgrasses	5.6

Canopy cover data for the site was collected in April 2019. Data was collected from 25 plot frames. Canopy cover for the site overall was 24.2% with 11.5% native cover and 10.4% invasive cover (Table 7). Twelve native species were recorded at this site in 2019. The dominant native species were bunchgrasses, with 6.0% coverage. The dominant invasive species was cheatgrass (*Bromus tectorum*) with 8.8% coverage.

A shrub survival transect was not established at this site due to its small size. Planted sagebrush had a coverage of 0.4% and occurred in 12% of the plot frames.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed on the site and had less than 1% cover.

Table 7. Percent Canopy Cover and Frequency of Occurrence at the 116-C-5 Site in 2019 (2 Pages).

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Artemisia tridentata</i> (big sagebrush) existing	0.1	4.0
<i>Artemisia tridentata</i> (big sagebrush) planted	0.4	12.0
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	0.1	4.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	8.8	80.0
<i>Bunchgrass</i> sp. (multiple)	6.0	72.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	0.4	12.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.3	8.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.1	4.0
<i>Erigeron poliospermus</i> (cushion fleabane)	0.8	4.0
<i>Eriogonum niveum</i> (snow buckwheat) existing	1.6	32.0
<i>Eriogonum niveum</i> (snow buckwheat) planted	0.1	4.0
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.1	4.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.5	16.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.3	8.0
<i>Melilotus officinalis</i> (sweet clover) <sup>(a)</sup>	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	4.1	72.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.1	4.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	0.1	4.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	X	X
Crust	0.3	8.0
Soil	0.9	8.0
Litter	80.0	80.0
Rock/Cobble	11.0	76.0
Unavailable Space	1.4	24.0
<b>Total Canopy Cover</b>	<b>24.2</b>	
<b>Native Cover %</b>	<b>11.5</b>	
Invasive Cover %	10.4	
Unadjusted canopy cover	23.9	
Unadjusted Native % Cover	11.4	
Unadjusted Invasive % Cover	10.3	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 7. Snow buckwheat and bunchgrasses growing at the 116-C-5 Site in 2019.**

## **1.2 100-K AREA SITES**

Low native species cover and shrub survival measurements in 2017 monitoring led to the 100-K-95, 100-K-CTA, and the 128-K-2 SSA sites being recommended for additional revegetation actions. The 100-K-95 and 100-K-CTA sites were both redone in FY 2019, and the 128-K-2-SSA site had forb seedlings added in FY 2019.

### **1.2.1 100-K-95 Site (100-K Tar Dump)**

The 100-K-95 Site was originally revegetated in FY 2014. Fourth-year monitoring in 2017 showed a shrub density of 220 plants/ha (89 plants/ac) due to a large die off of shrubs after the first year (2014 to 2015). 2017 canopy cover measurements show 69.1% coverage with only 5.2% being native species. Big sagebrush (*Artemisia tridentata*) was the dominant native species at the time of 2017 monitoring, cheatgrass (*Bromus tectorum*) had a coverage of 55.4%.

The 100-K-95 Site was redone in FY 2019 (Figure 8). This site was broadcast seeded with shrub, forb, and grass species (Table 8). Care was taken to avoid crushing mature sagebrush plants during this process. This site was also planted with sagebrush, bitterbrush (*Purshia tridentata*), and hopsage (*Grayia spinosa*) seedlings.

**Table 8. Species seeded at the 100-K-95 Site in FY 2019.**

Species	Detected in 2019?	Pounds per Acre
Gray Rabbitbrush ( <i>Ericameria nauseosa</i> )	Yes	0.14
Green Rabbitbrush ( <i>Chrysothamnus viscidiflorus</i> )	No	0.14
Blue Mountain Buckwheat ( <i>Eriogonum strictum</i> )	No	0.14
Snow Buckwheat ( <i>Eriogonum niveum</i> )	Yes	0.18
Munro's globemallow ( <i>Sphaeralcea munroana</i> )	Yes	0.18
Carey's balsamroot ( <i>Balsamorhiza careyana</i> )	No	0.18
Crouching milkvetch ( <i>Astragalus succumbens</i> )	No	0.18
Cushion fleabane ( <i>Erigeron poliospernus</i> )	Erigeron sp.	0.16
Threadleaf fleabane ( <i>Erigeron filifolius</i> )	Erigeron sp.	0.16
Hoary falseyarrow ( <i>Chaenactis douglasii</i> )	Yes	0.16
Sandberg's bluegrass ( <i>Poa secunda</i> )	Yes	9.8
Needle-and-thread grass ( <i>Hesperostipa comata</i> )	Yes	7.0
Indian ricegrass ( <i>Oryzopsis hymenoides</i> )	Yes	5.6
Bottlebrush squirreltail ( <i>Elymus elymoides</i> )	Yes	5.6

Canopy cover monitoring was performed at the 100-K-95 Site in April 2019. Total canopy cover was 38.1%, with 7.6% native and 30.5% invasive cover (Table 9). Native cover had increased by 2.4% since 2017 monitoring. Seventeen native species were recorded growing at this site, nine of which were seeded during 2019 revegetation efforts. This is an increase from the 11 native species detected during 2017 monitoring. The dominant native species were unidentified young bunchgrasses, which had a coverage of 2.3%. Big sagebrush remaining from the initial revegetation had a coverage of 1.5%. The dominant invasive species remains cheatgrass, which had a coverage of 22.5%.

First-year shrub transect monitoring was conducted in July 2019. One 100-m transect was established during the revegetation process in order to track shrub planting density and quality. This transect was used for survival monitoring in July. Shrubs planted in FY 2014 and 2019 were both recorded on this transect. Including existing shrubs, shrub density was 909 plants/ha (368 plants/ac). Considering only the shrubs that had been planted in 2019, shrub density was 730 plants/ha (295 plants/ac), which is above success criteria. The average sagebrush size at this site was 0.1 m (0.33 ft) high by 0.1 m (0.33 ft) wide.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed on the site but was not detected during canopy cover monitoring.

**Table 9. Percent Canopy Cover and Frequency of Occurrence at the 100-K-95 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achnatherum hymenoides</i> (Indian ricegrass)	1.2	8.0

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<i>Artemisia tridentata</i> (big sagebrush)	1.5	4.0
<i>Artemisia tridentata</i> (planted)	0.3	12.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	22.5	92.0
Bunchgrass sp. (multiple)	2.3	52.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	X	X
<i>Chaenactis douglasii</i> (Douglas' dustymaiden)	X	X
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	2.6	64.0
<i>Elymus elymoides</i> (squirreltail)	0.1	4.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.1	4.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.0	0.0
<i>Erigeron</i> (sp.)	X	X
<i>Eriogonum niveum</i> (snow buckwheat)	X	X
<i>Grayia spinosa</i> (planted)	X	X
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.1	4.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	4.0	80.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	X	X
<i>Lomatium gormanii</i> (Gorman's biscuitroot)	0.1	4.0
<i>Matricaria chamomilla</i> (wild chamomile) <sup>(a)</sup>	X	X
<i>Microsteris gracilis</i> (slender phlox)	1.0	40.0
<i>Poa secunda</i> (Sandberg bluegrass)	0.9	16.0
<i>Purshia tridentata</i> (planted)	X	X
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	0.8	32.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	0.6	24.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
Crust	0.2	8.0
Soil	28.1	72.0
Litter	69.3	100.0
Rock/Cobble	0.8	32.0
Unavailable Space <sup>c</sup>	0.0	0.0
<b>Total canopy cover</b> (excludes crust/soil/litter)	<b>38.1</b>	
<b>Total Native % Cover</b>	<b>7.6</b>	
Total Invasive % Cover	30.5	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames

<sup>c</sup> Not measured at this site



**Figure 8. The 100-K-95 Site in 2019, Showing Straw from Revegetation the Previous Winter. Note the Mature Sagebrush on the Outskirts that was Avoided during Revegetation Activities.**

### 1.2.2 100-K-CTA Site (Container Transfer Area)

The 100-K-CTA site was originally revegetated in FY 2015. Due to a lack of shrubs that established on the site during initial monitoring in 2016, no shrub transect was established for this site. The 2017 canopy cover monitoring found 38.4% coverage, with 7.6% native cover and 30.8% invasive cover. Additional revegetation efforts were recommended to increase native species cover and to improve the shrub establishment on the site. The substrate at this site is mostly loam with large cobbles interspersed throughout.

The 100-K-CTA site was redone in FY 2019 (Figure 9). This site was broadcast seeded with shrub, forb, and grass species (Table 10). Care was taken to avoid crushing mature sagebrush plants during this process. This site was also planted with sagebrush, bitterbrush (*Purshia tridentata*), and hopsage (*Grayia spinosa*) seedlings.

**Table 10. Species seeded at the 100-K-CTA Site in 2019 (2 Pages).**

Species	Detected in 2019?	Pounds per Acre
Gray Rabbitbrush ( <i>Ericameria nauseosa</i> )	Yes	0.14
Green Rabbitbrush ( <i>Chrysothamnus viscidiflorus</i> )	No	0.14
Blue Mountain Buckwheat ( <i>Eriogonum strictum</i> )	No	0.14
Snow Buckwheat ( <i>Eriogonum niveum</i> )	Yes	0.18
Munro's globemallow ( <i>Sphaeralcea munroana</i> )	Yes	0.18
Carey's balsamroot ( <i>Balsamorhiza careyana</i> )	No	0.18

Crouching milkvetch ( <i>Astragalus succumbens</i> )	Yes	0.18
Cushion fleabane ( <i>Erigeron poliospernus</i> )	No	0.16
Threadleaf fleabane ( <i>Erigeron filifolius</i> )	No	0.16
Hoary falseyarrow ( <i>Chaenactis douglasii</i> )	Yes	0.16
Sandberg's bluegrass ( <i>Poa secunda</i> )	Yes	9.8
Needle-and-thread grass ( <i>Hesperostipa comata</i> )	Yes	7.0
Indian ricegrass ( <i>Oryzopsis hymenoides</i> )	Yes	5.6
Bottlebrush squirreltail ( <i>Elymus elymoides</i> )	Yes	5.6

Canopy cover monitoring was performed at the 100-K-CTA Site in April 2019. Total canopy cover was 29.6%, with 10.4% native and 19.2% invasive cover (Table 11). Native cover had increased by 2.8% since 2017 monitoring. Nineteen native species were recorded growing at this site, nine of which were seeded during 2019 revegetation efforts. This is an increase of 11 native species detected at the site since 2017 monitoring, where only 8 were found. The dominant native species was needle-and-thread grass (*Hesperostipa comata*), which had a coverage of 3.0%, followed by big sagebrush from the original planting with a cover of 2.5%. The dominant invasive species remains cheatgrass (*Bromus tectorum*), which had a coverage of 8.4%.

First-year shrub transect monitoring was conducted in July 2019. Two 100-m transects were established in order to track shrub planting density and quality. Only newly planted shrubs were recorded, shrubs planted in FY 2014 were not recorded on this transect. Shrub density was 825 plants/ha (334 plants/ac), which is above success criteria and is an improvement on the pre-redo shrub success. The average sagebrush size at this site was 0.14 m (0.46 ft) high by 0.06 m (0.20 ft) wide, the average bitterbrush size was 0.2 m (0.66 ft) high by 0.09 m (0.30 ft) wide, and the average hopsage size was 0.18 m (0.59 ft) high by 0.08 m (0.26 ft) wide.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed on the site at a coverage of less than 1%.

**Table 11. Percent Canopy Cover and Frequency of Occurrence at the 100-K-CTA Site in 2019 (2 Pages).**

Species	East Area		West Area		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X	0.6	4	0.6	4.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	X	X	X	X	X	X
<i>Artemisia tridentata</i> (big sagebrush) (existing)	1.7	8.0	3.4	4.0	2.5	6.0
<i>Artemisia tridentata</i> (big sagebrush) (transplants)	0.5	18.0	0.4	16.0	0.4	17.0
<i>Astragalus purshii</i> (woollypod milkvetch)	0.1	4.0	-	-	0.1	4.0
<i>Astragalus succumbens</i> (crouching milkvetch)	X	X	X	X	X	X

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<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	7.1	96	9.6	100.0	8.4	98.0
<i>Bunchgrass sp.</i> (multiple)	0.1	4.0	0.4	15.0	0.2	9.5
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	0.4	4.0	0.9	16.0	0.6	10.0
<i>Chaenactis douglasii</i> (Douglas' dustymaiden)	0.1	4.0	0.1	5.0	0.1	4.5
<i>Chenopodium leptophyllum</i> (narrowleaf goosefoot)	X	X	X	X	X	X
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	1.5	60.0	2.1	75.0	1.8	67.5
<i>Elymus elymoides</i> (squirreltail)	X	X	X	X	X	X
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.2	8.0	0.2	6.5	0.2	7.3
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	-	-	0.1	5.0	0.1	5.0
<i>Eriogonum niveum</i> (snow buckwheat)	X	X	X	X	X	X
<i>Grayia spinosa</i> (spiny hopsage) (transplants)	X	X	-	-	X	X
<i>Hesperostipa comata</i> (needle-and-thread grass)	2.9	54.0	3.1	60.0	3.0	57.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	2.1	64.0	1.7	68.5	1.9	66.3
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.7	26.0	1.1	32.5	0.9	29.3
<i>Poa secunda</i> (Sandberg bluegrass)	1.7	28.0	2.7	34.0	2.2	31.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	1.3	22	0.5	9.5	0.9	15.8
<i>Purshia tridentata</i> (antelope bitterbrush)	0.2	8.0	-	-	0.2	8.0
<i>Ranunculus testiculatus</i> (burr buttercup) <sup>(a)</sup>	-	-	0.1	4.0	0.1	4.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	2.9	74.0	2.4	76.0	2.6	75.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	2.5	58.0	2.0	45.5	2.2	51.8
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X	X	X	X	X
Crust	1.8	30.0	3.6	60.0	2.7	45.0
Soil	2.9	46.0	17.3	75.0	10.1	60.5
Litter	52.2	100.0	50.1	97.5	51.2	98.8
Rock/Cobble	30.6	88.0	14.9	85.0	22.7	86.5
Unavailable Space	2.4	26.0	5.0	34.0	3.7	30.0
<b>Total Canopy Cover</b>	26.1		33.0		<b>29.5</b>	
<b>Native % Cover</b>	8.7		12.0		<b>10.3</b>	
Invasive % Cover	17.4		21.0		19.2	
Unadjusted canopy cover	25.5		31.4		28.4	
Unadjusted Native % Cover	8.5		11.4		9.9	
Unadjusted Invasive % Cover	17.0		19.9		18.5	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

- = species not observed on site

X = present but not counted in plot frames



**Figure 9. The 100-K-CTA site after being redone in 2019.**

### **1.2.3 128-K-2 Site (Burn Pit and Soil Staging Area)**

The 128-K-2 Burn Pit and the 128-K-2 Soil Staging Area were monitored as one site due to their close proximity, similarity in age, and the supplemental planting that occurred at this site (Figure 10). Both sites were planted in FY 2013 and have a substrate that is sandy loam with varying amounts of cobble. The 2017 monitoring at the 128-K-2 Burn Pit site showed a decrease in native cover from the previous year. Total canopy cover was 35.8%, with 11.1% native cover. Eight native species were recorded at the site. The 2017 monitoring at the 128-K-2 Soil Staging Area also showed a decrease in native cover from the previous year, and canopy cover was 55.7% with 14.1% native cover. Only six native species were recorded at this site in 2017. When combined, these sites averaged 12.6% native cover and had nine native species detected. Additional revegetation actions were recommended for both of these areas. In FY 2019, these sites were planted with 7-in<sup>3</sup> forb plugs in an effort to increase native species cover and diversity. A total of 675 globemallow (*Sphaeralcea munroana*), 725 snow buckwheat (*Erigeron niveum*), and 100 cushion fleabane (*Erigeron poliospermus*) were planted at this site (Figure 11). Planting forb plugs is a new effort and the plug survival will be tracked closely to determine the cost-benefit of this process compared to seeding forbs. Canopy cover monitoring and transect monitoring were performed at this site in 2019.

Canopy cover monitoring occurred at the 128-K-2 site in April 2019 (Table 12). Canopy cover totaled 44.7%, with 27.3% native and 17.4% invasive cover. Various bunchgrasses accounted for the increase in native cover including Sandberg's bluegrass (*Poa secunda*, 8.8% cover), needle-and-thread grass (*Hesperostipa comata*, 5.0% cover), and bluebunch wheatgrass (*Pseudoroegneria spicata*, 4.4% cover). Native cover has increased by 13.2% since 2017. Cheatgrass (*Bromus tectorum*) was the dominant invasive species with 9.6% cover. Forb plugs

planted during FY 2019 accounted for an increase in native species cover by 1% and are expected to continue to grow, produce seed, and expand their populations. Multiple planted forbs were seen flowering and producing seed at this site. Ten native species were recorded at this site.

One transect was established in the portion of the 128-K-2 site previously referred to as the Burn Pit. Forbs planted in 2019 and sagebrush from the original 2013 planting were recorded on this transect. A total of 18.6% of the sagebrush on the transect had remnants of seed, suggesting they had bloomed the previous year. Many sagebrush recruits were recorded on the transect, suggesting the sagebrush is successfully seeding and expanding its population. Including recruits, sagebrush had a density of 1,020 plants/ha (413 plants/ac), well above success levels. Only one cushion fleabane was detected on the transect and it had a survival rate of 100%. Thirty-two Munro's globemallow plants were on the transect and had a survival rate of 75%. Thirty-eight snow buckwheat plants were on the transect and had a survival rate of 92%. Planted forbs had a density of 600 plants/ha (243 plants/ac).

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed on the site at a coverage of less than 1%.

**Table 12. Percent Canopy Cover and Frequency of Occurrence at the 128-K-2 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.4	2.9
<i>Amaranthus albus</i> (white pigweed) <sup>(a)</sup>	X	X
<i>Artemisia tridentata</i> (big sagebrush)	4.9	17.1
<i>Artemisia tridentata</i> (recruits)	1.4	11.4
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	9.6	94.3
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	0.3	11.4
<i>Chenopodium leptophyllum</i> (narrowleaf goosefoot)	X	X
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	3.8	94.3
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X
<i>Erigeron poliospermus</i> (cushion fleabane)	X	X
<i>Eriogonum niveum</i> (snow buckwheat)	0.8	17.1
<i>Hesperostipa comata</i> (needle-and-thread grass)	5.0	48.6
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	1.3	51.4
<i>Poa secunda</i> (Sandberg bluegrass)	8.8	85.7
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	4.4	22.9
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	1.2	48.6
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	0.1	5.7
<i>Sphaeralcea munroana</i> (Munro's globemallow)	0.2	8.6
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	0.1	2.9
Crust	11.4	65.7
Soil	17.9	71.4
Litter	25.9	100.0
Rock/Cobble	31.1	88.6

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Unavailable Space	5.5	65.7
<b>Total Canopy Cover</b>	<b>44.7</b>	
<b>Native % Cover</b>	<b>27.3</b>	
Invasive % Cover	17.4	
Unadjusted Canopy Cover	42.2	
Unadjusted Native % Cover	25.8	
Change in Native % Cover from 2017 <sup>c</sup>	13.2	
Unadjusted Invasive % Cover	16.4	
Change in Invasive % Cover from 2017 <sup>c</sup>	-16.8	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

<sup>c</sup> Average from 128-K-2-SSA and 128-K-2 Burn Pit

X = present but not counted in plot frames



**Figure 10. Top: The 128-K-2 Soil Staging Area in 2019. Bottom: The 128-K-2 Burn Pit in 2019. Both Sites Were Monitored as 128-K-2.**



**Figure 11. Top: A Globemallow Plug Planted at the 128-K-2 Site. Bottom: A Snow Buckwheat Plug Planted at the 128-K-2 site.**

### 1.3 100-N AREA SITES

Five sites were monitored in the 100-N Area: 130-N-1:1, 100-N-96, 100-N-83, 100-N-CTA, and 100-N-61:1. The 130-N-1:1 and 100-N-61:1 sites were revegetated in FY 2015, the 100-N-96 site in FY 2016, and the 100-N-83 and 100-N-CTA sites in FY 2017. These sites were remediated to meet the objectives for interim closure as established in the 100-N Area RDR/RAWP (DOE/RL-2005-93) and in the Interim Action ROD (EPA 2000a, 2000b). Site 100-N-96 had additional revegetation guidelines as stated in the *Memorandum of Agreement (MOA) Between the U.S. Department of Energy, Richland Operations Office and the Washington State Historic Office, and the Advisory Council on Historic Preservation Regarding the Remediation of the 100-N-96 Waste Site* (DOE-RL et al. 2014). Sites 100-N-83 and 100-N-CTA had additional revegetation guidelines as stated in the *Memorandum of Agreement (MOA) Between the U.S. Department of Energy, Richland Operations Office and the Washington State Department of Archaeology and Historic Preservation Regarding Removal and Remedial Actions, Demobilization and Area Revegetation for the 100-N Area of the Hanford Site* (DOE-RL et al. 2015a). Revegetation efforts entailed broadcast seeding at approximately 16.8 kg/ha (15 lbs/ac) with a mixture of native grasses including Sandberg's bluegrass (*Poa secunda*), Indian ricegrass (*Achnatherum hymenoides*), bluebunch wheatgrass (*Pseudoroegneria spicata*), squirreltail (*Elymus elymoides*), needle-and-thread grass (*Hesperostipa comata*), and prairie junegrass (*Koeleria macrantha*) topped with a straw mulch that was crimped into the soil surface. Shrub species (including big sagebrush [*Artemisia tridentata*], antelope bitterbrush [*Purshia tridentata*], and spiny hopsage [*Grayia spinosa*]) were transplanted on the sites at approximately 1,235 to 1,600 plants/ha (500 to 650 plants/ac) with a mix of approximately 75% sagebrush, 15% bitterbrush, and 10% spiny hopsage, with the exception of site 100-N-96. Site 100-N-96 received varying planting ratios ranging from 60 to 75% big sagebrush, 5 to 15% antelope bitterbrush, 10 to 30% spiny hopsage, and approximately 1% (cumulatively) of rubber rabbitbrush (*Ericameria nauseosa*) and yellow rabbitbrush (*Chrysothamnus viscidiflorus*).

#### 1.3.1 130-N-1:1 Site (183-N Northeastern Backwash Discharge Pond)

The 130-N-1:1 site (Figure 12) was revegetated in FY 2015 and monitoring was first conducted for the site in 2015. The substrate for the site is characterized predominantly by cobbles with some loamy sand in the south area (Area 1) and predominantly sandy loam in the north area (Area 2) with increased amounts of cobbles in the south portion of this area.

Fifth-year shrub transect monitoring for the site was conducted in July 2019. The results show a shrub density of 1,060 plants/ha (429 plants/ac) for Area 1 and 120 plants/ha (49 plants/ac) for Area 2; this equates to about 590 plants/ha (239 plants/ac) for the site overall. This is just below the success criteria of 600 plants/ha (240 plants/ac). Over 90% of the transplanted shrubs in Area 2 were lost within the first year (2015 to 2016) and only 6 of the original 85 plants recorded along the transect remain.

Canopy cover data for the site was collected in April 2019. Data was collected from 25 plot frames in each of the two areas. Canopy cover for the site overall was 37.4%, with 22.5% native cover and 14.9% invasive cover (Table 13). This represents an increase of 10.4% in native cover and decrease of 9.5% in invasive cover from 2018. Sandberg's bluegrass (*Poa secunda*) and bluebunch wheatgrass (*Pseudoroegneria spicata*) were the dominant native species with 7.6%

cover and 6.9% cover, respectively. Cheatgrass (*Bromus tectorum*) is the dominant invasive species with 7.9% cover. Fifteen native species were identified at this site in 2019.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was recorded at 1% cover occurring in 4% of the plot frames.

The year 2019 marks the fifth year of revegetation monitoring at the 130-N-1:1 site. In order to ensure this site is successful, additional shrub plantings are recommended to increase shrub density. Native cover is expected to increase in the coming years.

**Table 13. Percent Canopy Cover and Frequency of Occurrence at the 130-N-1:1 Site in 2019 (2 Pages).**

Species	Area 1 (cobble)		Area 2 (loamy sand)		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.6	4.0	X	X	0.3	2.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.6	24.0	2.8	52.0	1.7	38.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X	0.2	8.0	0.1	4.0
<i>Artemisia tridentata</i> (big sagebrush)	1.5	4.0	0.8	12.0	1.2	8.0
<i>Artemisia tridentata</i> (recruits)	0.9	16.0	X	X	0.5	8.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	6.0	100.0	9.8	100.0	7.9	100.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	0.2	8.0	X	X	0.1	4.0
<i>Chaenactis douglasii</i> (Douglas' dustymaiden)	X	X	-	-	X	X
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	1.5	60.0	2.1	64.0	1.8	62.0
<i>Elymus elymoides</i> (squirreltail)	0.9	16.0	2.0	20.0	1.5	18.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.1	4.0	0.1	4.0	0.1	4.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	-	-	0.1	4.0	0.1	2.0
<i>Erigeron pumilus</i> (shaggy fleabane)	X	X	-	-	X	X
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	-	-	0.1	4.0	0.1	2.0
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.3	12.0	0.2	8.0	0.3	10.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	1.0	40.0	2.2	68.0	1.6	54.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.4	16.0	0.8	32.0	0.6	24.0
<i>Lamium amplexicaule</i> (henbit deadnettle) <sup>(a)</sup>	0.2	8.0	-	-	0.1	4.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	X	X	X	X	X	X
<i>Melilotus officinalis</i> (sweetclover) <sup>(a)</sup>	0.1	4.0	-	-	0.1	2.0
<i>Microsteris gracilis</i> (slender phlox)	-	-	0.1	4.0	0.1	2.0
<i>Poa secunda</i> (Sandberg bluegrass)	6.2	88.0	8.9	96.0	7.6	92.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	9.1	72.0	4.7	36.0	6.9	54.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	0.9	36.0	0.8	32.0	0.9	34.0
<i>Sisymbrium altissimum</i> (tall tumblemustard) <sup>(a)</sup>	0.4	16.0	-	-	0.2	8.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	-	-	X	X	X	X
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X	-	-	X	X

Crust	1.3	12.0	1.7	48.0	1.5	30.0
Soil	12.9	60.0	21.5	96.0	17.2	78.0
Litter	15.9	96.0	21.4	92.0	18.7	94.0
Rock/Cobble	45.7	100.0	25.1	100.0	35.4	100.0
Unavailable Space	13.2	100.0	8.7	92.0	11.0	96.0
<b>Total Canopy Cover</b>	<b>35.6</b>		<b>39.1</b>		<b>37.4</b>	
<b>Total Native % Cover</b>	<b>23.3</b>		<b>21.8</b>		<b>22.5</b>	
Total Invasive % Cover	12.3		17.3		14.9	
Unadjusted canopy cover	30.9		35.7		33.3	
Unadjusted Native % Cover	20.2		19.9		20.1	
Change in Native % Cover from 2018	8.0		12.7		10.4	
Unadjusted Invasive % Cover	10.7		15.8		13.3	
Change in Invasive % Cover from 2018	2.0		-20.9		-9.5	

<sup>a</sup> = Invasive species

<sup>b</sup> = Washington State Classified Noxious Weed (class)

X = present but not counted in plots

- = species not found



**Figure 12. The Cobble Section of the 130-N-1:1 Site in 2019.**

### 1.3.2 100-N-96 Site (Military Camp Disposal Pits)

The 100-N-96 site (Figure 13) was revegetated in FY 2016 and monitoring was first conducted for the site in 2016. The substrate for the site is characterized by loamy sand with varying amounts of gravel. In keeping with the *Memorandum of Agreement (MOA) Between the U.S. Department of Energy, Richland Operations Office and the Washington State Historic Office, and the Advisory Council on Historic Preservation Regarding the Remediation of the 100-N-96 Waste Site* (DOE-RL et al. 2014), seeds from several native forbs were collected from the Hanford Site and broadcast on the site along with the standard native grass seed mix. Rubber rabbitbrush (*Ericameria nauseosa*) and yellow rabbitbrush (*Chrysothamnus viscidiflorus*) were also planted on this site along with the standard mix of big sagebrush, antelope bitterbrush, and spiny hopsage.

A 75-m (246-ft) shrub monitoring transect with approximately 3-m (9.8-ft) offsets was established for the site in 2016. Fourth-year monitoring was conducted for the site in May 2019; the results show a shrub density of 346 plants/ha (140 plants/ac) below the success criteria of 600 plants/ha (240 plants/ac). Survival from the previous year was 96% and survival since planting was 89.7%. Shrub survival has been fairly high in this area but shrubs were not initially planted at a density that would lead to successful cover.

Canopy cover data for the site was collected in April 2019. Canopy cover for the site was 50.7%, with native cover representing 19.3% and invasive cover representing 31.4% (Table 14). This represents an increase of 9.7% in native cover and an increase of 1.2% in invasive cover from 2018. The dominant native species was Sandberg's bluegrass (*Poa secunda*), with 11.9% cover followed by common yarrow (*Achillea millefolium*) with 2.1% cover. Cheatgrass (*Bromus tectorum*) was the dominant species for the site overall with 19.9% cover. Nine native species were detected during 2019 monitoring.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed on the site with less than 1% cover and was detected in 4% of plot frames.

As this site is nearing its fifth year and will not meet success criteria for shrub density and potentially for native cover, additional revegetation actions are planned for this site in FY 2020. Additional revegetation actions will be focused on increasing shrub density and native species diversity.

**Table 14. Percent Canopy Cover and Frequency of Occurrence at the 100-N-96 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	2.1	8.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.6	4.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.9	16.0
<i>Artemisia tridentata</i> (big sagebrush)	1.8	12.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	19.9	100.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	0.6	4.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	5.4	96.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.1	4.0

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<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	1.9	76.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.3	12.0
<i>Machaeranthera canescens</i> (hoary tansymustard)	0.1	4.0
<i>Poa secunda</i> (Sandberg bluegrass)	11.9	84.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	1.7	28.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	1.1	44.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	1.4	56.0
<i>Triticum sp.</i> (wheat) <sup>(a)</sup>	0.6	4.0
<i>Microsteris gracilis</i> (slender phlox)	0.3	12.0
Mushroom sp.	0.1	4.0
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	0.7	8.0
Crust	6.6	84.0
Soil	39.7	92.0
Litter	25.1	92.0
Rock/Cobble	12.9	40.0
Unavailable Space	0.6	24.0
<b>Total Canopy Cover</b>	<b>50.7</b>	
<b>Native % Cover</b>	<b>19.3</b>	
Invasive % Cover	31.4	
Unadjusted canopy cover	50.4	
Unadjusted Native % Cover	19.2	
Change in Native % Cover from 2018	9.7	
Unadjusted Invasive % Cover	31.2	
Change in Invasive % Cover from 2018	1.2	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 13. Sandberg's Bluegrass Cover at the 100-N-96 site in 2019.**

### **1.3.3 100-N-83 Site (Cleaned Contamination Area)**

The 100-N-83 site (Figure 14) was revegetated in FY 2017 and monitoring was first conducted for the site in 2017. The substrate for the site is mainly sandy loam with varying amounts of gravel and cobble. In keeping with the *Memorandum of Agreement (MOA) Between the U.S. Department of Energy, Richland Operations Office and the Washington State Department of Archaeology and Historic Preservation Regarding Removal and Remedial Actions, Demobilization and Area Revegetation for the 100-N Area of the Hanford Site* (DOE-RL et al. 2015a), seeds from several native forbs were collected from the Hanford Site and broadcast on the site along with the standard native grass seed mix.

Forb species seeded at the 100-N-CTA included coyote tobacco (*Nicotiana attenuata*), Munro's globemallow (*Sphaeralcea munroana*), longleaf phlox (*Phlox longifolia*), slender phlox (*Microsteris gracilis*), Carey's balsamorhiza (*Balsamorhiza careyana*), desert parsley (*Lomatium sp.*), common yarrow (*Achillea millefolium*), mariposa lily (*Calochortus macrocarpus*), upland larkspur (*Delphinium nuttallianum*), shaggy fleabane (*Erigeron pumilis*), white-stemmed blazingstar (*Mentzelia albicaulis*), woollypod milkvetch (*Astragalus purshii*), Douglas' dustymaiden (*Chaenactis douglasii*), and yellowbell (*Fritillaria pudica*). The rates at which these species were seeded and the viability of the seed planted is unknown. Native grass seed was broadcast seeded at an average of approximately 20.2 kg/ha (18 lb/ac) and was composed of Sandberg's bluegrass (*Poa secunda*), bluebunch wheatgrass (*Pseudoroegneria spicata*), needle-and-thread grass (*Hesperostipa comata*), Indian Ricegrass (*Achnatherum hymenoides*), bottlebrush squirreltail (*Elymus elymoides*), Idaho fescue (*Festuca idahoensis*), thickspike wheatgrass (*Elymus lanceolatus*), and sand dropseed (*Sporobolus cryptandrus*). All of these

grasses, except thickspike wheatgrass, Idaho fescue and sand dropseed, were recorded at the site in 2019.

Two 100-m (328-ft) shrub monitoring transects were monitored for the site in June 2019; Transect 1 in the lower (south) portion of the site and Transect 2 in the upper (north) portion of the site. Big sagebrush (*Artemisia tridentata*), spiny hopsage (*Grayia spinosa*), and antelope bitterbrush (*Purshia tridentata*) were recorded along both transects. The shrub density for the lower area was 720 plants/ha (291 plants/ac) and the density for the upper area was 740 plants/ha (299 plants/ac); this equates to about 730 plants/ha (295 plants/ac) for the site overall, above the success criteria of 600 plants/ha (240 plants/ac). Sagebrush at this site was relatively large for a 3-year old site, averaging 0.5 m (1.64 ft) high and 0.4 m (1.31 ft) wide. Bitterbrush averaged 0.3 m (0.98 ft) high and 0.5 m (1.64 ft) wide, and hopsage averaged 0.3 m (0.98 ft) high and 0.35 m (1.15 ft) wide.

Canopy cover data for the site was collected in April 2019. Canopy cover for the site was 53.3% (Table 15). Native cover for the site was 12.5%, an increase of 5.4% from the year previous. Invasive cover increased by 7.9% since 2018 monitoring. Fifteen native species were recorded for the site. Bluebunch wheatgrass (*Pseudoroegneria spicata*) is the dominant native species at this site with 3.5% cover. Cheatgrass (*Bromus tectorum*) is the dominant invasive species for the site overall with 30.5% cover, and increased by 7.2% since 2018.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, had a cover of less than 1% and occurred in 6% of the plot frames. Rush skeletonweed (*Chondrilla juncea*), a Washington State Class B noxious weed, was present on the site with less than 1% cover and was recorded in 2% of the plot frames.

