

2016 River Corridor Closure Contractor Revegetation and Mitigation Monitoring Report

September 2016

For Public Release

Washington Closure Hanford

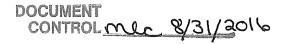


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2016 River Corridor Closure Contractor Revegetation and

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1.0 INTRODUCTION

This report documents the status of revegetation projects and natural resources mitigation efforts conducted for remediated waste sites and other activities associated with the *Comprehensive Environmental Response, Compensation, and Liability Act* cleanup of National Priorities List waste sites at the Hanford Site in Richland, Washington. This report contains vegetation monitoring data for the last 5 years, starting in the spring of 2012, and was collected from the River Corridor Closure Contract's revegetation and mitigation areas on the Hanford Site.

Vegetation is a key component within ecosystems. It sets the tone for ecosystem functionality, in addition to providing food and shelter for wildlife. Characterizing plant community structure and composition are important measures when estimating future site conditions and whether management goals have been achieved. To achieve self-sustaining native vegetative populations within restoration sites on the Hanford Site, the extent of each revegetation effort varied depending on the surrounding habitat, existing conditions, and future land-use designation of the area. The purpose of monitoring revegetation efforts is to measure the progress of plant succession and to evaluate the success of different planting techniques to improve overall restoration success. Each restoration site will be discussed separately and will include a brief description of the revegetation activities and the results from the 2016 monitoring efforts.

This report provides fifth-year survey results for the revegetated areas at the 600-30, 600-108, 600-109, 600-151, 600-152, and 600-178 sites. Fourth-year monitoring was conducted at the 100-C-7, 100-D-8, 100-D-65/66, 128-H-1, 128-K-2, 100-N-47, 181-N, and 181-NE/1908 NE sites. Third-year monitoring was conducted at the 100-C-7:1, 100-K-95, 118-D-2, 600-301, 600-369:3, and 600-370 sites. Second-year monitoring was conducted at the 130-N-1:1, 100-D-30/104, 600-356, 600-379, and Pit 24 sites. First-year monitoring was conducted at the 100-B-35, 100-N-96, 100-D-100, 100-H-28:2, and 600-358 sites (Figure 1).

Results from previous years' monitoring are provided in reports for each respective year (Phipps et al. 2015; Shaw et al. 2013a, 2013b, and 2014). Data tables from 2015, 2014, 2013, and 2012 are presented in Appendix A of this report.

1.1 METHODS USED TO EVALUATE VEGETATION RECOVERY

Revegetation monitoring consisted of a quantitative approach through repeated measurements to estimate canopy cover of all plant species observed within a plot frame; their frequency of occurrence; and percent survival of transplanted shrubs and trees measured within established transects including big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), spiny hopsage (*Atriplex spinosa*), Woods' rose (*Rosa woodsii*), black cottonwood (*Populus trichocarpa*), coyote willow (*Salix exigua*), peachleaf willow (*Salix amygdaloides*), redosier dogwood (*Cornus stolonifera*), and quaking aspen (*Populus tremuloides*). These methods provided a cost-efficient approach that can be analyzed to estimate relative seral stages and general site direction, levels of change, and provide long-term perspectives on achievement of management objectives.

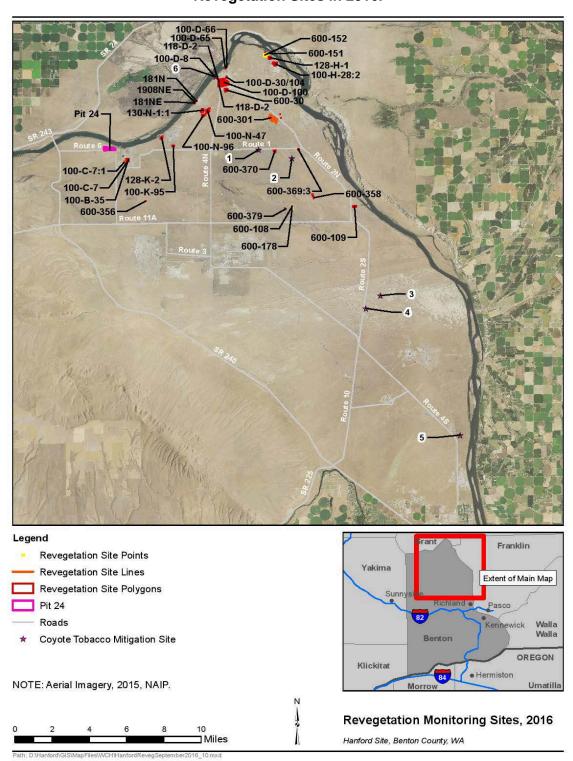


Figure 1. Hanford Site Map Showing Monitored Revegetation Sites in 2016.

Canopy cover and frequency 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." This method provides a measure of the amount of ground covered by each species. Because it is possible in dense stands of vegetation for species to overlap one another, total measured vegetative cover can exceed 100%. Within each restoration site monitored, a series of plot frames (15 to 250 plot frames) were analyzed to produce estimates of canopy cover for each species present. Frequency is represented as the percentage of occurrences a species is 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. Since species occurrences hold no numerical value within any particular plot, they are not included in canopy cover or frequency calculations for a site.

Survival of monitored shrubs was determined through establishment of stationary transects over 5 years. Transects are generally 100 m (328 ft) in length; however, shorter (25 to 75 m [82 to 246 ft]) transects have been established at sites too small in area to support larger transects. Locational measurements for each shrub monitored are recorded along the transect to identify individual survivorship (dead or alive) over the 5-year period, which is then converted into percent survival.

This report uses taxonomic nomenclature from *Flora of the Pacific Northwest* (Hitchcock and Cronquist 1973). Some of the plant taxonomic names have been updated and the revised names are provided in Appendix B of this report. Plant identification was conducted using the nomenclature in *Flora of the Pacific Northwest* (Hitchcock and Cronquist 1973) and in *Vascular Plants of the Hanford Site* (Sackschewsky and Downs 2001).

1.2 REVEGETATION EFFORTS

The type and extent of each revegetation effort is based on the location of the project and the future land designation of that area. For example, portions of the 300 Area, including the 300-FF-1 Process Ponds and burial grounds restoration area, have been designated for future industrial use; therefore, the revegetation goal is interim stabilization. The *Hanford Site Biological Resources Management Plan* (BRMaP) (DOE-RL 2013) suggests seeding only native bunchgrasses (as opposed to bunchgrasses and shrubs) for interim stabilization to provide habitat and to stabilize the soil surface but to avoid unnecessary plantings. At most remedial action sites, the objective of revegetation is to restore the land to vegetative communities dominated by native species that will eventually provide habitat for a diversity of both plant and animal species. Secondary objectives often include using different planting methods and techniques to improve success while incorporating experience and knowledge gained from previous plantings.

According to the Hanford Meteorological Station, the Hanford Site experienced slightly warmer than average temperatures during the 2015/2016 winter season (December 2015, January and February 2016), averaging 37.5 °F, 3.3 °F above normal (34.2 °F). Winter precipitation was higher than normal totaling 9.6 cm (3.78 in.) (133% of the normal 7.2 cm [2.84 in.]). Wind speeds for the winter months were near average with peak wind gusts reaching 53 miles per

hour (mph) on February 28, 2016. The spring season (March, April, May 2016) was also warmer than usual, averaging 57.9 °F, 3.9 °F above normal (54.0 °F). Spring precipitation was slightly below average totaling 3.9 cm (1.5 in.) (95% of the normal 4.1 cm [1.63 in.]). Wind speeds for the spring months were near average with peak wind gusts reaching 55 mph on March 1, 2016. This is important because precipitation rates directly affect soil moisture profiles. Moist soil profiles during winter and spring months are a necessity for healthy germination and development of vegetation, which ultimately controls plant composition and productivity. Adequate precipitation during these months is crucial for native shrubs and cool season bunchgrasses to compete against invasive species such as cheatgrass because many invasive species have greater capacities to germinate and develop under stressing conditions (e.g., low precipitation). Lack of precipitation during the winter and early spring months may cause a loss in moisture within the soil profile, which may hinder native vegetation's root development and cause mortality during summer months. As discussed above, higher than average seasonal precipitation rates were observed for the winter season and slightly lower than average for the spring season, which made for relatively normal soil conditions for establishment of native vegetation on restoration sites.

Restoration activities over past years have utilized a variety of techniques. For large sites having extensive ground disturbance, processes have generally included mechanical work including some level of decompaction in addition to broadcast seeding, ring rolling (cultipacking), strawing, crimping, and hand planting. Smaller, less disturbed sites may have generally received a combination of hand seeding, raking, and hand planting in lieu of mechanical processes. In recent years (fiscal year (FY) 2014 through FY 2016), nearly all large sites have received major decompaction utilizing heavy equipment and tractor drawn implements in addition to contouring efforts to create a naturally occurring topography. Examples of contouring can be viewed throughout the 100 Areas at a multitude of restoration sites; however, of note, 100-D-100, 100-C-7:1, and Pit 24 represent some of the more large scale contouring efforts in recent years.

Due to the scale of the FY 2016 restoration effort, not all sites were able to be planted within the preferred revegetation window (mid-November to early February). The following 18 sites were revegetated from February 16 to 25, 2016: 100-B-35, 100-H-28:2, 100-H-28:3, 100-H-28:5, 100-H-42, 116-H-5, 100-H-44, 100-H-49:1, 100-H-51:3, 600-20 Area A, 600-326:1, 600-326:2, 600-358, SG4-477, 600-349, 100-N-96, 600-367, and UPR-600-22. Four of the sites (100-B-35, 100-H-28:2, 600-358, and 100-N-96) were monitored per the methods described in Section 1.1. The remainder of the sites were observed in August 2016 to note the general condition of the sites with regard to revegetation efforts. Shrub transplants were observed on all of the sites except for 100-H-49:1 and 600-367. Minor components of bunchgrasses were observed on the sites as well. The dominant species throughout all of the sites was invasive Russian thistle. General revegetation processes included approximately 4,480 kg/ha (4,000 lb/ac) of straw mulch applied and crimped into the soil surface; broadcast seeding with a mixture of native grasses; and plantings with approximately 1,235 to 1,605 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 received varying planting ratios ranging from 60 to 75% sagebrush, 5 to 15% bitterbrush, 10 to 30% hopsage, and additionally approximately 1% gray rabbitbrush (Chrysothamnus nauseousus) and green rabbitbrush (Chrysothamnus viscidiflorus) (cumulatively). Small sites that were not candidates for mechanical work (including 600-326:1, 600-326:2, SG4-477, 600-349, and UPR-600-22) received hand seeding and raking in lieu of broadcast seeding via tractors and strawing and crimping.

2.0 100 AREA SITES

2.1 100-B/C SITES

Since 2012 multiple waste sites have been revegetated in the 100-B/C Area that are within the 5-year monitoring requirement. Four 100-B/C Area revegetated sites are within the 5-year requirement and were monitored in 2016 including 100-C-7 (revegetated in FY 2013), 100-C-7:1 (revegetated in FY 2014), Pit 24 (revegetated in FY 2015), and 100-B-35 (revegetated in FY 2016). These sites were remediated to meet the objectives for interim closure as established in the Remedial Design Report/Remedial Action Work Plan for the 100 Area (100 Area RDR/RAWP) (DOE-RL 2009) and in the Interim Action Record of Decision for the 100-BC-1, 100-BC-2,100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 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). These areas were broadcast seeded or hydroseeded (areas with steep slopes) with a mixture of native grasses including Sandberg's bluegrass, Indian ricegrass, bluebunch wheatgrass, bottlebrush squirreltail, needle-and-thread grass, and prairie junegrass. In addition, approximately 4,480 kg/ha (4,000 lb/ac) of straw mulch was applied that was spread and crimped into the soil surface. Sites were planted with approximately 1,235 to 1,605 plants/ha (500 to 650 plants/ac) with a mix of approximately 75% sagebrush, 15% bitterbrush, and 10% spiny hopsage. Water was applied to the sites at approximately 28,070 L/ha (3,000 gal/ac), as needed, during the revegetation process (most recently in March 2015).

2.1.1 100-C-7 Site (183-C Filter Building/Pumproom Facility and Demolition Waste)

Fourth-year monitoring was conducted at the 100-C-7 site on April 19 and 20, 2016 (Figure 2). Due to the large size of the site, it was broken into two sections, the west area being where the actual excavation took place and the east area where staging occurred. Both areas contain primarily cobbles with varying amounts of loamy sand and sandy loam.

Sitewide canopy cover averaged 26.3%, with native cover representing 14.6% and invasive cover representing 11.7% (Table 1).



Figure 2. The 100-C-7 Site in 2016.

Above: Eastern portion of the 100-C-7 site.



Below: Western portion of the 100-C-7 site.