**Table 15. Percent Canopy Cover and Frequency of Occurrence at the 100-N-83 Site in 2019 (2 Pages).**

Species	Lower Area		Upper Area		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.6	4.0	0.6	4.0	0.6	4.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	-	-	X	X	X	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	-	-	2.6	44.0	1.3	22.0
<i>Artemisia tridentata</i> (big sagebrush)	3.1	24.0	1.3	12.0	2.2	18.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	28.0	100.0	33.0	100.0	30.5	100.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	0.7	8.0	0.1	4.0	0.4	6.0
<i>Chondrilla juncea</i> (rush skeletonweed) (B) <sup>(b)</sup>	0.1	4.0	-	-	0.1	2.0
<i>Chorispora tenella</i> (crossflower) <sup>(a)</sup>	0.1	4.0	-	-	0.1	2.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	1.1	44.0	1.2	48.0	1.2	46.0
<i>Elymus elymoides</i> (squirreltail)	0.1	4.0	0.2	8.0	0.2	6.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.5	20.0	X	X	0.3	10.0
<i>Ericamerua nauseosa</i> (rubber rabbitbrush)	0.1	4.0	X	X	0.1	2.0

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<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	0.1	4.0	-	-	0.1	2.0
<i>Grayia spinosa</i> (spiny hopsage)	-	-	0.1	4.0	0.1	2.0
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.1	4.0	-	-	0.1	2.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.9	36.0	2.2	48.0	1.6	42.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	3.1	84.0	0.2	8.0	1.7	46.0
<i>Lomatium macrocarpum</i> (bigseed desertparsley)	-	-	X	X	X	X
<i>Machaeranthera canescens</i> (hoary tansyaster)	X	X	-	-	X	X
<i>Microsteris gracilis</i> (slender phlox)	0.3	12.0	0.4	16.0	0.4	14.0
<i>Poa secunda</i> (Sandberg bluegrass)	3.7	68.0	2.3	52.0	3.0	60.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	5.0	44.0	2.0	40.0	3.5	42.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	0.5	20.0	0.7	28.0	0.6	24.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	0.1	4.0	2.5	60.0	1.3	32.0
<i>Triticum sp.</i> (wheat) <sup>(a)</sup>	0.1	4.0	X	X	0.1	2.0
Crust	0.0	0.0	0.1	4.0	0.1	2.0
Soil	4.9	64.0	20.3	68.0	12.6	66.0
Litter	28.1	96.0	55.1	100.0	41.6	98.0
Rock/Cobble	32.4	96.0	11.4	68.0	21.9	82.0
Unavailable Space	12.3	84.0	4.4	56.0	8.4	70.0
<b>Total Canopy Cover</b>	<b>55.1</b>		<b>51.7</b>		<b>53.3</b>	
<b>Native % Cover</b>	<b>15.4</b>		<b>9.9</b>		<b>12.5</b>	
Invasive % Cover	39.7		41.7		40.8	
Unadjusted canopy cover	48.3		49.4		48.9	
Unadjusted Native % Cover	13.5		9.5		11.5	
Change in Native % Cover from 2018	8.3		2.5		5.4	
Unadjusted Invasive % Cover	34.8		39.9		37.4	
Change in Invasive % Cover from 2018	13.3		2.6		7.9	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames

- = species not observed



**Figure 14. The 100-N-83 Site in 2019. Top: Area 1 (Lower Portion) of the 100-N-83 Site in 2019. Bottom: Area 2 (Upper Portion) of the 100-N-83 Site in 2019.**

#### **1.3.4 100-N-CTA Site (Container Transfer Area)**

The 100-N-CTA site (Figure 15) was revegetated in FY 2017 and monitoring was first conducted for the site in 2017. The substrate for the site is characterized by loamy sand with varying

amounts of cobbles and boulders. In keeping with the *Memorandum of Agreement (MOA) Between the U.S. Department of Energy, Richland Operations Office and the Washington State Department of Archaeology and Historic Preservation Regarding Removal and Remedial Actions, Demobilization and Area Revegetation for the 100-N Area of the Hanford Site* (DOE-RL et al. 2015a), seeds from several native forbs were collected from the Hanford Site and were hand seeded on the site.

Forb species seeded at the 100-N-CTA included coyote tobacco (*Nicotiana attenuata*), Munro's globemallow (*Sphaeralcea munroana*), longleaf phlox (*Phlox longifolia*), slender phlox (*Microsteris gracilis*), Carey's balsamorhiza (*Balsamorhiza careyana*), desert parsley (*Lomatium sp.*), common yarrow (*Achillea millefolium*), mariposa lily (*Calochortus macrocarpus*), upland larkspur (*Delphinium nuttallianum*), shaggy fleabane (*Erigeron pumilis*), white-stemmed blazingstar (*Mentzelia albicaulis*), woollypod milkvetch (*Astragalus purshii*), Douglas' dustymaiden (*Chaenactis douglasii*), and yellowbell (*Fritillaria pudica*). The rates at which these species were seeded and the viability of the seed planted is unknown. Native grass seed was broadcast seeded at an average of approximately 18 lb/ac and was composed of Sandberg's bluegrass (*Poa secunda*), bluebunch wheatgrass (*Pseudoroegneria spicata*), needle-and-thread grass (*Hesperostipa comata*), Indian ricegrass (*Achnatherum hymenoides*), bottlebrush squirreltail (*Elymus elymoides*), Idaho fescue (*Festuca idahoensis*), thickspike wheatgrass (*Elymus lanceolatus*), and sand dropseed (*Sporobolus cryptandrus*).

Two 100-m (328-ft) shrub monitoring transects were monitored in May 2019; Transect 1 in the lower (south) portion of the site and Transect 2 in the upper (north) portion of the site. Big sagebrush (*Artemisia tridentata*), spiny hopsage (*Grayia spinosa*), and antelope bitterbrush (*Purshia tridentata*) were recorded along both transects. The shrub density for the lower area was 810 plants/ha (328 plants/ac) and 70 plants/ha (28 plants/ac) for the upper area. Only 10% of the shrubs recorded in the upper area in 2017 survived to 2018. This equates to an overall shrub density of 435 plants/ha (176 plants/ac) for the site overall, not meeting the success criteria of 600 plants/ha (240 plants/ac).

Canopy cover data for the site was collected in April 2019. Canopy cover varied between the two areas (lower and upper) with 41.7% cover recorded for the lower area and 36.8% for the upper area; the average canopy cover for the site overall was 39.2% (Table 16). Native cover for the site averaged 23.2%, with 29.4% recorded for the lower area and 17.2% recorded for the upper area. Native vegetation cover increased by 10.7% since 2018 and 13 native species were recorded for the site. Sandberg's bluegrass was the dominant native species with a cover of 14.1%. Cheatgrass (*Bromus tectorum*) was the dominant invasive species with a cover of 6.5%.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed in less than 1% of the plots.

The 100-N-CTA site has high native species diversity and a relatively high native species cover that appears to be trending upward. High shrub die-off between 2017 and 2018 resulted in unsuccessful shrub cover. Supplemental shrub planting is recommended for this site, especially in the northern portion, to increase the number of shrubs per acre.

**Table 16. Percent Canopy Cover and Frequency of Occurrence at the 100 N CTA Site in 2019 (2 Pages).**

Species	Lower Area		Upper Area		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X	0.1	4.0	0.1	2.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	1.1	24.0	0.1	4.0	0.6	14.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X	0.1	4.0	0.1	2.0
<i>Artemisia tridentata</i> (big sagebrush)	0.8	12.0	X	X	0.4	6.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	3.0	100.0	9.9	88.0	6.5	94.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	0.7	8.0	0.1	4.0	0.4	6.0
<i>Chaenactis douglasii</i> (Douglas' dustymaiden)	-	-	X	X	X	X
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.7	28.0	2.0	40.0	1.4	34.0
<i>Descurcania pinnata</i> (western tansymustard)	0.2	8.0	0.4	16.0	0.3	12.0
<i>Elymus elymoides</i> (squirreltail)	0.9	16.0	0.3	12.0	0.6	14.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.2	8.0	0.1	4.0	0.1	6.0
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.9	16.0	-	-	0.5	8.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.6	24.0	1.1	44.0	0.9	34.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	2.1	64.0	0.7	28.0	1.4	46.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	X	X	-	-	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	13.2	100.0	14.9	88.0	14.1	94.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	10.4	52.0	0.7	8.0	5.6	30.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	3.1	84.0	2.8	92.0	3.0	88.0
<i>Sisymbrium altissimum</i> (tall tumbledustard) <sup>(a)</sup>	1.5	40.0	2.4	56.0	2.0	48.0
<i>Sporobolus cryptandrus</i> (sand dropseed)	0.1	4.0	-	-	0.1	2.0
<i>Triticum sp.</i> (wheat) <sup>(a)</sup>	X	X	-	-	X	X
Crust	0.8	12.0	1.5	20.0	1.2	16.0
Soil	17.7	92.0	29.5	88.0	23.6	90.0
Litter	24.1	100.0	18.3	80.0	21.2	90.0
Rock/Cobble	21.5	92.0	24.5	88.0	23.0	90.0
Unavailable Space	5.3	56.0	3.1	64.0	4.2	60.0
<b>Total Canopy Cover</b>	41.7		36.8		<b>39.2</b>	
<b>Native % Cover</b>	29.4		17.2		<b>23.2</b>	
Invasive % Cover	12.4		19.6		16.0	
Unadjusted canopy cover	39.5		35.7		37.6	
Unadjusted Native % Cover	27.8		16.7		22.2	
Change in Native % Cover from 2018	13.5		8.0		10.7	
Unadjusted Invasive % Cover	11.7		19.0		15.4	
Change in Invasive % Cover from 2018	-3.5		4.7		0.6	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames

- = species not observed



**Figure 15. The 100-N Container Transfer Area Site in 2018. Top: Area 1 (Upper Portion) of the 100-N CTA Site in 2019. Bottom: Area 2 (Lower Portion) of the 100-N CTA Site in 2019.**

### 1.3.5 100-N-61:1 (Underground Pipelines)

The 100-N-61:1 site (Figure 16) was revegetated in FY 2015. Monitoring for this site was not conducted until June 2018, when the site was 3 years old. The substrate for the site is characterized predominantly by cobbles and backfill material.

No shrub transect was established for this site, as first-year monitoring did not occur until June 2018.

Canopy cover data for the site was collected in April 2019. Data was collected from 50 plot frames, 25 in the eastern area and 25 in the backfilled area to the northwest of N Reactor.

Canopy cover data for the two areas were fairly similar. Canopy cover for the site overall was 35.9%, with 18.9% native cover and 17% invasive cover (Table 17). Native cover increased by 7.9% and invasive cover increased by 6.0% from 2018. The dominant native species for this site was Sandberg's bluegrass (*Poa secunda*) with 7.5% cover followed by bluebunch wheatgrass (*Pseudoroegneria spicata*) with 6.6% cover. The dominant invasive species was cheatgrass (*Bromus tectorum*) with 8.4% cover and occurrence in 100% of the plot frames.

Areas of this site, especially the eastern portion, have little to no sagebrush (*Artemisia tridentata*) present. Additional revegetation actions increasing sagebrush on this site are recommended.

**Table 17. Percent Canopy Cover and Frequency of Occurrence at the 100-N-61:1 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.3	12.0
<i>Artemisia tridentata</i> (big sagebrush)	2.2	16.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	8.4	100.0
<i>Centaurea diffusa</i> (diffuse knapweed) <sup>(b)</sup>	1.5	18.0
<i>Chorispora tenella</i> (crossflower) <sup>(a)</sup>	0.1	4.0
<i>Descurciana pinnata</i> (western tansymustard)	0.8	32.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	1.3	50.0
<i>Elymus elymoides</i> (squirreltail)	X	X
<i>Epilobium brachycarpum</i> (tall annual willowherb)	X	4.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	12.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	1.3	52.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	1.1	44.0
<i>Lamium amplexicaule</i> (henbit deadnettle) <sup>(a)</sup>	1.6	42.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	7.5	90.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	6.6	62.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	X	24.0
<i>Sisymbrium altissimum</i> (tall tumbledmustard) <sup>(a)</sup>	0.4	16.0
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	0.0
Crust	1.4	26.0

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Soil	0.8	12.0
Litter	12.9	66.0
Rock/Cobble	58.2	100.0
Unavailable Space	8.5	92.0
<b>Total Canopy Cover</b>	<b>35.9</b>	
<b>Native % Cover</b>	<b>18.9</b>	
Invasive % Cover	17.0	
Unadjusted canopy cover	32.9	
Unadjusted Native % Cover	17.3	
Change in Native % Cover from 2018	7.9	
Unadjusted Invasive % Cover	15.6	
Change in Invasive % Cover from 2018	6.0	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 16. Top: Section of the 100-N-61:1 Site with Few Sagebrush Plants. Bottom: Bunchgrasses and Sagebrush Growing at the 100-N-61:1 Site.**

## 1.4 100-D AREA SITES

Seven sites were monitored for post-revegetation 5-year monitoring in the 100-D Area: 128-D-2, 628-3, 100-D-30/104, 100-D-100, 100-D Trailer Village, 100-D-48:2, and 100-D-49:2. The 100-D-30/104, 100-D-48:2 and 100-D-49:2 sites were revegetated in FY 2015; the 100-D-100 and 116-D-8 sites in FY 2016; and the 100-D Trailer Village site in FY 2017. These sites were remediated to meet the objectives for interim closure as established in the 100 Area RDR/RAWP (DOE/RL-96-17) and in the Interim Action ROD (EPA 1999).

Revegetation efforts at the 100-D-30/104, 100-D-100, 100-D Trailer Village, 100-D-48:2, and 100-D-49:2 sites entailed broadcast seeding or hydroseeding with a mixture of native grasses including Sandberg's bluegrass (*Poa secunda*), Indian ricegrass (*Achnatherum hymenoides*), bluebunch wheatgrass (*Pseudoroegneria spicata*), squirreltail (*Elymus elymoides*), needle-and-thread grass (*Hesperostipa comata*), and prairie junegrass (*Koeleria macrantha*) at approximately 15 lbs/ac. Broadcast seeding areas were topped with a straw mulch that was crimped into the soil surface. Areas with steep slopes were seeded by hydroseeding vs. broadcast seeding followed by mulch application. Shrub species (including big sagebrush [*Artemisia tridentata*], antelope bitterbrush [*Purshia tridentata*], and spiny hopsage [*Grayia spinosa*]) were transplanted on the sites at approximately 1,235 to 1,600 plants/ha (500 to 650 plants/ac) with a mix of approximately 75% sagebrush, 15% bitterbrush, and 10% spiny hopsage (with the exception of site 100-D-100). Sites planted in FY 2016 (100-D-100) received varying planting ratios ranging from 60 to 75% big sagebrush, 5 to 15% antelope bitterbrush, 10 to 30% spiny hopsage, and approximately 1% (cumulatively) rubber rabbitbrush (*Ericameria nauseosa*) and yellow rabbitbrush (*Chrysothamnus viscidiflorus*).

The 128-D-2 and 628-3 sites were both planted in FY 2011 and determined to not be meeting success criteria. Additional revegetation actions took place at these sites in FY 2019. The inner area of the 628-3 site was planted with forb and shrub plugs, and the outer area of 628-3 and the 128-D-2 site were reseeded and planted with the FY 2019 seed mix (Table 1).

### 1.4.1 100-D-30/104 Site (183-N Northeastern Backwash Discharge Pond)

The 100-D-30/104 site (Figure 17) was revegetated in FY 2015 and monitoring was first conducted for the site in 2015. This is a larger site that was divided into five areas (northwest-north, northeast, southwest-south, south central, and southeast) for monitoring purposes with 1 established transect in each area and data collected from 25 plot frames in each area. Substrates at the site are predominantly loamy sands with a large amount of cobble.

Five shrub monitoring transects were established for the site in 2015. Fifth-year monitoring for the site was conducted in May 2019. Sagebrush (*Artemisia tridentata*) was the only shrub detected at this site. The results show a shrub density of 766 plants/ha (310 plants/ac), above the success criteria of 600 plants/ha (240 plants/ac). The transects for each area varied greatly, with Transect 2 showing 440 plants/ha (178 plants/ac) and Transect 5 showing 1,440 plants/ha (583 plants/ac). Inconsistency in plant spacing may have led to these varied results. This highlights the importance of establishing multiple transects in large revegetation sites for a more accurate measure of shrub cover. Average sagebrush height was 0.32 m (1.05 ft) and width was 0.31 m (1.02 ft).

Canopy cover data for the site was collected in April 2019. Average canopy cover for the site was 35.1%, with native cover representing 21.9% and invasive cover representing 13.2% (Table 18). This represents an increase of 9.6% in native cover from 2018 and a decrease of 1.4% in invasive cover. The dominant species for the site overall was bluebunch wheatgrass (*Pseudoroegneria spicata*) with 8.1% cover overtaking cheatgrass (*Bromus tectorum*) with 5.5% cover. Other notable species at this site were Sandberg's bluegrass (*Poa secunda*, 4.0%) and big sagebrush (3.9%). Eighteen native species were detected at this site.

Diffuse knapweed (*Centaurea diffusa*) and rush skeletonweed (*Chondrilla juncea*), both Washington State Class B noxious weeds, were recorded on the site at less than 1% cover.

These data represent the last year of monitoring at this site. Shrub cover was successful and the continued trend towards increasing native cover is expected to continue at this site, no further actions are recommended.

**Table 18. Percent Canopy Cover and Frequency of Occurrence at the 100-D-30/104 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.8	13.0
<i>Artemisia tridentata</i> (big sagebrush)	3.9	23.2
<i>Bromus arvensis</i> (field brome) <sup>(a)</sup>	X	X
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	5.5	98.4
Bunchgrass sp. (multiple)	0.1	4.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	0.1	5.3
<i>Chondrilla juncea</i> (rush skeletonweed) (B) <sup>(b)</sup>	X	X
<i>Chorispora tenella</i> (crossflower) <sup>(a)</sup>	X	X
<i>Dalea ornata</i> (western prairie clover)	X	X
<i>Descurcania pinnata</i> (western tansymustard)	0.2	8.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.7	28.8
<i>Elymus elymoides</i> (squirreltail)	0.2	8.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.7	28.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	1.1	14.4
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	X	X
<i>Hesperostipa comata</i> (needle-and-thread grass)	1.3	35.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	2.4	81.6
<i>Koeleria macrantha</i> (prairie junegrass)	X	X
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.7	26.4
<i>Lamium amplexicaule</i> (henbit deadnettle) <sup>(a)</sup>	0.3	10.0
<i>Leymus cinereus</i> (basin wildrye)	0.7	8.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.3	10.0
<i>Medicago sativa</i> (alfalfa) <sup>(a)</sup>	X	X
<i>Melilotus officinalis</i> (sweet clover) <sup>(a)</sup>	0.8	17.0
<i>Penstemon acuminatus</i> (sharpleaf penstemon)	X	X
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	0.1	4.0

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<i>Poa secunda</i> (Sandberg bluegrass)	4.0	71.2
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	8.1	66.4
<i>Purshia tridentata</i> (antelope bitterbrush)	0.1	4.0
<i>Ranunculus testiculatus</i> (burr buttercup) <sup>(a)</sup>	0.2	8.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	1.1	43.2
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	0.8	32.8
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	0.1	5.3
Crust	4.0	46.4
Soil	22.0	73.6
Litter	19.5	100.0
Rock/Cobble	48.2	100.0
Unavailable Space	2.5	34.4
<b>Total canopy cover</b>	<b>35.1</b>	
<b>Total Native % Cover</b>	<b>21.9</b>	
Total Invasive % Cover	13.2	
Unadjusted Canopy Cover	34.2	
Unadjusted Native Cover	21.4	
Change in Native % Cover from 2018	9.6	
Unadjusted Invasive % Cover	12.9	
Change in Invasive % Cover from 2018	-1.4	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames





**Figure 17. The 100-D-30/104 Site in 2019. Top: North Portion of the 100-D-30/104 Site in 2019. Bottom: South Portion of the 100-D-30/104 Site in 2019.**

#### **1.4.2 100-D-100 Site (Process Sewer, Unplanned Release 183-DR Railroad Tracks)**

The 100-D-100 site (Figure 18) was revegetated in FY 2016 and monitoring was first conducted for the site in 2016. Fourth-year monitoring was conducted in 2019. This is a larger site that was divided into three areas (north, central, and south) for monitoring purposes with one established transect in each area and data collected from 25 plot frames in each area. Substrates at the site are predominantly loamy sands with large amounts of cobble.

Three shrub monitoring transects were established for the site in 2016. Fourth-year monitoring was conducted in May 2019. The results show a shrub density of 883 plants/ha (357 plants/ac) for the site overall, well above the success criteria of 600 plants/ha (240 plants/ac). A total of 95% of the planted shrubs have survived since the initial planting in 2016. Sagebrush (*Artemisia tridentata*) has a survival rate of 94% since the initial planting and an average size of 0.19 m (0.62 ft) by 0.22 m (0.72 ft). Spiny hopsage (*Grayia spinosa*) has a survival rate of 100% since the initial planting, but this is only represented by 6 plants on Transect 1, and has an average size of 0.1 m (0.33 ft) by 0.1 m (0.33 ft). Antelope bitterbrush (*Purshia tridentata*) has a survival rate of 99% at this site and an average size of 0.21 m (0.69 ft) by 0.52 m (1.71 ft). The survival rates of all planted shrubs at this site are high compared to other sites.

Canopy cover data for the site was collected in April 2019. Average canopy cover for the site was 25.9%, with native cover representing 13.6% and invasive cover representing 12.3% (Table 19). This represents an increase of 5.1% in native cover and of 3.9% in invasive cover from 2018. The dominant native species were Sandberg bluegrass (*Poa secunda*), bluebunch wheatgrass (*Pseudoroegneria spicata*), and big sagebrush with 5.1%, 3.0%, and 1.8% cover, respectively. Cheatgrass (*Bromus tectorum*) was the dominant invasive species for the site with

4.1% cover. Twenty native species were observed at this site in 2019. Considering the high shrub survival percentage of 95.3% from the first year, the lack of substantial cover by invasive species, and the high diversity of native species, no additional revegetation efforts are suggested at this time.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed on the site at less than 1% cover.

**Table 19. Percent Canopy Cover and Frequency of Occurrence at the 100-D-100 Site in 2019 (2 Pages).**

Species	Area 1 (N)		Area 2 (Central)		Area 3 (S)		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X	-	-	X	X	X	X
<i>Achnatherum hymenoides</i> (Indian ricegrass)	-	-	0.2	8.0	0.4	16.0	0.2	8.0
<i>Artemisia tridentata</i> (big sagebrush)	2.7	12.0	1.3	12.0	1.4	16.0	1.8	13.3
<i>Artemisia tridentata</i> (big sagebrush) (recruits)	X	X	-	-	-	-	X	X
<i>Astragalus caricinus</i> (buckwheat milkvetch)	X	X	-	-	-	-	X	X
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	6.0	100.0	3.2	88.0	3.0	100.0	4.1	96.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	-	-	0.6	4.0	0.2	8.0	0.3	4.0
<i>Chaenactis douglasii</i> (Douglas' dustymaiden)	0.1	4.0	-	-	X	X	0.03	1.3
<i>Chrysothamnus viscidiflorus</i> (yellow rabbitbrush)	-	-	-	-	X	X	X	X
<i>Descurciana pinnata</i> (western tansymustard)	1.0	40.0	0.7	28.0	1.2	48.0	1.0	38.7
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	1.7	68.0	0.9	36.0	0.7	28.0	1.1	44.0
<i>Elymus elymoides</i> (squirreltail)	0.3	12.0	0.2	8.0	0.1	4.0	0.2	8.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.3	12.0	0.4	16.0	0.4	16.0	0.4	14.7
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X	X	X	0.7	8.0	0.2	2.7
<i>Erigeron filifolius</i> (threadleaf fleabane)	X	X	-	-	-	-	X	X
<i>Eriogonum niveum</i> (snow buckwheat)	X	X	-	-	-	-	X	X
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	X	X	-	-	-	-	X	X
<i>Grayia spinosa</i> (spiny hopsage)	X	X	X	X	0.2	8.0	0.1	2.7
<i>Hesperostipa comata</i> (needle-and-thread grass)	-	-	-	-	0.1	4.0	0.03	1.3
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	1.6	64.0	1.1	24.0	1.1	44.0	1.3	44.0
<i>Koeleria macrantha</i> (prairie junegrass)	-	-	-	-	0.2	8.0	0.1	2.7
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.9	36.0	0.6	24.0	0.4	16.0	0.6	25.3
<i>Lamium amplexicaule</i> (henbit deadnettle) <sup>(a)</sup>	-	-	X	X	0.1	4.0	0.03	1.3
<i>Machaeranthera canescens</i> (hoary tansyaster)	X	X	-	-	0.1	4.0	0.03	1.3
<i>Medicago sativa</i> (alfalfa) <sup>(a)</sup>	X	X	-	-	-	-	X	X
<i>Melilotus officinalis</i> (sweet clover) <sup>(a)</sup>	1.2	8.0	X	X	0.6	4.0	0.6	4.0
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	0.2	8.0	X	X	-	-	0.1	2.7

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<i>Poa secunda</i> (Sandberg bluegrass)	4.3	92.0	5.7	92.0	5.2	88.0	5.1	90.7
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	3.9	56.0	3.8	72.0	1.4	36.0	3.0	54.7
<i>Purshia triedntata</i> (antelope bitterbrush)	1.5	4.0	0.6	4.0	X	X	0.7	2.7
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	2.4	96.0	1.7	68.0	2.3	92.0	2.1	85.3
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	1.0	40.0	1.6	64.0	1.0	40.0	1.2	48.0
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X	0.2	8.0	0.6	4.0	0.3	4.0
<i>Vulpia microstachys</i> (desert fescue)	X	X	-	-	-	-	X	X
Crust	0.1	4.0	0.1	4.0	0.8	12.0	0.3	6.7
Soil	23.1	100.0	36.2	80.0	31.6	88.0	30.3	89.3
Litter	14.4	100.0	16	100.0	16.0	100.0	15.5	100.0
Rock/Cobble	61.9	100.0	47.5	100.0	51.9	100.0	53.8	100.0
Unavailable Space	7.2	88.0	4.6	64.0	5.6	64.0	5.8	72.0
<b>Total canopy cover</b>	31.4		23.9		22.7		<b>25.9</b>	
<b>Total Native % Cover</b>	15.2		13.5		12.1		<b>13.6</b>	
Total Invasive % Cover	16.2		10.4		10.6		12.3	
Unadjusted canopy cover	29.1		22.8		21.4		24.4	
Unadjusted Native % Cover	14.1		12.9		11.4		12.8	
Change in Native % Cover from 2018							5.1	
Unadjusted Invasive % Cover	15.0		9.9		10.0		11.6	
Change in Invasive % Cover from 2018							3.9	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames

- = species not observed on site





**Figure 18. The 100-D-100 Site in 2019. Top: North Portion of the 100-D-100 Site in 2019. Bottom: Sandberg’s Bluegrass Growing at the 100-D-100 Site in 2019.**

### 1.4.3 100-D Trailer Village Site

The 100-D Trailer Village site (Figure 19) was revegetated in FY 2017 and monitoring was first conducted for the site in 2017. The substrate for the site is characterized predominantly by loamy sand with some scattered patches of gravel.

A 100-m (328-ft) shrub monitoring transect was established in 2017 and second-year monitoring occurred in May 2019. The results show a shrub density of 350 plants/ha (142 plants/ac), which falls below the success criteria of 600 plants/ha (240 plants/ac). None of the spiny hopsage (*Grayia spinosa*) or antelope bitterbrush (*Purshia tridentata*) plants recorded in 2017 survived into 2018. Only 30% of the big sagebrush (*Artemisia tridentata*) recorded in 2017 survived to 2019. Surviving sagebrush had an average size of 0.4 m (1.31 ft) by 0.3 m (0.98 ft).

Canopy cover data for the site was collected in April 2019. Total canopy cover for the site was 41.0%, with 20.1% native cover and 20.9% invasive cover (Table 20). Total invasive cover decreased by 3.1% since 2018 and total native cover increased by 16.2%. Total invasive cover has decreased by approximately 20% since 2017, largely due to a decrease in Russian thistle (*Salsola kali*) cover from 31.8% in 2017 to 2.5% in 2019. This may explain the large increase in native cover this year, as more growing space became available and there was less competition from invasive species. Sandberg’s bluegrass (*Poa secunda*) was the most abundant species with 13.5% cover. Fifteen native species were detected on the site in 2019. Cheatgrass (*Bromus tectorum*) was the dominant invasive species with 12.6% cover.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was recorded on the site with less than 1% cover occurring in 20% of the plot frames.

Additional shrub plantings are recommended at this site to bring shrub density to success levels. Continued tracking of canopy cover data is recommended.

**Table 20. Percent Canopy Cover and Frequency of Occurrence at the 100 D Trailer Village Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.6	24.0
<i>Ambrosia acanthicarpa</i> (flatspine bur ragweed)	X	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	1.7	28.0
<i>Artemisia tridentata</i> (big sagebrush)	2.4	16.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	12.6	100.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	X	X
<i>Chorispora tenella</i> (crossflower) <sup>(a)</sup>	0.3	12.0
<i>Descurcania pinnata</i> (western tansymustard)	0.3	12.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.4	16.0
<i>Elymus elymoides</i> (squirreltail)	0.1	4.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.1	4.0
<i>Hesperostipa comata</i> (needle-and-thread grass)	X	X
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.8	32.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.4	16.0
<i>Machaeranthera canescens</i> (hoary tansymustard)	X	X
<i>Phlox longifolia</i> (longleaf phlox)	X	X
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	0.2	8.0
<i>Poa secunda</i> (Sandberg bluegrass)	13.5	96.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	1.4	16.0
<i>Purshia tridentata</i> (antelope bitterbrush)	X	X
<i>Ranunculus testiculatus</i> (burr buttercup) <sup>(a)</sup>	0.1	4.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	2.5	80.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	3.6	84.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
Crust	0.0	0.0
Soil	70.4	100.0
Litter	24.0	100.0
Rock/Cobble	7.9	88.0
Unavailable Space	0.0	0.0
<b>Total canopy cover (excludes crust/soil/litter)</b>	<b>41.0</b>	
<b>Total Native % Cover</b>	<b>20.1</b>	
Change in Native % Cover from 2018	16.2	
Total Invasive % Cover	20.9	
Change in Invasive % Cover from 2018	-3.1	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 19. The 100-D Trailer Village Site in 2019, Showing Bunchgrasses and Dead Russian Thistle.**

#### **1.4.4 100-D-48:2 Site (Underground Pipelines)**

The 100-D-48:2 site (Figure 20) was revegetated in FY 2015. Monitoring for this site was not conducted until June 2018 when the site was 4 years old. This site is directly west of the 100-D-49:2 site.

No shrub transect was established for this site since monitoring did not begin until 2018.

Canopy cover data for the site was collected in April 2019. Data was collected from 25 plot frames. Canopy cover for the entire site was 57.7%, made up of 31.9% native cover and 25.8% invasive cover (Table 21). The dominant native species at this site were bluebunch wheatgrass (*Pseudoroegneria spicata*) and Sandberg's bluegrass (*Poa secunda*), both with 7.8% cover followed by rubber rabbitbrush (*Ericameria nauseosa*) with 5.4% cover. The dominant invasive species was cheatgrass (*Bromus tectorum*) with 8.0% cover. Sagebrush (*Artemisia tridentata*) had a cover of 4.3% at this site. Nineteen native species were recorded in 2019.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was recorded at this site with a cover of 1% and occurrence in 20% of the plot frames.

Both the native canopy cover and species diversity at this site are relatively high for a 5-year old site. As it is successful and past the 5-year mark, continued monitoring is not necessary. No additional actions are recommended at this site.

**Table 21. Percent Canopy Cover and Frequency of Occurrence at the 100-D-48:2 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Achnatherum hymenoides</i> (Indian ricegrass)	1.3	12.0
<i>Ambrosia acanthicarpa</i> (flatspine bur ragweed)	0.1	4.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	4.3	16.0
<i>Astragalus purshii</i> (woollypod milkvetch)	0.2	8.0
<i>Astragalus succumbens</i> (crouching milkvetch)	X	X
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	8.0	88.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	1.0	20.0
<i>Chorispota tenella</i> (crossflower) <sup>(a)</sup>	0.1	4.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.9	36.0
<i>Elymus elymoides</i> (squirreltail)	X	X
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.8	32.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	5.4	24.0
<i>Erigeron pumilus</i> (shaggy fleabane)	X	X
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	7.7	72.0
<i>Festuca sp.</i> (fescue)	0.6	4.0
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.7	8.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	2.0	80.0
<i>Koeleria macrantha</i> (prairie junegrass)	X	X
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.6	24.0
<i>Lamium amplexicaule</i> (henbit deadnettle) <sup>(a)</sup>	X	X
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.1	4.0
<i>Melilotus officinalis</i> (sweet clover) <sup>(a)</sup>	0.9	16.0
<i>Penstemon acuminatus</i> (sharp-leaf penstemon)	1.3	12.0
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	7.8	96.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	7.8	60.0
<i>Ranunculus testiculatus</i> (burr buttercup) <sup>(a)</sup>	0.3	12.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	3.1	84.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	0.1	4.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	0.1	4.0
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X
Crust	15.9	88.0
Soil	40.0	96.0
Litter	35.1	100.0
Rock/Cobble	21.3	100.0

Unavailable Space	4.4	60.0
<b>Total canopy cover</b>	<b>57.7</b>	
<b>Total Native % Cover</b>	<b>31.9</b>	
Total Invasive % Cover	25.8	
Unadjusted canopy cover	55.2	
Unadjusted Native % Cover	30.5	
Change in Native % Cover from 2018	10.3	
Unadjusted Invasive % Cover	24.7	
Change in Invasive % Cover from 2018	11.8	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 20. The 100-D-48:2 Site in 2019.**

**1.4.5 100-D-49:2 Site (Underground Pipelines)**

The 100-D-49:2 site (Figure 21) was revegetated in FY 2015. Monitoring for this site was not conducted until June 2018 when the site was 4 years old. This site is directly east of the 100-D-48:2 site.

No shrub transect was established for this site due to it not being monitored until 2018.

Canopy cover data for the site was collected in April 2019. Data was collected from 25 plot frames. Canopy cover for the entire site was 50.5%, made up of 20.1% native cover and 30.4% invasive cover (Table 22). Native cover has increased by 5.4% since 2018. The dominant native species at this site was Sandberg’s bluegrass (*Poa secunda*) with 7.7% cover followed by

bluebunch wheatgrass (*Pseudoroegneria spicata*) with 5.8% cover. The dominant invasive species was cheatgrass (*Bromus tectorum*) with 17.1% cover and occurrence in 100% of the plot frames. Sagebrush (*Artemisia tridentata*) had a cover of 0.6% at this site. Fourteen native species were recorded in 2018.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was recorded at this site and had a cover of 1.5%, occurring in 20.0% of plot frames.

Treatment of diffuse knapweed is recommended at this site. This site is not as successful as the neighboring 100-D-48:2 site, but still has a relatively high native species cover. Given the increasing trend in native cover and the age of this site, additional monitoring is not necessary.

**Table 22. Percent Canopy Cover and Frequency of Occurrence at the 100-D-49:2 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.1	4.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.8	12.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.6	4.0
<i>Artemisia tridentata</i> (big sagebrush)	0.6	4.0
<i>Astragalus succumbens</i> (crouching milkvetch)	0.6	4.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	17.1	100.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	1.5	20.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	1.1	44.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.3	12.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	2.3	16.0
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	4.3	72.0
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	2.0	60.0
<i>Koeleria macrantha</i> (prairie junegrass)	0.1	4.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	1.3	32.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.2	8.0
<i>Melilotus officinalis</i> (sweet clover) <sup>(a)</sup>	X	X
<i>Penstemon acuminatus</i> (sharp-leaf penstemon)	X	X
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	0.1	4.0
<i>Poa secunda</i> (Sandberg bluegrass)	7.7	92.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	5.8	40.0
<i>Ranunculus testiculatus</i> (burr buttercup) <sup>(a)</sup>	0.1	4.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	1.8	72.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	0.4	16.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	0.6	4.0
Crust	12.1	84.0
Soil	43.8	92.0
Litter	36.3	100.0
Rock/Cobble	12.5	96.0
Unavailable Space	2.2	48.0
<b>Total Canopy Cover</b>	<b>50.5</b>	

<b>Total Native % Cover</b>	<b>20.1</b>	
Total Invasive % Cover	30.4	
Unadjusted canopy cover	49.4	
Unadjusted Native % Cover	19.7	
Change in Native % Cover from 2018	5.4	
Unadjusted Invasive % Cover	29.7	
Change in Invasive % Cover from 2018	8.4	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 21. The 100-D-49:2 Site in 2019.**

#### **1.4.6 128-D-2 Site (Burn Pit)**

Two sections of the 128-D-2 site were re-worked in FY 2019 with the goal of increasing native species cover and shrub density. Both sections were reseeded with the FY 2019 Seed Mix (Table 1) and planted with big sagebrush (*Artemisia tridentata*), Munro's globemallow (*Sphaeralcea munroana*), and snow buckwheat (*Eriogonum niveum*). This site was first planted in FY 2011 and had not been monitored in the past. First-year monitoring for these sites occurred in 2019.

The 128-D-2 site was split into two sections, the west section and the east section. These sites are separated by an area of mature sagebrush and are reported on separately. Both sections had sandy soil (Figure 22). Canopy cover measurements for both sections were taken in April 2019. The western section had 19.0% canopy cover, with 9.9% native cover and 9.0% invasive cover

(Table 23). Young bunchgrasses (listed as Bunchgrass sp.) made up the majority of the native cover with 5.2% coverage. Cheatgrass (*Bromus tectorum*) was the dominant invasive species with 2.4% coverage. Twenty native species were detected in the western section. The eastern section was more successful with 29.5% total cover; the section was made up of 15.0% native and 14.5% invasive cover (Table 24). Sandberg's bluegrass (*Poa secunda*) had the highest native cover at 5.9%. Russian thistle (*Salsola kali*) had the highest invasive cover at 4.1%. Twenty-seven native species were detected in the eastern section.