Table 1. Percent Canopy Cover and Frequency of Occurrence at the 100-C-7 Site in 2016.

		lest	East		Entire Site	
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
Agropyron spicatum (bluebunch wheatgrass)	10.00	80.00	6.90	56.00	8.45	68.00
Ambrosia acanthicarpa (bur ragweed)			Х	Χ		
Artemisia tridentata (big sagebrush)	3.10	24.00	2.50	20.00	2.80	22.00
Bromus tectorum ^a (cheatgrass)	3.90	96.00	7.70	96.00	5.80	96.00
Centaurea diffusa a (diffuse knapweed)	0.10	4.00	Х	Χ	0.05	2.00
Chrysothamnus nauseosus (gray rabbitbrush)			Х	Χ		
Festuca microstachys (small sixweeks)			0.10	4.00		
Atriplex spinosa (spiny hopsage)	0.60	4.00	1.50	4.00	1.05	4.00
Holosteum umbellatum ^a (jagged chickweed)		-	0.20	8.00		
Lactuca serriola ^a (prickly lettuce)	0.30	12.00			0.15	6.00
Machaeranthera canescens (hoary aster)	X	Χ	0.10	4.00	Χ	Χ
Melilotus officinalis a (sweetclover)	X	Χ	Х	Χ	Х	Χ
Poa bulbosa ^a (bulbous bluegrass)	0.10	4.00	0.00	0.00		
Poa sandbergii (Sandberg's bluegrass)	1.60	44.00	2.80	72.00	2.20	58.00
Purshia tridentata (antelope bitterbrush)	X	Χ			Χ	Χ
Salsola kali ^a (Russian thistle)	2.00	80.00	2.50	100.00	2.25	90.00
Sisymbrium altissimum a (tumble mustard)	2.50	80.00	3.00	80.00	2.75	80.00
Sitanion hystrix (bottlebrush squirreltail)	X	Χ	0.10	4.00	0.05	2.00
Sporobolus cryptandrus (sand dropseed)	Χ	Χ			0.00	0.00
Triticum sp. ^a (wheat)	0.80	12.00	0.60	4.00	0.70	8.00
Crust	0.00	0.00	0.00	0.00	0.00	0.00
Soil	64.50	100.00	67.30	100.00	65.90	100.00
Litter	22.70	100.00	17.30	100.00	20.00	100.00
Total canopy cover (excludes crust/soil/litter)	25.00		28.00		26.25	
Total native % cover	15.30		13.90		14.55	
Change in native % cover from 2015	+0.80		+0.10		+0.40	
Total invasive % cover	9.70		13.80		11.70	
Change in invasive % cover from 2015	-1.50		+3.80		+1.10	

^a Invasive species.

Native bluebunch wheatgrass was the dominant species sitewide at 8.5% average cover followed by cheatgrass (invasive) at 5.8% average cover. This dominancy pattern was slightly higher in the west area (10% bluebunch wheatgrass to 3.9% cheatgrass); however, cheatgrass was slightly more dominant in the east area (7.7% cheatgrass to 6.9% bluebunch wheatgrass).

Shrub monitoring transects were established at both areas in 2013. Monitoring results indicated a 74.4% survival rate for sagebrush at the eastern portion. This is a slight decrease in survival

X = present but not counted in plot frames

^{-- =} species not observed on site

of about 3% from 2015. Monitoring results indicated a 79.2% survival rate for shrubs at the western portion with sagebrush survival at 86.2% and bitterbrush at 50%. This is an overall shrub survival of about 99.2% from 2015.

2.1.2 100-C-7:1 Site (183-C Water Treatment Facility Head House Foundation)

Third-year monitoring was conducted at the 100-C-7:1 site on April 25 through 28, 2016 (Figure 3). Monitoring efforts were broken down into 10 areas consisting of 1 stationary transect and 25 plot frames per area, totaling 10 stationary transects (covering 582 shrubs originally) and 250 plot frames across the site, consistent with the 2014 monitoring approach. For the purposes of this report, results from the 10 areas were broken down into 2 categories: areas within and directly adjacent to the actual excavation footprint (Sections 5, 6, and 9), and areas outside the excavation footprint (Sections 1, 2, 3, 4, 7, 8, and 10). When characterizing soil types across the site, distinct differences can be observed. Although all areas across the site are predominately cobble, areas within the excavation clearly show higher amounts of sand and loamy sand, while areas outside the excavation have much higher amounts of loam and sandy loam soils. Results from this comparison can be utilized as an important management tool when determining site prescriptions based on soil type, especially when dealing with deep excavations that have removed surface soil horizons containing organic components important for vegetative development.

Sitewide canopy cover averaged 31.9%, with native cover representing 5.1% and invasive cover representing 26.8% (Table 2). Cheatgrass (invasive) was the dominant species sitewide with average coverage of about 16%. Russian thistle and tumble mustard (invasive and dominant species from 2016) had a combined average of 6.1% and native bunchgrasses (Sandberg's bluegrass, bluebunch wheatgrass, and Indian rice grass) had a combined coverage of 4.9%. However, when analyzing data from within and outside the excavation, percent coverages were not consistent. Within the excavated area, invasive cover represented 9.3% cover versus 29.1% for outside excavation areas: this trend was also noted for this site in 2014 and 2015. Invasive cover for both areas and the site overall changed less than 1% from that observed in 2014 and 2015. Similar to 2015, comparison of native cover inside the excavated area versus outside shows comparable results between the two areas, with 10% and 8.2%, respectively. Another notable observation is that Indian ricegrass is the dominant native species (4.4%) in the excavated area versus Sandberg's bluegrass (2.5%) in the outside excavation area, indicating that Indian ricegrass may have a higher success rate in sand-dominated soils (e.g., excavated areas). Results of the 2014 monitoring for this site showed that the loamy soils outside of the excavated area were supporting nearly triple the vegetation cover observed in the sandy excavated areas; that has decreased to about a bit under twice as much in 2016 (37% outside versus19% inside).

Shrub monitoring transects were established at each of the 10 areas in 2014. Monitoring results indicated an overall 46.4% survival rate for all shrubs (sagebrush and antelope bitterbrush) for the entire site. The inside excavation area showed a 64.1% survival rate and the outside excavation area showed a 38.7% survival rate. This trend is opposite of that discussed above for canopy cover, where there is a significantly higher percentage of cover in the loamy soils of the areas outside of the excavation area versus the sand-dominated soils inside of the excavation area. Sagebrush had an overall survival rate of 49.6% for the site; with 67% survival for the inside area and 41.4% for the outside area. Bitterbrush survival for the site overall was 12%; with 28.6% survival for the inside area and 11.1% for the outside area.



Figure 3. The 100-C-7:1 Site in 2016.

Above: View of excavated portion of the 100-C-7:1 site.



Table 2. Percent Canopy Cover and Frequency of Occurrence at the 100-C-7:1 Site in 2016. (2 Pages)

at the 100-0-7.1 Site iii 2010. (21 ages)							
		side vation		itside avation	Entir	e Site	
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence	
Agropyron spicatum (bluebunch wheatgrass)	1.4	29.3	0.9	20.0	1.02	22.80	
Amsinckia lycopsoides (tarweed fiddleneck)			0.2	0.6	0.15	0.40	
Artemisia tridentata (big sagebrush)	2.2	16.0	2.0	14.3	2.06	14.80	
Bromus tectorum ^a (cheatgrass)	6.2	97.3	20.2	99.4	15.98	98.80	
Bunchgrasses ^b			0.2	6.9	0.12	4.80	
Centaurea diffusa ^a (diffuse knapweed)	0.4	9.3	0.4	21.7	0.42	18.00	
Chrysothamnus nauseousus (gray rabbitbrush)			0.1	0.6	0.06	0.40	
Descurainia pinnata (western tamsymustard)			Х	Х	0.00	0.00	
Draba verna ^a (spring whitlow grass)	0.1	2.7	0.0	0.6	0.03	1.20	
Erodium cicutarium ^a (common stork's bill)			0.0	0.6	0.01	0.40	
Festuca microstachys (small sixweeks)	0.1	4.0	0.0	0.6	0.04	1.60	
Holosteum umbellatum ^a (jagged chickweed)			0.2	4.6	0.13	3.20	
Hordeum leporinum ^a (hare barley)			X	Χ	0.00	0.00	
Koeleria cristata (prairie junegrass)	0.2	1.3			0.06	0.40	
Lactuca serriola ^a (prickly lettuce)	Χ	Χ	0.1	3.4	0.06	2.40	
Lamium amplexicaule ^a (henbit deadnettle)			0.0	0.6	0.01	0.40	
Machaeranthera canescens (hoary aster)			0.0	0.6	0.01	0.40	
Medicago sativa ^a (alfalfa)	Χ	Χ	X	Χ	0.00	0.00	
Melilotus officinalis ^a (sweetclover)			0.1	2.9	0.10	2.00	
Oryzopsis hymenoides (Indian ricegrass)	4.4	76.0	0.6	10.9	1.71	30.40	
Poa bulbosa ^a (bulbous bluegrass)	Χ	Χ	0.3	7.4	0.18	5.20	
Poa sandbergii (Sandberg's bluegrass)	1.6	62.7	2.5	36.6	2.20	44.40	
Purshia tridentata (antelope bitterbrush)	0.0	2.7	0.0	0.6	0.02	1.20	
Raphanus raphanistrum ^a (wild radish)			0.0	0.6	0.01	0.40	
Salsola kali ^a (Russian thistle)	1.5	61.3	2.3	81.7	2.09	75.60	
Sisymbrium altissimum ^a (tumble mustard)	1.1	37.3	5.3	72.0	4.03	61.60	
Sitanion hystrix (bottlebrush squirreltail)			1.6	15.4	1.10	10.80	
Sporobolus cryptandrus (sand dropseed)			X	Χ	0.00	0.00	
Stipa comata (needle-and-thread grass)	0.1	1.3	0.3	5.1	0.21	4.00	
Tragopogon dubius ^a (yellow salsify)	Х	Х	0.0	1.1	0.02	0.80	
Triticum aestivum ^a (common wheat)	Х	Х	0.1	3.6	0.07	2.50	
Crust	0.0	0.0	0.0	1.7	0.03	1.20	
Soil	80.4	100.0	59.6	100.0	65.82	100.00	
Litter	18.0	100.0	29.3	100.0	25.90	100.00	

	Inside Excavation		Outside Excavation		Entire Site		
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence	
Total canopy cover (excludes crust/soil/litter)	19.27		37.30		31.93	, = 0	
Total native % cover	10.0		8.2		5.13		
Change in native % cover from 2015	-6.8		-4.9		-9.11		
Total invasive % cover	9.3		29.1		26.80		
Change in invasive % cover from 2015	-5.0		-4.1		-0.74		

Table 2. Percent Canopy Cover and Frequency of Occurrence at the 100-C-7:1 Site in 2016. (2 Pages)

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

In addition to the typical upland vegetation efforts, the Pit 24 site also entailed the creation of wetland habitat and establishment of associated aquatic and riparian vegetation (Figure 4). Species planted in the riparian areas included black cottonwood, coyote willow, peachleaf willow, redosier dogwood, choke cherry, Woods' rose, golden currant, and quaking aspen. These species will provide a variety of canopy cover that will regulate temperature extremes within the pit; provide valuable nesting, shelter, and forage habitat; and help to outcompete invasive species. Other native wetland vegetation seeded within and adjacent to the wetted areas of the pit included hardstem bulrush (*Scirpus acutus*), softstem bulrush (*Scirpus validus*), poverty rush (*Juncus tenuis*), and fox sedge (*Carex vulpinoidea*). These species readily establish in wetland areas and will provide valuable habitat for waterfowl and other birds. Wildlife sightings and tracks observed have indicated a variety of wildlife have been utilizing Pit 24 since it was restored including deer, elk, raccoons, beavers, porcupines and coyotes in addition to the various songbirds, shore-birds, local waterfowl, and amphibians (Figures 5 through 7).

Second-year monitoring was conducted at the Pit 24 site during May through July 2016. Substrates vary throughout this large site, ranging primarily from gravelly loamy sand in the upland areas to gravelly sand and sandy loam in the riparian areas surrounding the multiple ponds on the site. Monitoring efforts consisted of a total of 14 transects, 115 upland plot frames, and 42 riparian plot frames. Transects consisted of four 100-m (328-ft) shrub transects in upland areas, nine riparian transects varying in length from 25 to 100 m (82 to 328 ft) around the recently constructed ponds, and one 100-m (328-ft) 'transition zone' transect incorporating planted trees within the upland area. Three distinct ecological areas (upland, riparian, and wetland) are present within the restored portion of Pit 24. Monitoring results for upland and riparian habitats are discussed in the following sections; however, wetland monitoring was not feasible due to seasonal water fluctuations and in-water hazards. Figures 8 and 9 show overviews of the larger west and east ponds.

^a Invasive species.

X = present but not counted in plot frames

^{-- =} species not observed on site



Figure 4. Overview of the Pit 24 Site in 2015.

(Google[™] earth © 2015 Google, Imagery Date 5/6/2015)



Figure 5. Deer Tracks Along West Pond.



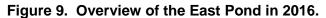
Figure 6. Waterfowl Utilizing East Pond in 2015.







Figure 8. Overview of the West Pond in 2016.





2.1.3.1 Pit 24 Upland Areas. Upland monitoring was conducted over five areas (115 plots) and four associated transects established with initial monitoring in 2015. Canopy cover averaged 22.9%, with native cover representing 7% and invasive cover representing 15.9% for the upland areas (Table 3). Russian thistle (invasive) was the dominant species sitewide at 7.2% cover followed by cheatgrass (invasive) with 3.8% cover. This was about a 10% increase in invasive cover from 2015 while native cover remained relatively consistent with that observed in 2015.

Shrubs were monitored along the four upland transects established in 2015. Monitoring results indicated an overall 55.7% survival rate for all upland area shrubs (sagebrush, antelope bitterbrush, and spiny hopsage). Sagebrush had an overall survival rate of 62.9% for the site, bitterbrush survival for the site was 51.4%, and spiny hopsage survival was 8.3%.

Table 3. Percent Canopy Cover and Frequency of Occurrence at Pit 24 Site (Upland Areas) in 2016. (2 Pages)

	Combine	ed Upland Areas
Species	Average % Cover	Average % Frequency of Occurrence
Achillea millefolium (yarrow)	0.08	1.78
Agropyron spicatum (bluebunch wheatgrass)	1.35	36.74
Ambrosia acanthicarpa (bur ragweed)	X	X
Artemisia tridentata (big sagebrush)	0.47	8.73
Bromus tectorum ^a (cheatgrass)	3.75	70.94
Bunchgrasses ^b	1.15	46.09
Centaurea diffusa a (diffuse knapweed)	1.43	14.67
Chrysothamnus nauseousus (gray rabbitbrush)	0.20	3.48
Cornus stolonifera (Redosier dogwood)	X	X
Cyperus erythrorhizos (redroot flatsedge)	X	X
Draba verna a (spring whitlow grass)	0.02	0.87
Epilobium paniculatum (tall willowherb)	0.02	0.87
Erigonum vemineum (broom buckwheat)	0.20	7.83
Atriplex spinosa (spiny hopsage)	X	X
Hippuris vulgaris (marestail)	X	X
Holosteum ^a umbellatum (jagged chickweed)	0.02	0.87
Lactuca serriola a (prickly lettuce)	X	X
Machaeranthera canescens (hoary aster)	0.02	0.87
Medicago sativa ^a (alfalfa)	0.02	0.87
Melilotus officinalis ^a (sweetclover)	0.49	3.55
Oryzopsis hymenoides (Indian ricegrass)	1.65	15.65
Phalaris arundinacea a (Reed canary-grass)	0.13	0.87
Phragmite australis ^a (common reed)	0.33	0.87
Poa bulbosa ^a (bulbous bluegrass)	0.11	4.35
Poa sandbergii (Sandberg's bluegrass)	0.89	27.17
Populus trichocarpa (black cottonwood)	0.15	1.74
Purshia tridentata (antelope bitterbrush)	0.11	4.35
Raphanus raphanistrum ^a (wild radish)	0.31	5.29
Rumex cripsus ^a (curly dock)	X	X

Table 3. Percent Canopy Cover and Frequency of Occurrence at Pit 24 Site (Upland Areas) in 2016. (2 Pages)

	Combine	ed Upland Areas
Species	Average % Cover	Average % Frequency of Occurrence
Salix exigua (coyote willow)	X	X
Salsola kali ^a (Russian thistle)	7.23	84.38
Sisymbrium altissimum a (tumble mustard)	1.44	42.14
Sitanion hystrix (bottlebrush squirreltail)	0.09	3.48
Sonchus oleraceus a (annual sowthistle)	Х	X
Sporobolus crytandrus (sand dropseed)	0.22	4.35
Stipa comata (needle-and-thread grass)	0.26	6.09
Tamarix parviflora ^a (tamarisk)	0.02	0.87
Tragopogon dubius ^a (yellow salsify)	0.02	0.87
Triticum aestivum a (common wheat)	0.59	14.78
Verbascum Thapsus ^a (common mullein)	0.02	0.87
Verbena bracteata (big-bract verbena)	0.06	0.91
Festuca microstachys (desert fescue)	0.09	3.48
Artr recruits	X	X
Crust	0.00	0.00
Soil	82.54	100.00
Litter	25.25	100.00
Total canopy cover (excludes crust/soil/litter)	22.93	
Total native % cover	7.00	
Change in native % cover from 2015	-0.51	
Total invasive % cover	15.93	
Change in invasive % cover from 2015	+10.39	

^a Invasive species.

2.1.3.2 Pit 24 Riparian Areas. Plot data were collected from a total of 42 plots around the larger east and west ponds at the Pit 24 site (24 around the east pond, 18 around the west pond). Plot frames were located approximately 25 m (82 ft) apart and between the ordinary high water mark and the water's edge, consistent with the initial monitoring conducted in 2015. Canopy cover for the riparian area plots averaged 36.9%, with native cover representing 17.3% and invasive cover representing 18.6% (Table 4). Common reed (invasive) was by far the most dominant species with 15.2% cover. This invasive species was present in 100% of the east pond plots and over 60% of the west pond plots. The most dominant native species were bushy cinquefoil and soft-stem bulrush with 5.1% and 3.9% cover, respectively.

Shrubs were monitored along the nine riparian transects and one transition zone transect established in 2015. Monitoring results indicated an overall 74.9% survival rate for the riparian shrubs (coyote willow, peachleaf willow, black cottonwood, redosier dogwood, and Woods' rose), ranging from 65% for cottonwoods to 91.7% for peachleaf willow. Additional upland species in the transition zone (sagebrush, antelope bitterbrush, and quaking aspen) had an overall survival rate of 66.7% for the site.

^b Bunchgrasses include Agropyron spicatum, Koeleria cristata, Oryzopsis hymenoides, Sitanion hystrix, Sporobolus cryptandrus, and Stipa comata.

X = present but not counted in plot frames

Table 4. Percent Canopy Cover and Frequency of Occurrence at the Pit 24 Site (Riparian Areas) in 2016. (2 Pages)

	East Po	East Pond Area		West Pond Area		Combined Riparian Areas	
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence	
Achillea millefolium (yarrow)	Х	Х	3.47	5.56	1.49	2.38	
Agropyron spicatum (bluebunch wheatgrass)	0.21	8.33			0.12	4.76	
Amaranthus albus a (white pigweed)			0.14	5.56	0.06	2.38	
Bromus tectorum ^a (cheatgrass)	0.10	4.17			0.06	2.38	
Carex aperia (Columbia sedge)			Х	Х	Х	Х	
Carex stipata (awlfruit sedge)	Х	Х	0.42	16.67	0.18	7.14	
Centaurea diffusa a (diffuse knapweed)	0.10	4.17	0.83	5.56	0.42	4.76	
Cirsium arvense ^a (Canada thistle)	Х	Х			Х	Х	
Conyza canadensis (horseweed)	0.10	4.17			0.06	2.38	
Coreopsis atkinsoniana (Columbia tickweed)	Х	Х			Х	Х	
Cornus stolonifera (redosier dogwood)	Х	Х	Х	Х	Х	Х	
Cyperus erythrorhizos (redroot flatsedge)	0.83	12.50	1.39	27.78	1.07	19.05	
Cyperus aristatus (bearded flatsedge)	0.10	4.17	0.28	11.11	0.18	7.14	
Digitaris sanguinalis ^a (hairy crabgrass)	0.52	20.83	0.42	16.67	0.48	19.05	
Elymus repens a (quackgrass)	0.63	25.00			0.36	14.29	
Euphorbia supina (prostrate spurge)	0.63	25.00	0.14	5.56	0.42	16.67	
Juncus tenuis (slender rush)	Х	Х	Х	Х	Х	Х	
Kochia scoparia a (kochia)	0.31	12.50	0.14	5.56	0.24	9.52	
Lactuca serriola a (prickly lettuce)	Х	Х	0.42	16.67	0.18	7.14	
Melilotus officinalis a (sweetclover)	Х	Х	0.14	5.56	0.06	2.38	
Oryzopsis hymenoides (Indian ricegrass)	0.21	8.33			0.12	4.76	
Panicum capillare (common witchgrass)	0.31	12.50	0.28	11.11	0.30	11.90	
Phragmite australis ^a (common reed)	20.52	100.00	8.19	61.11	15.24	83.33	
Poa pratensis (Ky bluegrass)			0.14	5.56	0.06	2.38	
Polygonum persicaria a (spotted ladysthumb)	Х	Х	3.19	44.44	1.37	19.05	
Populus trichocarpa (black cottonwood)	Х	Х	Х	Х	Х	Х	
Potentilla paradoxa (bushy cinquefoil)	1.77	29.17	9.58	83.33	5.12	52.38	
Rosa woodsii (Woods' rose)	0.10	4.17	Х	Х	0.06	2.38	
Rumex crispus ^a (curly dock)	0.10	4.17			0.06	2.38	
Salix amygdaloides (peach-leaf willow)	Х	Х	Х	Χ	Χ	Х	
Salix exigua (coyote willow)	0.10	4.17	4.17	11.11	1.85	7.14	
Salsola kali ^a (Russian thistle)	0.63	25.00	0.28	11.11	0.48	19.05	
Scirpus acutus (hard-stem bulrush)	0.10	4.17	Х	Х	0.06	2.38	
Scirpus validus (soft-stem bulrush)	5.31	66.67	2.08	27.78	3.93	50.00	
Sisymbrium altissimum ^a (tumble mustard)			0.28	11.11	0.12	4.76	
Sitanion hystrix (bottlebrush squirreltail)			0.83	5.56	0.36	2.38	
Tamarix parviflora ^a (tamarisk)	0.21	8.33	Х	Х	0.12	4.76	
Triticum aestivum a (common wheat)	0.10	4.17	0.42	16.67	0.24	9.52	

Table 4. Percent Canopy Cover and Frequency of Occurrence at the Pit 24 Site (Riparian Areas) in 2016. (2 Pages)

		nd Area	West Pond Area		Combined Riparian Areas	
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
Tragopogon dubius ^a (yellow salsify)	Х	Х			Χ	X
Typhia latifolia (cattail)	Х	Χ			Χ	Х
Verbascum Thapsus ^a (common mullein)	0.10	4.17	Х	Χ	0.06	2.38
Verbena bracteata (big bract verbena)	0.10	4.17	0.42	16.67	0.24	9.52
Saexr (SAEX recruits)	1.25	29.17	2.36	38.89	1.73	33.33
Crust	2.29	29.17	1.11	16.67	1.79	23.81
Soil	68.85	100.00	76.81	100.00	72.26	100.00
Litter	10.73	100.00	6.53	100.00	8.93	100.00
Total canopy cover (excludes crust/soil/litter)	34.48		40.00		36.85	
Total native % cover	11.15		25.56		17.32	
Change in native % cover from 2015	+5.11		+15.28		+9.46	
Total invasive % cover	23.33		14.44		18.63	
Change in invasive % cover from 2015	+7.91		+3.88		+5.30	

^a Invasive species.

2.1.4 100-B-35 (Electrical Substation)

First-year monitoring was conducted at the 100-B-35 site on April 20, 2016 (Figure 10). Substrates are primarily cobbly sandy loams. Total canopy cover was at 7.6% consisting of 3.2% native cover and 4.4% invasive cover (Table 5). Russian thistle and tumble mustard (invasive) were the dominant species with 2.1% and 1.6% cover, respectively. Bluebunch wheatgrass was the most abundant native species with 1.5% cover.

A 100-m (328-ft) shrub transect was established running east to west across the site. A total of 48 shrubs were recorded along the transect – 35 sagebrush and 13 spiny hopsage.

X = present but not counted in plot frames

^{-- =} species not observed on site



Figure 10. The 100-B-35 Site in 2016.

Table 5. Percent Canopy Cover and Frequency of Occurrence at the 100-B-35 Site in 2016.

Species	% Cover	% Frequency of Occurrence
Ambrosia acanthicarpa (bur ragweed)	0.10	4.00
Agropyron spicatum (bluebunch wheatgrass)	1.50	60.00
Artemisia tridentata (big sagebrush)	0.50	20.00
Bromus tectorum ^a (cheatgrass)	0.40	16.00
Bunchgrasses ^b	1.00	40.00
Atriplex spinosa (spiny hopsage)	0.10	4.00
Lactuca serriola ^a (prickly lettuce)	X	X
Melilotus officinalis ^a (sweet clover)	0.10	4.00
Purshia tridentata (antelope bitterbrush)	X	Χ
Salsola kali ^a (Russian thistle)	2.10	84.00
Sisymbrium altissimum ^a (tumble mustard)	1.60	64.00
Triticum sp. ^a (wheat)	0.20	8.00
Crust	0.00	0.00
Soil	62.10	100.00
Litter	34.00	100.00
Total canopy cover (excludes crust/soil/litter)	7.60	
Total native % cover	3.20	
Total invasive % cover	4.40	

Invasive species.
 Bunchgrasses include Agropyron spicatum, Koeleria cristata, Oryzopsis hymenoides, Sitanion hystrix, Sporobolus cryptandrus, and Stipa comata.
 X = present but not counted in plot frames

2.2 100-K SITES

The 128-K-2 site was revegetated in FY 2013 and the 100-K-95 site in FY 2014. These sites were remediated to meet the objectives for interim closure as established in the 100 Area RDR/RAWP (DOE-RL 2009) and in the Interim Action ROD (EPA 1999). These areas were broadcast seeded with a mixture of native grasses including Sandberg's bluegrass, Indian ricegrass, bluebunch wheatgrass, bottlebrush squirreltail, needle-and-thread grass, and prairie junegrass. In addition, approximately 4,480 kg/ha (4,000 lb/ac) of straw mulch was applied that was spread and crimped into the soil surface. Sites were planted with approximately 1,235 to 1,605 plants/ha (500 to 650 plants/ac) with a mix of approximately 75% sagebrush, 15% bitterbrush, and 10% spiny hopsage.

2.2.1 128-K-2 Site

Fourth-year monitoring was conducted at the 128-K-2 site on April 18, 2016 (Figure 11). Substrate at this site varies from primarily cobble with varying amounts of sandy loam to sandy loam with few cobbles. Total canopy cover for the site was 22.8% consisting of 7.1% native cover and 15.7% invasive cover (Table 6). Cheatgrass (invasive) was the dominant species accounting for 10.8% canopy cover (nearly half of the total canopy cover present). Sandberg's bluegrass and bluebunch wheatgrass were the dominant native species accounting for 3% and 2% canopy cover, respectively.

Shrub transect monitoring indicated a 7.6% decline in shrub survival from 2015, resulting in a 55.7% survival rate for transplanted sagebrush.



Figure 11. The 128-K-2 Site in 2016.

Table 6. Percent Canopy Cover and Frequency of Occurrence at the 128-K-2 Site in 2016.

Species	% Cover	% Frequency of Occurrence
Agropyron spicatum (bluebunch wheatgrass)	2.00	20.00
Artemisia tridentata (big sagebrush)	1.40	16.00
Bromus tectorum ^a (cheatgrass)	10.80	100.00
Centaurea diffusa ^a (diffuse knapweed)	0.10	4.00
Descurainia pinnata (western tansymustard)	0.60	4.00
Draba verna ^a (spring whitlow grass)	0.10	4.00
Holosteum umbellatuma (jagged chickweed)	0.40	16.00
Kochia scoparia ^a (kochia)	Х	X
Lactuca serriola ^a (prickly lettuce)	0.10	4.00
Poa bulbosa ^a (bulbous bluegrass)	0.20	8.00
Poa sandbergii (Sandberg's bluegrass)	3.00	80.00
Salsola kalia (Russian thistle)	3.20	88.00
Sisymbrium altissimuma (tumble mustard)	0.80	32.00
Sphaeralcea munroana (Munro's globemallow)	0.10	4.00
Sporoboous crytandrus (sand dropseed)	X	X
Stipa comata (needle-and-thread grass)	X	X
Tragopogon dubius ^a (yellow salsify)	Х	X
Crust	0.00	0.00
Soil	67.30	100.00
Litter	15.00	100.00
Total canopy cover (excludes crust/soil/litter)	22.80	
Total native % cover	7.10	
Change in native % cover from 2015	-4.90	
Total invasive % cover	15.70	
Change in invasive % cover from 2015	-7.80	

^a Invasive species.