One transect was established in each section of the 128-D-2 site. The western transect was monitored in May 2019 and had 1,270 shrubs/ha (514 shrubs/ac) and 170 forbs/ac (69 forbs/ac). Sagebrush was the only shrub on this transect and Munro's globemallow was the only forb on this transect. Sagebrush had an 87% survival rate since being planted and Munro's globemallow had a 100% survival rate. The eastern transect was monitored in June 2019 and had 930 shrubs/ha (376 shrubs/ac) and 270 forbs/ha (109 forbs/ac). Sagebrush (*Artemisia tridentata*) and bitterbrush (*Purshia tridentata*) were the shrubs monitored on this transect, and Munro's globemallow (*Sphaeralcea munroana*) and snow buckwheat (*Eriogonum niveum*) were the forbs. Sagebrush had a 96% survival rate after being planted, bitterbrush had a 100% survival rate, Munro's globemallow had an 87% survival rate, and snow buckwheat had a 70% survival rate.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was present in both sections with a 1.3% cover and 52.0% occurrence in the western section and 0.5% cover and 8.0% occurrence in the eastern section.

The 128-D-2 site has high native species diversity and cover for a first year site, and has successful shrub density levels. Continued monitoring is recommended.

**Table 23. Percent Canopy Cover and Frequency of Occurrence at the 128-D-2 West Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.8	32.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.1	4.0
<i>Artemisia tridentata</i> (big sagebrush)	0.1	4.0
<i>Artemisia tridentata</i> (recruits)	0.3	12.0
<i>Astragalus purshii</i> (woollypod milkvetch)	0.5	20.0
<i>Astragalus sclerocarpus</i> (stalked-pod milkvetch)	X	X
<i>Astragalus succumbens</i> (crouching milkvetch)	X	X
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	0.5	20.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	2.4	76.0
Bunchgrass sp. (multiple)	5.2	88.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	1.3	52.0
<i>Chaenactis douglasii</i> (Douglas' dustymaiden)	X	X
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	2.3	52.0
<i>Elymus elymoides</i> (squirreltail)	0.2	8.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.6	24.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X
<i>Erigeron filifolius</i> (threadleaf fleabane)	0.1	4.0

<i>Eriogonum niveum</i> (snow buckwheat)	0.2	8.0
<i>Festuca sp.</i> (fescue)	X	X
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.1	4.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.8	32.0
<i>Leptodactylon pungens</i> (prickly phlox)	X	X
<i>Lupinus pusillus</i> (low lupine)	0.1	4.0
<i>Melilotus officinalis</i> (sweet clover) <sup>(a)</sup>	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	1.0	20.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.1	4.0
<i>Ranunculus testiculatus</i> (burr buttercup) <sup>(a)</sup>	0.2	8.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	1.8	72.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	0.1	4.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	0.1	4.0
Crust	10.9	88.0
Soil	55.7	100.0
Litter	30.7	100.0
Rock/Cobble	3.3	56.0
Unavailable Space	0.3	12.0
<b>Total Canopy Cover</b>	<b>19.0</b>	
<b>Total Native % Cover</b>	<b>9.9</b>	
Total Invasive % Cover	9.0	
Unadjusted canopy cover	18.9	
Unadjusted Native % Cover	9.9	
Unadjusted Invasive % Cover	9.0	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames

**Table 24. Percent Canopy Cover and Frequency of Occurrence at the 128-D-2 East Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.2	6.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.1	4.0
<i>Ambrosia acanthicarpa</i> (flatspine bur ragweed)	1.3	32.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.1	4.0
<i>Artemisia tridentata</i> (big sagebrush)	0.1	4.0
<i>Artemisia tridentata</i> (transplants)	0.3	10.0
<i>Astragalus purshii</i> (woollypod milkvetch)	0.4	14.0
<i>Astragalus succumbens</i> (crouching milkvetch)	X	X
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	0.6	22.0
<i>Bromus tectorum</i> <sup>a</sup> (cheatgrass)	3.1	92.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	0.5	8.0

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<i>Chaenactis douglasii</i> (Douglas' dustymaiden)	0.2	6.0
<i>Chorisporea tenella</i> (crossflower) <sup>(a)</sup>	0.1	4.0
<i>Coldenia nuttallii</i> (desert mat)	0.2	8.0
<i>Descurcania pinnata</i> (western tansymustard)	X	X
<i>Cryptantha circumscissa</i> (matted cryptantha)	X	X
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	2.3	50.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.1	4.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.3	12.0
<i>Eriogonum niveum</i> (snow buckwheat)	0.5	20.0
<i>Eriogonum niveum</i> (transplant)	0.2	8.0
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	X	X
<i>Festuca sp.</i> (fescue)	0.1	4.0
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.5	8.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.7	26.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.4	16.0
<i>Leptodactylon pungens</i> (prickly phlox)	X	X
<i>Lupinus pusillus</i> (low lupine)	X	X
<i>Microsteris gracilis</i> (slender phlox)	0.3	10.0
<i>Oenothera pallida</i> (pale-evening primrose)	0.1	4.0
<i>Phacelia linearis</i> (threadleaf phacelia)	X	X
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	3.8	52.0
<i>Poa secunda</i> (Sandberg bluegrass)	5.9	70.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.5	18.0
<i>Purshia tridentata</i> (antelope bitterbrush)	X	X
<i>Ranunculus testiculatus</i> (burr buttercup) <sup>(a)</sup>	0.4	16.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	4.1	96.0
<i>Sisymbrium altissimum</i> (tall tumbledustard) <sup>(a)</sup>	2.2	58.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	0.4	4.0
<i>Sphaeralcea munroana</i> (transplants)	0.2	8.0
<i>Sporobolus cryptandrus</i> (sand dropseed)	X	X
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	0.1	4.0
Crust	1.0	18.0
Soil	41.2	96.0
Litter	55.8	100.0
Rock/Cobble	0.7	28.0
Unavailable Space	0.0	0.0
<b>Total canopy cover</b> (excludes ground cover)	<b>29.5</b>	
<b>Total Native % Cover</b>	<b>15.0</b>	
Total Invasive % Cover	14.5	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 22. The 128-D-2 Site in 2019. Top: The Western Section of the 128-D-2 Site in 2019. Bottom: The Eastern Section of the 128-D-2 Site in 2019.**

### 1.4.7 628-3 Site (Burn Pit)

The 628-3 site was planted in FY 2011 and additional revegetation actions took place in FY 2019 (Figure 23). This site was split into two areas for revegetation actions— the inner area and the outer area. The 628-3 inner area has significantly different substrate than the outer area, with sandier soil and a higher amount of cobble mixed in. The 628-3 outer area substrate is sandy loam with low amounts of cobble. The 628-3 inner area was planted with Munro’s globemallow (*Sphaeralcea munroana*) and snow buckwheat (*Eriogonum niveum*) plugs. The 628-3 outer area was re-worked and reseeded with the FY 2019 Seed Mix (Table 1), then planted with big sagebrush (*Artemisia tridentata*) plugs.

Canopy cover for the 628-3 inner area was measured in April 2019 (Table 25). Canopy cover totaled 34.3%, with 21.7% native cover and 12.6% invasive cover. Sagebrush had a coverage of 12.4% and Sandberg’s bluegrass (*Poa secunda*) had a coverage of 5.6%. The dominant invasive species was diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, with 4.7% cover and occurrence in 48% of the plot frames. Canopy cover for the 628-3 outer area was measured in April 2019 (Table 25). Canopy cover totaled 28.4%, with 6.6% native cover and 21.8% invasive cover. The dominant native species was slender phlox (*Microsteris gracilis*) with a cover of 1.4% followed by Sandberg’s bluegrass with a cover of 1.1%. The dominant invasive species was cheatgrass (*Bromus tectorum*) with 6.9% cover. As a whole, 25 species were recorded at the 628-3 site. Average canopy cover was 31.4%, with 14.2% native and 17.2% invasive cover.

One transect was established in the outer area of the 628-3 site to track survival of the planted shrubs. The transect was monitored in June 2019 and found a shrub density of 730 plants/ha (295 plants/ac), above success criteria. Average sagebrush size at this transect was 0.2 m (0.66 ft) by 0.05 m (0.16 ft).

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was detected at this site with 3.0% cover and occurrence in 30% of the plot frames. Treatment of diffuse knapweed is highly recommended at this site.

**Table 25. Percent Canopy Cover and Frequency of Occurrence at the 628-3 Site in 2019 (2 Pages).**

Species	Outer Area		Inner Area		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X	X	X	X	X
<i>Achnatherum hymenoides</i> (Indian ricegrass)	-	-	X	X	X	X
<i>Agoseris heterophylla</i> (false mountain dandelion)	0.4	16.0	-	-	0.4	16.0
<i>Ambrosia acanthicarpa</i> (flatspine bur ragweed)	-	-	0.8	32.0	0.8	32.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X	X	X	X	X
<i>Artemisia tridentata</i> (big sagebrush)	X	X	11.9	36.0	11.9	36.0
<i>Artemisia tridentata</i> (recruits)	-	-	0.5	20.0	0.5	20.0

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<i>Artemisia tridentata</i> (transplants)	0.2	8.0	-	-	0.2	8.0
<i>Astragalus caricinus</i> (buckwheat milkvetch)	-	-	X	X	X	X
<i>Astragalus purshii</i> (woollypod milkvetch)	0.1	4.0	-	-	0.1	4.0
<i>Astragalus succumbens</i> (crouching milkvetch)	X	X	-	-	X	X
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	0.4	16.0	-	-	0.4	16.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	6.9	96.0	2.1	84.0	4.5	90.0
<i>Calochortus macrocarpus</i> (sagebrush mariposa lily)	X	X	-	-	X	X
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	1.3	12.0	4.7	48.0	3.0	30.0
<i>Chaenactis douglasii</i> (Douglas' dustymaiden)	0.2	8.0	-	-	0.2	8.0
<i>Chrysothamnus viscidiflorus</i> (yellow rabbitbrush)	-	-	X	X	X	X
<i>Descurcania pinnata</i> (western tansymustard)	0.3	12.0	0.2	8.0	0.3	10.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	2.1	84.0	0.5	20.0	1.3	52.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.1	4.0	0.1	4.0	0.1	4.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	-	-	0.1	4.0	0.1	4.0
<i>Eriogonum niveum</i> (snow buckwheat)	0.5	20.0	0.1	4.0	0.3	12.0
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	0.6	4.0	0.2	8.0	0.4	6.0
<i>Grayia spinosa</i> (spiny hopsage)	-	-	0.4	16.0	0.4	16.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	1.7	68.0	0.5	20.0	1.1	44.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	X	X	0.4	16.0	0.4	16.0
<i>Lepidium perfoliatum</i> (clasping pepperweed) <sup>(a)</sup>	0.3	12.0	-	-	0.3	12.0
<i>Lupinus pusillus</i> (low lupine)	-	-	0.3	12.0	0.3	12.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	X	X	-	-	X	X
<i>Melilotus officinalis</i> (sweet clover) <sup>(a)</sup>	0.1	4.0	0.2	8.0	0.2	6.0
<i>Microsteris gracilis</i> (slender phlox)	1.4	56.0	0.5	20.0	1.0	38.0
<i>Plantago patagonica</i> (woolly plantain)	1.0	20.0	0.6	24.0	0.8	22.0
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	2.5	60.0	X	X	2.5	60.0
<i>Poa secunda</i> (Sandberg bluegrass)	1.1	44.0	5.6	84.0	3.4	64.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.7	28.0	0.1	4.0	0.4	16.0
<i>Ranunculus testiculatus</i> (burr buttercup) <sup>(a)</sup>	1.0	20.0	0.2	8.0	0.6	14.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	3.4	96.0	2.1	84.0	2.8	90.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	1.7	68.0	1.6	64.0	1.7	66.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	0.2	8.0	0.3	12.0	0.3	10.0
Crust	0.1	4.0	26.5	84.0	13.3	44.0
Soil	48.5	96.0	45.9	100.0	47.2	98.0
Litter	40.0	100.0	14.1	100.0	27.1	100.0
Rock/Cobble	7.0	80.0	5.1	84.0	6.1	82.0
Unavailable Space	0.7	8.0	0.9	16.0	0.8	12.0
<b>Total Canopy Cover</b>	28.4		34.3		31.4	
<b>Total Native % Cover</b>	6.6		21.7		14.2	
Total Invasive % Cover	21.8		12.6		17.2	
Unadjusted canopy cover	28.2		34.0		31.1	
Unadjusted Native % Cover	6.6		21.5		14.1	
Unadjusted Invasive % Cover	21.6		12.5		17.1	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 23. The 628-3 Site in 2019. Top: The Outer Area of the 628-3 Site in 2019, Showing the Inner Area on the Far Left. Bottom: The Inner Area of the 628-3 Site in 2019.**

## 1.5 100-H AREA SITES

Four sites were monitored in the 100-H Area: 100-H-28:2, 600-385, 100-H-24, and 116-H-1. The 100-H-24 site was revegetated in FY 2015, the 100-H-28:2 and 116-H-1 sites were revegetated in FY 2016, and the 600-385 site in FY 2017. These sites were remediated to meet the objectives for interim closure as established in the 100 Area RDR/RAWP (DOE/RL-96-17) and in the Interim Action ROD (EPA 1999). Site 600-385 had additional revegetation guidelines as stated in the *Memorandum of Agreement (MOA) Between the U.S. Department of Energy, Richland Operations Office, the Washington Department of Archaeology and Historic Preservation, and the Advisory Council on Historic Preservation Regarding the Remediation of Waste Site 600-385, and Removal of Miscellaneous Restoration Items SG4DH-169 and SG4DH-207 in the 100-D and 100-H Intermediary Area of the Hanford Site, Benton County, Washington (HCR#2011-100-083)* (DOE-RL et al. 2015b).

Revegetation efforts entailed broadcast seeding with a mixture of native grasses (including Sandberg's bluegrass [*Poa secunda*], Indian ricegrass [*Achnatherum hymenoides*], bluebunch wheatgrass [*Pseudoroegneria spicata*], squirreltail [*Elymus elymoides*], needle-and-thread grass [*Hesperostipa comata*], and prairie junegrass [*Koeleria macrantha*]) at approximately 16.8 kg/ha (15 lbs/ac). Broadcast seeding areas were topped with a straw mulch that was crimped into the soil surface. Shrub species (including big sagebrush [*Artemisia tridentata*], antelope bitterbrush [*Purshia tridentata*], and spiny hopsage [*Grayia spinosa*]) were transplanted on the sites at approximately 1,235 to 1,600 plants/ha (500 to 650 plants/ac) with a mix of approximately 75% sagebrush, 15% bitterbrush, and 10% spiny hopsage. Sites planted in FY 2016 (100-H-28:2) received varying planting ratios ranging from 60 to 75% big sagebrush, 5 to 15% antelope bitterbrush, 10 to 30% spiny hopsage, and approximately 1% (cumulatively) of rubber rabbitbrush (*Ericameria nauseosa*) and yellow rabbitbrush (*Chrysothamnus viscidiflorus*).

### 1.5.1 100-H-28:2 Site (Process Sewer Area)

The 100-H-28:2 site (Figure 24) was revegetated in FY 2016 and monitoring was first conducted for the site in 2016. This is a larger site that was divided into two areas (north and south) for monitoring purposes with 1 established transect in each area and data collected from 25 plot frames in each area. Substrates at the site are predominantly gravel and cobbles with varying amounts of loamy sand.

Two shrub monitoring transects were established for the site in 2016. In FY 2016 and FY 2017, these transects were monitored by recording plants only 3 m (9.8 ft) on either side of the tape. Third-year monitoring for the site was conducted in May 2019; the results show a shrub density of 525 plants/ha (212 plants/ac), below the success criteria of 600 plants/ha (240 plants/ac). Big sagebrush (*Artemisia tridentata*) is the most abundant with a total of 105 live plants recorded for the site. Sagebrush size averaged 0.36 m (1.18 ft) by 0.32 m (1.05 ft), bitterbrush (*Purshia tridentata*) size averaged 0.15 m (0.49 ft) by 0.3 m (0.98 ft), and hopsage (*Grayia spinosa*) size averaged 0.1 m (0.33 ft) by 0.2 m (0.66 ft). Though this site has high survival since the initial planting (~95%), it appears the site was not planted at the usual rate of about 1,400 plants/ha (600 plants/ac). Expanding the transect to cover more area revealed that this site has unsuccessful shrub cover.

Canopy cover data for the site was collected in April 2019. Average canopy cover for the site was 35.1%, with native cover representing 22.9% and invasive cover representing 12.2% (Table 26). This represents an increase of 9.2% in native cover and an increase of 3.8% in invasive cover from 2018. The dominant native species was bluebunch wheatgrass (*Pseudoroegneria spicata*) with 10.1% cover followed by Sandberg's bluegrass (*Poa secunda*) with 8.8% cover. Cheatgrass (*Bromus tectorum*) was the dominant invasive species for the site with 5.3% cover.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was recorded on the site with less than 1% cover occurring in 22% of the plot frames.

This site has a good ratio of native to invasive species and native species cover is increasing. Additional revegetation efforts to increase shrub density should be considered for this site.

**Table 26. Percent Canopy Cover and Frequency of Occurrence at the 100-H-28:2 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	1.0	8
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	5.3	100
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	0.8	22
<i>Chrysothamnus viscidiflorus</i> (yellow rabbitbrush)	X	X
<i>Descurciana pinnata</i> (western tansymustard)	0.1	4
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	1.3	50
<i>Elaeagnus angustifolia</i> (Russian olive) <sup>(a)</sup>	X	X
<i>Elymus elymoides</i> (squirreltail)	0.1	2
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.3	12
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.4	4
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Hesperostipa comata</i> (needle-and-thread grass)	1.0	18
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.9	36
<i>Koeleria macrantha</i> (prairie junegrass)	0.2	6
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.6	24
<i>Lamium amplexicaule</i> (henbit deadnettle) <sup>(a)</sup>	0.1	2
<i>Machaeranthera canescens</i> (hoary tansyaster)	X	X
<i>Melilotus officinalis</i> (sweetclover) <sup>(a)</sup>	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	8.8	100
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	10.1	86
<i>Purshia triedntata</i> (antelope bitterbrush)	X	X
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	2.4	96
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	0.3	12
<i>Sphaeralcea munroana</i> (Munro's globemallow)	0.1	2
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	0.1	2

<i>Verbascum thapsus</i> (common mullein) <sup>(a)</sup>	X	X
Crust	1	10
Soil	16.2	94
Litter	20.05	76
Rock/Cobble	32.4	100
Unavailable Space	5.25	80
<b>Total Canopy Cover</b>	<b>35.1</b>	
<b>Total Native % Cover</b>	<b>22.9</b>	
Total Invasive % Cover	12.2	
Unadjusted canopy cover	33.3	
Unadjusted Native % Cover	21.7	
Change in Native % Cover from 2018	9.2	
Unadjusted Invasive % Cover	11.6	
Change in Invasive % Cover from 2018	3.8	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 24. The 100-H-28:2 Site in 2019.**

### 1.5.2 600-385 Site (Dump Site)

The 600-385 site (Figure 25) was revegetated in FY 2017 and monitoring was first conducted for the site in 2017. The substrate for the site is characterized by loamy sand with varying amounts of gravel. In keeping with the *Memorandum of Agreement (MOA) Between the U.S. Department of Energy, Richland Operations Office, the Washington Department of Archaeology and Historic*

*Preservation, and the Advisory Council on Historic Preservation Regarding the Remediation of Waste Site 600-385, and Removal of Miscellaneous Restoration Items SG4DH-169 and SG4DH-207 in the 100-D and 100-H Intermediary Area of the Hanford Site, Benton County, Washington (HCRC#2011-100-083) (DOE-RL et al. 2015b), seeds from several native forbs were collected from the Hanford Site and broadcast on the site along with the standard native grass seed mix.*

One 100-m (328-ft) shrub monitoring transect was established in 2017. Transect monitoring took place in May 2019. The results show a density of 440 plants/ha (178 plants/ac). This does not meet the success criteria of 600 plants/ha (240 plants/ac). Shrub survival was 48% of those recorded in 2017. Standing water at this site in the late summer of 2017 is thought to have caused this decrease in shrub survival. Average sagebrush (*Artemisia tridentata*) and hopsage (*Grayia spinosa*) size at this site was 0.2 m (0.66 ft) by 0.2 m (0.66 ft).

Canopy cover data for the site was collected in May 2019. Data was collected from 25 plot frames. Canopy cover for the site overall was 38.5% with 27.8% native cover and 10.8% invasive cover (Table 27). Native cover increased by 6.6% since 2018 and invasive cover decreased by 8.7% from 2018. The dominant native species was Sandberg's bluegrass (*Poa secunda*) with 13.5% cover followed by bluebunch wheatgrass (*Pseudoroegneria spicata*) with 5.1% cover. Fifteen native species were detected at this site in 2019. Cheatgrass (*Bromus tectorum*) was the dominant invasive species at this site with 5.5% cover.

Kochia (*Bassia scoparia*) and diffuse knapweed (*Centaurea diffusa*), both Washington State Class B noxious weeds, were recorded at this site at levels less than 1% coverage.

Additional shrub transplants are recommended for this site in order to bring it to success levels.

**Table 27. Percent Canopy Cover and Frequency of Occurrence at the 600-385 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.1	4.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.1	4.0
<i>Artemisia tridentata</i> (big sagebrush)	0.2	8.0
<i>Bassia scoparia</i> (kochia) (B) <sup>(b)</sup>	0.3	12.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	5.5	100.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	0.1	4.0
<i>Chorispora tenella</i> (crossflower) <sup>(a)</sup>	X	X
<i>Descurcania pinnata</i> (western tansymustard)	1.2	28.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.4	16.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.3	12.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	4.9	40.0
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	0.7	8.0
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.3	12.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.7	28.0
<i>Hordeum leporinum</i> (hare barley) <sup>(a)</sup>	X	X

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<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.4	16.0
<i>Lepidium perfoliatum</i> (clasping pepperweed) <sup>(a)</sup>	0.3	12.0
<i>Leymus cinereus</i> (basin wildrye)	X	X
<i>Lupinus wyethii</i> (Wyeth's lupine)	X	X
<i>Melilotus officinalis</i> (sweet clover) <sup>(a)</sup>	X	X
<i>Phlox longifolia</i> (longleaf phlox)	0.1	4.0
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	0.1	4.0
<i>Poa secunda</i> (Sandberg bluegrass)	13.5	96.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	5.1	64.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	1.0	40.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	0.5	20.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X
Crust	3.1	28.0
Soil	27.2	92.0
Litter	35.9	100.0
Rock/Cobble	1.6	44.0
Unavailable Space	7.1	64.0
<b>Total Canopy Cover</b>	<b>38.5</b>	
<b>Total Native % Cover</b>	<b>27.8</b>	
Total Invasive % Cover	10.8	
Unadjusted canopy cover	35.8	
Unadjusted Native % Cover	25.8	
Change in Native % Cover from 2018	6.6	
Unadjusted Invasive % Cover	10.0	
Change in Invasive % Cover from 2018	-8.7	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 25. The 600-385 Site in 2019.**

### **1.5.3 100-H-24 Site (Substation)**

The entire 100-H-24 site was revegetated multiple times, most recently in FY 2015 (Figure 26). These multiple iterations of revegetation activities were most likely due to repeated industrial use of the 100-H-24 site. Monitoring for this site was not conducted until June 2018 when the site was 3 years old.

No shrub transect was established for this site due to the delayed monitoring. Sagebrush (*Artemisia tridentata*) has a cover of 2.1% at this site.

Canopy cover data for the site was collected in April 2019 (Table 28). Data was collected from 25 plot frames. Canopy cover for the entire site was 36.4%, made up of 21.4% native cover and 15.0% invasive cover. Native cover has increased by 5.5% since 2018 and invasive cover has increased by 2.0% since 2018. The dominant native species at this site was bluebunch wheatgrass (*Pseudoroegneria spicata*) with 11.4% cover followed by Sandberg's bluegrass (*Poa secunda*) with 5.1% cover. The dominant invasive species was cheatgrass (*Bromus tectorum*) with 9.0% cover and occurrence in 100% of the plot frames followed by Russian thistle (*Salsola kali*) with 2.2% cover. Ten native species were recorded in 2019, which represents low diversity, but this site is relatively small compared to other revegetation areas.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was recorded at this site and had a cover of less than 1%.

The bunchgrass cover at this site is significant and expected to continue to increase. No actions are recommended apart from continued monitoring.

**Table 28. Percent Canopy Cover and Frequency of Occurrence at the 100-H-24 Site in 2019.**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	2.1	8.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	9.0	100.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	0.5	20.0
<i>Chorispora tenella</i> (crossflower) <sup>(a)</sup>	X	X
<i>Chrysothamnus viscidiflorus</i> (yellow rabbitbrush)	0.1	4.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.2	8.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.4	16.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	0.1	4.0
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.6	4.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.9	36.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	1.0	40.0
<i>Melilotus officinalis</i> (sweet clover) <sup>(a)</sup>	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	5.1	84.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	11.4	80.0
<i>Purshia tridentata</i> (antelope bitterbrush)	0.6	4.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	2.2	88.0
<i>Sisymbrium altissimum</i> (tumble mustard) <sup>(a)</sup>	0.3	12.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X
Crust	3.2	28.0
Soil	3.3	36.0
Litter	28.4	88.0
Rock/Cobble	44.1	96.0
Unavailable Space	5.1	84.0
<b>Total Canopy Cover</b>	<b>36.4</b>	
<b>Total Native % Cover</b>	<b>21.4</b>	
Total Invasive % Cover	15.0	
Unadjusted canopy cover	34.5	
Unadjusted Native % Cover	20.3	
Change in Native % Cover from 2018	5.5	
Unadjusted Invasive % Cover	14.2	
Change in Invasive % Cover from 2018	2.0	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 26. The 100-H-24 Site in 2019.**

#### **1.5.4 116-H-1 Site (Liquid Waste Disposal Trench)**

The 116-H-1 site was revegetated multiple times, most recently in FY 2016. These multiple iterations of revegetation activities were most likely due to repeated industrial use of the 116-H-1 site. Monitoring for this site was not conducted until June 2018 when the site was 3 years old (Figure 27).

No shrub transect was established for this site. Sagebrush (*Artemisia tridentata*) was not common on the site.

Fourth-year canopy cover data for the site was collected in April 2019. Data was collected from 50 plot frames, 25 in the northern portion and 25 in the southern portion of the site. Canopy cover did not differ significantly between the two areas. Canopy cover for the entire site was 33.6%, made up of 14.0% native cover and 19.6% invasive cover (Table 29). The dominant native species at this site was Sandberg's bluegrass (*Poa secunda*) with 7.5% cover, followed by bluebunch wheatgrass (*Pseudoroegneria spicata*) with 4.5% cover. Bunchgrass coverage was patchy and there were large areas with little to no vegetation. The dominant invasive species was cheatgrass (*Bromus tectorum*) with 9.4% cover and occurrence in 100% of the plot frames. Twelve native species were recorded in 2019.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was recorded at this site and had a cover of 1.6%, occurring in 24% of the plot frames.

Additional shrub plantings are recommended at this site to increase native cover and shrub density. Continued monitoring of canopy cover is recommended to track changes in native cover.

**Table 29. Percent Canopy Cover and Frequency of Occurrence at the 116-H-1 Site in 2019.**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Agropyron cristatum</i> (crested wheatgrass) <sup>(a)</sup>	X	X
<i>Artemisia tridentata</i> (big sagebrush)	X	X
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	9.4	100.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	1.6	24.0
<i>Ceratocephala testiculata</i> (burr buttercup) <sup>(a)</sup>	0.1	4.0
<i>Chrysothamnus viscidiflorus</i> (yellow rabbitbrush)	X	X
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	1.6	64.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.1	4.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.2	6.0
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	0.1	4.0
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.7	18.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	2.6	82.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.4	14.0
<i>Melilotus officinalis</i> (sweet clover) <sup>(a)</sup>	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	7.5	100.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	4.5	70.0
<i>Purshia tridentata</i> (antelope bitterbrush)	X	X
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	2.3	90.0
<i>Salvia dorrii</i> (purple sage)	X	X
<i>Sisymbrium altissimum</i> (tumble mustard) <sup>(a)</sup>	0.4	14.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	0.1	2.0
<i>Verbascum thapsus</i> (common mullein) <sup>(a)</sup>	X	X
Crust	1.2	8.0
Soil	10.6	82.0
Litter	16.5	62.0
Rock/Cobble	45.2	98.0
Unavailable Space	6.9	88.0
<b>Total Canopy Cover</b>	<b>33.6</b>	
<b>Total Native % Cover</b>	<b>14.0</b>	
Total Invasive % Cover	19.6	
Unadjusted canopy cover	31.3	
Unadjusted Native % Cover	13.0	
Change in Native % Cover from 2018	4.4	
Unadjusted Invasive % Cover	18.3	
Change in Invasive % Cover from 2018	5.1	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 27. The 116-H-1 Site in 2019. Top: The Northern Section of the 116-H-1 Site. Bottom: The Southern Section of the 116-H-1 Site.**

## 1.6 100-F AREA SITES

Nine sites were monitored in the 100-F Area: 118-F-6 SSA, 100-F-47, 100-F-CTA, 100-F-57, 100-F-26, 118-F-1, 118-F-3, 118-F-5, and the 100-F Trailer Village. The 100-F-47 and 100-F-48 sites were revegetated in FY 2012 and monitoring was first conducted in FY 2016. The 100-F-47 and 100-F-48 sites had additional shrubs planted in FY 2018 in order to increase the shrub coverage. Only 100-F-47 was monitored in 2019 as a representative site. The eight other sites were determined to need additional revegetative actions due to failing shrub and/or native plant coverage and were all completely re-done in FY 2018. The original planting of 118-F-1, 100-F-26, and 118-F-5 took place in FY 2008, the original planting of 118-F-6 SSA took place in FY 2009, and the original planting of 100-F-47 and 100-F-CTA occurred in FY 2012. Initial revegetation efforts at all these sites entailed broadcast seeding at approximately 16.8 kg/ha (15 lbs/ac) with a mixture of native grasses including Sandberg's bluegrass (*Poa secunda*), Indian ricegrass (*Achnatherum hymenoides*), bluebunch wheatgrass (*Pseudoroegneria spicata*), squirreltail (*Elymus elymoides*), needle-and-thread grass (*Hesperostipa comata*), and prairie junegrass (*Koeleria macrantha*) topped with a straw mulch that was crimped into the soil surface. Shrub species including big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), and spiny hopsage (*Grayia spinosa*) were transplanted on the sites at approximately 1,235 to 1,600 plants/ha (500 to 650 plants/ac) with a mix of approximately 75% sagebrush, 15% bitterbrush, and 10% spiny hopsage. The 2017 monitoring of these sites showed higher invasive cover than native cover and low shrub coverage.

In FY 2018, additional revegetation actions at the 100-F Area involved both supplemental plantings of shrubs and the complete re-working of failing revegetation sites. All of the sites monitored and included in this report were completely re-done. Revegetation efforts at these sites included seeding approximately 16.8 kg/ha (15 lbs/ac) pure live seed of a mixture of native grasses including Sandberg bluegrass, Indian ricegrass, bluebunch wheatgrass, squirreltail, and needle-and-thread grass. Gray rabbitbrush (*Ericameria nauseosa*), snow buckwheat (*Eriogonum niveum*), Blue Mountain buckwheat (*Eriogonum strictum*), Munro's globemallow (*Sphaeralcea munroana*), Douglas' dustymaiden (*Chaenactis douglasii*), Carey's balsamroot (*Balsamorhiza careyana*), and sharpleaf penstemon (*Penstemon acuminatus*) were seeded as a mix at a rate of 1.1 lb/ac. Big sagebrush, antelope bitterbrush, and spiny hopsage were planted at a target rate of 1,480 plants/ha (600 plants/ac) at a mix of 67%, 16%, and 16%, respectively.

Three different revegetation treatments were used on the sites that were completely redone. The 118-F-1 and 118-F-6 seeding used an imprinter rather than a broadcast seeder, and these sites were not covered with straw mulch. The 100-F-CTA, the 100-F-Trailer Village, and 118-F-5 were imprinted and covered with straw mulch. The 100-F-57, 100-F-26, and 118-F-3 used the traditional method of broadcast seeding and covered with straw mulch.

### 1.6.1 100-F-47 Site (151-F Substation)

The 100-F-47 site (Figure 28) was originally revegetated in FY 2012 and monitoring was first conducted for the site in 2016. After finding low shrub density, additional supplemental revegetation actions were taken in FY 2018. Sagebrush, bitterbrush, and hopsage were planted at this site at a rate of approximately 864 plants/ha (350 plants/ac), 247 plants/ha (100 plants/ac), and 247 plants/ha (100 plants/ac), respectively. The substrate for the site is primarily gravel and cobble backfill with varying amounts of loamy sand.

A shrub monitoring transect was established for the site after supplemental planting in FY 2018 and was first monitored in 2018. A total of 1690 plants/ha (684 plants/ac) were measured at this site with 490 plants/ha (198 plants/ac) being shrubs planted in FY 2018. Sagebrush (*Artemisia tridentata*) planted at this site in FY 2018 had a survival rate of 46%, bitterbrush (*Purshia tridentata*) had a survival rate of 33%, and hopsage (*Grayia spinosa*) had a survival rate of 0%.

Canopy cover data was not collected for this site in 2018, data collected in 2019 will be compared to 2017 pre-supplementation data. Second-year canopy cover monitoring showed 42.5% total cover, with 23.1% native cover and 19.4% invasive cover (Table 30). This represents an increase of 10.0% in native cover and of 5.3% in invasive cover since 2017. The dominant native species is Sandberg's bluegrass (*Poa secunda*) with 6.3% cover followed by sagebrush with 4.8% cover. Eighteen native species were detected at this site. The dominant invasive species is cheatgrass (*Bromus tectorum*) with 10.3% cover.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was present on the site with 2.3% cover and occurrence in 52% of the plot frames.

Treatment of diffuse knapweed is highly recommended at this site. The supplemental planting appears to have been successful, as native cover is nearing 25% success levels and shrub density is successful. No further actions but continued monitoring are recommended at this time.

**Table 30. Percent Canopy Cover and Frequency of Occurrence at the 100-F-47 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.2	8.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	X	X
<i>Ambrosia acanthicarpa</i> (flatspine bur ragweed)	0.2	8.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.1	4.0
<i>Artemisia tridentata</i> (big sagebrush)	4.8	20.0
<i>Artemisia tridentata</i> (recruits)	0.7	28.0
<i>Astragalus succumbens</i> (crouching milkvetch)	X	X
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	10.3	100.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	2.3	52.0
<i>Descurcania pinnata</i> (western tansymustard)	0.3	12.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.8	32.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.9	36.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	1.9	20.0
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	0.3	12.0
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.2	8.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	1.0	40.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.5	20.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.1	4.0
<i>Plantago patagonica</i> (woolly plantain)	0.2	8.0
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	0.2	8.0

<i>Poa secunda</i> (Sandberg bluegrass)	6.3	92.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	3.7	48.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	2.0	80.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	X	X
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Sporobolus cryptandrus</i> (sand dropseed)	0.1	4.0
<i>Vulpia microstachys</i> (desert fescue)	1.1	44.0
Crust	0.4	16.0
Soil	9.5	64.0
Litter	28.0	92.0
Rock/Cobble	21.3	92.0
Unavailable Space	10.1	92.0
<b>Total Canopy Cover</b>	<b>42.5</b>	
<b>Total Native % Cover</b>	<b>23.1</b>	
Total Invasive % Cover	19.4	
Unadjusted canopy cover	38.2	
Unadjusted Native % Cover	20.8	
Change in Native % Cover from 2017 <sup>c</sup>	10.0	
Unadjusted Invasive % Cover	17.4	
Change in Invasive % Cover from 2017 <sup>c</sup>	5.3	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

<sup>c</sup> was not monitored in 2018

X = present but not counted in plot frames



**Figure 28. The 100-F-47 Site in 2019.**

### 1.6.2 118-F-1 Site (Burial Ground)

The 118-F-1 site was originally revegetated in FY 2009 and was not monitored; however, 118-F-6 acts as a representative site, suggesting 118-F-1 also failed to meet success criteria after the original planting. The 118-F-1 and 118-F-6 sites were revegetated in FY 2018 using an imprinter seeder and no straw mulch (Figure 29). The substrate for this site is predominantly sand with some gravel and cobbles. Vegetative coverage is patchy with areas of dense cheatgrass and areas of bare sand.

One transect was established on this site in May 2018. Second-year monitoring results show a shrub density of 810 plants/ha (328 plants/ac), putting this site above the success criteria of 600 plants/ha (240 plants/ac). Shrub survival for sagebrush (*Artemisia tridentata*), bitterbrush (*Purshia tridentata*), and hopsage (*Grayia spinosa*) averaged 50% from the first year. Average sagebrush size was 0.15 m by 0.10 m, bitterbrush size was 0.27 m by 0.13 m, and hopsage was 0.05 m by 0.05 m.