2.2.2 100-K-95 Site (100-K Tar Dump)

Third-year monitoring was conducted at the 100-K-95 site on April 19, 2016 (Figure 12). Substrate at this site is characterized by loamy sand and sandy loam soils with varying amounts of scattered boulders. For monitoring purposes, the site was previously broken down into Area 1 (nonstrawed) and Area 2 (strawed). Total canopy cover for both areas produced similar results, with 62.8% cover for Area 1 and 68% cover for Area 2, resulting in an overall average site cover of 65.4% (Table 7). Both areas showed an increase in native vegetation and decrease in invasive vegetation compared to the 2015 monitoring results; however, invasive species continue to be the dominant species with cheatgrass and tumble mustard accounting for over 70% of the canopy cover. Needle-and-thread grass was the dominant native species accounting for 6.5% of the canopy cover. Native cover was higher in the nonstrawed area with 18.6% cover versus 5.7% cover in the strawed area.

X = present but not counted in plot frames



Figure 12. The 100-K-95 Site in 2016.

Table 7. Percent Canopy Cover and Frequency of Occurrence at the 100-K-95 Site in 2016. (2 Pages)

	Area 1 (Nonstrawed)		Area 2 (Strawed)		Entire Site	
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
Achillea millefolium (yarrow)			Х	Χ	0.00	0.00
Allium sp. (wild onion)			Χ	Χ	0.00	0.00
Amsinckia lycopsoides (tarweed fiddleneck)			0.70	8.00	0.35	4.00
Artemisia tridentata (big sagebrush)	1.50	8.00	1.20	8.00	1.35	8.00
Balsmorhiza careyana (Carey's balsamroot)			Χ	Χ	0.00	0.00
Bromus tectorum ^a (cheatgrass)	38.75	100.00	43.70	100.00	41.23	100.00
Centaurea diffusa a (diffuse knapweed)	Χ	Χ	Χ	Χ	0.00	0.00
Chrysothamnus nauseosus (gray rabbitbrush)			Х	X	0.00	0.00
Draba verna ^a (spring whitlow grass)	1.00	44.00	1.20	28.00	1.10	36.00
Erigeron pumilus (shaggy fleabane)			3.40	4.00	1.70	2.00
Erodium cicutarium ^a (redstem stork's bill)	Х	Х	0.20	8.00	0.10	4.00
Holosteum umbellatum ^a (jagged chickweed)	2.13	88.00	6.30	92.00	4.21	90.00
Lomatium grayi (biscuitroot)			Х	Х	0.00	0.00
Microsteris gracilis (slender phlox)	8.00	96.00		-	4.00	48.00
Oryzopsis hymenoides (Indian ricegrass)	0.38	20.00		-	0.19	10.00

Table 7. Percent Canopy Cover and Frequency of Occurrence at the 100-K-95 Site in 2016. (2 Pages)

	Area 1 (Nonstrawed)		Area 2 (Strawed)		Entire Site	
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
Poa bulbosa a (bulbous bluegrass)		ŀ	0.10	4.00	0.05	2.00
Poa sandbergii (Sandberg's bluegrass)	0.25	8.00	0.40	16.00	0.33	12.00
Salsola kali a (Russian thistle)	0.13	4.00	1.90	76.00	1.01	40.00
Sisymbrium altissimum a (tumble mustard)	2.13	88.00	8.90	100.00	5.51	94.00
Stipa comata (needle-and-thread grass)	8.50	92.00	X	Χ	4.25	46.00
Crust	0.00	0.00	0.10	4.00	0.05	2.00
Soil	52.38	100.00	37.60	100.00	44.99	100.00
Litter	6.25	100.00	22.10	100.00	14.18	100.00
Total canopy cover (excludes crust/soil/litter)	62.75		68.00		65.38	
Total native % cover	18.63		5.70		12.16	
Change in native % cover from 2015	+18.00		+3.10		+10.55	
Total invasive % cover	44.13		62.30		53.21	
Change in invasive % cover from 2015	-18.01		-2.10		-10.05	

^a Invasive species.

Shrub monitoring transects were established in both Area 1 and Area 2 in 2014. Monitoring results indicated a survival rate of 23% for shrubs in the Area 1 (nonstrawed) and 3.5% for shrubs in Area 2 (strawed), resulting in an overall shrub survival of 13.2% for the site. Surviving shrubs consist of sagebrush only with a combined survival rate of 15.9%.

2.3 100-N SITES

The 100-N-47, 181-N, and 181-NE/1908-NE waste sites in the 100-N Area were revegetated in FY 2014; the 130-N-1:1 waste site in FY 2015; and the 100-N-96 in FY 2016. These sites were remediated to meet the objectives for interim closure as established in the 100 Area RDR/RAWP (DOE-RL 2009) and in the Interim Action ROD (EPA 1999). These areas were broadcast seeded with a mixture of native grasses including Sandberg's bluegrass, Indian ricegrass, bluebunch wheatgrass, bottlebrush squirreltail, needle-and-thread grass, and prairie junegrass. In addition, approximately 4,480 kg/ha (4,000 lb/ac) of straw mulch was applied that was spread and crimped into the soil surface. Sites were planted with approximately 1,235 to 1,605 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 received varying planting ratios ranging from 60 to 75% sagebrush, 5 to 15% bitterbrush, 10 to 30% hopsage, and, additionally, approximately 1% gray rabbitbrush (*Chrysothamnus nauseousus*) and green rabbitbrush (*Chrysothamnus viscidiflorus*) (cumulatively).

X = present but not counted in plot frames

^{-- =} species not observed on site

The 181-N and 181-NE/1908-NE waste sites represented unique opportunities as they are directly adjacent to the Columbia River. In addition to broadcast seeding and hydroseeding with native grass seeds and shrub planting, these sites also received riparian prescriptions that included additional species such as black cottonwood (*Populus trichocarpa*), coyote willow (*Salix exigua*), peachleaf willow (*Salix amygdaloides*), redosier dogwood (*Cornus stolonifera*), chokecherry (*Prunus virginiana*), Woods' rose (*Rosa woodsii*), and golden currant (*Ribes aureum*). Raptor poles were also installed at 181-NE/1908-NE, as this area receives frequent use by bald eagles (*Haliaeetus leucocephalus*) and other raptors. Originally, less than half of the riparian shrubs and trees received protective caging to minimize damage from herbivory. Due to instantaneous damage from herbivory in the days following the plantings (primarily from beaver [*Castor Canadensis*]), the decision was made to cage all riparian plantings. In the summer of 2016, monitoring staff noted that many of the transplanted trees were out growing their protective cages and recommended removal of the fencing; removal was conducted in July 2016. Minimal damage from herbivory was noted in August 2016 at the 100-N river sites.

2.3.1 181-N Waste Site

Fourth-year monitoring was conducted at the 181-N waste site on May 18, 2016 (Figure 13). Total canopy cover represented 20.7%, consistent with canopy cover in 2015. Native species accounted for 10.2% of the canopy cover and invasive species accounted for 10.5% of the canopy cover (Table 8). Cheatgrass (invasive) was the dominant species accounting for 6.7% of the canopy cover. Bluebunch wheatgrass was the dominant (nonwoody) native species with 2.7% canopy cover. Monitoring was mainly conducted between the ordinary high water mark and the toe of the main slope.

Tree transect monitoring indicated 90.2% survival from 2015, equating to an overall survival rate of 63% for transplanted black cottonwoods, redosier dogwoods, and coyote willows.

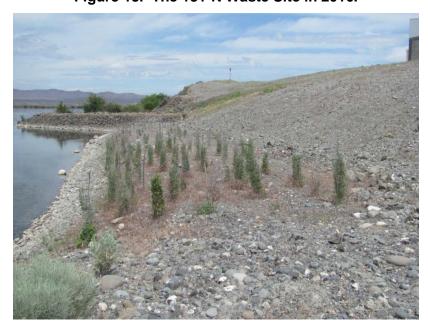


Figure 13. The 181-N Waste Site in 2016.

Table 8. Percent Canopy Cover and Frequency of Occurrence at the 181-N Waste Site in 2016.

Species	% Cover	% Frequency of Occurrence
Agropyron spicatum (bluebunch wheatgrass)	2.67	40.00
Artemisia tridentata (big sagebrush)	0.50	20.00
Bromus tectorum a (cheatgrass)	6.67	100.00
Carex sp. (sedge)	0.17	6.67
Centaurea diffusa a (diffuse knapweed)	1.00	6.67
Cornus stolonifera (redosier dogwood)	5.17	13.33
Lactuca serriola ^a (prickly lettuce)	1.17	13.33
Poa sandbergii (Sandberg's bluegrass)	0.00	33.33
Populus trichocarpa (black cottonwood)	0.17	6.67
Ribes aureum (golden currant)	X	X
Salix exigua (coyote willow)	1.50	6.67
Salsola kali ^a (Russian thistle)	1.00	46.67
Sisymbrium altissimum a (tumble mustard)	0.50	33.33
Triticum eastivum ^a (common wheat)	0.17	6.67
Verbascum Thapsus a (common mullein)	X	X
Artr recruit	X	X
Crust	49.67	0.00
Soil	45.17	100.00
Litter	3.50	100.00
Total canopy cover (excludes crust/soil/litter)	20.67	
Total native % cover	10.17	
Change in native % cover from 2015	-0.50	
Total invasive % cover	10.50	
Change in invasive % cover from 2015	-0.50	

^a Invasive species.

2.3.2 181-NE/1908-NE Waste Site

Fourth-year monitoring was conducted at the 181-NE/1908-NE waste sites on May 18, 2016 (Figure 14). Total canopy cover represented 18.5%. Native species accounted for 11.8% of the canopy cover and invasive species accounted for 6.7% of the canopy cover (Table 9). Bluebunch wheatgrass (native) was the dominant species with 7.4% cover. Cheatgrass was the dominant invasive species with 3.6% canopy cover.

Tree transect monitoring indicated 86% survival from 2015, equating to an overall survival rate of 68% for transplanted black cottonwoods, redosier dogwoods, and coyote willows. The debris fence was still in place and several of the fence posts have sprouted new growth (Figure 15).

X = present but not counted in plot frames



Figure 14. The 181-NE/1908-NE Waste Site in 2016.

Table 9. Percent Canopy Cover and Frequency of Occurrence at the 1908-N/181-NE Waste Site in 2016. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (common yarrow)	0.60	4.00
Agropyron spicatum (bluebunch wheatgrass)	7.40	60.00
Artemisia tridentata (big sagebrush)	0.70	8.00
Bromus tectorum ^a (cheatgrass)	3.60	88.00
Centaurea diffusa a (diffuse knapweed)	0.10	4.00
Chrysothamnus nauseosus (gray rabbitbrush)	0.20	8.00
Convolvulus arvensis ^a (field bindweed)	0.10	4.00
Lactuca serriola ^a (prickly lettuce)	0.60	24.00
Melilotus alba ^a (sweetclover)	X	Χ
Phalaris arundinacea a (reed canary-grass)	0.60	4.00
Poa sandbergii (Sandberg's bluegrass)	0.40	16.00
Poa pratensis (Ky bluegrass)	X	Χ
Populus trichocarpa (black cottonwood)	0.60	4.00
Ribes aureum (golden currant)	X	Χ
Rosa woodsii (Woods' rose)	0.70	8.00
Salix exigua (coyote willow)	0.70	8.00
Salsola kali ^a (Russian thistle)	0.80	32.00
Sisymbrium altissimum a (tumble mustard)	0.60	24.00
Tragopogon dubius ^a (yellow salsify)	0.10	4.00
Triticum aestivum a (common wheat)	0.20	8.00
Verbascum Thapsus ^a (common mullein)	X	Χ

Table 9. Percent Canopy Cover and Frequency of Occurrence at the 1908-N/181-NE Waste Site in 2016. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Artr recruits	0.50	20.00
Crust	0.00	0.00
Soil	83.60	100.00
Litter	13.50	100.00
Total canopy cover (excludes crust/soil/litter)	18.50	
Total native % cover	11.80	
Change in native % cover from 2015	-8.20	
Total invasive % cover	6.70	
Change in invasive % cover from 2015	-0.60	

^a Invasive species.

X = present but not counted in plot frames

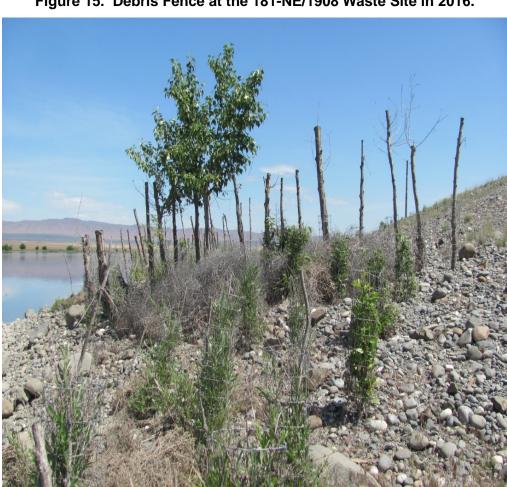


Figure 15. Debris Fence at the 181-NE/1908 Waste Site in 2016.

2.3.3 100-N-47 Military Artillery Site

Fourth-year monitoring was conducted at the 100-N-47 site on May 18, 2016 (Figure 16). Total canopy cover represented 55%. Native species accounted for 19.7% of the canopy cover and invasive species accounted for 35.3% of the canopy cover (Table 10). Cheatgrass (invasive) was the dominant species with 26.7% cover. Bluebunch wheatgrass was the dominant native species with 3.6% canopy cover.



Figure 16. The 100-N-47 Site in 2016.

Table 10. Percent Canopy Cover and Frequency of Occurrence at the 100-N-47 Site in 2016. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	1.30	12.00
Agropyron cristatum ^a (crested wheatgrass)	0.60	4.00
Agropyron spicatum (bluebunch wheatgrass)	3.60	28.00
Amsinckia lycopsoides (tarweed fiddleneck)	0.70	8.00
Artemisia tridentata (big sagebrush)	3.60	12.00
Bromus tectorum ^a (cheatgrass)	26.70	96.00
Centaurea diffusa a (diffuse knapweed)	0.30	12.00
Convolvulus arvensis ^a (field bindweed)	1.00	20.00
Descurainia pinnata (western tansymustard)	Х	Х
Erigeron pumilus (shaggy fleabane)	X	Х
Atriplex spinosa (spiny hopsage)	0.10	4.00
Holosteum umbellatum a (jagged chickweed)	0.10	4.00

Table 10. Percent Canopy Cover and Frequency of Occurrence at the 100-N-47 Site in 2016. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Lactuca seriola a (prickly lettuce)	0.10	4.00
Plantago patagonica(Indian wheat)	0.10	4.00
Poa sandbergii (Sandberg's bluegrass)	8.10	88.00
Salsola kali ^a (Russian thistle)	2.70	88.00
Sisymbrium altissimum ^a (tumble mustard)	3.80	56.00
Sphaeralcea munroana (Munro's globemallow)	1.20	8.00
Sporobolus cryptandrus (sand dropseed)	0.70	8.00
Stipa comata (needle-and-thread grass)	X	Х
Tragopogon dubius ^a (yellow salsify)	X	Х
Festuca microstachys (desert fescue)	0.10	4.00
Artr recruits	0.20	8.00
Crust	0.00	0.00
Soil	0.00	0.00
Litter	0.00	0.00
Total canopy cover (excludes crust/soil/litter)	55.00	
Total native % cover	19.70	
Change in native % cover from 2015	-6.10	
Total invasive % cover	35.30	
Change in invasive % cover from 2015	-3.20	

^a Invasive species.

Shrub transect monitoring indicated 81.5% survival from 2015, equating to an overall survival rate of 44% for transplanted shrubs. Despite the decline in transplanted shrubs, sagebrush recruits are establishing on the site so shrub densities should continue to increase.

2.3.4 130-N-1:1 Site (183-N Northeastern Backwash Discharge Pond)

Second-year monitoring was conducted at the 130-N-1:1 site on May 12, 2016 (Figure 17). For monitoring purposes the site was broken down into Area 1 (cobbly) and Area 2 (loamy). Canopy cover for Area 2 was over twice that recorded in Area 1, 53.8% versus 18.4%, resulting in an average coverage of 36.1% for the site overall (Table 11). Area 1 had relatively equal cover for native and invasive vegetation with 8.8% native and 9.6% invasive. Native vegetation accounted for only 5.7% of the cover in Area 2 while invasive vegetation accounted for 48.1% of the canopy cover in that area. The most dominant species were cheatgrass, Russian thistle, and tumble mustard with average canopy cover of 14%, 7.2%, and 6.2%, respectively, for the overall site. The dominant native species was dominated tarweed fiddleneck with average cover of 2.2%.

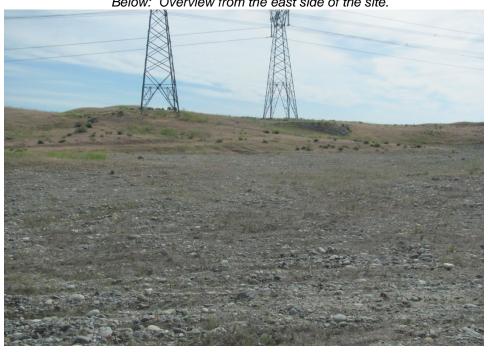
Shrub transect monitoring showed a survival rate of 68.3% in Area 1 and a very low survival rate of only 6% in Area 2, equating to an average survival rate of 36.8% for the site overall.

X = present but not counted in plot frames



Figure 17. The 130-N-1:1 Site in 2016.

Above: One of two revegetated strips in the north part of the site.



Below: Overview from the east side of the site.

Table 11. Percent Canopy Cover and Frequency of Occurrence at the 130-N-1:1 Site in 2016.

	Area 1	(cobbly)	Area 2	(loamy)	Entire Site		
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence	
Agropyron spicatum (bluebunch wheatgrass)	2.40	56.00			1.20	28.00	
Amsinckia lycopsoides (tarweed fiddleneck)	0.10	4.00	4.30	40.00	2.20	22.00	
Artemisia tridentata (big sagebrush)	0.90	16.00	0.20	8.00	0.55	12.00	
Bromus tectorum a (cheatgrass)	3.90	96.00	24.10	100.00	14.00	98.00	
Chorispora tenella a (blue mustard)	0.10	4.00			0.05	2.00	
Chrysothamnus nauseosous (gray rabbitbrush)	Х	Х			Х	Х	
Descurainia pinnata (western tansymustard)	0.10	4.00	0.20	8.00	0.15	6.00	
Draba verna ^a (spring whitlow grass)			0.60	24.00	0.30	12.00	
Erodium cicutarium ^a (redstem stork's bill)			0.10	4.00	0.05	2.00	
Holosteum umbellatum a (jagged chickweed)	0.10	4.00	1.30	52.00	0.70	28.00	
Hordeum murinum ^a (hare barley)			0.60	4.00	0.30	2.00	
Lamium amplexicaule ^a (henbit deadnettle)			0.10	4.00	0.05	2.00	
Melilotus officinalis ^a (sweet clover)	Х	Х			X	X	
Oryzopsis hymenoides (Indian ricegrass)	2.40	76.00			1.20	38.00	
Poa bulbosa ^a (bulbous bluegrass)			0.10	4.00	0.05	2.00	
Poa sandbergii (Sandberg's bluegrass)	2.80	72.00	0.80	32.00	1.80	52.00	
Salsola kali ^a (Russian thistle)	3.80	92.00	10.60	92.00	7.20	92.00	
Sisymbrium altissimum ^a (tumble mustard)	1.70	48.00	10.60	96.00	6.15	72.00	
Sphaeralcea munroana (Munro's							
globemallow)		4.00	X	X	X	X	
Stipa comata (needle-and-thread grass)	0.10	4.00	X	X	0.05	2.00	
Triticum aestivum a (common wheat)			X	X	X	X	
Festuca microstachys (desert fescue)			0.20	8.00	0.10	4.00	
Crust	0.00	0.00	0.00	0.00	0.00	0.00	
Soil	52.80	100.00	59.90	100.00	56.35	100.00	
Litter Total canopy cover (excludes	36.60	100.00	24.20	100.00	30.40	100.00	
crust/soil/litter)	18.40		53.80		36.10		
Total native % cover	8.80		5.70		7.25		
Change in native % cover from 2015	-6.20		-17.10		-11.65		
Total invasive % cover	9.60		48.10		28.85		
Change in invasive % cover from 2015	+5.30		+28.80		+17.05		
a							

^a Invasive species.

X = present but not counted in plot frames
-- = species not observed on site

2.3.5 100-N-96 Site (Military Camp Disposal Pits)

Site 100-N-96 is a culturally sensitive site that had additional revegetation treatment beyond the typical effort in response to the Memorandum of Agreement (MOA) regarding the remediation of the 100-N-96 waste site (HCRC#2010-100-111a [WCH 2013]). The site was seeded with additional native forb species including matted cryptantha (*Cryptantha circumscissa*), Columbia milkvetch (*Astragalus succumbens*), woolypod milkvetch (*Astragalus sclerocarpus*), Douglas' dustymaiden (*Chaenactis douglassii*), common yarrow (*Achillea millefolium*), miraposa lily (*Calochortus macrocarpus*), Western prairie clover (*Dalea ornata*), turpentine spring-parsley (*Cymopterus terebinthinus*), shaggy fleabane (*Erigeron pumilus*), longleaf phlox (*Phlox longifolia*), silverleaf phacelia (*Phacelia hastata*), wooly plantain (*Plantago patagonica*), Munro's globemallow (*Sphaeralcea munroana*), broom buckwheat (*Eriogonum vimineum*), snow buckwheat (*Eriogonum niveum*), Carey's balsamroot (*Balsamorhiza careyana*), pale evening primrose (*Oenothera pallida*), and dune scurfpea (*Psoralea lanceolata*). Gray rabbitbrush (*Chrysothamnus nauseousus*) and green rabbitbrush (*Chrysothamnus viscidiflorus*) were also planted in addition to the normal sagebrush, bitterbrush, and hopsage plantings.

First-year monitoring was conducted at the 100-N-96 site on May 19, 2016 (Figure 18). Substrates are primarily a cobbly sandy loam inner circle surrounded by a loamy circle. Total canopy cover for the site was at 29.6%, consisting of 3.9% native cover and 25.7% invasive cover (Table 12). Russian thistle (invasive) was the dominant species with 18% canopy cover. Young bunchgrasses accounted for the highest abundance of native species with 2.3% canopy cover.

A 75-m (246-ft) shrub transect was established, running west to east across the site. A total of 19 shrubs were recorded along the transect – 18 sagebrush and 1 spiny hopsage.



Figure 18. The 100-N-96 Site in 2016.

Table 12. Percent Canopy Cover and Frequency of Occurrence at the 100-N-96 Site in 2016.

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	0.20	8.00
Agropyron spicatum (bluebunch wheatgrass)	0.10	4.00
Amsinckia lycopsoides (tarweed fiddleneck)	0.20	8.00
Artemisia tridentata (big sagebrush)	0.20	8.00
Bromus tectorum ^a (cheatgrass)	4.50	80.00
Bunchgrasses ^b	2.30	92.00
Centaurea diffusa a (diffuse knapweed)	X	Х
Chenopodium leptophyllum (slimleaf goosefoot)	0.20	8.00
Chrysothamnus nauseosous (gray rabbitbrush)	X	X
Draba verna ^a (spring whitlow grass)	0.10	4.00
Atriplex spinosa (spiny hopsage)	X	Χ
Holosteum umbellatum a (jagged chickweed)	0.10	4.00
Hordeum murinum ^a (hare barley)	X	X
Melilotus officinalis a (sweet clover)	X	X
Plantago patagonica (Indian wheat)	X	Χ
Poa sandbergii (Sandberg's bluegrass)	0.70	28.00
Raphanus raphanistrum ^a (wild radish)	0.10	4.00
Salsola kali ^a (Russian thistle)	18.00	100.00
Sisymbrium altissimum a (tumble mustard)	2.30	72.00
Sphaeralcea munroana (Munro's globemallow)	X	Χ
Triticum ^a (wheat)	0.60	24.00
Crust	0.00	0.00
Soil	64.50	100.00
Litter	33.50	100.00
Total canopy cover (excludes crust/soil/litter)	29.60	
Total native % cover	3.90	
Total invasive % cover	25.70	

^a Invasive species.

2.4 100-D SITES

The 600-30 waste site in the 100-D Area was revegetated in FY 2012, the 100-D-8 and 100-D-65/66 waste sites were revegetated in FY 2013, the 118-D-2 waste site was revegetated in FY 2014, the 100-D-30/104 waste site was revegetated in FY 2015, and the 100-D-100 site was revegetated in FY 2016. These sites were remediated to meet the objectives for interim closure as established in the 100 Area RDR/RAWP (DOE-RL 2009) and in the Interim Action ROD (EPA 1999).

These sites were backfilled with pit-run gravel and revegetated by either broadcast seeding or hydroseeding with native grass seeds including Sandberg's bluegrass, sand dropseed,

^b Bunchgrasses include Agropyron spicatum, Koeleria cristata, Oryzopsis hymenoides, Sitanion hystrix, Sporobolus cryptandrus, and Stipa comata.

X = present but not counted in plot frames

needle-and-thread grass, bluebunch wheatgrass bottlebrush squirreltail, and prairie junegrass. Upon the completion of seeding, all upland areas were mulched with approximately 4,480 kg/ha (4,000 lb/ac) of straw and crimped into the soil surface to prevent wind erosion. The sites were then planted with shrubs at approximately 1,235 to 1,605 plants/ha (500 to 650 plants/ac) with a mix of approximately 75% sagebrush, 15% bitterbrush, and 10% spiny hopsage. However, in FY 2016, planting ratios varied from 60 to 75% sagebrush, 5 to 15% bitterbrush, 10 to 30% hopsage, and, additionally, approximately 1% gray rabbitbrush (*Chrysothamnus nauseousus*) and green rabbitbrush (*Chrysothamnus viscidiflorus*) (cumulatively). In areas with steep slopes, hydroseeding was utilized instead of broadcast seeding and straw mulching. In addition, water was applied to the sites at approximately 28,070 L/ha (3,000 gal/ac), as needed, during the revegetation process (most recently occurring during March 2015).

The 100-D-8, 100-D-65, and 100-D-66 waste sites represented unique opportunities as they are adjacent to the Columbia River. In addition to the prescribed treatments listed above, these sites also received riparian prescriptions that included additional species such as black cottonwood (*Populus trichocarpa*), coyote willow (*Salix exigua*), peachleaf willow (*Salix amygdaloides*), redosier dogwood (*Cornus stolonifera*), chokecherry (*Prunus virginiana*), Woods' rose (*Rosa woodsii*), and golden currant (*Ribes aureum*). Originally, less than half of the riparian shrubs and trees received protective caging to minimize damage from herbivory. Due to the site locations within major wildlife corridors, within the days directly following the plantings, major damage occurred (primarily from beaver [*Castor Canadensis*]), the decision was made to cage all riparian plantings. In the summer of 2016, monitoring staff noted that many of the transplanted trees were out growing their protective cages and recommended removal of the fencing; removal was conducted in July 2016. Major damage from herbivory was noted in August 2016. Nearly all of the living riparian trees at 100-D-8, 100-D-65, and 100-D-66 fell prey to beaver damage. Interestingly, redosier dogwoods were among the only remaining planted tree species observed in August 2016.

2.4.1 100-D-8 Site (105-DR Process Sewer Outfall)

Fourth-year monitoring was conducted at the 100-D-8 site on May 26, 2016 (Figure 19). Canopy cover for the site was 43.2%, consisting of 12.8% native cover and 30.4% invasive cover (Table 13). Native cover was mainly represented by bluebunch wheatgrass with 5% canopy cover. Invasive cover was represented mainly by cheatgrass, which was the dominant species for the site with 16.7% canopy cover.