Canopy cover at this site was measured with 25 plots in May 2019 (Table 31). Canopy cover totaled 31.7% with 9.5% native cover and 22.2% invasive cover. This represents an increase of 0.4% in native cover and 1.9% in invasive cover. Russian thistle (*Salsola kali*), the dominant invasive species in 2018, dropped from 9.4% coverage to 1.7% coverage in 2019. Cheatgrass (*Bromus tectorum*) increased from 5.8% to 13.1%. The dominant native species was Sandberg's bluegrass (*Poa secunda*) with 2.2% coverage. Nineteen native species were found at this site, an increase of seven species from 2018 monitoring. Of the six forbs that were seeded at this site, four were found growing at this site in 2019.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was present on the site with 2.3% cover and occurrence in 52% of the plot frames.

More time is needed to determine the success of this site but the high diversity of native plants observed and increasing native cover is a positive indicator.

**Table 31. Percent Canopy Cover and Frequency of Occurrence at the 118-F-1 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.1	4.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.1	4.0
<i>Artemisia tridentata</i> (big sagebrush)	1.2	8.0
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	0.1	4.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	13.1	100.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	0.2	8.0
<i>Chaenactis douglasii</i> (Douglas' dusty maiden)	0.7	8.0
<i>Cryptantha circumscissa</i> (cushion cryptantha)	X	X
<i>Descurcania pinnata</i> (western tansymustard)	0.7	28.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.4	16.0
<i>Elymus elymoides</i> (squirreltail)	X	X
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.6	24.0

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<i>Ericameria nauseosa</i> (rubber rabbitbrush)	1.1	24.0
<i>Eriogonum niveum</i> (snow buckwheat)	0.1	4.0
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	2.7	68.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.1	4.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.1	4.0
<i>Melilotus officinalis</i> (sweet clover) <sup>(a)</sup>	X	X
<i>Phacelia sp.</i> (phacelia)	X	X
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	0.8	32.0
<i>Poa secunda</i> (Sandberg bluegrass)	2.2	68.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	1.4	36.0
<i>Purshia tridentata</i> (antelope bitterbrush)	X	X
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	1.7	68.0
<i>Sisymbrium altissimum</i> (tall tumbledustard) <sup>(a)</sup>	0.9	36.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Sporobolus cryptandrus</i> (sand dropseed)	0.1	4.0
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X
Crust	4.2	68.0
Soil	43.6	100.0
Litter	6.4	96.0
Rock/Cobble	24.0	100.0
Unavailable Space	10.4	96.0
<b>Total Canopy Cover</b>	<b>31.7</b>	
<b>Total Native % Cover</b>	<b>9.5</b>	
Total Invasive % Cover	22.2	
Unadjusted canopy cover	28.4	
Unadjusted Native % Cover	8.5	
Change in Native % Cover from 2018	0.4	
Unadjusted Invasive % Cover	19.9	
Change in Invasive % Cover from 2018	1.9	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 29. The 118-F-1 Site in 2019.**

### **1.6.3 118-F-6 Site (Soil Staging Area)**

The 118-F-6 Soil Staging Area site (Figure 30) was revegetated in FY 2009 and monitoring was first conducted for the site in 2016. The substrate for the site is a loamy sand with varying amounts of gravel and cobbles. No shrub transect was established for the site in 2016 due to the scarcity of shrubs observed on the site. In 2018 this site was revegetated with an imprint seeder and no straw mulch.

In 2017, 7 years after this site was originally planted, 118-F-6 had little to no shrub cover and a canopy cover of 18.7% with 14.2% invasive and 4.5% native. In May 2018, after this site was redone, one transect was set up to measure shrub cover. Second-year monitoring took place in May 2019. The results show a shrub cover of 540 plants/ha (219 plants/ac) below the success criteria of 600 plants/ha (240 plants/ac). Sagebrush (*Artemisia tridentata*) survival in 2019 was 40%, hopsage (*Grayia spinosa*) survival was 23%, and bitterbrush (*Purshia tridentata*) survival was 21%. It is unknown why survival rates were abnormally low at this site.

Canopy cover data for this site was collected in May 2019 (Table 32). Data was collected from a total of 25 plot frames. Canopy cover for the site was 37.3%, with 6.3% native cover and 31.6% invasive cover. This represents a 0.7% decrease in native cover and a 1.7% increase in invasive cover since 2018. The high invasive cover is mainly made up cheatgrass (*Bromus tectorum*, 13.2% cover). The highest native coverage was from bluebunch wheatgrass (*Pseudoroegneria spicata*) with 1.7% cover. Twenty-two native grasses and forbs were identified at this site, an increase of six from 2018 monitoring. Prior to additional revegetation action, only five native grass and forb species were identified at this site. Of the six forbs that were seeded at this site, four were found growing at this site in 2019.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed at this site but was not detected in any plot frames.

The 118-F-6 site has significantly higher native plant diversity and cover than it did before additional revegetation actions. Shrub cover did not meet success levels. Further monitoring and evaluation is required before additional steps are taken to revegetate this site.

**Table 32. Percent Canopy Cover and Frequency of Occurrence at the 118-F-6 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.1	4.0
<i>Agoseris heterophylla</i> (false mountain dandelion)	0.1	4.0
<i>Artemisia tridentata</i> (big sagebrush)	0.9	16.0
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	0.1	4.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	13.2	100.0
<i>Bunchgrasses sp.</i> (multiple)	0.1	4.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	X	X
<i>Chaenactis douglasii</i> (Douglas' dusty maiden)	0.1	4.0
<i>Chondrilla juncea</i> (rush skeletonweed) (B) <sup>(b)</sup>	X	X
<i>Cryptantha circumscissa</i> (cushion cryptantha)	0.2	8.0
<i>Descurcania pinnata</i> (western tansymustard)	0.5	20.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	1.1	44.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.4	16.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.1	4.0
<i>Erigeron sp.</i> (fleabane)	X	X
<i>Eriogonum niveum</i> (snow buckwheat)	X	X
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	2.8	16.0
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.1	4.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	4.8	92.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.1	4.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.2	8.0
<i>Microsteris gracilis</i> (slender phlox)	0.3	12.0
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	2.8	32.0
<i>Poa secunda</i> (Sandberg bluegrass)	0.7	28.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	1.7	28.0
<i>Purshia tridentata</i> (antelope bitterbrush)	0.1	4.0
<i>Ranunculus testiculatus</i> (burr buttercup) <sup>(a)</sup>	0.2	8.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	1.5	60.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	2.2	48.0
<i>Sporobolus cryptandrus</i> (sand dropseed)	X	X

Crust	7.0	88.0
Soil	34.0	100.0
Litter	15.5	100.0
Rock/Cobble	18.8	96.0
Unavailable Space	9.2	76.0
<b>Total Canopy Cover</b>	<b>37.9</b>	
<b>Total Native % Cover</b>	<b>6.3</b>	
Total Invasive % Cover	31.6	
Unadjusted canopy cover	34.4	
Unadjusted Native % Cover	5.7	
Change in Native % Cover from 2018	-0.7	
Unadjusted Invasive % Cover	28.7	
Change in Invasive % Cover from 2018	1.7	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 30. The 118-F-6 Soil Staging Area Site in 2019.**

#### **1.6.4 100-F-CTA Site (Container Transfer Area)**

The 100-F-CTA site (Figure 31) was revegetated in FY 2012 and monitoring was first conducted for the site in 2016. This site met success criteria in 2017 monitoring with 640 plants/ha (259 plants/ac). Native canopy cover at this site was not successful in 2017 with 9.6% native cover and 12.3% invasive cover. Due to the low native cover and patchy shrub cover at this site, it was redone in FY 2018. This site was imprinted and covered with a straw mulch, care was taken to

avoid running machinery over existing patches of shrubs. The substrate for the site is primarily gravel and cobble backfill with varying amounts of loamy sand.

A shrub monitoring transect was established for the site after the completion of revegetation activities in 2018; this transect was monitored for second-year monitoring in May 2019. The 2019 results show a shrub density of 560 plants/ha (227 plants/ac), not meeting the success criteria of 600 plants/ha (240 plants/ac). Shrub survival was 66.7% of the previous year.

Canopy cover data for the site was collected in May 2019. Data was collected from a total of 25 plot frames. Canopy cover for the site was 30.9% with native cover representing 8.0% and invasive cover representing 22.9% (Table 33). This represents an increase of 0.5% in native cover and of 9.2% in invasive cover from 2018. The dominant native species was Sandberg's bluegrass (*Poa secunda*) with 4.4% cover. The dominant invasive species was cheatgrass (*Bromus tectorum*) with 16.4%. Cheatgrass cover has increased by 12.5% since 2018. Sixteen native grass and forb species were identified at this site; five more than in 2018 monitoring; prior to the additional revegetation actions only six native grass and forb species were found at this site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was present on the site with 1.9% cover and occurrence in 16% of the plot frames.

The 100-F-CTA site has significantly higher native plant diversity than it did before additional revegetation actions. Native plant cover is not as high as it was before additional revegetation actions but native plant cover is expected to increase. Shrub cover did not meet success levels. Further monitoring and evaluation is required before additional steps are taken to revegetate this site.

**Table 33. Percent Canopy Cover and Frequency of Occurrence at the 100 F CTA Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.1	4.0
<i>Artemisia tridentata</i> (big sagebrush)	0.8	12.0
<i>Artemisia tridentata</i> (recruits)	0.2	8.0
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	0.1	4.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	16.4	92.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	1.9	16.0
<i>Chaenactis douglasii</i> (Douglas' dusty maiden)	X	X
<i>Dalea ornata</i> (prairie clover)	X	X
<i>Descurcania pinnata</i> (western tansymustard)	0.1	4.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	X	X
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.2	8.0
<i>Eriogonum niveum</i> (snow buckwheat)	0.1	4.0
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	0.1	4.0
<i>Festuca</i> sp. (fescue)	X	X
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	1.0	40.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.1	4.0

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<i>Lepidium perfoliatum</i> (clasping pepperweed) <sup>(a)</sup>	0.1	4.0
<i>Oenothera pallida</i> (pale-evening primrose)	X	X
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	4.4	80.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	1.4	56.0
<i>Purshia tridentata</i> (antelope bitterbrush)	0.1	4.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	2.0	80.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	0.7	28.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Vulpia microstachys</i> (desert fescue)	0.3	12.0
Crust	0.7	8.0
Soil	14.2	84.0
Litter	42.3	92.0
Rock/Cobble	15.6	88.0
Unavailable Space	2.5	40.0
<b>Total Canopy Cover</b>	<b>30.9</b>	
<b>Total Native % Cover</b>	<b>8.0</b>	
Total Invasive % Cover	22.9	
Unadjusted canopy cover	30.1	
Unadjusted Native % Cover	7.8	
Change in Native % Cover from 2018	0.5	
Unadjusted Invasive % Cover	22.3	
Change in Invasive % Cover from 2018	9.2	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 31. The 100-F-CTA Site in 2019, Showing a Patch of Sagebrush that was Avoided During FY 2018 Revegetation Activities.**

### 1.6.5 100-F Trailer Village Site

The 100-F Trailer Village site was revegetated in FY 2018 using an imprinter seeder and straw mulch (Figure 32). The 100-F Trailer Village site was originally revegetated in FY 2013 and was not monitored but the 100-F-CTA site acts as a representative site, suggesting the 100-F Trailer Village would also benefit from additional revegetation activities. The substrate for this site is predominantly loamy sand with gravel.

A shrub monitoring transect was established for the site after the completion of revegetation activities in 2018; this transect was monitored for second-year monitoring in May 2019. The 2019 results show a shrub density of 600 plants/ha (243 plants/ac), just meeting the success criteria of 600 plants/ha (240 plants/ac). Shrub survival was 37% of the previous year.

Canopy cover at this site was measured with 25 plots in May 2019 (Table 34). Canopy cover totaled 28.0% with 6.6% native cover and 21.4% invasive cover. This represents an increase of 1.8% in native cover and of 4.9% in invasive cover. The dominant native species was Sandberg's bluegrass (*Poa secunda*) with 3.0% cover. The dominant invasive plant was cheatgrass (*Bromus tectorum*) with a coverage totaling 14.5%. Eighteen species of native forbs and grasses were identified at this site, eight more than in 2018.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was present on the site but did not occur in any of the plot frames.

The 100-F Trailer Village site has significantly higher native plant diversity than the representative site did before additional revegetation actions. Native plant cover is not as high as it was at the representative site before additional revegetation actions, but native plant cover is expected to increase. Shrub cover is likely to drop below success levels in the coming years. Further monitoring and evaluation is required before additional steps are taken to revegetate this site.

**Table 34. Percent Canopy Cover and Frequency of Occurrence at the 100-F Trailer Village Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Achnatherum hymenoides</i> (Indian ricegrass)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	0.6	4.0
<i>Artemisia tridentata</i> (recruits)	X	X
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	0.1	4.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	14.5	92.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	X	X
<i>Chaenactis douglasii</i> (Douglas' dusty maiden)	0.1	4.0
<i>Chorispora tenella</i> (crossflower) <sup>(a)</sup>	0.1	4.0
<i>Dalea ornata</i> (prairie clover)	X	X
<i>Descurcania pinnata</i> (western tansymustard)	0.4	16.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.7	28.0
<i>Elymus elymoides</i> (squirreltail)	X	X
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.8	32.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.2	8.0
<i>Eriogonum niveum</i> (snow buckwheat)	X	X
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	1.6	64.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.3	12.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	X	X
<i>Melilotus officinalis</i> (sweet clover) <sup>(a)</sup>	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	3.0	80.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	1.0	40.0
<i>Purshia tridentata</i> (antelope bitterbrush)	0.1	4.0
<i>Ranunculus testiculatus</i> (burr buttercup) <sup>(a)</sup>	1.0	20.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	2.4	76.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	0.7	28.0
<i>Vulpia microstachys</i> (desert fescue)	0.3	12.0
Crust	0.0	0.0
Soil	23.2	88.0
Litter	41.9	100.0

Rock/Cobble	14.8	88.0
Unavailable Space	0.5	20.0
<b>Total Canopy Cover</b>	<b>28.0</b>	
<b>Total Native % Cover</b>	<b>6.6</b>	
Total Invasive % Cover	21.4	
Unadjusted canopy cover	27.9	
Unadjusted Native % Cover	6.6	
Change in Native % Cover from 2018	1.8	
Unadjusted Invasive % Cover	21.3	
Change in Invasive % Cover from 2018	4.9	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 32. The 100-F Trailer Village in 2019.**

### 1.6.6 118-F-5 Site (Sawdust Pit)

The 118-F-5 site was revegetated in FY 2018 using an imprinter seeder and straw mulch (Figure 33). The 118-F-5 site was originally revegetated in FY 2008 and was not monitored. The 2017 evaluations recommended additional revegetation actions to increase shrubs and native plant cover at this site. The substrate for this site is predominantly sandy loam with heavy cobble changing to sandy loam with some gravel. The northwestern third of the site had especially high rates of cobble.

Two transects were established on this site were monitored for the second time in May 2019. Monitoring results show an average shrub density of 225 plants/ha (91 plants/ac), putting this site below the success criteria of 600 plants/ha (240 plants/ac). Shrubs had an average survival rate of 29%. Average sagebrush (*Artemisia tridentata*) size was 0.16 m (0.52 ft) by 0.12 m (0.39 ft), average bitterbrush (*Purshia tridentata*) size was 0.1 m (0.33 ft) by 0.1 m (0.33 ft), and average hopsage (*Grayia spinosa*) size was 0.1 m (0.33 ft) by 0.08 m (0.26 ft).

Canopy cover at this site was measured with 50 plots in June 2018 (Table 35). Canopy cover totaled 41.1%, with 9.2% native cover and 32.2% invasive cover. This represents an increase of 5.1% in native cover and an increase of 22.8% in invasive cover. The dominant native species was Sandberg's bluegrass (*Poa secunda*) with a coverage totaling 3.8%. The dominant invasive plant was cheatgrass (*Bromus tectorum*) with a coverage totaling 27.9%. Cheatgrass coverage has increased by over 20% at this site in the last year. Thirty species of native forbs and grasses were identified at this site.

Diffuse knapweed (*Centaurea diffusa*) and rush skeleton weed (*Chondrilla juncea*), both Washington State Class B noxious weeds, were present on the site but were not detected in plot frames.

This site has been heavily invaded by cheatgrass in the last year and saw large losses in shrubs, pushing it below success criteria levels. Replanting this site with shrubs without knowing the cause of the die-off would be premature. Native cover is increasing at this site, and there are a high number of native plant species. Further monitoring and evaluation is required before additional steps are taken to revegetate this site.

**Table 35. Percent Canopy Cover and Frequency of Occurrence at the 118-F-5 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.4	6
<i>Ambrosia acanthicarpa</i> (flatspine bur ragweed)	0.1	2
<i>Achnatherum hymenoides</i> (Indian ricegrass)	X	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.6	22
<i>Artemisia tridentata</i> (big sagebrush)	X	X
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	X	X
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	27.9	98
Bunchgrass sp. (multiple)	0.1	2
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	X	X
<i>Ceratocephala testiculata</i> (bur buttercup) <sup>(a)</sup>	0.1	4
<i>Chaenactis douglasii</i> (Douglas' dusty maiden)	X	X
<i>Chondrilla juncea</i> (rush skeletonweed) (B) <sup>(b)</sup>	X	X
<i>Descurcania pinnata</i> (western tansymustard)	0.4	14
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	1.0	40
<i>Elymus elymoides</i> (squirreltail)	0.1	4

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<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.1	4
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.5	8
<i>Erigeron poliospermus</i> (cushion fleabane)	X	X
<i>Erigeron pumilus</i> (shaggy fleabane)	X	X
<i>Eriogonum niveum</i> (snow buckwheat)	X	X
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Hesperostipa comata</i> (needle-and-thread grass)	X	X
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.6	24
<i>Koeleria macrantha</i> (prairie junegrass)	X	X
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.1	2
<i>Machaeranthera canescens</i> (hoary tansyaster)	1.1	12
<i>Microsteris gracilis</i> (slender phlox)	0.3	12
<i>Opuntia polyacantha</i> (plains pricklypear)	X	X
<i>Plantago patagonica</i> (woolly plantain)	0.2	6
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	1.5	28
<i>Poa secunda</i> (Sandberg bluegrass)	3.8	56
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.4	14
<i>Purshia tridentata</i> (antelope bitterbrush)	X	X
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	0.7	26
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	0.1	4
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Sporobolus cryptandrus</i> (sand dropseed)	X	X
<i>Triteleia grandiflora</i> (Douglas' clusterlily)	X	X
<i>Triticum sp.</i> (wheat) <sup>(a)</sup>	X	X
<i>Vulpia microstachys</i> (desert fescue)	1.4	56
Crust	0.6	4
Soil	22.5	94
Litter	45.5	100
Rock/Cobble	11.1	64.0
Unavailable Space	1.2	46.0
<b>Total Canopy Cover</b>	<b>41.4</b>	
<b>Total Native % Cover</b>	<b>9.2</b>	
Total Invasive % Cover	32.2	
Unadjusted canopy cover	41.0	
Unadjusted Native % Cover	9.1	
Change in Native % Cover from 2018	5.1	
Unadjusted Invasive % Cover	31.9	
Change in Invasive % Cover from 2018	22.8	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 33. The 118-F-5 Site in 2019, Showing High Amounts of Cheatgrass.**

#### **1.6.7 100-F-57 Site (190-F Water Pump House Debris)**

The 100-F-57 site was originally revegetated in FY 2009 and was not monitored. The 2017 evaluations recommended additional revegetation actions to increase shrubs and native plant cover at this site. The 100-F-57 site was revegetated in FY 2018 using a broadcast seeder and straw mulch (Figure 34). The substrate for this site is predominantly loamy sand with high amounts of cobble, scattered asphalt patches, and some debris.

One transect was established on this site after FY 2018 revegetation actions. Monitoring results show an average shrub density of 1,919 plants/ha (777 plants/ac), high above the success criteria of 600 plants/ha (240 plants/ac). Shrubs had an average survival rate of 63%. Average sagebrush (*Artemisia tridentata*) size was 0.12 m (0.39 ft) by 0.12 m (0.39 ft), average bitterbrush (*Purshia tridentata*) size was 0.2 m (0.66 ft) by 0.15 m (0.66 ft), and average hopsage (*Grayia spinosa*) size was 0.11 m (0.36 ft) by 0.05 m (0.16 ft).

Canopy cover at this site was measured with 25 plots in May 2019 (Table 36). Canopy cover totaled 42.5%, with 7.8% native cover and 34.7% invasive cover. This represents a decrease in native cover of 3.1% and an increase in invasive cover of 17%. The dominant native species was bluebunch wheatgrass (*Pseudoroegneria spicata*) with 2.1% cover. The dominant invasive plant was cheatgrass (*Bromus tectorum*) with a coverage totaling 27.8%, representing an 18.6% increase from 2018 monitoring. Twenty-four species of native forbs and grasses were identified at this site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was present on the site but was not detected in any plot frames.

This site has been heavily invaded by cheatgrass in the last year and native cover has decreased since first-year monitoring. Despite this, native species diversity and shrub density are both very high, suggesting native cover will increase in the future. Further monitoring and evaluation is required before additional steps are taken to revegetate this site.

**Table 36. Percent Canopy Cover and Frequency of Occurrence at the 100-F-57 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.8	12.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.3	12.0
<i>Ambrosia acanthicarpa</i> (flatspine bur ragweed)	0.1	4.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	0.3	12.0
<i>Astragalus succumbens</i> (crouching milkvetch)	X	X
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	0.1	4.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	27.8	100.0
Bunchgrass sp. (multiple)	0.1	4.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	X	X
<i>Ceratocephala testiculata</i> (bur buttercup) <sup>(a)</sup>	0.5	20.0
<i>Chaenactis douglasii</i> (Douglas' dusty maiden)	X	X
<i>Descurcania pinnata</i> (western tansymustard)	0.6	24.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	1.2	48.0
<i>Elymus elymoides</i> (squirreltail)	X	X
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.4	16.0
<i>Eriogonum niveum</i> (snow buckwheat)	X	X
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	0.1	4.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	1.4	56.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.2	8.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	X	X
<i>Melilotus officinalis</i> (sweetclover) <sup>(a)</sup>	X	X
<i>Penstemon</i> sp. (beardtongue)	X	X
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	0.4	16.0
<i>Poa secunda</i> (Sandberg bluegrass)	1.7	68.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	2.1	64.0
<i>Purshia tridentata</i> (antelope bitterbrush)	X	X
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	1.3	52.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	0.3	12.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Sporobolus cryptandrus</i> (sand dropseed)	X	X
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X

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<i>Triticum sp.</i> (wheat) <sup>(a)</sup>	X	X
<i>Vulpia microstachys</i> (desert fescue)	1.0	40.0
Crust	0.0	0.0
Soil	17.6	72.0
Litter	46.2	100.0
Rock/Cobble	7.0	64.0
Unavailable Space	4.2	68.0
<b>Total Canopy Cover</b>	<b>42.5</b>	
<b>Total Native % Cover</b>	<b>7.8</b>	
Total Invasive % Cover	34.7	
Unadjusted canopy cover	40.7	
Unadjusted Native % Cover	7.5	
Change in Native % Cover from 2018	-3.1	
Unadjusted Invasive % Cover	33.2	
Change in Invasive % Cover from 2018	17.0	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames





**Figure 34. The 100-F-57 Site in 2019. Top: An Overview of 100-F-57, Showing Sagebrush and Dense Cheatgrass Cover. Bottom: Carey's Balsamroot Sprouting among Cheatgrass at 100-F-57.**

### 1.6.8 100-F-26 Site (Water Treatment Facility Pipelines)

The 100-F-26 site was originally revegetated in FY 2009 and was not monitored. The 2017 evaluations recommended additional revegetation actions to increase shrubs and native plant cover at this site. The 100-F-26 site was revegetated in FY 2018 using a broadcast seeder and straw mulch (Figure 35). The substrate for this site is predominantly loamy sand with some gravel and cobbles.

One transect was established on this site after FY 2018 planting and this transect was monitored for a second year in May 2019. Monitoring results show an average shrub density of 662 plants/ha (268 plants/ac), putting this site above the success criteria of 600 plants/ha (240 plants/ac). Shrubs had a 63% survival rate post-planting. Average sagebrush (*Artemisia tridentata*) size was 0.2 m (0.66 ft) by 0.1 m (0.33 ft) and average hopsage (*Grayia spinosa*) size was 0.2 m (0.66 ft) by 0.1 m (0.33 ft).

This site is relatively small, and canopy cover was measured with 12 plot frames in May 2019 (Table 37). Canopy cover totaled 71.5%, with 8.3% native cover and 63.1% invasive cover. This represents a 4.3% increase in native cover and a 19.3% increase in invasive cover. The dominant native species was Sandberg's bluegrass (*Poa secunda*) with 4.2% cover. The dominant invasive species was cheatgrass (*Bromus tectorum*) with a coverage totaling 56.0%. Fourteen species of native forbs and grasses were identified at this site.

No Washington State Noxious Weeds were identified at this site.

More time is needed to determine the success of this site. Cheatgrass coverage at this site is extremely high and may limit the ability of native plants to establish and grow. This site is smaller than the other sites and its small surface area to boundary ratio may have enabled cheatgrass to invade with relative ease. Further monitoring and evaluation is required before additional steps are taken to revegetate this site.

**Table 37. Percent Canopy Cover and Frequency of Occurrence at the 100-F-26 Site in 2019.**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	1.3	8.3
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	56.0	100.0
<i>Chaenactis douglasii</i> (Douglas' dusty maiden)	X	X
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.4	16.7
<i>Elymus elymoides</i> (squirreltail)	X	X
<i>Eriogonum niveum</i> (snow buckwheat)	X	X
<i>Festuca</i> sp. (fescue)	X	X
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	1.3	50.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.4	16.7
<i>Poa secunda</i> (Sandberg bluegrass)	4.2	83.3
<i>Purshia tridentata</i> (antelope bitterbrush)	X	X
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	X	X
<i>Sisymbrium altissimum</i> (tall tumblemustard) <sup>(a)</sup>	0.2	8.3
<i>Vulpia microstachys</i> (desert fescue)	1.3	50.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	4.8	33.3
<i>Lomatium macrocarpum</i> (bigseed desertparsley)	X	X
<i>Descurcania pinnata</i> (western tansymustard)	0.2	8.3
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.2	8.3
<i>Hesperostipa comata</i> (needle-and-thread grass)	1.3	8.3
Crust	0.0	0.0
Soil	14.4	58.3
Litter	84.6	100.0
Rock/Cobble	0.0	0.0
Unavailable Space	0.0	0.0
<b>Total Canopy Cover</b>	<b>71.5</b>	
<b>Total Native % Cover</b>	<b>8.3</b>	
Change in Native % Cover from 2018	4.3	
Total Invasive % Cover	63.1	
Change in Invasive % Cover from 2018	19.3	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 35. The 100-F-26 Site in 2019 Showing High Levels of Cheatgrass Cover, View Facing West.**

### **1.6.9 118-F-3 Site (Burial Ground)**

The 118-F-3 site was originally revegetated in FY 2008 and was not monitored. The 2017 evaluations recommended additional revegetation actions to increase shrubs and native plant cover at this site. The 118-F-3 site was revegetated in FY 2018 using a broadcast seeder and straw mulch (Figure 36). The substrate for this site is predominantly sandy with areas of cobbles and boulders.

One transect was established on this site after planting in FY 2018 and second-year monitoring at this site was conducted in May 2019. May monitoring results show an average shrub density of 410 plants/ha (166 plants/ac), putting this site below the success criteria of 600 plants/ha (240 plants/ac). Shrubs had a 32% survival rate post-planting. Average sagebrush (*Artemisia tridentata*) size was 0.19 m (0.62 ft) by 0.13 m (0.45 ft) and average bitterbrush (*Purshia tridentata*) size was 0.23 m (0.75 ft) by 0.11 m (0.36 ft).

Canopy cover at this site was measured with 25 plots in May 2019 (Table 38). Canopy cover totaled 30.5%, with 13.0% native cover and 17.5% invasive cover. This represents an increase of 6.2% in native cover and a decrease of 3.2% in invasive cover. The dominant native species was Sandberg's bluegrass (*Poa secunda*) with 3.7% cover. The dominant invasive plant was cheatgrass (*Bromus tectorum*) with a coverage of 8.3%. Sixteen species of native forbs and grasses were identified at this site, five more than were detected in 2018.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was present on the site and had 1% cover and occurred in 4% of the plot frames.

The 118-F-3 site saw a significant die-off in shrubs that pushed shrub density below success levels. Native cover and diversity did increase significantly at this site from 2018 to 2019, and cheatgrass is at a relatively low level compared to the other 100-F sites planted in 2018. Further monitoring and evaluation is required before additional steps are taken to revegetate this site.

**Table 38. Percent Canopy Cover and Frequency of Occurrence at the 118-F-3 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.1	4.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	X	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	0.8	12.0
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	X	X
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	8.3	96.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	0.6	4.0
<i>Chaenactis douglasii</i> (Douglas' dusty maiden)	0.1	4.0
<i>Descurcania pinnata</i> (western tansymustard)	0.2	8.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	1.0	40.0
<i>Elymus elymoides</i> (squirreltail)	X	X
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	3.4	36.0
<i>Eriogonum niveum</i> (snow buckwheat)	0.2	8.0
<i>Hesperostipa comata</i> (needle-and-thread grass)	X	X
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	2.9	76.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.2	8.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	X	X
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	1.1	24.0
<i>Poa secunda</i> (Sandberg bluegrass)	3.7	68.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	3.6	64.0
<i>Purshia tridentata</i> (antelope bitterbrush)	X	X
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	1.8	52.0
<i>Sisymbrium altissimum</i> (tall tumbledustard) <sup>(a)</sup>	0.4	16.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X
<i>Triticum sp.</i> (wheat) <sup>(a)</sup>	X	X
Crust	0.5	20.0
Soil	23.5	92.0
Litter	43.4	100.0
Rock/Cobble	17.8	92.0
Unavailable Space	7.0	64.0
<b>Total Canopy Cover</b>	<b>30.5</b>	
<b>Total Native % Cover</b>	<b>13.0</b>	
Total Invasive % Cover	17.5	
Unadjusted canopy cover	28.4	

Unadjusted Native % Cover	12.1	
Change in Native % Cover from 2018	6.2	
Unadjusted Invasive % Cover	16.3	
Change in Invasive % Cover from 2018	-3.2	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 36. The 118-F-3 Site in 2019.**

### **1.6.10 Discussion: Revegetation Methods and Effectiveness of Additional Actions**

#### ***Revegetation Methods***

Three different revegetation treatments were used at revegetation sites that were redone in the 100-F Area in 2018. The goal of this method was to compare results from different revegetation treatments and to determine if any revegetation treatment yielded greater success over the 5-year post-restoration monitoring period.

Two of the three methods included using an imprinting seeder rather than a broadcast seeder. The imprinter uses a roller with angular teeth that creates even depressions in the soil (Figure 37). These depressions create microhabitats within the revegetation site where moisture will accumulate and may provide a more favorable environment for seed germination.



**Figure 37. Uniform Depressions Left by the Imprinter at the 118-F-6 Area.**

The three methods used at 100-F revegetation sites were: imprinting without straw mulch, imprinting with straw mulch, and broadcast seeding with straw mulch. Second-year monitoring native and invasive cover results varied for all three treatments (Table 39). Imprinted sites had the same average native cover with and without mulch (7.9%). In 2019, imprinted sites had an average native cover of 7.9% while broadcast seeded sites had an average native cover of 9.7% (Table 40). This contrasts 2018 results, where imprinted sites had a slightly higher average cover than broadcast seeded sites. This variation is expected to continue until sites have matured and stabilized, at which point more accurate measurements can be made.

Invasive cover at the broadcast seeded with mulch sites is over 10% greater than the imprinted sites. Though the broadcasted sites have slightly higher native cover, having higher invasive cover may be more detrimental to native species in the long term. The broadcasted sites have an average of 18 species per site, less than the imprinted sites. This may be due to the higher invasive cover and competition at broadcasted sites.

More monitoring trend data is needed to determine if one method of treatment results in more successful revegetation sites. Variations in native cover between treatments are small and could also be due to variation in site conditions.

**Table 39. Treatments and Results by Site at the 100-F Area in 2019 (2 Pages).**

Site	Action	Native Cover (%)	Invasive Cover (%)	Native Species (#)
118-F-1	Imprint only	9.5	22.2	19
118-F-6	Imprint only	6.3	31.6	22
100-F-CTA	Imprint with mulch	8	22.9	16
100-F-Trailer Village	Imprint with mulch	6.6	21.4	18
118-F-5	Imprint with mulch	9.2	32.2	30
100-F-57	Broadcast with mulch	7.8	34.7	24

100-F-26	Broadcast with mulch	8.3	63.1	14
118-F-3	Broadcast with mulch	13	17.5	16

**Table 40. Summary of Results by Treatment at the 100-F Area in 2019.**

Treatment	Native Cover (%)	Invasive Cover (%)	Native Species (#)
Imprint only	7.9	26.9	20.5
Imprint with mulch	7.9	25.5	21.3
Broadcast with mulch	9.7	38.4	18

Though the different treatments were all used in a similar geographic area, the soil types at each site varied from sandy soils (118-F-3) to primarily gravel and cobble substrates (100-F-CTA). The soil type likely plays a significant role in the success of the revegetation site. Future monitoring may show correlation between certain revegetation treatments and success; however, causation cannot be inferred from this data alone.

#### ***Revegetation Effectiveness***

After observations suggested revegetation sites at 100-F were not meeting success criteria, selected sites were revisited in 2016 to determine current canopy cover (Table 41). Sites 118-F-6, 118-F-5, and 100-F-26 (in 2016 report at 1607-F-1) were monitored in 2016 and 100-F-CTA was monitored in 2017. Results from 2016 and 2017 will be compared to 2019 post-revegetation results for these individual sites, and the 2016 and 2017 site results will be averaged and compared to sites that were not monitored pre-2018 activities. The 100-F-47 site was also monitored in 2016 but is not included in this average because it was a supplemental planting site, not a total re-work site; meaning it had a better understory than the sites that were chosen for re-seeding. Summarized results from 2019 monitoring efforts are in Table 42.

**Table 41. 2016 Monitoring Results: Pre-2018 Revegetation Actions.**

Site	Native Cover (%)	Invasive Cover (%)	Native Species (#)	Shrub Survival (%)
118-F-6	13.3	47.8	16	17.05
118-F-5	10.1	50.75	20	18.9
100-F-26	8.3	101.8	8	45.5
100-F-CTA	9.6	12.3	9	50
<b>F-Area Average</b>	<b>10.3</b>	<b>53.2</b>	<b>13.3</b>	<b>32.9</b>

**Table 42. 2019 Monitoring Results: Post-2018 Revegetation Actions.**

Site	Native Cover (%)	Invasive Cover (%)	Native Species (#)	Shrub Survival (%)
118-F-1	9.5	22.2	19	50
118-F-6	6.3	31.6	22	28
100-F-CTA	8	22.9	16	67
100-F-Trailer Village	6.6	21.4	18	37
118-F-5	9.2	32.2	30	29
100-F-57	7.8	34.7	24	63
100-F-26	8.3	63.1	14	63
118-F-3	13	17.5	16	32
<b>F-Area Average</b>	<b>8.6</b>	<b>30.7</b>	<b>19.9</b>	<b>46.1</b>

The majority of the sites in Table 41 were 7 years old when the 2016 data were collected (with the exception of the 100-F-CTA site, which was 5 years old). The 100-F sites that were redone in FY 2018 are 1 year old, so native cover is not expected to surpass previous measurements at this time. Invasive cover is lower in 2019 than it was before reworking the sites. Though 2019 shrub survival is low, it is higher than historic shrub survival numbers at the 100-F sites.

Native species have increased significantly at every 100-F site since 2016. The sites that were completely redone in 2018 were seeded with six grasses, six forbs, and one shrub. All of the redone sites had between 10 and 17 native plant species identified during first-year monitoring, and between 14 and 30 species identified during second-year monitoring. This is a relatively high number and suggests that redoing these sites may have greatly increased native plant diversity. The additional revegetation actions were successful at increasing native plant diversity at these previously failing revegetation sites.

Native cover before additional revegetation actions averaged 10.3% cover in 2016 monitoring. Native cover in 2019 averaged 8.6% after 1 year of growth. Native cover is expected to increase over time as native plants establish and grow. Native cover is also expected to increase due to the large diversity of native species present at this site. Typically, native plant cover at revegetation sites trends positively and increases year after year, especially after the initial invasion of Russian thistle subsides. At the representative 100-F sites, native plant cover had been trending negatively in 2016. By not intervening at these sites, native plant cover there likely would have continued to decline.