Figure 19. The 100-D-8 Waste Site in 2016.

Above: Lower area vegetation.



Below: Upper area vegetation.

Table 13. Percent Canopy Cover and Frequency of Occurrence at the 100-D-8 Site in 2016.

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	1.20	8.00
Agropyron spicatum (bluebunch wheatgrass)	5.00	28.00
Amsinckia lycopsoides (tarweed fiddleneck)	0.10	4.00
Artemisia biennis ^a (biennial wormwood)	6.30	24.00
Artemisia tridentata (big sagebrush)	2.40	16.00
Bromus tectorum ^a (cheatgrass)	16.70	92.00
Carex sp. (sedge)	Х	Х
Centaurea diffusa a (diffuse knapweed)	0.10	4.00
Chrysothamnus nauseosous (gray rabbitbrush)	0.10	4.00
Cirsium arvense ^a (Canada thistle)	0.10	4.00
Convolvulus arvensis ^a (field bindweed)	Х	Х
Coreopsis atkinsoniana (Columbia tickweed)	Х	Х
Cornus stolonifera (redosier dogwood)	0.60	4.00
Eriogonum niveum (snow buckwheat)	Х	Х
Lactuca serriola ^a (prickly lettuce)	Х	Х
Melilotus officinalis ^a (sweet clover)	0.60	4.00
Morus alba ^a (white mulberry)	1.50	4.00
Phalaris arundinacea ^a (reed canarygrass)	1.50	4.00
Plantago lanceolata (English plantain)	Х	Х
Poa sandbergii (Sandberg's bluegrass)	2.00	40.00
Populus trichocarpa (black cottonwood)	0.60	4.00
Prunus virginiana (chokecherry)	Х	Х
Purshia tridentata (antelope bitterbrush)	0.10	4.00
Rosa gymnocarpa (woods rose)	0.60	4.00
Salix exigua (coyote willow)	Х	Х
Salsola kali ^a (Russian thistle)	1.00	40.00
Sisymbrium altissimum ^a (tumble mustard)	1.80	32.00
Sitanion hystrix (bottlebrush squirreltail)	Х	Х
Sphaeralcea munroana (Munro's globemallow)	Х	Х
Stipa comata (needle-and-thread)	Х	Х
Tragopogon dubius ^a (yellow salsify)	Х	Х
Triticum eastivum ^a (common wheat)	0.10	4.00
Verbascum thapsus ^a (common mullein)	0.70	8.00
Artr recruits	0.10	4.00
Crust	0.00	0.00
Soil	57.90	100.00
Litter	34.90	100.00
Total canopy cover (excludes crust/soil/litter)	43.20	
Total native % cover	12.80	
Change in native % cover from 2015	-0.07	
Total invasive % cover	30.40	
Change in invasive % cover from 2015	-2.60	

^a Invasive species.

X = present but not counted in plot frames

Transect monitoring indicated an overall survival rate of 26.7% for monitored trees, consisting of a 32% survival rate for monitored black cottonwoods, 42.9% for redosier dogwoods, and a 4.6% survival rate for coyote willows. Monitoring staff noted that much of the protective fencing around the transplanted trees was potentially restricting growth and recommended removal of the fencing; removal was conducted in July 2016. Heavy herbivory was noted during a site visit the following month when only redosier dogwoods and chokecherry were observed. Signs of beaver herbivory were evident on the remaining stumps of some of the cottonwoods.

2.4.2 100-D-65/66 Outfalls Site

Fourth-year monitoring was conducted at the 100-D-65 and 100-D-66 outfalls on May 31, 2016 (Figure 20). Total canopy cover for the site was 45.5%, consisting of 25% native cover and 20.5% invasive cover, fairly consistent with the 2015 cover. Bluebunch wheatgrass was the dominant native species with 14.6% canopy cover and cheatgrass was the dominant invasive species with 16.2% canopy cover (Table 14).



Figure 20. The 100-D-65/66 Outfalls Site in 2016.

Table 14. Percent Canopy Cover and Frequency of Occurrence at the 100-D-65/66 Outfalls Site in 2016. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	1.30	12.00
Agropyron spicatum (bluebunch wheatgrass)	14.60	48.00
Artemisia biennis (biennial wormwood)	3.00	24.00
Artemisia tridentata (big sagebrush)	1.90	16.00

Table 14. Percent Canopy Cover and Frequency of Occurrence at the 100-D-65/66 Outfalls Site in 2016. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Bromus japonicas a (Japanese brome)	0.80	12.00
Bromus tectorum ^a (cheatgrass)	16.20	92.00
Centaurea diffusa a (diffuse knapweed)	0.40	16.00
Chrysothamnus nauseosa (gray rabbitbrush)	0.60	4.00
Cirsium arvense ^a (Canada thistle)	0.10	4.00
Convolvulus arvensis a (field bindweed)	Х	Х
Coreopsis tinctoria (Columbia tickweed)	0.10	4.00
Cymopterus terebinthinus (turpentine spring parsley)	0.10	4.00
Microsteris gracilis (slender phlox)	X	Χ
Morus alba ^a (white mulberry)	1.20	8.00
Phalaris arundinacea ^a (reed canary-grass)	1.50	4.00
Plantago lanceolata (English plantain)	0.30	12.00
Poa sandbergii (Sandberg's bluegrass)	0.90	16.00
Populus trichocarpa (black cottonwood)	0.60	4.00
Prunus virginiana (chokecherry)	X	Χ
Purshia tridentata (antelope bitterbrush)	X	Χ
Ribes aureum (golden currant)	0.70	8.00
Rosa woodsii (woods rose)	0.60	4.00
Salix exigua (coyote willow)	0.10	4.00
Salsola kali ^a (Russian thistle)	X	Χ
Sitanion hystrix (bottlebrush squirreltail)	X	Χ
Sporobolus cryptandrus (sand dropseed)	0.20	8.00
Triticum eastivum ^a (common wheat)	0.10	4.00
Verbascum thapsus a (common mullein)	0.20	8.00
Crust	0.00	0.00
Soil	54.80	100.00
Litter	39.50	100.00
Total canopy cover (excludes crust/soil/litter)	45.50	
Total native % cover	25.00	
Change in native % cover from 2015	+0.60	
Total invasive % cover	20.50	
Change in invasive % cover from 2015	+4.70	

^a Invasive species.

Consistent with previous years (2013, 2014, and 2015), planted tree cuttings, despite protective cages, experienced heavy damage from wildlife resulting in a loss of over 50% from the previous year. Mule deer (*Odocoileus hemionus*) are present throughout the Hanford Site and frequently use riparian and terrestrial travel routes delineated by the Columbia River shoreline. In Washington, during the months of August and September, mule deer antler growth usually peaks and the antlers begin hardening (mineralizing). Within a few weeks, bucks begin shedding their velvet. To shed the velvet, bucks scrape their antlers on a variety of vegetation. If present, young trees make ideal candidates for scraping. In addition, during the rut bucks will

X = present but not counted in plot frames

rub their antlers on trees and other vegetation to leave scent for does and to mark their territory to other bucks in the area. Damage accrued at this site was primarily incurred by mule deer, which are frequently present on the site.

Tree transect monitoring indicated a 14.5% overall survival rate for monitored trees since initial planting and 47.4% overall survival rate from 2015. From initial planting in FY 2013, black cottonwoods showed a survival rate of 21.9%, coyote willows had a survival rate of 4.6%, and peach-leaf willows had a survival rate of 20%. The three redosier dogwoods originally planted in FY 2013 and observed along the transect are no longer present but others were observed on the site. Monitoring staff noted that much of the protective fencing around the remaining transplanted trees was potentially restricting growth and recommended removal of the fencing; removal was conducted in July 2016. Heavy herbivory was noted during a site visit the following month when only redosier dogwoods were observed.

2.4.3 600-30 (100-DR Construction Laydown Area)

Fifth-year monitoring was conducted at the 600-30 site on May 26, 2016 (Figure 21). Monitoring results indicated canopy cover at 48.9%, consisting of 21.9% native cover and 27% invasive cover (Table 15). Invasive cheatgrass was the dominant species with 23.3% canopy cover and occurring in every plot. Native Munro's globemallow with 6% and Sandberg's bluegrass with 5.1% canopy cover were the next most dominant species. Previous reports stated that two distinct vegetative zones had established, Area 1 in the southern and eastern portions of the site where Munro's globemallow was the dominant native species present with regard to canopy cover and Area 2 in the northern and western areas of the site where Sandberg's bluegrass was the dominant native species present with regard to canopy cover. This vegetation distinction was not as prevalent this year as Munro's globemallow was recorded in both areas with comparable coverages (5.1% in Area 1 and 6.9% in Area 2); Sandberg's bluegrass was the dominant species in Area 1 with 8.4% but not so in Area 2 where it had only 1.8% canopy cover.



Figure 21. The 600-30 Site in 2016.

Table 15. Percent Canopy Cover and Frequency of Occurrence at the 600-30 Site in 2016. (2 Pages)

	Area 1 (South and East)			2 (North West)	Entir	e Site
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
Achillea millefolium (yarrow)	1.60	24.00	2.50	40.00	2.05	32.00
Agropyron spicatum (bluebunch wheatgrass)	0.40	16.00	Х	Х	0.20	8.00
Ambrosia acanthicarpa (bur ragweed)	Χ	Χ	Х	Χ	0.00	0.00
Amsinckia lycopsoides (tarweed fiddleneck)	Х	Х	Х	Χ	0.00	0.00
Artemisia tridentata (big sagebrush)	0.60	4.00	2.10	8.00	1.35	6.00
Astragalus purshii (wolloypod milkvetch)	0.60	4.00	0.60	4.00	0.60	4.00
Balsamorhiza careyana (Carey's balsamroot)	1.50	4.00	1.50	4.00	1.50	4.00
Bromus tectorum ^a (cheatgrass)	20.70	100.00	25.80	100.00	23.25	100.00
Centaurea diffusa a (diffuse knapweed)	Χ	Χ	0.60	4.00	0.30	2.00
Chondrilla juncea ^a (rush skeletonweed)	Χ	Χ	Χ	Χ	0.00	0.00
Chrysothamnus neaseosus (gray rabbitbrush)	Х	Х			0.00	0.00
Draba verna ^a (spring whitlowgrass)	0.90	36.00	2.00	60.00	1.45	48.00
Erodium cicutarium ^a (redstem stork's bill)	Χ	Χ			0.00	0.00
Holosteum umbellatum ^a (jagged chickweed)	1.40	56.00	2.70	88.00	2.05	72.00
Hordeum murinum ^a (hare barley)	0.10	4.00			0.05	2.00
Machaeranthera canescens (hoary aster)	0.20	8.00	1.20	28.00	0.70	18.00
Oryzopsis hymenoides (Indian ricegrass)	0.20	8.00	0.70	8.00	0.45	8.00
Plantago patagonica (Indian wheat)	Χ	Х	0.10	4.00	0.05	2.00
Poa sandbergii (Sandberg's bluegrass)	8.40	84.00	1.80	72.00	5.10	78.00
Salsola kali ^a (Russian thistle)	2.10	84.00	1.00	40.00	1.55	62.00
Sisymbrium altissimum a (tumble mustard)	2.30	52.00	1.60	44.00	1.95	48.00
Sitanion hystrix (bottlebrush squirreltail)	0.10	4.00	0.10	4.00	0.10	4.00
Sphaeralcea munroana (Munro's globemallow)	5.10	16.00	6.90	40.00	6.00	28.00
Sporobolus cryptandrus (sand dropseed)	Χ	Χ			0.00	0.00
Stipa comata (needle-and-thread grass)	Χ	X	0.10	4.00	0.05	2.00
Artr recruits	0.20	8.00			0.10	4.00
Crust	0.00	0.00	0.00	0.00	0.00	0.00
Soil	61.20	100.00	55.90	100.00	58.55	100.00
Litter	23.50	100.00	27.80	100.00	25.65	100.00

Table 15. Percent Canopy Cover and Frequency of Occurrence at the 600-30 Site in 2016. (2 Pages)

		(South East)		2 (North West)	Entir	e Site
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
Total canopy cover (excludes crust/soil/litter)	46.40		51.30		48.85	
Total native % cover	19.00		22.30		21.90	
Change in native % cover from 2015	-10.30		+6.00		-0.90	
Total invasive % cover	24.90		29.00		26.95	
Change in invasive % cover from 2015	+2.40		+6.60		+4.50	

^a Invasive species.

Area 1 and Area 2 substrates primarily consist of sandy loam and loamy sands, although Area 2 may have slightly higher amounts of cobble in select areas. Consistent with previous years, Area 1 had slightly higher species diversity with 26 species observed as opposed to Area 2, which had 21 species noted.

Shrub monitoring indicated a 30% survival rate for monitored shrubs, showing no loss over the last year.

2.4.4 118-D-2 Site (100-D Burial Ground No. 2)

Third-year monitoring was conducted at the 118-D-2 site on May 31, 2016 (Figure 22). This is a larger site that was broken down into three areas (east, southwest, and northwest) for monitoring purposes with 25 plots and 1 shrub transect per area. Substrates vary throughout this site with primarily loamy sands in the northwest area and cobbles with varying amounts of sandy loam and loamy sand in the east and southwest areas.

Total canopy cover for the area overall was 42.8%. Cover consisted of 4.4% native cover and 37.7% invasive cover (Table 16). Invasive cheatgrass was the dominant species with 24.5% canopy cover followed by Russian thistle and tumble mustard (also invasive) with 6.7% and 5% canopy cover, respectively. Sandberg's bluegrass was the dominant native species with only about 2% canopy cover.

Shrub transect monitoring indicated a slight loss of about 5% (one plant) from that recorded for 2015, resulting in an overall 6.4% survival rate for transplanted shrubs. Only sagebrush transplants remain with an 8.2% survival rate.

X = present but not counted in plot frames

^{-- =} species not observed on site



Figure 22. The 118-D-2 Site in 2016.