Supplemental shrub plantings, or planting additional shrub plugs on sites that had previously been revegetated, took place at the 100-F-47 and 100-F-48 sites in FY 2018. The 100-F-48 site was not monitored in 2019. The 100-F-47 site had 23.1% native cover, 18 native species, and a shrub density of 1,690 shrubs/ha (684 shrubs/ac) after supplemental planting. This is an increase of 10% native canopy cover and of about 710 shrubs/ha (288 shrubs/ac). This site is nearing successful native canopy cover and is expected to continue to have successful shrub density.

Continued monitoring is necessary to track site progress over time.

## 1.7 100-IU-2 AND 100-IU-6 AREA SITES

Seven sites were monitored in the 100-IU-2/100-IU-6 Area: 600-301, 600-370, 600-356, 600-358, 600-100, 600-120, and 600-379. All of these sites, with the exception of 600-379, had additional revegetation actions performed in FY 2019 after the FY 2018 report recommended additional actions at these sites. All of the sites worked on in FY 2019 were supplemented with additional shrubs and forbs with the exception of the 600-356 and 600-301 sites, which were completely re-worked. The 600-379 site was revegetated in FY 2015 and fifth year monitoring occurred at this site in 2019.

Original revegetation efforts at all sites entailed broadcast seeding with a mixture of native grasses (including Sandberg bluegrass [*Poa secunda*], Indian ricegrass [*Achnatherum hymenoides*], bluebunch wheatgrass [*Pseudoroegneria spicata*], squirreltail [*Elymus elymoides*], needle-and-thread grass [*Hesperostipa comata*], and prairie junegrass [*Koeleria macrantha*]) at approximately 16.8 kg/ha (15 lbs/ac). Broadcast seeding areas were topped with a straw mulch that was crimped into the soil surface. Shrub species (including big sagebrush [*Artemisia tridentata*], antelope bitterbrush [*Purshia tridentata*], and spiny hopsage [*Grayia spinosa*]) were transplanted on the sites at approximately 1,235 to 1,600 plants/ha (500 to 650 plants/ac) with a mix of approximately 75% sagebrush, 15% bitterbrush, and 10% spiny hopsage. Site 600-358 had a varied ratio of transplanted shrubs with 60 to 70% big sagebrush, 5 to 15% antelope bitterbrush, 10 to 30% spiny hopsage, and approximately 1% (cumulatively) rubber rabbitbrush (*Ericameria nauseosa*) and yellow rabbitbrush (*Chrysothamnus viscidiflorus*).

### 1.7.1 600-301 Site (White Bluffs Sanitary Sewer Pipelines)

The 600-301 site (Figure 38) was revegetated in FY 2014 and monitoring was first conducted for the site in 2014. Additional revegetation actions were recommended after fifth-year monitoring in 2018 where shrub density was only 20 plants/ha (8 plants/ac) and native cover was not successful at 13.2%. In FY 2019, this site was completely redone and seeded with the FY 2019 Seed Mix (Table 1). It was planted with sagebrush (*Artemisia tridentata*), bitterbrush (*Purshia tridentata*), and hopsage (*Grayia spinosa*). The substrate for the site is characterized by sand and loamy sand with a small amount of intermixed cobbles.

First-year shrub transect monitoring occurred in June 2019. The results show a shrub density of 1,210 plants/ha (490 plants/ac) above success criteria of 600 plants/ha (240 plants/ac). Overall shrub survival was 97.6%. This transect was monitored only 4 months after planting and second-year transect monitoring will give more information about overall shrub survival.

Canopy cover data for the site was collected in April 2019. Data was collected from 25 plot frames. Canopy cover for the site was 40.7%, with 17.9% native cover and 22.8% invasive cover (Table 43). This represents an increase of 4.7% in native cover and decrease of 9.9% in invasive cover from 2018. The dominant native species was Sandberg's bluegrass (*Poa secunda*) with 13.1% cover. Cheatgrass (*Bromus tectorum*) was the dominant invasive species for the site with 8.2% cover, a decrease from 21.1% cover in 2018. Nineteen native species were recorded at the 600-301 site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was present on the site but was not detected in any plot frames.

Short-term monitoring results are showing higher native cover, higher species diversity, and successful shrub density at the 600-301 site after FY 2019 revegetation actions. Continued monitoring is necessary to track site progress over time.

**Table 43. Percent Canopy Cover and Frequency of Occurrence at the 600-301 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.7	8.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.8	12.0
<i>Artemisia tridentata</i> (big sagebrush) (transplant)	0.1	4.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	8.2	96.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	X	X
<i>Chaenactis douglasii</i> (Douglas' dustymaiden)	0.3	12.0
<i>Chrysothamnus viscidiflorus</i> (yellow rabbitbrush)	X	X
<i>Descurcania pinnata</i> (western tansymustard)	0.5	20.0
<i>Digitaria sp.</i> (crabgrass) <sup>(a)</sup>	0.5	20.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	2.3	72.0
<i>Elymus elymoides</i> (squirreltail)	0.2	8.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.3	12.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.6	4.0
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	2.5	24.0
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.6	24.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.8	32.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.6	24.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.2	8.0
<i>Poa secunda</i> (Sandberg bluegrass)	13.1	100.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.1	4.0
<i>Purshia tridentata</i> (antelope bitterbrush) (transplant)	X	X
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	4.4	96.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	3.5	40.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	0.2	8.0
<i>Sporobolus cryptandrus</i> (sand dropseed)	0.1	4.0
<i>Vulpia microstachys</i> (desert fescue)	0.1	4.0
Crust	0.2	8.0
Soil	34.0	84.0
Litter	54.2	100.0
Rock/Cobble	6.5	32.0
Unavailable Space	0.0	0.0
<b>Total canopy cover</b> (excludes crust/soil/litter)	<b>40.7</b>	
<b>Total Native % Cover</b>	<b>17.9</b>	
Change in Native % Cover from 2018	4.7	
Total Invasive % Cover	22.8	
Change in Invasive % Cover from 2018	-9.9	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 38. The 600-301 Site in 2019.**

### **1.7.2 600-356 Site (Dump Area)**

The 600-356 site (Figure 39) was revegetated in FY 2015 and monitoring was first conducted for the site in 2015. Additional revegetation actions were recommended after fourth-year monitoring in 2018 where shrub density was 0 plants/ha (0 plants/ac) after all shrubs on the transect died and native cover was not successful at 7.5%. In FY 2019, this site was completely redone and seeded with the FY 2019 Seed Mix (Table 1). It was planted with sagebrush (*Artemisia tridentata*), bitterbrush (*Purshia tridentata*), and hopsage (*Grayia spinosa*). The substrate for the site is predominantly cobbly sandy loam.

A new transect was established after the 2019 rework. First-year shrub transect monitoring occurred in July 2019. The results show a shrub density of 1,500 plants/ha (587 plants/ac), above success criteria of 600 plans/ha (240 plant/ac). Overall shrub survival was 99.3%. This transect was monitored only 4 months after planting and second-year transect monitoring will give more information about overall shrub survival.

Canopy cover data for the site was collected in May 2019. Data was collected from 25 plot frames. Canopy cover for the site was 36.8%, with 8.3% native cover and 29.1% invasive cover (Table 44). This represents an increase of 0.8% in native cover and decrease of 16.7% in

invasive cover from 2018. The dominant native species were young bunchgrasses with 2.1% cover. Cheatgrass (*Bromus tectorum*) was the dominant invasive species for the site with 17.0% cover, a nearly 20% decrease from 2018. Twenty-two native species were recorded at the 600-356 site, a large amount for a site of that size.

No listed Washington State Class B noxious weeds were observed on the site.

Short-term monitoring results are showing higher native cover, higher species diversity, and successful shrub density at the 600-356 site after FY 2019 revegetation actions. Continued monitoring is necessary to track site progress over time.

**Table 44. Percent Canopy Cover and Frequency of Occurrence at the 600-356 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.6	4.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.6	4.0
<i>Ambrosia acanthicarpa</i> (flatspine bur ragweed)	0.2	8.0
<i>Artemisia tridentata</i> (big sagebrush)	0.1	4.0
<i>Astragalus succumbens</i> (crouching milkvetch)	0.3	12.0
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	0.1	4.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	17.0	100.0
Bunchgrass sp. (multiple)	2.1	64.0
<i>Chaenactis douglasii</i> (Douglas' dustymaiden)	0.1	4.0
<i>Descurciana pinnata</i> (western tansymustard)	0.6	24.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	2.3	92.0
<i>Elymus elymoides</i> (squirreltail)	0.6	4.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.2	8.0
<i>Erigeron poliospermus</i> (cushion fleabane)	X	X
<i>Eriogonum niveum</i> (snow buckwheat)	0.2	8.0
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	0.8	32.0
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.7	8.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.6	24.0
<i>Hordeum leporinum</i> (hare barley) <sup>(a)</sup>	X	X
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.9	36.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.1	4.0
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	0.9	16.0
<i>Poa secunda</i> (Sandberg bluegrass)	1.5	60.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	X	X
<i>Purshia tridentata</i> (antelope bitterbrush)	X	X
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	4.0	80.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	2.5	40.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X
<i>Vulpia microstachys</i> (desert fescue)	0.3	12.0

Crust	0.0	0.0
Soil	23.7	84.0
Litter	53.2	100.0
Rock/Cobble	7.9	68.0
Unavailable Space	0.4	16.0
<b>Total Canopy Cover</b>	<b>36.8</b>	
<b>Total Native % Cover</b>	<b>8.3</b>	
Total Invasive % Cover	29.1	
Unadjusted canopy cover	36.7	
Unadjusted Native % Cover	8.3	
Change in Native % Cover from 2018	0.8	
Unadjusted Invasive % Cover	29.0	
Change in Invasive % Cover from 2018	-16.7	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 39. The 600-356 Site in 2019, Showing the Natural Surrounding Area on the Left and the Revegetated Portion on the Right.**

### 1.7.3 600-370 Site (Dump Area)

The 600-370 site (Figure 40) was revegetated in FY 2014 and monitoring was first conducted for the site in 2014. In FY 2019, shrub and forb plugs were planted at the 600-307 site. Munro’s globemallow (*Sphaeralcea munroana*), snow buckwheat (*Eriogonum niveum*), bitterbrush (*Purshia tridentata*), and hopsage (*Grayia spinosa*) were all planted at this site in FY 2019. The

substrate for the site is characterized by sand with varied amounts of cobbles and small boulders. Black sand is common in the western portion of the site.

The same transect that was used for routine 5-year monitoring was used for a sixth year in order to measure the plugs planted in FY 2019. Only the plugs planted in FY 2019 were monitored on this transect in May 2019. Fifth-year monitoring of this transect in 2018 showed a shrub density of 770 plants/ha (312 plants/ac). Additional shrub plugs resulted in an increase of 200 shrubs/ha (81 shrubs/ac), bringing the total shrub density up to 970 shrubs/ac (393 shrubs/ac). Average sagebrush (*Artemisia tridentata*) size at this site was 0.1 m (0.33 ft) by 0.02 m (0.07 ft) and average bitterbrush (*Purshia tridentata*) size was 0.3 m (0.98 ft) by 0.02 m (0.07 ft). Additional forb plugs resulted in an increase of 240 forbs/ha (97 forbs/ac). A total of 8.3% of the forbs were in bloom at the time of monitoring. This is the first year of transplanting forb plugs, so survival will be tracked closely over time.

Canopy cover data for the site was collected in April 2019. Data was collected from 25 plot frames. Canopy cover for the site was 36.3%, with 9.3% native cover and 26.8% invasive cover (Table 45). This represents a decrease of 2.3% in native cover and an increase of 5.7% in invasive cover from 2018. The dominant native species was big sagebrush (*Artemisia tridentata*) with 2.7% cover. Nineteen native species were observed at this site in 2019. Cheatgrass (*Bromus tectorum*) was the dominant species for the site overall with 16.1% cover.

No listed Washington State Class B noxious weeds were observed on the site.

Native cover has decreased in the sixth year of monitoring this site. Once the forbs and shrubs planted in 2019 establish and grow, native cover will likely increase. This site should continue to be monitored to track both forb plug survival and changes in native canopy cover.

**Table 45. Percent Canopy Cover and Frequency of Occurrence at the 600-370 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.1	4.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.1	4.0
<i>Artemisia tridentata</i> (big sagebrush)	2.7	12.0
<i>Brassica sp.</i> (mustard) <sup>(a)</sup>	0.2	8.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	16.1	100.0
<i>Chrysothamnus viscidiflorus</i> (yellow rabbitbrush)	X	X
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	4.8	72.0
<i>Elymus elymoides</i> (squirreltail)	0.2	8.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	2.1	24.0
<i>Eriogonum niveum</i> (snow buckwheat)	0.8	12.0
<i>Eriogonum vimineum</i> (wickerstem buckwheat)	0.6	4.0
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.1	4.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	3.2	88.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.3	12.0
<i>Lamium amplexicaule</i> (henbit deadnettle) <sup>(a)</sup>	0.1	4.0

<i>Machaeranthera canescens</i> (hoary tansyaster)	X	X
<i>Microsteris gracilis</i> (slender phlox)	1.0	40.0
<i>Oenothera pallida</i> (pale evening primrose)	0.1	4.0
<i>Poa secunda</i> (Sandberg bluegrass)	1.0	40.0
<i>Psoraleidium lanceolatum</i> (lemon scurfpea)	X	X
<i>Purshia tridentata</i> (antelope bitterbrush)	0.1	4.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	0.3	12.0
<i>Sisymbrium altissimum</i> (tall tumbledustard) <sup>(a)</sup>	0.6	24.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	0.1	4.0
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X
<i>Vulpia microstachys</i> (desert fescue)	X	X
Crust	5.7	52.0
Soil	43.3	100.0
Litter	22.2	88.0
Rock/Cobble	5.9	40.0
Unavailable Space	4.6	28.0
<b>Total Canopy Cover</b>	<b>36.3</b>	
<b>Total Native % Cover</b>	<b>9.4</b>	
Total Invasive % Cover	26.8	
Unadjusted canopy cover	34.6	
Unadjusted Native % Cover	9.0	
Change in Native % Cover from 2018	-2.2	
Unadjusted Invasive % Cover	25.6	
Change in Invasive % Cover from 2018	5.7	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 40. The 600-370 Site in 2019, Showing Both the Cobble-Heavy and the Sand Area.**

### 1.7.4 600-358 Site (Gable Mountain Fringe Dump Area)

The 600-358 site (Figure 41) was revegetated in FY 2016 and monitoring was first conducted for the site in 2016. In addition to the standard native grass seed mix that was broadcast over the site, seeds from several native forbs were collected from the Hanford Site and hand seeded on the site. This site is surrounded by mature native vegetation that should promote natural recovery of the site. Third-year monitoring in 2018 identified a need for additional revegetation actions in order for this site to be successful. The 2018 monitoring found a shrub density of 402 plants/ha (163 plants/ac), with native canopy cover of 9.0% and invasive cover of 4.0%. Sagebrush (*Artemisia tridentata*), bitterbrush (*Purshia tridentata*) and hopsage (*Grayia spinosa*) were planted at this site in FY 2019. The substrate for the site is characterized by loamy sand with some gravel through the revegetated roadway and predominantly gravel with varying amounts of loamy sand in the dump area at the north end of the roadway.

One 100-m (328-ft) and one 65-m (213-ft) shrub monitoring transects were established at this site in 2016, one on the southern and one on the northern portion of the site. Fourth-year shrub monitoring was conducted at this site in June 2018. Existing plants from the original planting and plants that were planted in FY 2019 were both counted on the established transects. The southern transect had a shrub density of 510 plants/ha (206 plants/ac) and the northern transect had a shrub density of 938 plants/ha (380 plants/ac) for a combined density of 724 plants/ha (293 plants/ac), above the success criteria of 600 plants/ha (240 plants/ac).

Canopy cover data for the site was collected in April 2018. Data was collected from 25 plot frames. Canopy cover for the site overall was 32.3%, with 14.9% native cover and 17.4% invasive cover (Table 46). Native cover increased by 5.9% since 2018 and invasive cover has increased by 13.3% since 2018. Fourteen native species were identified at this site in 2019. The dominant native species was Sandberg's bluegrass (*Poa secunda*) with 7.4% cover followed by bluebunch wheatgrass (*Pseudoroegneria spicata*) with 5.5% cover. Cheatgrass (*Bromus tectorum*) was the dominant invasive species for the site with 11.7% cover.

No listed Washington State Class B noxious weeds were observed on the site.

Shrub density has been moved into successful levels by the 2019 additional revegetation actions. Native cover at this site is increasing and as supplemental shrubs establish and grow, native cover will continue to increase.

**Table 46. Percent Canopy Cover and Frequency of Occurrence at the 600-358 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	X	X
<i>Artemisia tridentata</i> (big sagebrush) (planted)	0.2	8.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	11.7	100.0
<i>Chrysothamnus viscidiflorus</i> (yellow rabbitbrush)	X	X
<i>Descurciana pinnata</i> (western tansymustard)	0.2	8.0

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<i>Draba verna</i> (spring draba) <sup>(a)</sup>	3.2	88.0
<i>Elymus elymoides</i> (squirreltail)	0.1	4.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.2	8.0
<i>Eriogonum niveum</i> (snow buckwheat)	X	X
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.1	4.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	1.0	40.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.2	8.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	X	X
<i>Melilotus officinalis</i> (sweet clover) <sup>(a)</sup>	X	X
<i>Microsteris gracilis</i> (slender phlox)	1.2	48.0
<i>Poa secunda</i> (Sandberg bluegrass)	7.4	96.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	5.5	40.0
<i>Purshia trieditata</i> (antelope bitterbrush)	X	X
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	0.6	24.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	0.6	24.0
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X
Crust	4.3	32.0
Soil	46.7	84.0
Litter	23.1	96.0
Rock/Cobble	15.6	36.0
Unavailable Space	0.3	12.0
<b>Total Canopy Cover</b>	<b>32.3</b>	
<b>Total Native % Cover</b>	<b>14.9</b>	
Total Invasive % Cover	17.4	
Unadjusted canopy cover	32.2	
Unadjusted Native % Cover	14.9	
Change in Native % Cover from 2018	5.9	
Unadjusted Invasive % Cover	17.3	
Change in Invasive % Cover from 2018	13.3	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 41. The 600-358 Site in 2019. Top: The Roadway Portion of the Site, Cutting Through a Mature Sagebrush Area. Bottom: The Upper Portion of the Site, Showing High Amounts of Cobble.**

### 1.7.5 600-100 Site (White Bluffs Landfill)

The 600-100 site (Figure 42) was first revegetated in FY 2012. Fifth-year monitoring results are not available for this site, but fourth-year monitoring results show 18.3% native cover and 65% sagebrush survival. This site was planted with snow buckwheat (*Eriogonum niveum*), shaggy fleabane (*Erigeron pumilus*), sagebrush (*Artemisia tridentata*), and bitterbrush (*Purshia tridentata*). This site consists of deep, well-drained sandy soils.

One new transect was established at this site in 2019; this transect was monitored in July 2019. Snow buckwheat was measured on this transect at 320 forbs/ha (130 forbs/ac). Established shrubs and recruits had a density of 490 shrubs/ha (198 shrubs/ac), below success levels. Planting sagebrush and bitterbrush increased shrub density to 890 shrubs/ha (360 shrubs/ac), bringing the site above success levels. Average planted sagebrush size was 0.19 m (0.62 ft) by 0.08 m (0.26 ft) and average planted bitterbrush size was 0.18 m (0.59 ft) by 0.09 m (0.29 ft).

Canopy cover data for this site was collected in April 2019. Average canopy cover for the site overall was 28.7%, with 13.8% native cover and 14.6% invasive cover (Table 47). This represents a decrease of 4.5% in native cover and of 2.1% in invasive cover from 2015 monitoring. The dominant native species was Sandberg bluegrass (*Poa secunda*) with 10.4% cover. Eighteen native species were detected at this site. Cheatgrass (*Bromus tectorum*) was the dominant invasive species with 6.0% cover.

Diffuse knapweed (*Centaurea diffusa*), Washington State Class B noxious weeds, was observed on this site at less than 1% cover.

Supplemental plantings have pushed this site into successful shrub density levels. As the supplemental plants establish and mature, native canopy cover is expected to increase. Continued monitoring is necessary to track the progress of this site.

**Table 47. Percent Canopy Cover and Frequency of Occurrence at the 600-100 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.3	12.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	X	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	1.0	20.0
<i>Artemisia tridentata</i> (big sagebrush)	0.1	4.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	6.0	84.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	0.7	28.0
<i>Ceratocephala testiculata</i> <sup>a</sup> (bur buttercup)	0.1	4.0
<i>Cryptantha circumscissa</i> (matted cryptantha)	0.2	8.0
<i>Descurcania pinnata</i> (western tansymustard)	X	X
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	1.1	44.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X
<i>Erigeron poliospermus</i> (cushion fleabane)	1.0	40.0
<i>Eriogonum vimineum</i> (wickerstem buckwheat)	X	X
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Hesperostipa comata</i> (needle-and-thread grass)	X	X

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<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	3.0	60.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.8	32.0
<i>Lepidium perfoliatum</i> (clasping pepperweed) <sup>(a)</sup>	X	X
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.3	12.0
<i>Microsteris gracilis</i> (slender phlox)	0.3	12.0
<i>Oenothera pallida</i> (pale-evening primrose)	0.2	8.0
<i>Poa secunda</i> (Sandberg bluegrass)	10.4	88.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	X	X
<i>Purshia tridentata</i> (antelope bitterbrush)	0.2	8.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	1.4	56.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	1.6	44.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X
Crust	4.9	24.0
Soil	71.4	100.0
Litter	11.9	52.0
Rock/Cobble	1.6	24.0
Unavailable Space	0	0.0
<b>Total canopy cover (excludes crust/soil/litter)</b>	<b>28.7</b>	
<b>Total Native % Cover</b>	<b>13.8</b>	
Change in Native % Cover from 2015	-4.5	
Total Invasive % Cover	14.6	
Change in Invasive % Cover from 2015	-2.1	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 42. The 600-100 Site in 2019.**

### 1.7.6 600-120 Site (Burn Pit)

The 600-120 site (Figure 43) was first revegetated in FY 2011. No monitoring data is available for this site. A 2018 survey found that though the southern part of the site had good sagebrush (*Artemisia tridentata*) and Indian Ricegrass (*Oryzopsis hymenoides*) cover, the rest of the site had patchy native plant cover. This site was supplementally planted with sagebrush (*Artemisia tridentata*) and bitterbrush (*Purshia tridentata*) plugs. This site consists of deep, well-drained sandy soils.

One new transect was established at this site in 2019 in the section of the 600-120 site that was lacking shrubs. This transect was monitored in July 2019. Both newly planted shrubs and shrubs from the FY 2011 planting were recorded on this transect. Established shrubs and recruits had a density of 100 shrubs/ha (40 shrubs/ac), well below success levels. Planting supplementary sagebrush and bitterbrush increased shrub density to 580 shrubs/ha (235 shrubs/ac), bringing the site almost to success levels. Average planted sagebrush size was 0.09 m (0.30 ft) by 0.12 m (0.39 ft) and average planted bitterbrush size was 0.23 m (0.75 ft) by 0.1 m (0.33 ft). Deer and/or elk herbivory was noted at this site both by the planting staff and by monitoring staff. Multiple forb and shrub plugs were found removed from their holes.

Canopy cover data for this site was collected in April 2019. Average canopy cover for the site overall was 34.4%, with 21.6% native cover and 12.8% invasive cover (Table 48). The dominant native species was Sandberg bluegrass (*Poa secunda*) with 15.1% cover. Seventeen native species were detected at this site. Cheatgrass (*Bromus tectorum*) was the dominant invasive species with 6.8% cover.

Diffuse knapweed (*Centaurea diffusa*) and rush skeletonweed (*Chondrilla juncea*), both Washington State Class B noxious weeds, were observed on this site.

Supplemental plantings have improved shrub density levels at this site. As shrubs continue to grow and reproduce, shrub density and native canopy cover are both expected to increase. Continued monitoring is necessary to track the progress of this site.

**Table 48. Percent Canopy Cover and Frequency of Occurrence at the 600-120 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Achnatherum hymenoides</i> (Indian ricegrass)	4.2	32.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.1	4.0
<i>Artemisia tridentata</i> (big sagebrush)	9.6	24.0
<i>Artemisia tridentata</i> (planted)	0.2	8.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	6.8	96.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	1.5	60.0
<i>Chondrilla juncea</i> (rush skeletonweed) (B) <sup>(b)</sup>	X	X
<i>Chrysothamnus viscidiflorus</i> (yellow rabbitbrush)	X	X
<i>Descurcania pinnata</i> (western tansymustard)	X	X
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.7	28.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	1	40.0

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<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X
<i>Erigeron filifolius</i> (threadleaf fleabane)	X	X
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Hesperostipa comata</i> (needle-and-thread grass)	X	X
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.5	20.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.9	36.0
<i>Lepidium perfoliatum</i> (clasping pepperweed) <sup>(a)</sup>	X	X
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.2	8.0
<i>Microsteris gracilis</i> (slender phlox)	0.4	16.0
<i>Oenothera pallida</i> (pale-evening primrose)	0.3	12.0
<i>Poa secunda</i> (Sandberg bluegrass)	15.1	100.0
<i>Purshia tridentata</i> (antelope bitterbrush)	0.1	4.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	1	40.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	1.4	36.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X
Crust	2.8	36.0
Soil	55.5	96.0
Litter	39.9	92.0
Rock/Cobble	0.2	8.0
Unavailable Space	0	0.0
<b>Total canopy cover</b> (excludes crust/soil/litter)	<b>34.4</b>	
<b>Total Native % Cover</b>	<b>21.6</b>	
Change in Native % Cover from 2018	8.4	
Total Invasive % Cover	12.8	
Change in Invasive % Cover from 2018	-19.9	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 43. The 600-120 Site in 2019. Top: Overview of the 600-120 Site Showing the Section Lacking Shrubs and the Section with Heavy Sagebrush Cover. Bottom: A Sagebrush Seedling Planted at the 600-120 Site.**

### 1.7.7 600-379 Site (Burn Area)

The 600-379 site (Figure 44) was revegetated in FY 2015 and monitoring was first conducted for the site in 2015. The substrate for the site is predominantly sandy loam with varying amounts of small cobbles. Fifth-year monitoring occurred at this site in FY 2019.

No shrub transect has been established for the site due to its small size.

Canopy cover data for the site was collected in April 2018. Data was collected from 10 plot frames. Canopy cover for the site was 60.8%, with 11.8% native cover and 49.0% invasive cover (Table 49). This represents an increase of 6.8% in native cover and a decrease of 15.0% in invasive cover from 2018. The dominant native species was prairie junegrass (*Koeleria macrantha*) with 3.5% cover. Eleven native species were found on this site. Cheatgrass (*Bromus tectorum*) was the dominant species for the site overall with 40.5% cover.

Native cover has increased over the last 2 years and invasive cover has decreased over the last 2 years, suggesting this site will continue to improve. Additional revegetation actions should be considered for this site but high cheatgrass density may hinder these processes.

**Table 49. Percent Canopy Cover and Frequency of Occurrence at the 600-379 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	1.5	10.0
<i>Artemisia tridentata</i> (big sagebrush)	1.5	10.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	40.5	100.0
<i>Chorispora tenella</i> (crossflower) <sup>(a)</sup>	1.8	70.0
<i>Chrysothamnus viscidiflorus</i> (yellow rabbitbrush)	X	X
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	4.8	90.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	2.0	80.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X
<i>Eriogonum</i> sp. (buckwheat sp.)	0.3	10.0
<i>Hesperostipa comata</i> (needle-and-thread grass)	2.3	40.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	2.0	80.0
<i>Koeleria macrantha</i> (prairie junegrass)	3.5	40.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	0.8	30.0
Crust	3.3	80.0
Soil	34.5	90.0
Litter	61.8	100.0
Rock/Cobble	0.8	30.0
Unavailable Space	0.0	0.0
<b>Total canopy cover</b> (excludes crust/soil/litter)	<b>60.8</b>	
<b>Total Native % Cover</b>	<b>11.8</b>	
Change in Native % Cover from 2018	6.8	
Total Invasive % Cover	49.0	
Change in Invasive % Cover from 2018	-15.0	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 44. The 600-379 Site in 2019.**

## 1.8 300 AREA SITES

Four sites in the 300 Area were monitored for routine 5-year monitoring in 2019: 300-288:2, 300-North A-D, 618-2&3, and 618-10. The 300-North A-D site was revegetated in FY 2013, the 618-2&3 site was revegetated in FY 2015, the 300-288:2 site was revegetated in FY 2017, and the 618-10 site was revegetated in FY 2019. These sites were remediated to meet the objectives for interim closure as established in the 300 Area RDR/RAWP (DOE/RL-2001-47 and DOE/RL-2014-13-ADD1) and in the Interim Action ROD (EPA 1999).

Revegetation efforts at the 300-288:2, 300-North A-D, and 618-2&3 sites entailed broadcast seeding with a mixture of native grasses including Sandberg bluegrass (*Poa secunda*), Indian ricegrass (*Achnatherum hymenoides*), bluebunch wheatgrass (*Pseudoroegneria spicata*), squirreltail (*Elymus elymoides*), needle-and-thread grass (*Hesperostipa comata*), and prairie Junegrass (*Koeleria macrantha*) at approximately 20.2 kg/ha (18 lbs/ac). Broadcast seeding areas were topped with a straw mulch that was crimped into the soil surface. Shrub species (including big sagebrush [*Artemisia tridentata*], antelope bitterbrush [*Purshia tridentata*], and spiny hopsage [*Grayia spinosa*]) were transplanted on the site at approximately 1,730 plants/ha (700 plants/ac) with a mix of approximately 75% sagebrush, 15% bitterbrush, and 10% spiny hopsage.

Revegetation efforts at the 618-10 site involved five different seed mixes that were applied at various rates per acre. Seeded species and rates are included in Appendix B and are available in

*Site Specific Revegetation Plans for 618-10, 316-4, 600-96, 600-63, and 600-276 (CH2MHILL 2018).* The site was planted with sagebrush (*Artemisia tridentata*), bitterbrush (*Purshia tridentata*), snow buckwheat (*Eriogonum niveum*), and green rabbitbrush (*Chrysothamnus viscidiflorus*).

### 1.8.1 300-288:2 Container Transfer Area Site

The 300-288:2 CTA site (Figure 45) was revegetated in FY 2017 and monitoring was first conducted for the site in 2017. This is a larger site that was divided into two areas (east and west) for monitoring purposes with one established transect in each area and data collected from 25 plot frames in each area. Substrates at the site are predominantly sandy loam with varying amounts of cobbles.

Two 100-m (328-ft) shrub monitoring transects with 5-m (16.4-ft) offsets to each side were established for the site in 2017, one in the west portion of the site and another in the east. Third-year monitoring of the transect area was conducted in July 2019. The west transect data shows 480 plants/ha (194 plants/ac) with a total shrub survival of 30.4% since the initial planting in FY 2017. The east transect data shows 750 plants/ha (304 plants/ac) with a total shrub survival of 43.1% since the initial planting in FY 2017. This equates to an overall shrub density of 615 plants/ha (249 plants/ac) for the site, meeting the success criteria of 600 plants/ha (240 plants/ac).

Canopy cover data for the site was collected in April 2019. Average canopy cover for the site was 43.5%, with native cover representing 28.9% and invasive cover representing 14.6% (Table 50). Native cover had increased by 14.5% and invasive cover had increased by 6.1% since 2018 monitoring. Sandberg's bluegrass (*Poa secunda*) and bluebunch wheatgrass (*Pseudoroegneria spicata*) were the most dominant native species with 13.6% and 11.9% cover, respectively. Cheatgrass (*Bromus tectorum*) was the most abundant invasive species with a cover of 6.2%.

Diffuse knapweed, a Washington State Class B noxious weed, was observed in the plot frames and had less than 1% cover and occurrence in 4% of the plot frames.

**Table 50. Percent Canopy Cover and Frequency of Occurrence at the 300-288:2 Site in 2019 (2 Pages).**

Species	Entire Site	
	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Achnatherum hymenoides</i> (Indian ricegrass)	1.5	40.0
<i>Agropyron cristatum</i> (crested wheatgrass) <sup>(a)</sup>	0.6	4.0
<i>Artemisia tridentata</i> (big sagebrush)	0.2	6.0
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	X	X

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<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	6.2	92.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	0.6	4.0
<i>Descurainia pinnata</i> (western tansymustard)	0.2	8.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.3	10.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.7	28.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X
<i>Eriogonum niveum</i> (snow buckwheat)	0.1	4.0
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	1.9	46.0
<i>Grayia spinosa</i> (spiny hopsage)	0.6	4.0
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.2	8.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.2	8.0
<i>Koeleria macrantha</i> (prairie junegrass)	0.2	8.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	1.9	74.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	X	X
<i>Melilotus officinalis</i> (sweet clover) <sup>(a)</sup>	0.1	4.0
<i>Poa secunda</i> (Sandberg bluegrass)	13.6	100.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	11.9	96.0
<i>Purshia tridentata</i> (antelope bitterbrush)	X	X
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	2.7	88.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	0.3	10.0
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X
Crust	0.0	0.0
Soil	33.4	96.0
Litter	21.7	100.0
Rock/Cobble	16.9	94.0
Unavailable Space	1.8	52.0
<b>Total Canopy Cover</b>	<b>43.5</b>	
<b>Total Native % Cover</b>	<b>28.9</b>	
Total Invasive % Cover	14.6	
Unadjusted canopy cover	42.9	
Unadjusted Native % Cover	28.9	
Change in Native % Cover from 2018	14.5	
Unadjusted Invasive % Cover	14.0	
Change in Invasive % Cover from 2018	5.5	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 45. The 300-288:2 Site in 2019.**

### **1.8.2 300-North A-D Site (Various Facilities)**

The 300-North A-D site encompasses the 300 North A, 300 North B, 300 North C, and 300 North D sites. These sites were revegetated in FY 2013 but were not monitored after planting. The first year the 300-North A-D site was monitored was in 2018 when the site was 5 years old (Figure 46). Second-year monitoring at the 300-North A-D site occurred in April 2019.

No shrub transect was established for this site.

Canopy cover data for the site was collected in April 2019. Data was collected from 50 plot frames, 25 in the northern D area of the site and 25 in the southern A, B, and C areas of the site. Canopy cover did not differ significantly between the northern and southern areas. Canopy cover for the entire site was 34.8%, made up of 16.0% native cover and 18.8% invasive cover (Table 51). This marks a 3.1% increase in native cover and a 4.6% increase in invasive cover since 2018. The dominant native species at this site was Sandberg's bluegrass (*Poa secunda*) with 9.6% cover. Sagebrush (*Artemisia tridentata*) occurs at low levels (0.1% cover) at this site. The dominant invasive species was cheatgrass (*Bromus tectorum*) with 9.9% cover and occurrence in 100% of the plot frames. Sixteen native species were recorded in 2019.

Diffuse knapweed (*Centaurea diffusa*), kochia (*Bassia scoparia*), and rush skeletonweed (*Chondrilla juncea*), all Washington State Class B noxious weeds, were recorded at this site. Diffuse knapweed had a cover of 1.1% and occurred in 12% of the plot frames.

Canopy cover has increased in the 2 years this site has been monitored. This site is lacking a sagebrush component and sagebrush could be added in to increase native cover in the future.