Table 16. Percent Canopy Cover and Frequency of Occurrence at the 118-D-2 Site in 2016. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	X	Х
Agropyron spicatum (bluebunch wheatgrass)	0.10	4.00
Amsinckia lycopsoides (tarweed fiddleneck)	0.10	4.00
Artemisia tridentata (big sagebrush)	0.70	8.00
Bromus tectorum ^a (cheatgrass)	24.53	97.33
Bunchgrasses ^b	X	Χ
Calochortus macrocarpus (miraposa lily)	0.03	1.33
Centaurea diffusa a (diffuse knapweed)	0.20	1.33
Chrysothamnus nauseousus (gray rabbitbrush)	0.00	0.00
Draba verna a (spring whitlow grass)	0.50	13.33
Erodium cicutarium ^a (redstem stork's bill)	0.03	1.33
Holosteum umbellatum ^a (jagged chickweed)	1.00	26.67
Hordeum leporinum ^a (hare barley)	0.03	1.33
Lactuca seriola a (prickly lettuce)	0.13	5.33
Lepidium perfoliatum ^a (clasping pepperweed)	0.03	1.33
Microsteris gracilis (pink microsteris)	1.03	14.67

Table 16. Percent Canopy Cover and Frequency of Occurrence at the 118-D-2 Site in 2016. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Oryzopsis hymenoides (Indian ricegrass)	X	Х
Plantago patagonica (Indian wheat)	0.20	2.67
Poa sandbergii (Sandberg's bluegrass)	1.97	52.00
Salsola kali ^a (Russian thistle)	6.73	88.00
Sisymbrium altissimum a (tumble mustard)	4.97	68.00
Sitanion hystrix (bottlebrush squirreltail)	X	Χ
Sphaeralcea munroana (Munro's globemallow)	0.20	1.33
Stipa comata (needle-and-thread grass)	0.20	1.33
Tragopogon dubius ^a (yellow salsify)	0.10	4.00
Crust	0.00	0.00
Soil	66.23	100.00
Litter	27.37	100.00
Total canopy cover (excludes crust/soil/litter)	42.80	
Total native % cover	4.43	
Change in native % cover from 2015	-8.44	
Total invasive % cover	37.77	
Change in invasive % cover from 2015	+4.77	

a Invasive species.

2.4.5 100-D-30/104 Site (183-N Northeastern Backwash Discharge Pond)

Second-year monitoring was conducted at the 100-D-30/104 site on June 9 and 13 through 15, 2016 (Figure 23). For monitoring purposes, the site was divided into 5 areas with 25 plot frames and 1 transect per area. Substrates at the site primarily consist of very cobbly loamy sand. Total average canopy cover was at 19.5%, consisting of 5.7% native cover and 13.8% invasive cover (Table 17). Russian thistle (invasive) was the dominant species with 10.5% canopy cover. Bunchgrasses were the dominant native species accounting for 2% of the canopy cover.

^b Bunchgrasses include Agropyron spicatum, Koeleria cristata, Oryzopsis hymenoides, Sitanion hystrix, Sporobolus cryptandrus, and Stipa comata.

X = present but not counted in plot frames



Figure 23. The 100-D-30/104 Site in 2016.

Above: View of the west portion of the 100-D-30/104 site from the north.



Below: View from the west side of the 100-D-30/104 site.

Table 17. Percent Canopy Cover and Frequency of Occurrence at the 100-D-30/104 Site in 2016.

Species	% Cover	% Frequency of Occurrence
Agrypyron spicatum (bluebunch wheatgrass)	0.96	26.40
Artemisia tridentata (big sagebrush)	0.48	19.20
Bromus tectorum ^a (cheatgrass)	1.22	44.80
Bunchgrasses ^b	2.00	80.00
Centaurea diffusa a (diffuse knapweed)	0.14	2.40
Chrysothamnus nauseousus (gray rabbitbrush)	0.12	0.80
Machaeranthera canescens (hoary aster)	0.02	0.80
Melilotus alba ^a (sweetclover)	0.84	6.40
Oryzopsis hymenoides (Indian ricegrass)	1.10	24.80
Poa sandbergii (Sandberg's bluegrass)	0.52	16.80
Raphanus raphanistrum ^a (wild radish)	0.14	5.60
Salsola kali ^a (Russian thistle)	10.48	95.20
Sisymbrium altissimum a (tumble mustard)	0.64	21.60
Sitanion hystrix (bottlebrush squirreltail)	0.02	0.80
Stipa comata (needle-and-thread grass)	0.48	12.00
Tragopogon dubius ^a (yellow salsify)	0.04	3.20
Triticum aestivum ^a (common wheat)	0.28	11.20
Crust	0.00	0.00
Soil	58.14	100.00
Litter	41.22	100.00
Total canopy cover (excludes crust/soil/litter)	19.48	
Total native % cover	5.70	
Change in native % cover from 2015	-11.35	
Total invasive % cover	13.78	
Change in invasive % cover from 2015	8.14	

a Invasive species

Shrub transect monitoring showed a survival rate of 68.9% from 2015, all sagebrush. Despite the limited success to date, wildlife appear to inhabit the area as deer were observed on the site on multiple occasions during the monitoring process (Figure 24).

^b Bunchgrasses include Agropyron spicatum, Koeleria cristata, Oryzopsis hymenoides, Sitanion hystrix, Sporobolus cryptandrus, and Stipa comata.



Figure 24. Deer Observed on the 100-D-30/104 Site in 2016.

2.4.6 100-D-100 Site (Process Sewer, Unplanned Release 183-DR Railroad Tracks)

First-year monitoring was conducted at the 100-D-100 site in June 2016 (Figure 25). Substrates are primarily cobbles with varying amounts of loamy sand. This is a larger area that was broken down into three areas for monitoring purposes – north (Area 1), central (Area 2), and south (Area 3). Monitoring consisted of 25 plot frames and one 100-m (328-ft) transect for each area. Total canopy cover for the site was at 11%, consisting of 4.8% native cover and 6.2% invasive cover (Table 18). Russian thistle (invasive) was the dominant species with 5.3% cover. Young bunchgrasses accounted for the highest abundance of native species with 2.1% cover.

Three 100-m (328-ft) shrub transects were established on the site. Transect 1 is in the north portion and runs northeast to southwest, Transect 2 is in the central portion and runs west to east, and Transect 3 is in the south portion and runs west to east. A total of 88 sagebrush and 50 antelope bitterbrush were recorded along the transects for the area.



Figure 25. The 100-D-100 Site in 2016.

Table 18. Percent Canopy Cover and Frequency of Occurrence at the 100-D-100 Site in 2016. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Agropyron spicatum (bluebunch wheatgrass)	0.73	22.67
Amaranthus albus ^a (white pigweed)	0.03	1.33
Artemisia tridentata (big sagebrush)	0.37	14.67
Bromus tectorum ^a (cheatgrass)	0.30	12.00
Bunchgrasses ^b	2.10	84.00
Chrysothamnus nauseousus (gray rabbitbrush)	X	X
Melilotus officinalis ^a (sweet clover)	0.07	2.67
Orysopsis hymenoides (Indian ricegrass)	0.43	17.33
Poa sandbergii (Sandberg's bluegrass)	0.30	12.00
Purshia tridentata (antelope bitterbrush)	0.10	4.00
Raphanus raphanistrum ^a (wild radish)	0.07	2.67
Salsola kali ^a (Russian thistle)	5.30	94.67
Sisymbrium altissimum ^a (tumble mustard)	0.40	16.00
Sporobolus cryptandrus (sand dropseed)	0.27	10.67
Stipa comata (needle-and-thread grass)	0.50	20.00
Crust	0.00	0.00
Soil	72.67	100.00
Litter	26.47	100.00

Table 18. Percent Canopy Cover and Frequency of Occurrence at the 100-D-100 Site in 2016. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Total canopy cover (excludes crust/soil/litter)	10.97	
Total native % cover	4.80	
Total invasive % cover	6.17	

a Invasive species.

2.5 100-H SITES

In FY 2012, the 600-151 and 600-152 waste sites were revegetated in the 100-H Area. In FY 2013, the 128-H-1 waste site was revegetated and in FY 2016 the 100-H-28:2 waste site was revegetated. These sites were remediated to meet the objectives for interim closure as established in the 100 Area RDR/RAWP (DOE-RL 2009) and in the Interim Action ROD (EPA 1999).

The sites were backfilled with pit-run gravel and then revegetated by broadcast seeding native grass seeds including Sandberg's bluegrass, sand dropseed, needle-and-thread grass, bluebunch wheatgrass, and bottlebrush squirreltail. Upon the completion of seeding, the entire area was mulched with approximately 4,480 kg/ha (4,000 lb/ac) of straw and crimped into the soil surface to prevent wind erosion. The sites were then planted with shrubs at approximately 1,235 to 1,605 plants/ha (500 to 650 plants/ac) with a mix of approximately 75% sagebrush, 15% bitterbrush, and 10% spiny hopsage. However, in FY 2016, planting ratios varied from 60 to 75% sagebrush, 5 to 15% bitterbrush, 10 to 30% hopsage, and, additionally, approximately 1% gray rabbitbrush (*Chrysothamnus nauseousus*) and green rabbitbrush (*Chrysothamnus viscidiflorus*) (cumulatively). In addition, water was applied to the sites at approximately 28,070 L/ha (3,000 gal/ac), as needed, during the revegetation process (most recently occurring during March 2015).

2.5.1 600-151 Site (Dumping Area, Military Installation)

Fifth-year monitoring was conducted at the 600-151 site on May 25, 2016 (Figure 26). Substrates at this site primarily consist of sandy loam soils with small amounts of cobble. Total canopy cover was at 76.5%, consisting of 3.3% native cover and 72.1% invasive cover. Cheatgrass (invasive) was the dominant species with 41.5% canopy cover followed by clasping pepperweed (invasive) with 27% canopy cover (Table 19).

Shrub monitoring showed a slight decrease in sagebrush survival with 16.9% overall survival rate from original planting and 91.7% from shrubs surviving in 2015.

This site is surrounded by poor-quality habitat dominated by cheatgrass and clasping pepperweed, which has been challenging for the establishment of native vegetation.

^b Bunchgrasses include Agropyron spicatum, Koeleria cristata, Oryzopsis hymenoides, Sitanion hystrix, Sporobolus cryptandrus, and Stipa comata.

X = present but not counted in plot frames



Figure 26. The 600-151 Site in 2016.

Table 19. Percent Canopy Cover and Frequency of Occurrence at the 600-151 Site in 2016. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Agropyron spicatum (bluebunch wheatgrass)	0.33	13.33
Artemisia tridentata (big sagebrush)	1.00	6.67
Bromus tectorum ^a (cheatgrass)	41.50	100.00
Centaurea diffusa a (diffuse knapweed)	Х	X
Chrysothamnus nauseousus (gray rabbit brush)	Х	Χ
Draba verna ^a (spring whitlow grass)	0.33	13.33
Atriplex spinosa (spiny hopsage)	Х	X
Holosteum umbellatum ^a (jagged chickweed)	1.00	40.00
Hordeum leporinum ^a (hare barley)	Х	X
Lepidium perfoliatum ^a (clasping pepperweed)	27.00	93.33
Poa sandbergii (Sandberg's bluegrass)	2.00	46.67
Salsola kali ^a (Russian thistle)	Х	X
Sisymbrium altissimum a (tumble mustard)	3.33	33.33
Sphaeralcea munroana (Munro's globemallow)	Х	X
Artr recruits	Х	Χ
Crust	0.00	0.00
Soil	30.33	100.00
Litter	53.83	100.00

Table 19. Percent Canopy Cover and Frequency of Occurrence at the 600-151 Site in 2016. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Total canopy cover (excludes crust/soil/litter)	76.50	
Total native % cover	3.33	
Change in native % cover from 2015	-1.34	
Total invasive % cover	72.17	
Change in invasive % cover from 2015	+5.34	

a Invasive species.

2.5.2 600-152 Site (Military Septic Tanks)

Fifth-year monitoring was conducted at the 600-152 site on May 25, 2016 (Figure 27). Substrates at this site are primarily sandy loam soils with low amounts of cobbles. Total canopy cover was at 76%, consisting of 2.8% native cover and 73.2% invasive cover. Cheatgrass (invasive) was the dominant species with 45% canopy cover followed by clasping pepperweed (invasive) with 24.2% canopy cover (Table 20).



Figure 27. The 600-152 Site in 2016.

Above: Southern area.

X = present but not counted in plot frames



Table 20. Percent Canopy Cover and Frequency of Occurrence at the 600-152 Site in 2016. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Agropyron spicatum (bluebunch wheatgrass)	Х	Х
Ambrosia acanthicarpa (bur ragweed)	X	Χ
Amsinckia lycopsoides (tarweed fiddleneck)	1.17	13.33
Artemisia tridentata (big sagebrush)	X	Χ
Bromus tectorum ^a (cheatgrass)	45.00	93.33
Centaurea diffusa a (diffuse knapweed)	X	Χ
Chrysothamnus nauseosus (gray rabbitbrush)	1.00	6.67
Descurainia pinnata (western tansymustard)	X	Χ
Holosteum umbellatum ^a (jagged chickweed)	1.50	60.00
Lepidium perfoliatum ^a (clasping pepperweed)	24.17	86.67
Poa pratensis (Kentucky bluegrass)	X	Χ
Poa sandbergii (Sandberg's bluegrass)	0.67	26.67
Salsola kali ^a (Russian thistle)	0.17	6.67
Sisymbrium altissimum ^a (tumble mustard)	2.33	26.67
Crust	0.00	0.00
Soil	53.17	100.00
Litter	36.83	100.00

Table 20. Percent Canopy Cover and Frequency of Occurrence at the 600-152 Site in 2016. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Total canopy cover (excludes crust/soil/litter)	76.00	
Total native % cover	2.83	
Change in native % cover from 2015	-13.50	
Total invasive % cover	73.17	
Change in invasive % cover from 2015	+26.50	

^a Invasive species.