**Table 51. Percent Canopy Cover and Frequency of Occurrence at the 300 North Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.1	4.0
<i>Artemisia tridentata</i> (big sagebrush)	0.1	0.0
<i>Astragalus</i> sp. (milkvetch)	X	X
<i>Bassia scoparia</i> (kochia) (B) <sup>(b)</sup>	X	X
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	9.9	100.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	1.1	12.0
<i>Chondrilla juncea</i> (rush skeletonweed) (B) <sup>(b)</sup>	X	X
<i>Descurcania pinnata</i> (western tansymustard)	0.3	2.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.4	6.0
<i>Elymus elymoides</i> (squirreltail)	0.1	4.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	1.1	42.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.9	16.0
<i>Eriogonum niveum</i> (snow buckwheat)	X	X
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	1.3	40.0
<i>Festuca</i> sp. (fescue)	0.0	0.0
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.4	16.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	1.1	42.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.8	32.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.7	18.0
<i>Melilotus officinalis</i> (sweet clover) <sup>(a)</sup>	0.2	6.0
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	1.1	24.0
<i>Poa secunda</i> (Sandberg bluegrass)	9.6	96.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	2.2	38.0
<i>Purshia tridentata</i> (antelope bitterbrush)	X	X
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	2.2	88.0
<i>Sisymbrium altissimum</i> (tall tumbledustard) <sup>(a)</sup>	0.1	4.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	0.1	4.0
Crust	1.9	16.0
Soil	10.4	16.0
Litter	9.9	38.0
Rock/Cobble	56.3	50.0
Unavailable Space	3.8	38.0
<b>Total Canopy Cover</b>	<b>34.8</b>	
<b>Total Native % Cover</b>	<b>16.0</b>	
Total Invasive % Cover	18.8	
Unadjusted canopy cover	33.5	
Unadjusted Native % Cover	15.4	

Change in Native % Cover from 2018	3.1	
Unadjusted Invasive % Cover	18.1	
Change in Invasive % Cover from 2018	4.6	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 46. Two areas of the 300-North A-D Site in 2019, Showing Differences in Canopy Cover.**

### 1.8.3 618-2&3 Site (Solid Waste Burial Ground)

The 618-2&3 site was revegetated in FY 2015 but was not monitored immediately after planting. The 618-2&3 site is a combination of the 618-2 and 618-3 sites. Since revegetation in FY 2015, it appears the 618-2 area of this site was converted to a gravel laydown yard. The substrate at this site is cobble backfill. This site was 3 years old at the time it was first monitored in 2018.

No shrub transect was established for this site.

Canopy cover data for the site was collected in April 2019 (Figure 47). Data was collected from 25 plot frames. Canopy cover for the entire site was 20.0%, made up of 13.8% native cover and 6.2% invasive cover (Table 52). This represents an increase of 5.8% in native cover and of 1.3% in invasive cover. The dominant native species at this site was bluebunch wheatgrass (*Pseudoroegneria spicata*) with 5.0% cover followed by Sandberg's bluegrass (*Poa secunda*) with 4.4% cover. Sagebrush (*Artemisia tridentata*) was not observed at this site. The dominant invasive species was cheatgrass (*Bromus tectorum*) with 2.7% cover and occurrence in 88% of the plot frames. Eight native species were recorded in 2019.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was recorded at this site with a cover less than 1%.

As this is the second year canopy cover data was collected at this site, continued monitoring is recommended before any additional revegetation actions are taken. This site is lacking a sagebrush component, and sagebrush could be added in to increase native cover in the future.

**Table 52. Percent Canopy Cover and Frequency of Occurrence at the 618-2&3 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achnatherum hymenoides</i> (Indian ricegrass)	X	X
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	2.7	88.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	0.7	8.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.1	4.0
<i>Elymus elymoides</i> (squirreltail)	0.1	4.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	1.7	68.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	1.6	44.0
<i>Eriogonum niveum</i> (snow buckwheat)	X	X
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	0.1	4.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	1.1	44.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.5	20.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.3	12.0
<i>Poa secunda</i> (Sandberg bluegrass)	4.4	96.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	5.0	100.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	0.5	20.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	0.2	8.0
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X
Crust	0.8	12.0
Soil	16.6	92.0

Litter	29.5	100.0
Rock/Cobble	48.1	96.0
Unavailable Space	5.2	68.0
<b>Total Canopy Cover</b>	<b>20.0</b>	
<b>Total Native % Cover</b>	<b>13.8</b>	
Total Invasive % Cover	6.2	
Unadjusted canopy cover	19.0	
Unadjusted Native % Cover	13.1	
Change in Native % Cover from 2018	5.8	
Unadjusted Invasive % Cover	5.9	
Change in Invasive % Cover from 2018	1.3	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 47. The 618-2&3 Site in 2019, Showing the 618-3 Portion of the Site.**

#### **1.8.4 618-10 Site (Burial Ground)**

The 618-10 site was revegetated in FY 2019. This site is approximately 127 ac and was split into four areas during the initial revegetation. Soil substrate varies from sandy loam to gravely sand, seed mix varied depending on the substrate. See Appendix B for a description of seed mix and rates for the different areas. Forty-two native species were seeded at 618-10 and sagebrush (*Artemisia tridentata*), bitterbrush (*Purshia tridentata*), snow buckwheat (*Eriogonum niveum*), and green rabbitbrush (*Chrysothamnus viscidiflorus*) plugs were planted. In addition to seeding and hand planting shrubs, six “Forb Islands” were established. These islands were hand seeded

with forb species in an effort to establish forb populations that could expand into the rest of the revegetation site.

First year transect monitoring occurred at the 618-10 site in June 2019. Three transects were established in Area 1, 4 transects were established in Area 2, 2 transects were established in Area 3, and 1 transect was established in Area 4 for a total of 10 transects established at the 618-10 site. Sagebrush and bitterbrush were recorded on these transects to measure total shrub density, and snow buckwheat was recorded to track forb survival. Area 1 had a combined shrub density of 1,096 shrubs/ha (444 shrubs/ac), Area 2 had a combined shrub density of 983 shrubs/ha (398 shrubs/ac), Area 3 had a combined shrub density of 795 shrubs/ha (322 shrubs/ac), and Area 4 had a shrub density of 890 shrubs/ha (360 shrubs/ac). The 618-10 site had a combined total of 941 shrubs/ha (381 shrubs/ac), above success levels.

First year plot monitoring occurred at the 618-10 site in May 2019. Three sets of 25 plot frames were taken in Area 1, four sets of 25 plot frames were taken in Area 2, two sets of 25 plot frames were taken in Area 3, and one set of 25 plot frames was taken in Area 4. In addition to these plots, 10 plot frames were taken within 50 m of the center of each forb island site, totaling 60 additional forb island plots. A total of 310 plot frames were measured at the 618-10 site. Plot monitoring data is reported by area due to the size of this site.

Area 1 (Figure 48) has 23.3% canopy cover made up of 10.3% native cover and 12.9% invasive cover (Table 53). Twenty-nine native species were detected at Area 1. The dominant species in this area was Russian thistle (*Salsola kali*) with 5.7% cover, and the most abundant native species was Indian Ricegrass (*Achnatherum hymenoides*) with 1.7% cover.

Area 2 (Figure 49) has 17.1% canopy cover made up of 7.5% native cover and 9.6% invasive cover (Table 54). Thirty-two native species were detected at Area 2. The dominant species in this area was Russian thistle with 3.2% cover followed by young bunchgrasses with 3.0% cover.

Area 3 (Figure 50) has 22.6% canopy cover made up of 9.0% native cover and 13.7% invasive cover (Table 55). Thirty-six native species were detected at Area 3. The dominant species in this area was Russian thistle with 6.0% cover followed by young bunchgrasses with 2.8% cover.

Area 4 (Figure 51) has 29.5% canopy cover made up of 11.6% native cover and 17.9% invasive cover (Table 56). Twenty native species were detected at Area 4. The dominant invasive species in this area was cheatgrass (*Bromus tectorum*) with 5.3% cover, and the dominant native species in this area was bur ragweed (*Ambrosia acanthicarpa*) with 5.3% cover.

The 618-10 site as a whole averaged 23.1% canopy cover, made up of 9.6% native cover and 13.5% invasive cover.

The six forb islands were grouped by soil type with three islands in sandy loam soils and three islands in gravelly sand soils. Canopy cover within 50 m of the sandy loam forb islands averaged 16.6%, with 8.8% native cover and 7.8% invasive cover (Table 57). Twenty-six native species were detected in this area (Figure 52). Of the 16 forbs hand seeded in this area, 11 were germinating in 2019. Russian thistle dominated this area with 4.8% cover followed by young bunchgrasses with 2.3% cover. Canopy cover within 50 m of the gravelly sand forb islands averaged 20.9%, with 9.8% native cover and 11.2% invasive cover (Table 58). Twenty-seven native species were detected in this area (Figure 53). Of the 14 forbs hand seeded in this area, 7 were germinating in 2019. Russian thistle dominated this area with 3.8% cover followed by bur ragweed with 3.3% cover.

Continued monitoring of this site is necessary to track plant establishment and growth as the site matures.

**Table 53. Percent Canopy Cover and Frequency of Occurrence at 618-10 Area 1 in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.1	4.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	1.7	66.7
<i>Ambrosia acanthicarpa</i> (flatspine bur ragweed)	1.5	38.7
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Artemisia tridentata</i> (big sagebrush) (transplants)	0.4	16.0
<i>Brassica sp.</i> (mustard) <sup>(a)</sup>	0.5	20.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	1.0	41.3
Bunchgrass species (multiple)	0.3	13.3
<i>Chaenactis douglasii</i> (Douglas' dustymaiden)	X	X
<i>Chondrilla juncea</i> (rush skeletonweed) (B) <sup>(b)</sup>	1.2	8.0
<i>Cryptantha circumscissa</i> (matted cryptantha)	X	X
<i>Cymopterus terebinthinus</i> (turpentine springparsley)	1.5	4.0
<i>Dalea ornata</i> (western prairie clover)	0.1	4.0
<i>Descurcania pinnata</i> (western tansymustard)	1.2	28.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.3	10.0
<i>Eriogonum niveum</i> (snow buckwheat)	0.3	16.0
<i>Gilia sinuata</i> (shy gilia)	X	X
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.3	12.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.4	14.7
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.1	4.0
<i>Microsteris gracilis</i> (slender phlox)	X	X
<i>Nama densum</i> (purple mat)	X	X
<i>Oenothera pallida</i> (pale-evening primrose)	X	X
<i>Penstemon acuminatus</i> (sharpleaf penstemon)	0.1	4.0
<i>Phacelia hastata</i> (whiteleaf phacelia)	0.1	4.0
<i>Phlox longifolia</i> (longleaf phlox)	X	X
<i>Plantago patagonica</i> (woolly plantain)	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	0.6	17.3
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.3	10.7
<i>Psoralidium lanceolatum</i> (lemon scurfpea)	0.7	6.0
<i>Purshia tridentata</i> (antelope bitterbrush)	0.3	13.3
<i>Rumex venosus</i> (winged dock)	0.6	5.3
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	5.7	100.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	1.5	53.3
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X
<i>Triticum aestivum</i> (common wheat) <sup>(a)</sup>	X	X
<i>Triticum sp.</i> (wheat) <sup>(a)</sup>	0.5	20.0

<i>Triticum x elymus trachycaulus</i> (Regreen) <sup>(a)</sup>	1.8	58.7
Crust	0.0	0.0
Soil	64.7	98.7
Litter	28.0	100.0
Rock/Cobble	5.2	70.7
Unavailable Space	0.9	24.0
<b>Total Canopy Cover</b>	<b>23.3</b>	
<b>Total Native % Cover</b>	<b>10.3</b>	
Total Invasive % Cover	12.9	
Unadjusted canopy cover	23.0	
Unadjusted Native % Cover	10.2	
Unadjusted Invasive % Cover	12.8	

<sup>a</sup> = Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plots



**Figure 48. Area 1 of the 618-10 Site in 2019.**

**Table 54. Percent Canopy Cover and Frequency of Occurrence at 618-10 Area 2 in 2019 (3 Pages).**

<b>Species</b>	<b>% Cover</b>	<b>% Freq of Occ</b>
<i>Achillea millefolium</i> (common yarrow)	0.1	2.0
<i>Amaranthus albus</i> (white pigweed) <sup>(a)</sup>	0.4	16.0
<i>Ambrosia acanthicarpa</i> (flatspine bur ragweed)	1.2	34.0

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<i>Artemisia tridentata</i> (big sagebrush)	0.2	9.0
<i>Artemisia tridentata</i> (recruits)	0.1	4.0
<i>Astragalus caricinus</i> (buckwheat milkvetch)	X	X
<i>Astragalus purshii</i> (woollypod milkvetch)	X	X
<i>Astragalus sclerocarpus</i> (stalked-pod milkvetch)	X	X
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	X	X
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	2.5	38.0
<i>Bunchgrass</i> sp. (multiple)	3.0	86.7
<i>Chaenactis douglasii</i> (Douglas' dustymaiden)	X	X
<i>Chenopodium leptophyllum</i> (narrowleaf goosefoot)	X	X
<i>Chondrilla juncea</i> (rush skeletonweed) (B) <sup>(b)</sup>	X	X
<i>Chrysothamnus viscidiflorus</i> (yellow rabbitbrush)	X	X
<i>Coldenia nuttallii</i> (desert mat)	0.1	4.0
<i>Cryptantha circumscissa</i> (matted cryptantha)	X	X
<i>Cymopterus terebinthinus</i> (turpentine springparsley)	0.1	4.0
<i>Dalea ornata</i> (western prairie clover)	X	X
<i>Descurciana pinnata</i> (western tansymustard)	0.1	4.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	1.0	10.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.1	4.0
<i>Eriogonum niveum</i> (snow buckwheat)	0.3	12.0
<i>Eriogonum vimineum</i> (wickerstem buckwheat)	0.1	4.0
<i>Erysimum asperum</i> (rough wallflower)	0.1	4.0
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.5	20.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.3	10.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	X	X
<i>Medicago sativa</i> (alfalfa) <sup>(a)</sup>	0.1	4.0
<i>Melilotus officinalis</i> (sweet clover) <sup>(a)</sup>	X	X
<i>Mentzelia albicaulis</i> (whitestem stickleaf)	0.1	4.0
<i>Nicotiana acuminata</i> (coyote tobacco)	X	X
<i>Oenothera pallida</i> (pale-evening primrose)	0.1	4.0
<i>Penstemon acuminatus</i> (sharpleaf penstemon)	0.1	4.0
<i>Phacelia hastata</i> (whiteleaf phacelia)	0.2	8.0
<i>Poa secunda</i> (Sandberg bluegrass)	0.6	17.0
<i>Purshia tridentata</i> (antelope bitterbrush)	0.3	12.0
<i>Rumex venosus</i> (winged dock)	X	X
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	3.2	87.0
<i>Sisymbrium altissimum</i> (tall tumbledustard) <sup>(a)</sup>	0.9	29.0
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X
<i>Triticum x elymus trachycaulus</i> (Regreen) <sup>(a)</sup>	0.6	22.0
<i>Triticum</i> sp. (wheat) <sup>(a)</sup>	0.8	32.0
<i>Vulpia microstachys</i> (desert fescue)	0.1	1.3
Crust	0.0	0.0
Soil	62.6	100.0
Litter	33.3	100.0
Rock/Cobble	2.2	34.0
Unavailable Space	0.3	5.0

<b>Total Canopy Cover</b>	<b>17.1</b>	
<b>Total Native % Cover</b>	<b>7.5</b>	
Total Invasive % Cover	9.6	
Unadjusted canopy cover	17.0	
Unadjusted Native % Cover	7.5	
Unadjusted Invasive % Cover	9.6	

<sup>a</sup> = Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plots



**Figure 49. Area 2 of the 618-10 Site in 2019.**

**Table 55. Percent Canopy Cover and Frequency of Occurrence at 618-10 Area 3 in 2019 (3 Pages).**

<b>Species</b>	<b>% Cover</b>	<b>% Freq of Occ</b>
<i>Achillea millefolium</i> (common yarrow)	0.3	12.0
<i>Ambrosia acanthicarpa</i> (flatspine bur ragweed)	1.3	42.0
<i>Artemisia tridentata</i> (big sagebrush)	0.2	6.0
<i>Astragalus caricinus</i> (buckwheat milkvetch)	X	X
<i>Astragalus purshii</i> (woollypod milkvetch)	X	X
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	X	X
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	1.8	30.0
<i>Bunchgrass</i> sp. (multiple)	2.8	90.0
<i>Chaenactis douglasii</i> (Douglas' dustymaiden)	X	X

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<i>Chenopodium leptophyllum</i> (narrowleaf goosefoot)	X	X
<i>Chrysothamnus viscidiflorus</i> (yellow rabbitbrush)	X	X
<i>Coldenia nuttallii</i> (desert mat)	0.2	6.0
<i>Cryptantha circumscissa</i> (matted cryptantha)	0.2	6.0
<i>Cymopterus terebinthinus</i> (desert parsley)	X	X
<i>Dalea ornata</i> (western prairie clover)	X	X
<i>Descurciana pinnata</i> (western tansymustard)	0.5	20.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.4	14.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.1	4.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.1	4.0
<i>Eriogonum niveum</i> (snow buckwheat)	0.7	18.0
<i>Eriogonum vimineum</i> (wickerstem buckwheat)	X	X
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	X	X
<i>Erysimum capitatum</i> (rough wallflower)	X	X
<i>Gilia sinuata</i> (shy gilia)	0.1	4.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.1	4.0
<i>Hordeum leporinum</i> (hare barley) <sup>(a)</sup>	X	X
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.2	8.0
<i>Lamium amplexicaule</i> (henbit deadnettle) <sup>(a)</sup>	0.9	24.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.1	4.0
<i>Medicago sativa</i> (alfalfa) <sup>(a)</sup>	X	X
<i>Melilotus officinalis</i> (sweet clover) <sup>(a)</sup>	X	X
<i>Mentzelia albicaulis</i> (whitestem stickleaf)	0.2	8.0
<i>Nama densum</i> (purple mat)	X	X
<i>Nicotiana acuminata</i> (coyote tobacco)	0.1	4.0
<i>Oenothera pallida</i> (pale-evening primrose)	X	X
<i>Penstemon acuminatus</i> (sharpleaf penstemon)	X	X
<i>Phacelia hastata</i> (whiteleaf phacelia)	0.2	8.0
<i>Plantago patagonica</i> (woolly plantain)	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	1.7	68.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.1	4.0
<i>Psoraleidium lanceolatum</i> (dune scurfpea)	X	X
<i>Purshia tridentata</i> (antelope bitterbrush)	0.3	10.0
<i>Ranunculus testiculatus</i> (burr buttercup) <sup>(a)</sup>	X	X
<i>Rumex venosus</i> (winged dock)	X	X
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	6.0	98.0
<i>Sisymbrium altissimum</i> (tall tumbledustard) <sup>(a)</sup>	1.5	38.0
<i>Triticum aestivum</i> (common wheat) <sup>(a)</sup>	0.6	24.0
<i>Triticum x elymus trachycaulus</i> (Regreen) <sup>(a)</sup>	2.4	46.0
Crust	0.0	0.0
Soil	66.1	98.0
Litter	27.1	100.0
Rock/Cobble	2.1	26.0
Unavailable Space	0.0	0.0
<b>Total canopy cover</b> (excludes ground cover)	<b>22.6</b>	
<b>Total Native % Cover</b>	<b>9.0</b>	

Total Invasive % Cover	13.7	
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<sup>a</sup> = Invasive species

X = present but not counted in plots



**Figure 50. Area 3 of the 618-10 Site in 2019.**

**Table 56. Percent Canopy Cover and Frequency of Occurrence at 618-10 Area 4 in 2019 (2 Pages).**

Species	% Cover	% Freq of Occ
<i>Achillea millefolium</i> (common yarrow)	0.2	8.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.5	20.0
<i>Ambrosia acanthicarpa</i> (flatspine bur ragweed)	5.3	92.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	0.3	12.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	6.2	88.0
Bunchgrass species (multiple)	0.3	12.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	X	X
<i>Chenopodium leptophyllum</i> (narrowleaf goosefoot)	X	X
<i>Chondrilla juncea</i> (rush skeletonweed) (B) <sup>(b)</sup>	0.3	12.0
<i>Chrysothamnus viscidiflorus</i> (yellow rabbitbrush)	0.1	4.0

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<i>Coldenia nuttallii</i> (desert mat)	0.1	4.0
<i>Cryptantha circumscissa</i> (matted cryptantha)	1.3	52.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	4.4	96.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.1	4.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X
<i>Eriogonum niveum</i> (snow buckwheat)	0.1	4.0
<i>Eriogonum</i> sp. (buckwheat sp.)	0.1	4.0
<i>Filago arvensis</i> (field fluffweed) <sup>(a)</sup>	0.4	16.0
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.6	24.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	1.0	40.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.4	16.0
<i>Lamium amplexicaule</i> (henbit deadnettle) <sup>(a)</sup>	0.1	4.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.2	8.0
<i>Poa secunda</i> (Sandberg bluegrass)	1.7	48.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.1	4.0
<i>Purshia tridentata</i> (antelope bitterbrush)	X	X
<i>Ranunculus testiculatus</i> (burr buttercup) <sup>(a)</sup>	0.3	12.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	1.9	76.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	1.1	44.0
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	0.1	4.0
<i>Triticum aestivum</i> (common wheat) <sup>(a)</sup>	0.2	8.0
<i>Triticum x elymus trachycaulus</i> (Regreen) <sup>(a)</sup>	1.3	32.0
<i>Vulpia microstachys</i> (desert fescue)	0.5	20.0
Crust	0.0	0.0
Soil	60.3	96.0
Litter	31.1	100.0
Rock/Cobble	4.9	76.0
Unavailable Space	1.0	20.0
<b>Total Canopy Cover</b>	<b>29.5</b>	
<b>Total Native % Cover</b>	<b>11.6</b>	
Total Invasive % Cover	17.9	
Unadjusted canopy cover	29.2	
Unadjusted Native % Cover	11.5	
Unadjusted Invasive % Cover	17.7	

<sup>a</sup> = Invasive species

<sup>b</sup> = Washington State Classified Noxious Weed (class)

X = present but not counted in plots



**Figure 51. Area 4 of the 618-10 Site in 2019.**

**Table 57. Percent Canopy Cover and Frequency of Occurrence at 618-10 Sandy Loam Forb Islands in 2019 (2 Pages).**

Species	% Cover	% Freq of Occ	Hand Seeded?
<i>Abronia mellifera</i> (white sand verbena)	X	X	Yes
<i>Achillea millefolium</i> (common yarrow)	0.1	3.3	
<i>Ambrosia acanthicarpa</i> (flatspine bur ragweed)	0.8	30.0	
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X	
<i>Artemisia tridentata</i> (big sagebrush)	0.1	3.3	
<i>Astragalus caricinus</i> (buckwheat milkvetch)	X	X	Yes
<i>Astragalus purshii</i> (woollypod milkvetch)	0.1	3.3	Yes
<i>Astragalus sclerocarpus</i> (stalked-pod milkvetch)	X	X	Yes
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	0.6	23.3	Yes
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	0.7	26.7	
<i>Bunchgrass sp.</i> (multiple)	2.3	73.3	
<i>Chaenactis douglasii</i> (Douglas' dustymaiden)	0.7	26.7	Yes
<i>Chrysothamnus viscidiflorus</i> (yellow rabbitbrush)	X	X	
<i>Coldenia nuttallii</i> (desert mat)	X	X	
<i>Cymopterus terebinthinus</i> (turpentine springparsley)	0.4	16.7	Yes
<i>Dalea ornata</i> (western prairie clover)	X	X	Yes
<i>Descurcania pinnata</i> (western tansymustard)	0.4	16.7	
<i>Eriogonum niveum</i> (snow buckwheat)	0.2	6.7	
<i>Erysimum asperum</i> (rough wallflower)	0.7	26.7	Yes

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<i>Hordeum leporinum</i> (hare barley) <sup>(a)</sup>	X	X	
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.3	10.0	
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.1	3.3	
<i>Nicotiana acuminata</i> (coyote tobacco)	X	X	
<i>Penstemon acuminatus</i> (sharpleaf penstemon)	0.4	16.7	Yes
<i>Phacelia hastata</i> (whiteleaf phacelia)	0.1	3.3	
<i>Poa secunda</i> (Sandberg bluegrass)	1.8	56.7	
<i>Purshia tridentata</i> (antelope bitterbrush)	0.1	3.3	
<i>Rumex venosus</i> (winged dock)	0.1	3.3	Yes
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	4.8	96.7	
<i>Sisymbrium altissimum</i> (tall tumbledustard) <sup>(a)</sup>	0.8	33.3	
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	0.1	3.3	
<i>Triticum aestivum</i> (common wheat) <sup>(a)</sup>	0.6	23.3	
<i>Triticum x elymus trachycaulus</i> (Regreen) <sup>(a)</sup>	0.6	23.3	
Crust	0.0	0.0	
Soil	66.7	100.0	
Litter	33.3	100.0	
Rock/Cobble	0.0	0.0	
Unavailable Space	0.0	0.0	
<b>Total canopy cover</b> (excludes ground cover)	<b>16.6</b>		
Total Native % Cover	<b>8.8</b>		
Total Invasive % Cover	7.8		

<sup>a</sup> = Invasive species

X = present but not counted in plots



**Figure 52. A Flag Marks the Center of the Sandy Loam Forb Island in the Southern Half of Area 3.**

**Table 58. Percent Canopy Cover and Frequency of Occurrence at 618-10 Gravelly Sand Forb Islands in 2019 (2 Pages).**

Species	% Cover	% Freq of Occ	Hand Seeded?
<i>Achillea millefolium</i> (common yarrow)	0.2	6.7	
<i>Ambrosia acanthicarpa</i> (flatspine bur ragweed)	3.3	46.7	
<i>Astragalus caricinus</i> (buckwheat milkvetch)	0.2	6.7	
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	1.8	40.0	
<i>Bunchgrass</i> sp. (multiple)	1.4	56.7	
<i>Chaenactis douglasii</i> (Douglas' dustymaiden)	0.1	3.3	
<i>Cryptantha circumscissa</i> (matted cryptantha)	0.9	36.7	Yes
<i>Dalea ornata</i> (western prairie clover)	X	X	
<i>Descurciana pinnata</i> (western tansymustard)	X	X	
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.1	3.3	
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.1	3.3	
<i>Erigeron</i> sp. (fleabane)	0.1	3.3	Yes
<i>Eriogonum niveum</i> (snow buckwheat)	0.1	3.3	
<i>Eriogonum vimineum</i> (wickerstem buckwheat)	X	X	
<i>Filago arvensis</i> (field fluffweed) <sup>(a)</sup>	0.3	10.0	
<i>Gilia sinuata</i> (shy gilia)	0.1	3.3	
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.3	13.3	
<i>Hordeum leporinum</i> (hare barley) <sup>(a)</sup>	X	X	
<i>Kochia scoparia</i> (kochia) <sup>(a)</sup>	0.1	3.3	
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.1	3.3	
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.7	26.7	Yes
<i>Nama densum</i> (purple mat)	X	X	
<i>Nicotiana acuminata</i> (coyote tobacco)	0.1	3.3	Yes
<i>Oenothera pallida</i> (pale-evening primrose)	X	X	
<i>Penstemon acuminatus</i> (sharpleaf penstemon)	0.3	10.0	
<i>Phacelia hastata</i> (whiteleaf phacelia)	0.8	30.0	Yes
<i>Phlox longifolia</i> (longleaf phlox)	0.2	6.7	Yes
<i>Plantago patagonica</i> (woolly plantain)	0.3	13.3	Yes
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	0.1	3.3	
<i>Poa secunda</i> (Sandberg bluegrass)	0.7	26.7	
<i>Psoralidium lanceolatum</i> (dune scurfpea)	X	X	
<i>Rumex venosus</i> (winged dock)	0.1	3.3	
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	3.8	53.3	
<i>Sisymbrium altissimum</i> (tall tumbledustard) <sup>(a)</sup>	2.3	56.7	
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	1.4	23.3	
<i>Triticum aestivum</i> (common wheat) <sup>(a)</sup>	0.1	3.3	

<i>Triticum x elymus trachycaulus</i> (Regreen) <sup>(a)</sup>	0.9	36.7	
<i>Vulpia microstachys</i> (desert fescue)	0.3	13.3	
Crust	0.0	0.0	
Soil	53.3	100.0	
Litter	32.5	100.0	
Rock/Cobble	4.0	43.3	
Unavailable Space	0.0	0.0	
<b>Total canopy cover</b> (excludes ground cover)	<b>20.9</b>		
Total Native % Cover	<b>9.8</b>		
Total Invasive % Cover	11.2		

<sup>a</sup> = Invasive species

X = present but not counted in plots



**Figure 53. Matted *Cryptantha* Growing at the Gravelly Sand Forb Island in Area 3 in 2019.**

## 1.9 200 AREA SITES

Five revegetation projects in the 200 Areas were monitored in FY 2019: L-840, L-525, L-419, L-853/854, and L-894. The L-840 and L-525 sites were revegetated in FY 2017, the L-419 site was revegetated in FY 2018, and the L-853/854 and L-894 sites were revegetated in FY 2019.

In FY 2017, an export water line was installed and the disturbed areas revegetated. For revegetation and monitoring purposes the area was divided into two sites, the 200-West (L-840) Export Water Pipeline site and the 200-East (L-525) Export Water Pipeline site. Per the *Site-Specific Revegetation Plan for the Export Water Pipeline* (L-840) and the *Site-Specific*

*Revegetation Plan for the Export Water Pipeline (L-525)* (MSA 2016 and MSA 2017a), revegetation efforts entailed broadcast seeding with a mixture of native grasses including Sandberg bluegrass (*Poa secunda*), Indian ricegrass (*Achnatherum hymenoides*), and needle-and-thread grass (*Hesperostipa comata*) at approximately 10.9 kg/ha (9.75 lbs/ac) combined with a native forb mix of a minimum of four species at approximately 0.45kg/ha (0.4 lbs/ac). Broadcast seeding areas were topped with a straw mulch that was crimped into the soil surface. Shrub species including big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), and spiny hopsage (*Grayia spinosa*) were transplanted on the sites at approximately 1,482 plants/ha (600 plants/ac) with a mix of approximately 66% sagebrush, 17% bitterbrush, and 17% spiny hopsage.

In FY 2018, an export water line was installed between the 2901-Y Valve House and the 282-E Inlet Valve House in the 200-East Area. The pipeline is approximately 3.73 km (2.37 miles) in length and is close and parallel to the L-525 Export Water Pipeline. Per the *Site-Specific Revegetation Plan for the Export Water Pipeline (L-419)* (MSA 2017b), revegetation efforts entailed broadcast seeding with a mixture of native grasses including Sandberg bluegrass (*Poa secunda*), Indian ricegrass (*Achnatherum hymenoides*), and needle-and-thread grass (*Hesperostipa comata*) at approximately 17.4 kg/ha (15.5 lbs/ac). Native forb seed was also broadcasted across the site including Munro's globemallow (*Sphaeralcea munroana*), Carey's balsamorhiza (*Balsamorhiza careyana*), shaggy fleabane (*Erigeron pumilis*), slender hawksbeard (*Crepis atribarba*), snow buckwheat (*Eriogonum niveum*), and Douglas' Dustymaiden (*Chaenactis douglasii*) at a rate of 2.1 kg/ha (1.88 lbs/ac). Shrub species including big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), and spiny hopsage (*Grayia spinosa*) were transplanted on the sites at approximately 1,482 plants/ha (600 plants/ac) with a mix of approximately 66% sagebrush, 17% bitterbrush, and 17% spiny hopsage.

In FY 2019, the L-853/854 export water line was revegetated. This site was broadcast seeded with a mixture of native grasses including Sandberg bluegrass (*Poa secunda*) and needle-and-thread grass (*Hesperostipa comata*) at a rate of 4.6 kg/ha (3.7 lbs/ac) and 3.4 kg/ha (3 lbs/ac), respectively, along with cushion fleabane (*Erigeron poliospermus*), Munro's globemallow, and slender hawksbeard at a rate of 0.22 kg/ha (0.2 lb/ac). Shrub species including big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), and spiny hopsage (*Grayia spinosa*) were transplanted on the sites at approximately 1,482 plants/ha (600 plants/ac) with a mix of approximately 66% sagebrush, 17% bitterbrush, and 17% spiny hopsage.

The L-894 export water line was also revegetated in FY 2019 following the *Site Specific Revegetation Plan for Project L-894* (MSA 2017c). The site was broadcast seeded with a mixture of native grasses including Sandberg bluegrass (*Poa secunda*), Indian ricegrass (*Achnatherum hymenoides*), and needle-and-thread grass (*Hesperostipa comata*) at a rate of approximately 10.1 kg/ha (9.0 lbs/ac). Forb species seeded included Mariposa lily (*Calochortus macrocarpus*), western prairie clover (*Dalea ornata*), desert parsley (*Cymopterus terebinthinus*), hoary tansyaster (*Machaeranthera canescens*), and slender hawksbeard. Pale evening primrose (*Oenothera pallida*) was also included in the seed mix but rock primrose (*Oenothera caespitosa*) was incorrectly substituted by the vendor. Forbs were seeded at a rate of 0.52 kg/ha (0.46 lb/ac). Shrub species (including big sagebrush [*Artemisia tridentata*] and spiny hopsage [*Grayia spinosa*]) were transplanted on the sites at approximately 1,482 plants/ha (600 plants/ac) with a mix of approximately 66% sagebrush and 33% spiny hopsage.

### 1.9.1 200-West (L-840) Export Water Pipeline Site

The 200-West (L-840) Export Water Pipeline site (Figure 54) was revegetated in FY 2017 and monitoring was first conducted for the site in 2017. This is a larger site that was divided into 5 areas for monitoring purposes with data collected from 20 plot frames in each area and 1 transect at the southwest end of the site. That transect was retired in 2018 due to being converted to an industrial use area. A new transect was established in 2019. Substrates for the site are sandy loams to loamy sands with varied amounts of gravel and cobble.

One transect was established in FY 2019 to estimate shrub density at the L-840 site. This transect counted sagebrush (*Artemisia tridentata*) that were planted in FY 2017, as well as recruits from the soil and surrounding areas. There were a large number of recruits throughout the L-840 site. This transect found 6,881 shrubs/ha (2,786 shrubs/ac), well above shrub density requirements. Many of the shrubs counted were recruits and will naturally thin out in the coming years, but it is expected that this site will remain above success levels.

Canopy cover data for the site was collected in April 2019. Average canopy cover for the site overall was 53.5% with native cover representing 24.8% and invasive cover representing 28.7% (Table 59). Native cover increased by 14.2% since 2018 and invasive cover decreased by 0.7% since 2018. Sandberg's bluegrass (*Poa secunda*) was the dominant native species for the site with 11.0% cover. Cheatgrass (*Bromus tectorum*) was the dominant invasive species for the site with 13.0% cover. Since 2017 monitoring, Russian thistle (*Salsola kali*) cover has decreased from 32.3% to 2.8%. Twenty-three native species were identified at this site in 2019 (Figure 54).

Third-year monitoring at this site shows highly successful sagebrush density and native cover quickly approaching success levels. No further action apart from continued monitoring is recommended at this site.

**Table 59. Percent Canopy Cover and Frequency of Occurrence at the 200 West L-840 Waterline Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achnatherum hymenoides</i> (Indian ricegrass)	1.1	20.0
<i>Agropyron cristatum</i> (crested wheatgrass) <sup>(a)</sup>	X	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.1	5.0
<i>Artemisia tridentata</i> (big sagebrush)	3.6	45.0
<i>Astragalus succumbens</i> (crouching milkvetch)	1.1	7.5
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	0.1	5.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	13.0	100.0
<i>Calochortus macrocarpus</i> (sagebrush mariposa lily)	0.1	5.0
<i>Chorispora tenella</i> (crossflower) <sup>(a)</sup>	0.1	5.0
<i>Crepis atriobarba</i> (slender hawksbeard)	X	X
<i>Descurcania pinnata</i> (western tansymustard)	0.6	24.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.4	15.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.1	5.0
<i>Erigeron pumilus</i> (shaggy fleabane)	0.8	5.0
<i>Eriogonum niveum</i> (snow buckwheat)	2.8	32.5

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Fescue sp. (unknown)	0.1	5.0
<i>Grayia spinosa</i> (spiny hopsage)	0.8	5.0
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.4	17.5
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.8	30.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.7	28.0
<i>Lupinus pusillus</i> (low lupine)	0.1	5.0
Lupinus sp. (lupine sp.)	0.1	5.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.3	10.0
<i>Microsteris gracilis</i> (slender phlox)	0.1	5.0
<i>Phlox speciosa</i> (showy phlox)	0.1	5.0
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	0.9	36.7
<i>Poa secunda</i> (Sandberg bluegrass)	11.0	95.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.4	16.7
<i>Rumex venosus</i> (winged dock)	X	X
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	2.8	73.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	2.8	43.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	0.8	6.7
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	7.3	95.0
Crust	0.1	4.0
Soil	54.6	99.0
Litter	41.3	100.0
Rock/Cobble	4.3	83.0
Unavailable Space	0.2	9.0
<b>Total Canopy Cover</b>	<b>53.5</b>	
<b>Total Native % Cover</b>	<b>24.8</b>	
Total Invasive % Cover	28.7	
Unadjusted canopy cover	53.4	
Unadjusted Native % Cover	24.8	
Change in Native % Cover from 2018	14.2	
Unadjusted Invasive % Cover	28.7	
Change in Invasive % Cover from 2018	-0.7	

<sup>a</sup> Invasive species

X = present but not counted in plot frames



**Figure 54. The 200-West (L-840) Export Water Pipeline Site in 2019. Top: Overview of the L-840 Site in 2019. Bottom: Globemallow, Snow Buckwheat, and Fleabane Growing at the L-840 Site in 2019.**

### 1.9.2 200-East (L-525) Export Water Pipeline Site

The 200-East (L-525) Export Water Pipeline site (Figure 55) was revegetated in FY 2017 and monitoring was first conducted for the site in 2017. This is a larger site that was divided into 5 areas for monitoring purposes with data collected from 20 plot frames in each area and 1 transect at the northwest end of the site. Substrates for the site are sandy loams to loamy sands with varied amounts of gravel and cobbles.

A 100-m (328-ft) shrub monitoring transect with 5-m (16.4-ft) offsets to each side was established for the site in 2017. The 2018 monitoring revealed extremely low survival on this transect (1%), so a new transect was established in 2019 to determine if low survival was common throughout the line. Third-year monitoring of Transect 1 and first-year monitoring of Transect 2 were conducted in July 2019. More shrubs were recorded on Transect 1 in 2019 than in 2018 monitoring, and shrub density at this transect was 143 plants/ha (58 plants/ac), below success criteria of 600 plants/ha (240 plants/ac). Transect 2 had a density of 200 plants/ha (81 plants/ac), below success criteria. The similar low shrub density at Transect 2 suggests that low shrub survival post-planting occurred throughout the L-525 site.

Canopy cover data for the site was collected in April 2019. Average canopy cover for the site overall was 37.3%, with native cover representing 15.5% and invasive cover representing 21.8% (Table 60). Native cover had increased by 6.6% and invasive cover has increased by 9.3% at this site since 2018 monitoring. Sandberg's bluegrass (*Poa secunda*) was the dominant native species with 10.8% of the native cover. Twenty-three native species were recorded at this site, and this site has a high diversity of forb species. Cheatgrass (*Bromus tectorum*) was the dominant invasive species for the site with 14.7% cover, an increase of about 10% from 2018.

This site is surrounded by mature stands of sagebrush. The high native diversity and success of forbs at this site suggests native canopy cover will continue to increase at this site. The L-840 site, planted with the same methods and at the same time as the L-525 site, has a high number of sagebrush recruits. Before additional revegetation actions are taken to increase shrub density, sagebrush recruits at this site should be closely monitored to see if the surrounding sagebrush stands can successfully seed the area.

**Table 60. Percent Canopy Cover and Frequency of Occurrence at the 200 West L-525 Waterline Site in 2019 (2 Pages).**

Species	Entire Site	
	% Cover	% Frequency of Occurrence
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.7	12.0
<i>Agropyron cristatum</i> (crested wheatgrass) <sup>(a)</sup>	X	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.1	2.0
<i>Artemisia tridentata</i> (big sagebrush)	0.4	4.0
<i>Artemisia tridentata</i> (recruits)	0.03	1.0
<i>Astragalus caricinus</i> (buckwheat milkvetch)	X	X

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<i>Astragalus succumbens</i> (crouching milkvetch)	X	X
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	0.4	7.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	14.7	100.0
Bunchgrasses sp. (multiple)	0.03	1.0
<i>Chaenactis douglasii</i> (Douglas' dustymaiden)	0.1	2.0
<i>Chorispora tenella</i> (crossflower) <sup>(a)</sup>	X	X
<i>Crepis atribarba</i> (slender hawksbeard)	X	X
<i>Descurainia pinnata</i> (western tansymustard)	X	X
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.1	4.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.1	2.0
<i>Erigeron pumilus</i> (shaggy fleabane)	0.1	5.0
<i>Eriogonum niveum</i> (snow buckwheat)	0.7	9.0
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.8	8.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.1	3.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.9	37.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.1	2.0
<i>Microsteris gracilis</i> (slender phlox)	0.1	3.0
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	0.03	1.0
<i>Poa secunda</i> (Sandberg bluegrass)	10.8	88.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.5	8.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	3.8	87.0
<i>Sisymbrium altissimum</i> (tall tumbledustard) <sup>(a)</sup>	2.0	45.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	0.6	5.0
<i>Sporobolus cryptandrus</i> (sand dropseed)	0.03	1.0
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X
<i>Triticum sp.</i> (wheat) <sup>(a)</sup>	0.03	1.0
<i>Vulpia microstachys</i> (desert fescue)	0.1	2.0
Crust	0.0	1.0
Soil	36.9	95.0
Litter	40.0	100.0
Rock/Cobble	9.7	50.0
Unavailable Space	0.7	17.0
<b>Total Canopy Cover</b>	<b>37.3</b>	
<b>Total Native % Cover</b>	<b>15.5</b>	
Total Invasive % Cover	21.8	
Unadjusted canopy cover	37.1	
Unadjusted Native % Cover	15.4	
Change in Native % Cover from 2018	6.6	
Unadjusted Invasive % Cover	21.6	
Change in Invasive % Cover from 2018	9.3	

<sup>a</sup> Invasive species

X = present but not counted in plot frames



**Figure 55. The 200-East (L-525) Export Water Pipeline Site in 2019 Showing High Forb Diversity.**

### **1.9.3 200-East (L-419) Export Water Pipeline Site**

The 200-East (L-419) Export Water Pipeline site (Figure 56) was revegetated in FY 2018 and monitoring was first conducted for the site in 2018. This is a larger site that was divided into 5 areas for monitoring purposes with data collected from 20 plot frames in each area and 3 transects spaced along the site. Loamy sand is the predominant substrate at this site.

Three 100-m (328-ft) shrub monitoring transects with 5-m (16.4-ft) offsets to each side were established for the site in 2018. Second-year monitoring was conducted at this site in June 2019. Low shrub survival was recorded from 2018 to 2019. Using data from these three transects, an overall shrub density of 426 plants/ha (173 plants/ac) was recorded for the site, below success criteria of 600 plants/ha (240 plants/ac). Shrub survival averaged 23.3% from the initial planting.

Canopy cover data for the site was collected in May 2019. Average canopy cover for the site overall was 32.4%, with native cover representing 6.4% and invasive cover representing 26.0% (Table 61). Native cover has increased by 3.5% and invasive cover has increased by 2.7% since 2018. Eighteen native species were identified at this site in 2019. The dominant species at this site was cheatgrass (*Bromus tectorum*) with 16.1% cover. Russian thistle levels have decreased at this site from 20% to 4% from 2018 to 2019. The dominant native species at this site was Sandberg's bluegrass (*Poa secunda*) with 1.7% cover.

Second-year monitoring shows increasing canopy cover and a relatively high level of native species. Shrub density is below success levels. Continued monitoring of shrub density and close tracking of sagebrush recruits is necessary for this site to determine if sagebrush will reach successful shrub density levels.

**Table 61. Percent Canopy Cover and Frequency of Occurrence at the 200 East L-419 Waterline Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.5	20.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.1	5.0
<i>Artemisia tridentata</i> (big sagebrush)	1.0	15.0
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	0.1	5.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	16.1	100.0
<i>Bunchgrasses sp.</i> (multiple)	0.2	8.3
<i>Chaenactis douglasii</i> (Douglas' dustymaiden)	0.1	5.0
<i>Descurcania pinnata</i> (western tansymustard)	0.5	21.3
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.4	8.8
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.3	10.0
<i>Erigeron pumilus</i> (shaggy fleabane)	0.3	10.0
<i>Eriogonum niveum</i> (snow buckwheat)	0.4	17.0
<i>Grayia spinosa</i> (spiny hopsage)	0.1	5.0
<i>Hesperostipa comata</i> (needle-and-thread grass)	0.1	5.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.2	7.5
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	1.4	54.0
<i>Microsteris gracilis</i> (slender phlox)	0.1	5.0
<i>Oenothera pallida</i> (pale-evening primrose)	0.8	5.0
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	0.8	5.0
<i>Poa secunda</i> (Sandberg bluegrass)	1.7	41.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.3	13.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	4.0	86.0
<i>Sisymbrium altissimum</i> (tall tumbledmustard) <sup>(a)</sup>	2.9	66.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Triticum sp.</i> <sup>a</sup> (wheat)	0.1	5.0
Crust	0.0	0.0
Soil	36.9	93.0
Litter	50.7	100.0
Rock/Cobble	6.7	78.0
Unavailable Space	1.7	26.0
<b>Total Canopy Cover</b>	<b>32.4</b>	
<b>Total Native % Cover</b>	<b>6.4</b>	
Total Invasive % Cover	26.0	
Unadjusted canopy cover	31.9	
Unadjusted Native % Cover	6.3	
Change in Native % Cover from 2018	3.5	
Unadjusted Invasive % Cover	25.6	
Change in Invasive % Cover from 2018	2.7	

<sup>a</sup> Invasive species

X = present but not counted in plot frames



**Figure 56. The Export Water Pipeline Site (L-419) in 2019.**

#### **1.9.4 200-East (L-853/L-854) Export Water Pipeline Site**

The 200-East (L-853/L-854) Export Water Pipeline site (Figure 57) was revegetated in FY 2019 and monitoring was first conducted for the site in 2019. This is a larger site that was divided into 5 areas for monitoring purposes with data collected from 25 plot frames in each area and 3 transects spaced along the site. Substrate at this site is predominately loam with varying amounts of cobble.

Three 100-m (328-ft) shrub monitoring transects with 5-m (16.4-ft) offsets to each side were established for the site in 2019. First-year monitoring was conducted at this site in June 2019. Using data from these three transects, an overall shrub density of 843 plants/ha (341 plants/ac) was recorded for the site, above success criteria of 600 plants/ha (240 plants/ac). Average sagebrush (*Artemisia tridentata*) size at this site was 0.33 m (1.08 ft) by 0.22 m (0.72 ft).

Canopy cover data for the site was collected in May 2019. Average canopy cover for the site overall was 27.0%, with native cover representing 6.1% and invasive cover representing 20.9% (Table 62). Eighteen native species were identified at this site in 2019. The dominant species at this site was Russian thistle (*Salsola kali*) with 7.9% cover. The dominant native species at this site was Sandberg's bluegrass (*Poa secunda*) with 2.3% cover.

First-year monitoring shows successful shrub density levels and relatively high native species diversity. Continued monitoring is necessary to track the progress of this site.

**Table 62. Percent Canopy Cover and Frequency of Occurrence at the L-853/854 Waterline Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.7	15.2
<i>Artemisia tridentata</i> (big sagebrush)	0.1	5.6
<i>Artemisia tridentata</i> (recruits)	0.3	13.3
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	3.7	86.4
<i>Bunchgrass</i> sp. (multiple)	1.0	39.2
<i>Chenopodium leptophyllum</i> (narrowleaf goosefoot)	0.1	4.0
<i>Chorispora tenella</i> (crossflower) <sup>(a)</sup>	X	X
<i>Crepis atriobarba</i> (slender hawkbeard)	0.1	3.2
<i>Descurcania pinnata</i> (western tansymustard)	0.2	8.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	1.1	39.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.2	6.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.3	12.0
<i>Erigeron poliospermus</i> (cushion fleabane)	0.02	0.8
<i>Erigeron pumilus</i> (shaggy fleabane)	0.02	0.8
<i>Grayia spinosa</i> (spiny hopsage)	0.1	2.7
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.6	23.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	1.1	39.2
<i>Lamium amplexicaule</i> (henbit deadnettle) <sup>(a)</sup>	0.1	4.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.02	0.8
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	X	X
<i>Poa secunda</i> (Sandberg's bluegrass)	2.3	80.8
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.6	24.0
<i>Purshia tridentata</i> (antelope bitterbrush)	0.1	2.0
<i>Ranunculus testiculatus</i> (burr buttercup) <sup>(a)</sup>	0.2	9.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	7.9	88.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	5.9	83.2
<i>Triticum</i> sp. (wheat) <sup>(a)</sup>	0.3	6.0
<i>Vulpia microstachys</i> (desert fescue)	X	X
Crust	0.0	0.0
Soil	46.9	96.8
Litter	38.5	98.4
Rock/Cobble	4.0	44.8
Unavailable Space	0.6	15.2
<b>Total Canopy Cover</b>	<b>27.0</b>	
<b>Total Native % Cover</b>	<b>6.1</b>	
Total Invasive % Cover	20.9	
Unadjusted canopy cover	26.8	
Unadjusted Native % Cover	6.1	
Unadjusted Invasive % Cover	20.7	

<sup>a</sup> Invasive species

X = present but not counted in plot frames



**Figure 57. The L-853/L-854 Site in 2019.**

### **1.9.5 200-East (L-894) Export Water Pipeline Site**

The 200-East (L-894) Export Water Pipeline site (Figure 58) was revegetated in FY 2019 and monitoring was first conducted for the site in 2019. This is a larger site that was divided into 5 areas for monitoring purposes with data collected from 25 plot frames in each area and 3 transects spaced along the site. Substrate at this site is predominately loam with varying amounts of cobble.

Three 100-m (328-ft) shrub monitoring transects with 5-m (16.4-ft) offsets to each side were established for the site in 2019. First-year monitoring was conducted at this site in June 2019. Using data from these three transects, an overall shrub density of 1,679 plants/ha (680 plants/ac) was recorded for the site, above success criteria of 600 plants/ha (240 plants/ac). Average sagebrush (*Artemisia tridentata*) size at this site was 0.14 m (0.46 ft) by 0.08 m (0.26 ft) and average hopsage (*Grayia spinosa*) size was 0.19 m (0.62 ft) by 0.07 m (0.23 ft).

Canopy cover data for the site was collected in April 2019. Average canopy cover for the site overall was 11.1%, with native cover representing 5.2% and invasive cover representing 5.9% (Table 63). Twenty-one native species were identified at this site in 2019. The dominant species at this site were young bunchgrasses with 2.6% cover. The dominant invasive species at this site was cheatgrass (*Bromus tectorum*) with 1.8% cover.

*Kochia (Bassia scoparia)*, a Washington State Class B noxious weed, was detected at this site at less than 1% cover and occurred in 4% of plot frames.

First-year monitoring shows successful shrub density levels and relatively high native species diversity. Continued monitoring is necessary to track the progress of this site.

**Table 63. Percent Canopy Cover and Frequency of Occurrence at the L-894 Waterline Site in 2019  
(2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.2	8.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.3	11.2
<i>Artemisia tridentata</i> (big sagebrush)	0.2	9.6
<i>Artemisia tridentata</i> (recruit)	0.1	4.8
<i>Astragalus</i> sp. (milkvetch sp.)	0.1	0.8
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	X	X
<i>Bassia scoparia</i> (kochia) (B) <sup>(b)</sup>	0.1	68.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	2.6	90.4
Bunchgrasses (multiple)	0.1	4.0
<i>Calochortus macrocarpus</i> (sagebrush mariposa lily)	0.2	7.2
<i>Chenopodium leptophyllum</i> (narrowleaf goosefoot)	X	X
<i>Chorispota tenella</i> (crossflower) <sup>(a)</sup>	X	X
<i>Comandra umbellata</i> (bastard toadflax)	0.1	4.8
<i>Crepis atribarba</i> (slender hawksbeard)	0.0	0.8
<i>Cymopterus terebinthinus</i> (turpentine springparsley)	0.1	7.2
<i>Descurcania pinnata</i> (western tansymustard)	0.3	10.4
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	0.2	8.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.1	5.6
<i>Grayia spinosa</i> (spiny hopsage)	0.1	4.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.0	0.8
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	1.7	44.8
<i>Lamium amplexicaule</i> (henbit deadnettle) <sup>(a)</sup>	X	X
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.6	23.2
<i>Microsteris gracilis</i> (slender phlox)	0.1	2.4
<i>Oenothera caespitosa</i> (rockrose)	0.1	0.8
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	0.1	0.8
<i>Poa secunda</i> (Sandberg's bluegrass)	2.4	72.8
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.1	2.4
<i>Purshia tridentata</i> (antelope bitterbrush)	X	X
<i>Rumex crispus</i> (curly dock) <sup>(a)</sup>	X	X
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	1.1	43.2
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	0.1	0.8
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Triticum</i> sp. (wheat) <sup>(a)</sup>	X	X
Crust	0.0	0.0
Soil	49.4	97.6
Litter	43.8	100.0
Rock/Cobble	1.3	43.2
Unavailable Space	0.3	6.4
<b>Total Canopy Cover</b>	<b>11.1</b>	
<b>Total Native % Cover</b>	<b>5.2</b>	
Total Invasive % Cover	5.9	

Unadjusted canopy cover	11.1	
Unadjusted Native % Cover	5.2	
Unadjusted Invasive % Cover	5.9	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 58. The L-894 Site in 2019. Top: An Overview of the L-894 Site, Four Months After Planting. Bottom: A Young Hopsage Plant at the L-894 Site in 2019.**

## MONITORING RESULTS – LONG TERM TREND MONITORING SITES

As part of an effort to better understand long-term trends in revegetation site native and invasive cover, 12 older revegetation sites were monitored in 2018. These sites were planted between 2002 and 2007. Five of those 12 sites were identified as needing continued monitoring to track trends in vegetation cover, and those sites were monitored in 2019.

### 1.10 100 B/C AREA SITES

Two sites were monitored for long-term trend in the 100-B/C Area: 116-B/C Misc. and 128-C-1. These sites were planted from 2006 to 2007. Additional revegetation actions with the goal of increasing sagebrush abundance are scheduled for the 116-B/C Miscellaneous (116-B/C Misc.) and 100-C-9 areas in FY 2020.

#### 1.10.1 116-B/C Miscellaneous Site (Multiple WIDS Locations)

This site encompasses multiple Waste Information Data System (WIDS) sites in the northern 100-B/C Area. WIDS sites included in the 116-B/C Misc. site were the 116-B-11 site, the 116-C-5 site, the 100-C-6 site, the 100-B-8 site, and the 100-B-7 site. The majority of this area was revegetated in FY 2007 with a small section of the northern portion revegetated in FY 2000. The substrate at this site is a high amount of cobble and rock mixed with loam (Figure 59).

No initial monitoring data is available for these sites after they were planted in 2007. The representative site for this area and planting year is the 100-C-9 Site. The 100-C-9 had native cover of 18.4% and invasive cover of 21.4% in 2010 monitoring.

Canopy cover data for the site was collected in April 2019. Data was collected from 50 plot frames. Canopy cover for the site was 41.6%, with 25.6% native cover and 16.0% invasive cover (Table 64). This represents an increase of 3.6% in native cover and of 8.3% in invasive cover from 2018. The dominant native species was snow buckwheat (*Eriogonum niveum*) with 7.1% cover followed by Sandberg's bluegrass (*Poa secunda*) with 6.3% cover. The dominant invasive species was cheatgrass (*Bromus tectorum*) with 8.6% cover. Eleven native species were recorded at this site, five of which were native forbs.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed at this site at less than 1% cover and was detected in 20% of plot frames.

Compared to 2010 data for 100-C-9, the representative revegetation site for FY 2007 plantings in the B/C Area, the 116-B/C Misc. site had improved over the last 9 years. Native cover had increased to successful levels, invasive cover has decreased since 2007, and biotic crust has increased. It is expected this site will continue to improve. Continued long-term monitoring is not necessary for this site.

**Table 64. Percent Canopy Cover and Frequency of Occurrence at the 116-B/C Miscellaneous Site in 2019.**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	5.6	16.0
<i>Artemisia tridentata</i> (big sagebrush) (recruits)	X	X
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	0.1	2.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	8.6	100.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	0.8	20.0
<i>Descurcania pinnata</i> (western tansymustard)	X	X
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	1.2	46.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	4.2	30.0
<i>Erigeron pumilus</i> (shaggy fleabane)	0.2	8.0
<i>Eriogonum niveum</i> (snow buckwheat)	7.1	52.0
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	1.2	26.0
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	1.8	72.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.3	12.0
<i>Poa bulbosa</i> (bulbous bluegrass) <sup>(a)</sup>	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	6.3	82.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.9	8.0
<i>Ranunculus testiculatus</i> (burr buttercup) <sup>(a)</sup>	0.1	2.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	0.9	36.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	0.4	16.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	0.1	4.0
Crust	11.6	92.0
Soil	7.6	88.0
Litter	12.8	100.0
Rock/Cobble	64.2	100.0
Unavailable Space	3.7	60.0
<b>Total Canopy Cover %</b>	<b>41.6</b>	
<b>Native Cover %</b>	<b>25.6</b>	
Invasive Cover %	16.0	
Unadjusted Canopy Cover	39.3	
Unadjusted Native % Cover	24.2	
Change in Native Cover from 2018	3.6	
Unadjusted Invasive % Cover	15.2	
Change in Invasive % Cover from 2018	8.3	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 59. Overview of the 116-B/C Misc. Site in 2019.**

### **1.10.2 128-C-1 Site (Burn Pit)**

The 128-C-1 site was revegetated in FY 2006. The 128-C-1 site was backfilled to grade with pit-run cobble and broadcast seeded with a native grass seed mix that included Sandberg's bluegrass (*Poa secunda*), needle-and-thread grass (*Hesperostipa comata*), Indian Ricegrass (*Achnatherum hymenoides*), bluebunch wheatgrass (*Pseudoroegneria spicata*), thickspike wheatgrass (*Elymus lanceolatus*), and prairie junegrass (*Koeleria macrantha*). Triple-16 fertilizer and polyacrylamide was applied with the grass seed along with 4.5 metric tons/ha (4 tons/ac) of straw mulch. The site was planted with sagebrush (*Artemisia tridentata*) and spiny hopsage (*Grayia spinosa*) seedlings at a rate of 96% and 4%. The substrate at this site is pit-run cobble backfill.

Canopy cover monitoring was performed at the 128-C-1 site in 2010, 5 years after planting (Figure 60). At the time of 2010 monitoring, total canopy cover was 41.0%, made up of 19.7% invasive and 21.3% native species. Sagebrush had a cover of 0.8%. Sandberg's bluegrass was the most abundant native species with 17.7% cover followed by bluebunch wheatgrass at 1.2% cover. The most abundant invasive species was cheatgrass (*Bromus tectorum*) with a cover of 15.5%. Biotic crust had a cover of 0.7%. Twelve native species were recorded in 2010.

Canopy cover data for this site was collected for a second year of long-term monitoring in April 2019 (Figure 61). Data was collected from 25 plot frames. Canopy cover for the site was 32.0%, with 19.2% native cover and 12.7% invasive cover (Table 65). This represents an increase in native cover of 2.6% and an increase in invasive cover of 0.7% since 2018. The dominant native species were Sandberg's bluegrass (*Poa secunda*) with 6.3% cover and sagebrush (*Artemisia tridentata*) with 5.5% cover. The dominant invasive species was cheatgrass (*Bromus tectorum*) with 6.0% cover. Ten native species were recorded in 2019.

Diffuse knapweed (*Centaurea diffusa*) and rush skeletonweed (*Chondrilla juncea*), both Washington State Class B noxious weeds, were observed at this site at less than 1% cover.

At the time of 2019 monitoring, this site was 13 years old. Native cover and invasive cover had both decreased since 2010 monitoring, but native cover measured in 2019 was higher than the native cover measured in 2018. This site shifted from being dominated by grasses in 2010 to being dominated by sagebrush. Cheatgrass decreased at this site, from 15.5% in 2010 to 6.0% in 2019. Biotic crust cover has increased from 0.7% in 2010 to 6.9% in 2019. Though the native cover at this site is not yet successful, vegetative composition at this site indicates it is a healthy site that is resistant to invasion by cheatgrass with growing native cover.

**Table 65. Percent Canopy Cover and Frequency of Occurrence at the 128-C-1 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.1	4.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.2	8.0
<i>Artemisia tridentata</i> (big sagebrush)	5.5	12.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	6.0	100.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	0.2	8.0
<i>Chondrilla juncea</i> (rush skeletonweed) (B) <sup>(b)</sup>	X	X
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	2.1	64.0
<i>Elymus elymoides</i> (squirreltail)	0.6	4.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.1	4.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	4.9	24.0
<i>Erigeron pumilus</i> (shaggy fleabane)	0.1	4.0
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	0.1	4.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.8	32.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	1.5	40.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.1	4.0
<i>Poa secunda</i> (Sandberg bluegrass)	6.3	92.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.7	8.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	1.3	52.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	0.3	12.0
Crust	6.9	80.0
Soil	3.1	68.0
Litter	18.4	100.0
Rock/Cobble	72.1	96.0
Unavailable Space	3.3	52.0
<b>Total Canopy Cover %</b>	<b>32.0</b>	
<b>Native Cover %</b>	<b>19.2</b>	
Invasive Cover %	12.7	
Unadjusted Canopy Cover	30.9	
Unadjusted Native % Cover	18.6	

Change in Native Cover from 2018	2.6	
Unadjusted Invasive % Cover	12.3	
Change in Invasive % Cover from 2018	0.7	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 60. The 128-C-1 Site in 2010.**



**Figure 61. The 128-C-1 Site in 2019.**

### **1.11 100-K AREA SITES**

One site was surveyed in the 100-K Area: 116-K-1. The 116-K-1 site was planted in February and March 2006, notably late in the planting season. The sites were broadcast seeded with a native grass seed mix that included Sandberg's bluegrass (*Poa secunda*), needle-and-thread grass (*Hesperostipa comata*), Indian ricegrass (*Achnatherum hymenoides*), bluebunch wheatgrass (*Pseudoroegneria spicata*), thickspike wheatgrass (*Elymus lanceolatus*), and prairie junegrass (*Koeleria macrantha*). Triple-16 fertilizer and polyacrylamide was applied with the grass seed along with 4.5 metric tons/ha (4,015 lb/ac) of straw mulch. The site was planted with sagebrush (*Artemisia tridentata*) and spiny hopsage (*Grayia spinosa*) seedlings at a rate of 98.5% and 1.5%. The substrate at this site is pit-run cobble backfill. The 116-K-2 site, which shares a border with the 116-K-1 site, was monitored for 4 years and is the representative site for this area and planting year.

#### **1.11.1 116-K-1 Site (100-K Crib)**

The 116-K-2 site is the representative site for the adjacent 116-K-1 site; 116-K-2 was not monitored. Both sites were revegetated in FY 2006. The 116-K-1 site is located on the northwestern end of the 116-K-2 site. The 116-K-2 site is about a mile long and was segmented into four areas for monitoring. The most representative area of 116-K-2 to 116-K-1 is Transect 1 (T1) of the monitoring area; this is what the 116-K-1 2018 data was compared to.

Canopy cover monitoring was performed at the 116-K-2 site in 2009, 4 years after planting. At the time of 2009 monitoring, total canopy cover was 61.5%, made up of 19.7% invasive and 41.8% native species. Bluebunch wheatgrass (*Pseudoroegneria spicata*) was the most abundant

native species with 32.5% cover followed by Sandberg's bluegrass (*Poa secunda*) at 6.5% cover. The most abundant invasive species was cheatgrass (*Bromus tectorum*) with a cover of 12.8%. Biotic crust had a cover of 8.3%. Nine native species were recorded in 2009. Shrubs recorded at T1 had a 68% survival rate; however, the total number of shrubs planted at this site is not known so density cannot be calculated.

Canopy cover data for the site was collected again in April 2019 (Figure 62). Data was collected from 25 plot frames. Canopy cover for the site was 54.9%, with 40.9% native cover and 13.9% invasive cover (Table 66). This represents a 19.0% increase in native cover from 2018, and a 7.3% decrease in invasive cover since 2018. The dominant native species were Sandberg's bluegrass at 18.9% cover and rubber rabbitbrush (*Ericameria nauseosa*) with 12.6% cover. Cheatgrass (*Bromus tectorum*) and diffuse knapweed (*Centaurea diffusa*) were the dominant invasive species for the site, both with 3.0% cover. Biotic crust cover measured 23.7%. Twelve native species were recorded in 2019.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed at this site at 3.0% cover and was detected in 40% of plot frames. Treatment of diffuse knapweed is highly recommended at this site. Rush skeleton weed (*Chondrilla diffusa*), a Washington State Class B noxious weed, was observed at this site at less than 1% cover.

At the time of 2019 monitoring, this site was 13 years old. Native cover at this site has increased significantly since 2018 monitoring, and 40.9% native cover measured in 2019 is close to the 41.8% native cover measured in 2009. Rather than bluebunch wheatgrass being the abundant native species, rubber rabbitbrush and Sandberg's bluegrass are the dominant species. Biotic crust levels are high at this site and have increased since 2009. High native species diversity and biotic crust levels both suggest this site will have resistance to further invasion by weeds like cheatgrass and that this site is relatively stable.

**Table 66. Percent Canopy Cover and Frequency of Occurrence at the 116-K-1 Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.6	4.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	0.6	4.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	3.0	100.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	3.0	40.0
<i>Chondrilla juncea</i> (rush skeletonweed) (B) <sup>(b)</sup>	X	X
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	2.8	92.0
<i>Elymus elymoides</i> (squirreltail)	X	X
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	12.6	60.0
<i>Erigeron pumilus</i> (shaggy fleabane)	0.1	4.0
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	0.1	4.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	1.9	76.0

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<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.1	4.0
<i>Leymus cinereus</i> (basin wildrye)	0.1	4.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.2	8.0
<i>Microsteris gracilis</i> (slender phlox)	0.1	4.0
<i>Poa secunda</i> (Sandberg bluegrass)	18.9	100.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	2.6	24.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	1.2	48.0
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	0.1	4.0
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X
Crust	23.7	100.0
Soil	1.9	20.0
Litter	11.2	96.0
Rock/Cobble	41.5	100.0
Unavailable Space	12.5	96.0
<b>Total Canopy Cover %</b>	<b>54.9</b>	
<b>Native Cover %</b>	<b>40.9</b>	
Invasive Cover %	13.9	
Unadjusted Canopy Cover	48.0	
Unadjusted Native % Cover	35.8	
Change in Native Cover from 2018	19.0	
Unadjusted Invasive % Cover	12.2	
Change in Invasive % Cover from 2018	-7.3	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 62. The 116-K-1 Site in 2019.**

## 1.12 100 N AREA SITES

The 116-N-3 site was monitored in the 100-N Area for long-term trend. This site was planted in FY 2005.

### 1.12.1 116-N-3 Site (1325-N Crib and Trench)

The 116-N-3 site stretches through an area known as the *Mooli Mooli* to local Native American Tribes and is a significant area to religion, traditions, and cultural heritage. When the 116-N-3 trench was ready for remediation, it was backfilled and recontoured to restore the removed portions of *Mooli Mooli*. Revegetation activities took place in FY 2005.

The site was broadcast seeded with a native grass seed mix that included Sandberg's bluegrass (*Poa secunda*), needle-and-thread grass (*Hesperostipa comata*), Indian ricegrass (*Achnatherum hymenoides*), bluebunch wheatgrass (*Pseudoroegneria spicata*), thickspike wheatgrass (*Elymus lanceolatus*), and prairie junegrass (*Koeleria macrantha*). Triple-16 fertilizer was applied with the grass seed along with 4.5 metric tons/ha (4,015 lb/ac) of straw mulch. The site was planted with sagebrush (*Artemisia tridentata*) and spiny hopsage (*Grayia spinosa*) seedlings. There were 13,050 shrubs (11,500 sagebrush and 1,550 spiny hopsage).

Shrub survival information is not included in the available reports. Canopy cover monitoring in 2008 showed 44.7% native and 27.8% invasive species coverage (Figure 63). Sandberg's bluegrass (*Poa secunda*) made up the majority of the native coverage at 33.0% cover followed by bluebunch wheatgrass (*Pseudoroegneria spicata*) with 9.9% cover. Cheatgrass (*Bromus tectorum*) was the dominant invasive species with 20.3% cover followed by Russian thistle (*Salsola kali*) with 4.2% cover. Sagebrush (*Artemisia tridentata*) was seen on the site but not recorded in any of the plot frames. Biotic crust cover measured 0%. Nine native species were recorded at this site in 2009.

Canopy cover data for this site was collected again in May 2018 and in April 2019 (Figure 64). Data was collected from 25 plot frames. Canopy cover for the site totaled 60.4% with 32.1% native cover and 27.6% invasive cover. Native cover increased by 15.8% since 2018 monitoring and invasive cover decreased by 2.3%. The dominant native species was bluebunch wheatgrass (*Pseudoroegneria spicata*) with 11.9% cover followed by Sandberg's bluegrass (*Poa secunda*) with 11.0% cover. The dominant invasive species was cheatgrass (*Bromus tectorum*) with 12.8% cover. Biotic crust measured 8.9%. Twelve native species were recorded at this site in 2019.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed at this site at 2.4% cover and was detected in 36.0% of plot frames. Rush skeleton weed (*Chondrilla diffusa*), a Washington State Class B noxious weed, was observed at this site but was not detected in any plot frames.

At the time of 2019 monitoring, this site was 14 years old. Native cover is past successful levels due to heavy cover of bunchgrasses. Invasive cover has remained around 27% since 2008. Both native species diversity and biotic crust cover have increased since 2008. This suggests this site will continue to improve.

**Table 67. Percent Canopy Cover and Frequency of Occurrence at the 116-N-3 Site in 2019.**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Achnatherum hymenoides</i> (Indian ricegrass)	X	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	X	X
<i>Artemisia tridentata</i> (recruits)	0.6	4.0
<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	12.8	100.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	2.4	36.0
<i>Chondrilla juncea</i> (rush skeletonweed) (B) <sup>(b)</sup>	X	X
<i>Digitaria</i> sp. (crabgrass sp.) <sup>(a)</sup>	0.6	4.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	3.9	76.0
<i>Elymus elymoides</i> (squirreltail)	0.6	4.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.1	4.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	3.8	32.0
<i>Eriogonum vimineum</i> (wickerstem buckwheat)	X	X
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	0.2	8.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	1.2	48.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	1.5	60.0
<i>Poa secunda</i> (Sandberg bluegrass)	11.0	88.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	11.9	68.0
<i>Salsola kali</i> (Russian thistle) <sup>(a)</sup>	1.0	40.0
<i>Salvia dorrii</i> (grayball sage)	X	X
<i>Sisymbrium altissimum</i> (tall tumbled mustard) <sup>(a)</sup>	X	X
<i>Sporobolus cryptandrus</i> (sand dropseed)	X	X
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X
Crust	8.9	80.0
Soil	1.0	20.0
Litter	15.6	56.0
Rock/Cobble	28.6	96.0
Unavailable Space	14.6	100.0
<b>Total Canopy Cover %</b>	<b>60.4</b>	
<b>Native Cover %</b>	<b>32.1</b>	
Invasive Cover %	27.6	
Unadjusted Canopy Cover	51.6	
Unadjusted Native % Cover	27.4	
Change in Native Cover from 2018	15.8	
Unadjusted Invasive % Cover	23.6	
Change in Invasive % Cover from 2018	-2.3	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 63. Bluebunch Wheatgrass Growing at the 116-N-3 Site in 2009.**



**Figure 64. Overview of the 116-N-3 Site in 2019.**

**1.13 300 AREA SITES**

The 316-1/300 RFBP site was revegetated in FY 2004 and monitored for long-term trend in 2018 and 2019. This site was broadcast seeded with a grass seed mix that included crested wheatgrass (*Agropyron cristatum*), Regreen (*Agropyron* hybrid), needle-and-thread grass (*Hesperostipa comata*), Indian ricegrass (*Achnatherum hymenoides*), bluebunch wheatgrass (*Pseudoroegneria spicata*), and thickspike wheatgrass (*Elymus lanceolatus*). Terra Bond (water retaining crystals) were applied during seeding at a rate of 16.8 kg/ha (15 lb/ac), and straw mulch was spread over the seed to prevent wind erosion.

**1.13.1 316-1 Site / 300 RFBP Site (300 Area South Process Pond)**

The 316-1 and 300 RFBP sites were revegetated as one unit in FY 2004 and no sagebrush (*Artemisia tridentata*) was planted at this site. The substrate at this site is sandy.

Canopy cover data was collected for the 300-FF-1 Operable Unit in 2006, after 3 years of growth (Figure 65). Canopy cover averaged 50.2%, with 18.6% native cover and 31.6% invasive cover. The most abundant native species was Sandberg’s bluegrass (*Poa secunda*) with 9.4% cover followed by bluebunch wheatgrass with 7.6% cover. The most abundant invasive species was cheatgrass (*Bromus tectorum*) with 16.9% cover. Biotic crust had a cover of 0.8%. Twenty-four native species were recorded during this monitoring.

Canopy cover data for the 316-1 site was collected in June 2018 and again in April 2019 (Table 68). Data was collected from 25 plot frames. Canopy cover for the site was 48.5%, made up of 27.6% native and 20.9% invasive cover. This represents an increase of 13.3% in native cover and a decrease of 7.8% in invasive cover. The dominant native species was Sandberg’s bluegrass (*Poa secunda*) with 14.9% cover followed by bluebunch wheatgrass (*Pseudoroegneria spicata*) with 7.6% cover. The dominant invasive species was cheatgrass (*Bromus tectorum*) with 7.3% cover. Biotic crust measured 32.5%. Nine native species were detected at this site in 2019.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed at this site with 1.9% cover and occurred in 16% of plot frames.

At the time of 2019 monitoring, this site was 15 years old (Figure 66). Native cover has increased and invasive cover has decreased since 2006. Biotic crust levels have also increased. Few sagebrush are present at this site and the overstory is dominated by rubber rabbitbrush. This site exceeds success criteria and is expected to remain stable.

**Table 68. Percent Canopy Cover and Frequency of Occurrence at the 316-14/300 RFBP Site in 2019 (2 Pages).**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefollium</i> (common yarrow)	X	X
<i>Agropyron cristatum</i> (crested wheatgrass) <sup>(a)</sup>	4.2	16.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.7	8.0
<i>Artemisia tridentata</i> (big sagebrush)	X	X

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<i>Bromus tectorum</i> (cheatgrass) <sup>(a)</sup>	7.3	100.0
<i>Centaurea diffusa</i> (diffuse knapweed) (B) <sup>(b)</sup>	1.9	16.0
<i>Draba verna</i> (spring draba) <sup>(a)</sup>	1.8	32.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	2.7	28.0
<i>Erodium cicutarium</i> (redstem stork's bill) <sup>(a)</sup>	3.9	96.0
<i>Festuca sp.</i> (fescue)	1.3	12.0
<i>Holosteum umbellatum</i> (jagged chickweed) <sup>(a)</sup>	0.8	32.0
<i>Lactuca serriola</i> (prickly lettuce) <sup>(a)</sup>	0.7	28.0
<i>Lepidium latifolium</i> (broadleaved pepperweed) (B) <sup>(a)</sup>	0.1	4.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.2	8.0
<i>Melilotus officinalis</i> (sweet clover) <sup>(a)</sup>	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	14.9	92.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	7.6	52.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Tragopogon dubius</i> (yellow salsify) <sup>(a)</sup>	X	X
Crust	32.5	100.0
Soil	26.8	96.0
Litter	30.7	100.0
Rock/Cobble	7.1	88.0
Unavailable Space	0.9	36.0
<b>Total Canopy Cover %</b>	<b>48.5</b>	
<b>Native Cover %</b>	<b>27.6</b>	
Invasive Cover %	20.9	
Unadjusted Canopy Cover	48.1	
Unadjusted Native % Cover	27.4	
Change in Native Cover from 2018	13.3	
Unadjusted Invasive % Cover	20.7	
Change in Invasive % Cover from 2018	-7.8	

<sup>a</sup> Invasive species

<sup>b</sup> Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



**Figure 65. Revegetated Process Ponds in the 300-FF-1 Operable Unit (2006).**



**Figure 66. The 316-1 / 300 RFBP Site in 2019.**

## DISCUSSION

### 1.14 5-YEAR MONITORING SITES

Revegetation of remediated and disturbed sites on the Hanford Site is performed to support the U.S. Department of Energy, Richland Operations Office's goal of meeting cleanup and revegetation requirements mandated in the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*. Revegetation and monitoring activities of remediated and disturbed sites on the Hanford Site are conducted in accordance with the *Hanford Site Revegetation Manual* (DOE/RL-2011-116), area specific revegetation plans (DOE/RL-96-17, Rev. 6, Appendix H, DOE/RL-2005-93, Rev. 1, Appendix G, and DOE/RL-2001-47, Rev. 3, Appendix C); as well as other area and/or site-specific guidance such as Mitigation Action Plans and Memorandums of Agreement.

Landscapes within semi-arid climates take decades or even centuries to reestablish naturally to functional and sustainable ecosystems after disturbances. The Hanford Site presents many challenges to revegetation efforts due to its complex shrub-steppe ecosystem, decades of natural and anthropogenic disturbances, widespread invasive species (e.g., cheatgrass, *Bromus tectorum* and Russian thistle, *Salsola kali*), and limited fill material that often has a high percentage of rock (gravel and cobbles). It is also important to realize that habitats within a landscape may differ significantly from one another. Not all plants grow in the same soil or climatic conditions. A prescription that is successful for one site may not work for another. Factors such as substrate, moisture, adjacent topography and species composition, prescribed species and application rates, seasonal timing for planting, annual precipitation, and proper planting and seeding techniques all influence the success of a particular revegetation site.

MSA is responsible for monitoring and evaluating Hanford Site revegetation sites previously restored by the RCCC and CHPRC within areas that have transitioned to MSA, and for monitoring restoration areas associated with site reliability projects implemented by MSA. MSA's goal through revegetation monitoring is to ensure the success of the restoration process. As described in this report, this is accomplished by conducting annual monitoring of representative revegetated sites to provide quantitative data (shrub density and canopy cover percentages) that can be used to evaluate trends, individual site success or failure, and provide insight regarding the effectiveness of different planting strategies for different conditions. Sites that are not meeting the prescribed success criteria are evaluated to determine if additional revegetation efforts need to be implemented to achieve success.

A total of 48 revegetated sites were monitored during routine 5-year monitoring by MSA in 2019 (Table 69). Ten of these sites (100-F-47, 100-F-48, 118-F-1, 118-F-6, 100-F-CTA, 100-F Trailer Village, 118-F-5, 100-F-57, 100-F-26, 118-F-3) had additional revegetation actions implemented in the winter of FY 2018; eight of those were completely reworked and two had supplemental shrub plantings to increase shrub density. An additional 13 sites (100-C-7, 116-C-5, 100-K-95, 100-K-CTA, 128-K-2 SSA, 128-D-2, 628-3, 600-301, 600-100, 600-120, 600-370, 600-356, 600-358) had additional revegetation actions implemented in the winter of FY 2019; 7 of these were completely reworked, 5 had supplemental shrub plantings, and 1 was seeded via an ATV. These sites had been identified as needing additional revegetation actions in previous monitoring based on representative sites in the area that had failed the prescribed success criteria. Different revegetation methods were employed at these sites and the success of these different methods

will be tracked throughout the 5-year monitoring period. Future monitoring at these sites will provide valuable information both about the success of different revegetation methods and about the effectiveness of these additional revegetation actions.

The remaining 25 revegetated sites had no additional revegetation actions and were monitored with routine 5-year monitoring. Monitoring for each site entailed documentation of native shrubs (sagebrush [*Artemisia tridentata*], antelope bitterbrush [*Purshia tridentata*] and spiny hopsage [*Grayia spinosa*]) within established transect areas and documentation of native and invasive canopy cover percentages, as well as frequency of occurrence for each species observed on the site. For each site monitored, these data were evaluated against the success criteria of 600 plants/ha (240 plants/ac) for native shrub density and 25% native cover (shrubs, grasses, forbs combined).

Of the 48 revegetated sites, 9 did not have shrub transects, either due to the site being too small or they did not have transects established during the first year of growth. Twenty-six of the 39 sites monitored for shrub density are currently meeting the shrub density success criteria of over 600 plants/ha (240 plants/ac). Additional revegetation actions designed to increase shrub density are recommended at the 13 failing sites, and four sites have been scheduled for supplemental plantings in the winter of FY 2020.

All 48 sites were monitored for native canopy cover. Average cover at all 5-year monitoring sites was 15.2%. Of the 48 sites, 3 had successful shrub cover (6.3%). Compared to the long-term trend sites, where 80% had successful cover, this is low. In addition, first-year monitoring sites had an average native cover of 10.3%, while fifth-year monitoring sites had an average native cover of 21.3%. These two trends suggest that native cover improves to successful levels over time.

The *Unavailable Space* measurement used when determining ground cover was used in 2019, following a recommendation after 2018 monitoring. This measurement determined what percentage of the site was actually available for seeds to germinate and grow. Inclusion of this measure improved the accuracy of canopy cover calculations by only considering areas where plants could grow. This measurement slightly increased canopy cover measurements in most sites and will be used in future monitoring.

Washington State-listed noxious weeds were observed on 39 of the 48 sites monitored in 2019. Diffuse knapweed (*Centaurea diffusa*), a Class B noxious weed, was the most common weed observed on revegetation sites. Noxious weed treatment occurs on an ongoing basis at revegetation sites and those with high infestations are prioritized.

**Table 69. The 2019 5-Year Revegetation Monitoring Summary (4 Pages)**

Site	Year Planted	Monitoring Year	Shrub Density (goal >240 plants/ac)	Native Canopy Cover % (goal >25)	Change in % Native Canopy Cover	Recommendations/ Notes
<b>B/C Area Sites</b>						
100-C-7	FY 2014, FY 2019 (A)	6	269 (2018)	15.7	+ 3.9	Continue to monitor.
Pit 24 (Upland)	FY 2015	5	251	22.1	+ 8.1	Continue noxious weed treatment.
100-B-35	FY 2016	4	279	17.8	+ 7.2	Continue to monitor.
116-C-5	FY 2007, FY 2019 (R)	1	N/A	11.5	N/A	Continue to monitor.
<b>K Area Sites</b>						
100-K-95	FY 2014, FY 2019 (R)	1	295	7.6	+ 2.4	Continue to monitor.
100-K-CTA	FY 2015, FY 2019 (R)	1	334	10.4	+ 2.8	Continue to monitor.
128-K-2 SSA	FY 2013, FY 2019 (S)	7	413	27.3	+ 13.2	Continue to monitor forb survival.
<b>N Area Sites</b>						
130-N-1:1	FY 2015	5	239	22.5	+ 10.4	Supplemental shrub planting scheduled for FY 2020.
100-N-96	FY 2016	4	140	19.3	+ 9.7	ATV seeding and shrub planting scheduled for FY 2020.
100-N-83	FY 2017	3	295	12.5	+ 5.4	Continue to monitor.
100-N CTA	FY 2017	3	176	23.2	+ 10.7	Supplemental shrub planting scheduled for FY 2020.
100-N-61:1	FY 2015	2	N/A	18.9	+ 7.9	Continue to monitor.
<b>D Area Sites</b>						
100-D-30/104	FY 2015	5	310	21.9	+ 9.6	Positive trend, monitoring complete.
100-D-100	FY 2016	4	357	13.6	+ 5.1	Continue to monitor.

**Table 69. The 2019 5-Year Revegetation Monitoring Summary (4 Pages)**

Site	Year Planted	Monitoring Year	Shrub Density (goal >240 plants/ac)	Native Canopy Cover % (goal >25)	Change in % Native Canopy Cover	Recommendations/ Notes
100-D Trailer Village	FY 2017	3	142	20.1	+ 16.2	Supplemental planting recommended.
100-D-48:2	FY 2015	2	N/A	31.9	+ 10.3	Positive trend, monitoring complete.
100-D-49:2	FY 2015	2	N/A	20.1	+ 5.4	Positive trend, monitoring complete.
128-D-2	FY 2011, FY 2019 (R)	1	445	12.5	N/A	Continue to monitor.
628-3	FY 2011, FY 2019 (R)	1	295	14.2	N/A	Continue to monitor.
<b>H Area Sites</b>						
100-H-28:2	FY 2016	4	212	22.9	+ 9.2	Supplemental planting recommended.
600-385	FY 2017	3	178	27.8	+ 6.6	Supplemental shrub planting scheduled for FY 2020.
100-H-24	FY 2015	2	N/A	21.4	+ 5.5	Continue to monitor.
116-H-1	FY 2016	2	N/A	14.0	+ 4.4	Continue to monitor.
<b>F Area Sites</b>						
100-F-47	FY 2012, FY 2018 (R)	2	684	23.1	+ 10.0	Continue to monitor.
118-F-1	FY 2008, FY 2018 (R)	2	328	9.5	+ 0.4	Continue to monitor.
118-F-6	FY 2009, FY 2018 (R)	2	219	6.3	- 0.7	Continue to monitor.
100-F-26	FY 2008, FY 2018 (R)	2	268	8.3	+ 4.3	Continue to monitor.
118-F-3	FY 2008, FY 2018 (R)	2	166	13	+ 6.2	Continue to monitor.

**Table 69. The 2019 5-Year Revegetation Monitoring Summary (4 Pages)**

Site	Year Planted	Monitoring Year	Shrub Density (goal >240 plants/ac)	Native Canopy Cover % (goal >25)	Change in % Native Canopy Cover	Recommendations/ Notes
100-F-57	FY 2009, FY 2018 (R)	2	777	7.8	- 3.1	Continue to monitor.
100-F-CTA	FY 2012, FY 2018 (R)	2	227	8.0	+ 0.5	Continue to monitor.
100-F Trailer Village	FY 2013, FY 2018 (R)	2	243	6.6	+ 1.8	Continue to monitor.
118-F-5	FY 2008, FY 2018 (R)	2	91	9.2	+ 5.1	Continue to monitor.
<b>600 Area Sites</b>						
600-301	FY 2014, FY 2019 (R)	1	490	17.9	+ 4.7	Continue to monitor.
600-100	FY 2011, FY 2019 (S)	1	360	13.8	- 4.5	Continue to monitor.
600-120	FY 2012, FY 2019 (S)	1	235	21.6	+ 8.4	Continue to monitor.
600-370	FY 2014, FY 2019 (S)	6	393	9.3	- 2.2	Continue to monitor.
600-356	FY 2015, FY 2019 (R)	1	587	8.3	+ 0.8	Continue to monitor.
600-358	FY 2016, FY 2019 (S)	4	293	14.9	+ 5.9	Continue to monitor.
600-379	FY 2015	5	N/A	11.8	+ 6.8	Additional revegetation actions recommended.
<b>300 Area Sites</b>						
300-288:2	FY 2017	3	249	29.4	+ 14.5	Continue to monitor.
300-North A,B,C,D	FY 2013	2	N/A	16.0	+ 3.1	Supplemental planting recommended.

**Table 69. The 2019 5-Year Revegetation Monitoring Summary (4 Pages)**

Site	Year Planted	Monitoring Year	Shrub Density (goal >240 plants/ac)	Native Canopy Cover % (goal >25)	Change in % Native Canopy Cover	Recommendations/ Notes
618-2 & 3	FY 2016	2	N/A	13.8	+ 5.8	Supplemental planting recommended.
618-10	FY 2019	1	381	9.6	N/A	Continue to monitor.
<b>200 Area Sites</b>						
L-840	FY 2017	3	2786	24.8	+ 14.2	Continue to monitor.
L-525	FY 2017	3	70	15.5	+ 6.6	Continue to monitor. Consider additional supplemental revegetation activities.
L-419	FY 2018	2	173	6.4	+ 3.5	Continue to monitor. Consider additional supplemental revegetation activities.
L-853 / L-854	FY 2019	1	341	6.1	N/A	Continue to monitor.
L-894	FY 2019	1	680	5.2	N/A	Continue to monitor.

A = Seeded via ATV

R = Revegetation Work Redone

S = Supplemental Planting

### 1.15 LONG-TERM TREND SITES

DOE/RL-2011-116, *Hanford Site Revegetation Manual*, makes a distinction between fifth-year success criteria and “Desired Future Condition” for revegetation sites. This distinction is important as restoration sites will not have reached a mature state after 5 years. Fifth-year success criteria lists target shrub survival as 600 plants/ha (240 plants/ac), perennial grass cover as 10%, and seeded forb/legume cover as 2 plants/m<sup>2</sup> (0.2 plants/ft<sup>2</sup>). “Desire Future Condition” lists desirable native plant cover for each soil type at some point in the undefined future, broken down by shrub, perennial grass, and forb cover. A cover of 25% native plants is listed in DOE/RL-2011-116 as a “Desired Future Condition,” not as a condition that defines success after 5 years. No 5-year success criteria concerning total native plant cover is listed in the Manual.

The criteria requiring total canopy cover of greater than 25% for native plants after 5 years is found in the 100 Area RDR/RAWP (DOE/RL-96-17, Appendix H); DOE/RL-2005-93, *Remedial Design Report/Remedial Action Work Plan for the 100-N Area*, (Appendix G); and DOE/RL-2001-47, *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (Appendix C). These documents state if this is not achieved the cause should be identified and rectified with

additional plantings, fertilization, irrigation, or soil amendments, as applicable. Rectifying an unsuccessful revegetation site requires many resources, is expensive, and there is no guarantee it will be more successful. Identifying the cause of site failure is unlikely, as variables such as precipitation, freezing, hot temperatures, planting time, plant quality, seeding techniques, soil quality, seed quality, site topography, non-native species invasion, and many other factors may interact at the time of planting and for years after planting. Additionally, as the revegetation services contractor changes, site-specific planting techniques, seeding rates, and seed mixes have been lost. Without this information and without being able to discern the exact cause(s) of site failures, successfully rectifying an unsuccessful site presents quite a challenge. The timetable of reaching 25% cover after 5 years and before the site is fully mature presents the question – Is it more effective to rectify unsuccessful plantings or to not intervene and wait for natural processes to take place?

In order to provide an answer to this question, starting in 2018 MSA performed long-term trend monitoring of revegetation sites planted 10 to 16 years ago. The goal of this effort was to characterize the native canopy cover of sites past their fifth year of growth. These results would be used to determine if sites had successful native canopy cover past their final year of monitoring. In 2018, 12 revegetation sites planted from 2002 to 2007 were monitored to determine revegetation success after 10 to 16 years of growth. Five of these revegetation sites were identified as needing further monitoring and were monitored in 2019: 116-B/C Misc. (FY 2007), 128-C-1 (FY 2005), 116-K-1 (FY 2006), 116-N-3 (FY 2005), and 316-1/300 RFBP (FY 2004).

Canopy cover was measured to determine total native cover, invasive cover, native species diversity, the ratio of native to invasive species cover, and dominant native species at the sites. Data collected from older revegetation sites may show that sites trend towards success in the long term, or may indicate that without intervention, unsuccessful sites will not improve in this time period. These data will be used to inform future revegetation efforts, especially intervention efforts at unsuccessful sites.

One of the challenges that was encountered when analyzing historic data from long-term trend sites was interpreting vast differences in plant species cover. Past *River Corridor Closure Contractor Revegetation and Mitigation Monitoring* reports (WCH-24, WCH-133, WCH-223, WCH 288, WCH-362, WCH-428, WCH-512) include measurements of site cover that exceed 100% in areas with significant cobble cover (e.g., 116-N-3 results in 2009 [WCH-362], 100-F Area results in 2009 [WCH-362], 100-C-9 results in 2011 [WCH-512]) and high yearly fluctuation of native canopy cover (e.g. +46.8% and +56.2% [WCH-512], -43.7% and -43.5% [WCH-428], +40.3% and +31.2% [WCH-362]). Though fluctuations in native canopy cover are to be expected, changes to this degree in a time period as short as a year are at least partially due to observer bias. Though the same monitoring techniques have been used on monitoring sites, individual differences in estimation can drastically change the results. This problem could be solved by having the same individual monitor all sites throughout all years, but this is not realistic. Cross-training monitoring staff is likely the most realistic solution.

Native canopy cover was measured at long-term monitoring sites. Two of the five monitoring sites saw increases in native cover, and four of the five were above success levels. Average native canopy cover at the long-term trend sites was 29.1% cover, higher than the average native canopy cover at the 5-year monitoring sites (15.5% cover) and higher than the average native canopy cover at sites that were 5 years old (21.3% cover). Sites also saw increases in canopy

cover from 2018 monitoring to 2019 monitoring. These increases suggest an upward trend in native canopy cover at revegetation sites and suggest that the typical revegetation site will meet or exceed the 25% success criteria in the long-term.

Biotic crust increased by an average of 14.8% at long-term trend sites from initial monitoring. Biotic crust typically takes decades to form and helps retain soil moisture and prevent erosion. Increases of biotic crust cover are a positive indicator of site health at long-term trend sites.

Continued monitoring of long-term trend sites is recommended in order to track and establish patterns of recovery at older revegetation sites. From 2019 long-term trend monitoring, it appears that native species cover at revegetation sites continues to increase past the fifth year of monitoring. At these 10- to 16-year old sites, native species are outcompeting invasive species and biotic crust levels are increasing. These data indicate that sites will likely continue to recover and may reach 25% native cover success criteria after the fifth year of monitoring. For sites that still have relatively low (less than 15%) native cover after 10 years, intervention will likely be the only way to increase native species cover. In order to gain more information about long-term site recovery, continued monitoring of long-term trend sites is recommended. It is recommended that different long-term trend sites are monitored for FY 2020.

**Table 70. 2018 Long Term Trend Site Monitoring**

Site	Year Planted	Species Cover Comparison (%)		Change in Biotic Crust Cover (%)	Notes
		Initial Monitoring	2019 Monitoring		
<b>100-B/C Area</b>					
116-B/C Misc.	FY 2007	18.4	25.6	+ 11.6	Trending positively, no further monitoring required.
128-C-1	FY 2006	21.3	19.2	+ 6.2	Trending positively from 2018 with low invasive species, no further monitoring required.
<b>100-K Area</b>					
116-K-1	FY 2006	41.8	40.9	+ 15.7	Trending positively from 2018, high native cover, no further monitoring required.
<b>100-N Area</b>					
116-N-3	FY 2005	44.7	32.1	+ 8.9	Trending positively from 2018, high native cover, no further monitoring required.
<b>300 Area</b>					
316-1 / 300 RFBP	FY 2004	18.6	27.6	+ 31.7	Trending positively, no further monitoring required.

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**APPENDIX A**

**2019 REVEGETATION MONITORING TAXONOMY LIST**

**APPENDIX A**  
**2019 REVEGETATION MONITORING TAXONOMY LIST**

<b>Current Scientific Name</b> (USDA Plants Database)	<b>Synonyms</b> (Hitchcock & Cronquist and/or Sackschewsky and Downs)	<b>Common Name</b> (USDA database)	<b>Native (N) or Introduced (a)</b>	<b>Washington State Noxious Weed Class (A, B or C)</b>
<i>Abronia mellifera</i>		white sand verbena	N	
<i>Achillea millefolium</i>		common yarrow	N	
<i>Achnatherum hymenoides</i>	<i>Oryzopsis hymenoides</i>	Indian ricegrass	N	
<i>Agoseris sp.</i>		agoseris	N	
<i>Agoseris heterophylla</i>		false mountain dandelion	N	
<i>Agropyron cristatum</i> <sup>a</sup>		crested wheatgrass	a	
<i>Agropyron dasystachyum</i>		thickspike wheatgrass	N	
<i>Aliciella leptomeria</i>	<i>Gilia leptomeria</i>	sand gilia	N	
<i>Allium ascalonicum</i> <sup>a</sup>		wild onion	a	
<i>Amaranthus albus</i>		white pigweed	a	
<i>Ambrosia acanthicarpa</i>		flatspine bur ragweed	N	
<i>Amsinckia lycopsoides</i>	<i>Benthamia lycopsoides</i>	tarweed fiddleneck	N	
<i>Artemisia biennis</i>		biennial wormwood	N	
<i>Artemisia tridentata</i>		big sagebrush	N	
<i>Astragalus caricinus</i>		buckwheat milkvetch	N	
<i>Astragalus purshii</i>		woollypod milkvetch	N	
<i>Astragalus sclerocarpus</i>		stalked-pod milkvetch	N	
<i>Astragalus succumbens</i>		crouching milkvetch	N	
<i>Balsamorhiza careyana</i>		Carey's balsamroot	N	
<i>Bassia scoparia</i>		kochia	a	B
<i>Brassica sp</i> <sup>a</sup>		mustard	a	
<i>Bromus arvensis</i> <sup>a</sup>	<i>Bromus japonicus</i>	field brome	a	
<i>Bromus tectorum</i> <sup>a</sup>		cheatgrass	a	
<i>Calochortus macrocarpus</i>		sagebrush mariposa lily	N	
<i>Carex sp.</i>		sedge	N	
<i>Centaurea diffusa</i> <sup>b</sup>		diffuse knapweed (B)	a	B
<i>Ceratocephala testiculata</i> <sup>a</sup>	<i>Ranunculus testiculatus</i>	bur buttercup	a	
<i>Chaenactis douglasii</i>		Douglas' dustymaiden	N	
<i>Chenopodium album</i>		lambsquarters	N	
<i>Chenopodium leptophyllum</i>	<i>Chenopodium album</i>	narrowleaf goosefoot	N	
<i>Chondrilla juncea</i> <sup>b</sup>		rush skeletonweed	a	B
<i>Chorispota tenella</i> <sup>a</sup>		crossflower	a	
<i>Chrysothamnus viscidiflorus</i>		yellow rabbitbrush	N	
<i>Cirsium arvense</i> <sup>b</sup>		Canada thistle	a	C
<i>Coldenia nuttallii</i>		desert mat	N	
<i>Comandra umbellata</i>		bastard toadflax	N	

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<i>Convolvulus arvensis</i> <sup>b</sup>		field bindweed	a	C
<i>Coreopsis</i> sp.		tickseed	N	
<i>Coreopsis tinctoria</i>	<i>Coreopsis atkinsoniana</i>	golden tickseed	N	
<i>Cornus sericea</i>	<i>Cornus stolonifera</i>	redosier dogwood	N	
<i>Crepis aribarba</i>		slender hawkbeard	N	
<i>Cryptantha circumscissa</i>		matted cryptantha	N	
<i>Cymopterus terebinthinus</i>		turpentine springparsley	N	
<i>Dalea ornata</i>	<i>Petalostemon ornatum</i>	western prairie clover	N	
<i>Descurcania pinnata</i>		western tansymustard	N	
<i>Digitaris</i> sp. <sup>a</sup>		crabgrass	a	
<i>Digitaris sanguinalis</i>		hairy crabgrass	a	
<i>Draba verna</i> <sup>a</sup>		spring draba	a	
<i>Elaeagnus angustifolia</i> <sup>a</sup>		Russian olive	a	
<i>Elymus elymoides</i>	<i>Sitanion hystrix</i>	squirreltail	N	
<i>Elymus repens</i>		quackgrass	a	
<i>Epilobium brachycarpum</i>	<i>Epilobium paniculatum</i>	tall annual willowherb	N	
<i>Ericameria nauseosa</i>	<i>Chrysothamnus nauseosus</i>	rubber rabbitbrush	N	
<i>Erigeron filifolius</i>		threadleaf fleabane	N	
<i>Erigeron poliospermus</i>		cushion fleabane	N	
<i>Erigeron pumilus</i>		shaggy fleabane	N	
<i>Eriogonum niveum</i>		snow buckwheat	N	
<i>Eriogonum vimineum</i>	<i>Eriogonum baileyi</i>	wickerstem buckwheat	N	
<i>Erodium cicutarium</i> <sup>a</sup>		redstem stork's bill	a	
<i>Erysimum asperum</i>	<i>Cheirinia aspera</i>	western wallflower	N	
<i>Filago arvensis</i> <sup>a</sup>		field fluffweed	a	
<i>Galium aparine</i>		stickywilly	N	
<i>Gilia sinuata</i>		shy gilia	N	
<i>Grayia spinosa</i>	<i>Atriplex spinosa</i>	spiny hopsage	N	
<i>Helianthella uniflora</i>		oneflower helianthella	N	
<i>Hesperostipa comata</i>	<i>Stipa comata</i>	needle and thread grass	N	
<i>Holodiscus discolor</i>		oceanspray	N	
<i>Holosteum umbellatum</i> <sup>a</sup>		jagged chickweed	a	
<i>Hordeum leporinum</i> <sup>a</sup>		hare barley	a	
<i>Hypericum perforatum</i> <sup>b</sup>		common St. Johnswort	a	C
<i>Kochia scoparia</i>		kochia	a	
<i>Koeleria macrantha</i>		prairie Junegrass	N	
<i>Lactuca serriola</i> <sup>a</sup>		prickly lettuce	a	
<i>Lamium amplexicaule</i> <sup>a</sup>		henbit deadnettle	a	
<i>Layia glandulosa</i>		white daisy tidy tips	N	
<i>Lepidium latifolium</i> <sup>a</sup>	<i>Cardaria latifolia</i>	broadleaved pepperweed	a	B
<i>Lepidium perfoliatum</i> <sup>a</sup>		clasping pepperweed	a	
<i>Leptodactylon pungens</i>		prickly phlox	N	

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<i>Leymus cinereus</i>		basin wildrye	N	
<i>Linaria dalmatica</i>		dalmatian toadflax	a	B
<i>Linum lewisii</i>		prairie flax	N	
<i>Lomatium grayi</i>		Gray's biscuitroot	N	
<i>Lomatium gormanii</i>		Gorman's biscuitroot	N	
<i>Lomatium macrocarpum</i>		bigseed desertparsley	N	
<i>Lomatium sp.</i>		desertparsley	N	
<i>Lupinus pusillus</i>		low lupine	N	
<i>Lupinus wyethii</i>		Wyeth's lupine	N	
<i>Lycium barbarum<sup>a</sup></i>		matrimony vine	a	
<i>Machaeranthera canescens</i>		hoary tansyaster	N	
<i>Malva neglecta<sup>a</sup></i>		common mallow	a	
<i>Matricaria recutita<sup>a</sup></i>		wild chamomile	a	
<i>Medicago sativa<sup>a</sup></i>		alfalfa	a	
<i>Melilotus officinalis<sup>a</sup></i>	<i>Melilotus alba</i>	sweet clover	a	
<i>Mentzelia albicaulis</i>		whitestem stickleaf	N	
<i>Microsteris gracilis</i>		slender phlox	N	
<i>Morus alba<sup>a</sup></i>		white mulberry	a	
<i>Nama densus</i>		purple mat	N	
<i>Nicotiana attenuata</i>		coyote tobacco	N	
<i>Oenothera caspitosa</i>		rockrose	N	
<i>Oenothera pallida</i>		pale-evening primrose	N	
<i>Opuntia polyacantha</i>		plains pricklypear	N	
<i>Penstemon acuminatus</i>		sharpleaf penstemon	N	
<i>Phacelia hastata</i>		whiteleaf phacelia	N	
<i>Phacelia linearis</i>		threadleaf phacelia	N	
<i>Phalaris arundinacea<sup>b</sup></i>		reed canarygrass	a	C
<i>Phlox longifolia</i>		longleaf phlox	N	
<i>Phlox speciosa</i>		showy phlox	N	
<i>Phragmites australis<sup>b</sup></i>		common reed	a	B
<i>Plantago lanceolata<sup>a</sup></i>		narrowleaf plantain	a	
<i>Plantago patagonica</i>		woolly plantain	N	
<i>Poa bulbosa<sup>a</sup></i>		bulbous bluegrass	a	
<i>Poa secunda</i>	<i>Poa sandbergii</i>	Sandberg bluegrass	N	
<i>Polygonum aviculare<sup>a</sup></i>		prostrate knotweed	a	
<i>Polygonum convolvulus<sup>a</sup></i>		black bindweed	a	
<i>Polygonum persicaria</i>		spotted ladys thumb	a	
<i>Polypogon monspeliensis<sup>a</sup></i>		annual rabbitsfoot grass	a	
<i>Populus balsamifera</i>	<i>Populus trichocarpa</i>	black cottonwood	N	
<i>Prunus virginiana</i>		chokechery	N	
<i>Pseudoroegneria spicata</i>	<i>Agropyron spicatum</i>	bluebunch wheatgrass	N	
<i>Psoraleidium lanceolatum</i>	<i>Psoralea lanceolata</i>	dune scurfpea	N	
<i>Purshia tridentata</i>		antelope bitterbrush	N	

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<i>Ranunculus testiculatus</i> <sup>a</sup>		burr buttercup	a	
<i>Raphanus raphanistrum</i> <sup>a</sup>		wild radish	a	
<i>Ribes aureum</i>		golden currant	N	
<i>Rosa woodsii</i>		Woods' rose	N	
<i>Rumex crispus</i>		curly dock	a	
<i>Rumex venosus</i>		windged dock	N	
<i>Salix amygdaloides</i>		peachleaf willow	N	
<i>Salix exigua</i>		narrowleaf willow	N	
<i>Salsola kali</i> <sup>a</sup>		Russian thistle	a	
<i>Salvia doriai</i>		grayball sage	N	
<i>Sanguisorba minor</i> <sup>a</sup>	<i>Poterium sanguisorba</i>	small burnet	a	
<i>Sisymbrium altissimum</i> <sup>a</sup>		tall tumbledustard	a	
<i>Sphaeralcea munroana</i>		Munro's globemallow	N	
<i>Sporobolus cryptandrus</i>		sand dropseed	N	
<i>Tamarix ramosissima</i> <sup>b</sup>		saltcedar	a	B
<i>Tragopogon dubius</i> <sup>a</sup>		yellow salsify	a	
<i>Triteleia grandiflora</i>	<i>Brodiaea douglasii</i>	Douglas' clusterlily	N	
<i>Triticum aestivum</i> <sup>a</sup>		common wheat	a	
<i>Triticum sp.</i> <sup>a</sup>		wheat	a	
<i>Triticum x elymus trachycaulus</i> <sup>a</sup>		Regreen	a	
<i>Ulmus pumila</i> <sup>a</sup>		Siberian elm	a	
<i>Verbascum thapsus</i> <sup>a</sup>		common mullein	a	
<i>Verbena bracteata</i>		bigbract verbena	N	
<i>Vicia sp.</i>		vetch	N	
<i>Vulpia microstachys</i>	<i>Festuca microstachys</i>	desert fescue	N	

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**APPENDIX B**

**618-10 SPECIES LIST**

Total Seed Applied to Site

Species	Applied On Site (lbs)	
<i>Artemisia tridentata</i> (Big sagebrush)	29.7	
<i>Chrysothamnus nauseosa</i> (Gray rabbitbrush)	11.1	Shrub Species
<i>Chrysothamnus viscidiflorus</i> (Green rabbitbrush)	12.7	
<i>Erigonum nivium</i> (Snow buckwheat)	22.1	
<i>Purshia tridentata</i> (Antelope bitterbrush)	26	
<i>Hesperostipa comata</i> (Needle-and-thread grass)	433.2	
<i>Koeleria macrantha</i> (Prairie junegrass)	30.9	Grass Species
<i>Poa secunda</i> (Sandberg's bluegrass)	479	
<i>Sporobolus cryptandrus</i> (Sand dropseed)	26	
<i>Triticum x elymus trachycaulus</i> (Regreen)	1722.7	
<i>Abronia mellifera</i> (White sand verbena)	0.03	Forb & Legume Species
<i>Achillea millefolium</i> (Yarrow)	2.5	
<i>Arenaria franklinii</i> (Franklin's sandwort)	0.2	
<i>Astragalus caricinus</i> (Buckwheat milkvetch)	0.27	
<i>Astragalus purshii</i> (Woolly pod milkvetch)	0.58	
<i>Astragalus succumbens</i> (Crouching milkvetch)	0.16	
<i>Astragalus sclerocarpus</i> (Stalked-pod milkvetch)	4.3	
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	2.87	
<i>Calochortus macrocarpus</i> (Mariposa lily)	0.24	
<i>Chaenactis douglasii</i> (Hoary false-yarrow)	0.27	
<i>Crepis atribarba</i> (Slender hawkbeard)	0.14	
<i>Criptantha circumscissa</i> (Matted cryptantha)	0.07	
<i>Erigeron filifolius</i> (Threadleaf fleabane)	0.05	
<i>Erigeron poliospermus</i> (Cushion fleabane)	0.08	
<i>Erigeron pumilus</i> (Shaggy fleabane)	0.09	
<i>Erysimum asperum</i> (Rough wallflower)	0.21	
<i>Fritellaria pudica</i> (Yellowbell)	0.01	
<i>Hymenopappus filifolius</i> (Columbia cutleaf)	0.03	
<i>Machaeranthera canescens</i> (Hoary aster)	2.6	
<i>Nicotiana attenuata</i> (Coyote tobacco)	1.4	
<i>Oenothera pallida</i> (Pale eveningprimrose)	2.9	
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	399.7	
<i>Penstemon accuminatus</i> (Sand beardtongue)	3	
<i>Petalostemon ornatum</i> (Western prairie clover)	5.3	
<i>Phacelia hastata</i> (Whiteleaf scorpionweed)	1.5	
<i>Phacelia linearis</i> (Threadleaf scorpionweed)	0.01	
<i>Phlox longifolia</i> (Long-leaf phlox)	0.05	
<i>Plantago patagonica</i> (Indian wheat)	0.24	
<i>Psoralea lanceolata</i> (Dune scurf-pea)	0.16	
<i>Pterexia terebinthina</i> (Turpentine springparsley)	2.18	
<i>Rumex venosus</i> (Winged dock)	1.25	
<i>Sphaeralcea munroana</i> (Munro's globemallow)	2.8	
Rice Hulls	1985.1	Broadcast Medium
<b>Total</b>	<b>5213.71</b>	

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