Shrub transect monitoring indicated that the five remaining sagebrush transplants observed in 2015 are still alive; the overall survival rate for shrubs remains at 12.2%. As noted in the 2014 and 2015 reports, gray rabbitbrush recruitment was observed throughout the site.

This site, like nearby 600-151, is surrounded by poor-quality habitat dominated by cheatgrass and clasping pepperweed, which has been challenging for the establishment of native vegetation.

2.5.3 128-H-1 Site (Burn Pit)

Fourth-year monitoring was conducted at the 128-H-1 site on May 25, 2016 (Figure 28). Substrates at this site are primarily composed of cobbles with varying amounts of loamy sand, although the upper portion of the site transitions into sandy loam with fewer cobbles. Total canopy cover was at 46.1%, consisting of 14.2% native species cover and 31.9% invasive species cover (Table 21). Cheatgrass (invasive) was the dominant with 23.1% canopy cover followed by Munro's globemallow (native) with 4.9% canopy cover.

A shrub transect was established in 2013 containing 99 shrubs consisting of sagebrush, bitterbrush, and spiny hopsage. Survival for monitored shrubs indicated sagebrush as the highest survival rate at 56.2% followed by spiny hopsage at 14.3% and antelope bitterbrush at 8.3%. This equates to an overall survival rate of 88% from 2015 and 44.4% since initial planting in 2013.

X = present but not counted in plot frames



Figure 28. The 128-H-1 Site in 2016.

Table 21. Percent Canopy Cover and Frequency of Occurrence at the 128-H-1 Site in 2016. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	0.70	8.00
Agropyron spicatum (bluebunch wheatgrass)	1.40	16.00
Artemisia tridentata (big sagebrush)	3.10	8.00
Astragalus purshii (woolypod milkvetch)	X	Χ
Bromus tectorum ^a (cheatgrass)	23.10	100.00
Centaurea diffusa a (diffuse knapweed)	0.30	12.00
Chenopodium leptophyllum (narrowleaf goosefoot)	0.10	4.00
Chrysothamnus nauseosus (gray rabbitbrush)	0.20	8.00
Draba verna ^a (spring whitlow grass)	0.30	12.00
Erodium cicutarium ^a (redstem stork's bill)	0.10	4.00
Atriplex spinosa (spiny hopsage)	0.60	4.00
Holosteum umbellatuma ^a (jagged chickweed)	0.20	8.00
Lepidium perfoliatum ^a (clasping pepperweed)	1.80	32.00
Macaeranthera canascens (hoary aster)	0.10	4.00
Poa bulbosa a (bulbous bluegrass)	0.20	8.00
Poa sandbergii (Sandberg's bluegrass)	2.80	72.00
Salsola kali ^a (Russian thistle)	1.40	56.00
Sisymbrium altissimum a (tumble mustard)	4.50	64.00
Sphaeralcea munroana (Munro's globemallow)	4.90	24.00
Sporobolus cryptandrus (sand dropseed)	0.10	4.00
Stipa comata (needle-and-thread grass)	X	Χ
Festuca microstachys (desert fescue)	0.10	4.00

Table 21. Percent Canopy Cover and Frequency of Occurrence at the 128-H-1 Site in 2016. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Artr recruits	0.10	4.00
Crust	0.00	0.00
Soil	68.90	100.00
Litter	24.00	100.00
Total canopy cover (excludes crust/soil/litter)	46.10	
Total native % cover	14.20	
Change in native % cover from 2015	-0.70	
Total invasive % cover	31.90	
Change in invasive % cover from 2015	+3.50	

^a Invasive species.

2.5.4 100-H-28:2 Site (Process Sewer)

First-year monitoring was conducted at the 100-H-28:2 site on July 11, 2016 (Figure 29). Substrates are primarily gravel and cobbles with varying amounts of loamy sand. This is a larger area that was broken down into two areas for monitoring purposes – north (Area 1) and south (Area 2). Monitoring consisted of 25 plot frames and one 100-m (328-ft) transect for each area. Total canopy cover for the site was at 17.2%, consisting of 3.8% native cover and 13.4% invasive cover (Table 22). Russian thistle (invasive) was the dominant species with 10.7% canopy cover. Young bunchgrasses accounted for the highest abundance of native species with 2.4% canopy cover.

Two 100-m (328-ft) shrub transects were established on the site. Transect 1 is in the north portion and runs east to west; Transect 2 is in the south portion and runs southwest to northeast. A total of 58 sagebrush were recorded along the transects for the area.

Figure 29. The 100-H-28:2 Site in 2016.

Above: Northern area.

X = present but not counted in plot frames



Table 22. Percent Canopy Cover and Frequency of Occurrence at the 100-H-28:2 Site in 2016.

Species	% Cover	% Frequency of Occurrence
Agropyron spicatum (bluebunch wheatgrass)	0.4	14.0
Amaranthus albus ^a (white pigweed)	X	Χ
Artemisia tridentata (big sagebrush)	0.3	12.0
Bromus tectorum a (cheatgrass)	0.3	12.0
Bunchgrasses ^b	2.4	96.0
Centaurea diffusa a (diffuse knapweed)	0.2	8.0
Chrysothamnus nauseosus (gray rabbitbrush)	X	Χ
Atriplex spinosa (spiny hopsage)	0.1	2.0
Melilotus officinalis ^a (sweet clover)	0.3	10.0
Poa sandbergii (Sandberg's bluegrass)	0.3	12.0
Purshia tridentata (antelope bitterbrush)	X	X
Raphanus raphanistrum ^a (wild radish)	0.2	8.0
Salsola kali ^a (Russian thistle)	10.7	98.0
Sisymbrium altissimum a (tumble mustard)	1.0	38.0
Sporobolus cryptandrus (sand dropseed)	0.1	4.0
Stipa comata (needle-and-thread grass)	0.3	12.0
Triticum aestivum a (common wheat)	0.8	30.0
Verbena bracteata	Х	Χ
Crust	0.0	0.0
Soil	63.5	100.0
Litter	34.6	100.0

Table 22. Percent Canopy Cover and Frequency of Occurrence at the 100-H-28:2 Site in 2016.

Species	% Cover	% Frequency of Occurrence
Total canopy cover (excludes crust/soil/litter)	17.15	
Total native % cover	3.80	
Total invasive % cover	13.35	

^a Invasive species.

3.0 100-IU-2 AND 100-IU-6 SITES

The following waste sites in the 100-IU-2/100-IU-6 Area were included in the 2016 monitoring effort: 600-100, 600-370, 600-109, 600-356, 600-369:3, 600-108, 600-178, 600-379, and 600-358. These sites were remediated to meet the objectives for interim closure as established in the 100 Area RDR/RAWP (DOE-RL 2009) and in the Interim Action ROD (EPA 1999). The sites were excavated to the extent required to meet specified soil cleanup levels, the contaminated materials were disposed of at the Environmental Restoration Disposal Facility (ERDF) then backfilled with pit-run gravel and revegetated by broadcast seeding with native grass seeds including Sandberg's bluegrass, needle-and-thread grass, bluebunch wheatgrass, prairie junegrass, and bottlebrush squirreltail. Upon the completion of seeding, the entire area was mulched with approximately 4,480 kg/ha (4,000 lb/ac) of straw and crimped into the soil surface to prevent wind erosion. Upon completion of crimping, the sites were planted with shrubs at approximately 1,235 to 1,605 plants/ha (500 to 650 plants/ac) with a mix of approximately 75% sagebrush, 15% bitterbrush, and 10% spiny hopsage. However, in FY 2016, planting ratios varied from 60 to 75% sagebrush, 5 to 15% bitterbrush, 10 to 30% hopsage, and, additionally, approximately 1% gray rabbitbrush (Chrysothamnus nauseousus) and green rabbitbrush (Chrysothamnus viscidiflorus) (cumulatively).

3.1 100-IU-2 SITES

3.1.1 600-301 Site (White Bluffs Sanitary Sewer Pipelines)

Third-year monitoring was conducted at the 600-301 site on April 14, 2016 (Figure 30). Substrate at this site is characterized primarily by sand and loamy sand soils with small amounts of intermixed cobbles. Total canopy cover was 38.1%, consisting of 7.3% native cover and 30.8% invasive cover (Table 23). Cheatgrass (invasive) was the dominant species with 13.7% canopy cover followed by bulbous bluegrass with 8.2% canopy cover. Native bunchgrasses comprised 6.4% of the canopy cover.

Shrub transect monitoring indicated an overall survival rate of only 1.9%. Only 3 of the 45 previously monitored spiny hopsage were observed along the transect. No antelope bitterbrush or sagebrush were recorded for the transect.

^b Bunchgrasses include Agropyron spicatum, Koeleria cristata, Oryzopsis hymenoides, Sitanion hystrix, Sporobolus cryptandrus, and Stipa comata.

X = present but not counted in plot frames



Figure 30. The 600-301 Site in 2016.

Table 23. Percent Canopy Cover and Frequency of Occurrence at the 600-301 Site in 2016. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	Х	Х
Amaranthus albus ^a (white pigweed)	0.90	36.00
Artemisia tridentata (big sagebrush)	0.20	8.00
Bromus tectorum ^a (cheatgrass)	13.70	100.00
Centaurea diffusa a (diffuse knapweed)	0.10	4.00
Erodium cicutarium ^a (redstem stork's bill)	0.30	12.00
Atriplex spinosa (spiny hopsage)	0.60	4.00
Holosteum umbellatum ^a (jagged chickweed)	2.40	36.00
Kochia scoparia ^a (kochia)	X	Χ
Oryzopsis hymenoides (Indian ricegrass)	Х	X
Poa bulbosa ^a (bulbous bluegrass)	8.20	56.00
Poa sandbergii (Sandberg's bluegrass)	6.30	92.00
Salsola kali ^a (Russian thistle)	1.20	48.00
Sisymbrium altissimum ^a (tumble mustard)	4.00	40.00
Sporobolus cryptandrus (sand dropseed)	0.10	4.00
Stipa comata (needle-and-thread grass)	X	X
Artr recruits	0.10	4.00
Crust ^b	4.10	28.00
Soil	50.80	100.00
Litter	15.70	100.00

Table 23. Percent Canopy Cover and Frequency of Occurrence at the 600-301 Site in 2016. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Total canopy cover (excludes crust/soil/litter)	38.10	
Total native % cover	7.30	
Change in native % cover from 2015	-2.60	
Total invasive % cover	30.80	
Change in invasive % cover from 2015	-13.80	

^a Invasive species.

3.1.2 600-370 Site (Dumping Area)

Third-year monitoring was conducted at the 600-370 site on April 13, 2016 (Figure 31). Substrates at this site are primarily characterized by sandy soils with varying amounts of large cobbles. Total canopy cover was at 30.1%, consisting of 2.1% native cover (Table 24). Cheatgrass was the dominate species with 11.9% cover. The dominant native (non-woody) species was Sandberg's bluegrass with 1.2% cover.



Figure 31. The 600-370 Site in 2016.

b = moss/lichen cover versus crust

X = present but not counted in plot frames

Table 24. Percent Canopy Cover and Frequency of Occurrence at the 600-370 Site in 2016.

Species	% Cover	% Frequency of Occurrence
Agropyron spicatum (bluebunch wheatgrass)	0.10	4.00
Amsinckia lycopsoides (tarweed fiddleneck)	X	X
Artemisia tridentata (big sagebrush)	4.20	28.00
Bromus tectorum ^a (cheatgrass)	11.90	100.00
Chorispora tenella ^a (blue mustard)	0.10	4.00
Chrysothamnus nauseosus (gray rabbitbrush)	X	X
Cryptantha circumscissa (matted cryptantha)	0.20	8.00
Eriogonum niveum (snow buckwheat)	X	X
Erodium circutarium ^a (redstem stork's bill)	0.60	24.00
Holosteum umbellatum a (jagged chickweed)	4.60	64.00
Lactuca serriola ^a (prickly lettuce)	0.10	4.00
Oenothera pallida (pale eveningprimrose)	X	X
Poa sandbergii (Sandberg's bluegrass)	1.20	48.00
Psoralea lanceolata (scurf-pea)	0.60	4.00
Salsola kali ^a (Russian thistle)	3.50	80.00
Sisymbrium altissimum ^a (tumble mustard)	3.00	60.00
Triticum aestivum a (common wheat)	X	X
Crust	0.00	0.00
Soil	68.40	100.00
Litter	16.40	100.00
Total canopy cover (excludes crust/soil/litter)	30.10	
Total native % cover	+2.10	
Change in native % cover from 2015	-5.00	
Total invasive % cover	23.80	
Change in invasive % cover from 2015	-10.60	

^a Invasive species.

Shrub transect monitoring indicated overall shrub survival for the site at 45.2%. Sagebrush survival was at 46.4%. Note that these percentages are slightly higher than recorded in 2015 due to the presence of live sagebrush transplants in 2016 that were recorded as "Dead" in 2015. None of the transplanted antelope bitterbrush recorded in 2014 remained.

3.2 100-IU-6 SITES

3.2.1 600-109 Site (Hanford Trailer Camp Landfill)

Fifth-year monitoring was conducted at the 600-109 site on March 30, 2016 (Figure 32). In recent years, two differing vegetative communities have established at this site. For this report they are categorized as the east and west areas. Originally, excavation of the Hanford Trailer Camp Landfill took place in the east area and the west area was used for staging and stockpiling. Substrates differ drastically between the areas; the east area contains primarily

X = present but not counted in plot frames

cobbles with varying small amounts of sandy loam and the west area consists of primarily sandy loams with small amounts of loamy sands. The west area had a higher native canopy cover with 60.4% versus 37.2% in the east area (Table 25). The most notable difference between the two areas with regard to native cover occurred with Sandberg's bluegrass, which had 20% cover in the west area versus 9.7% in the east, resulting in an average canopy cover of 14.9% for the site overall. Cheatgrass was the most dominant invasive species with 11.5% canopy cover for the site overall. Species diversity was comparable between the two areas with 17 species in the west area and 20 species in the east area.

Shrub transect monitoring indicated an overall survival rate of 91.3%, which has been consistent since 2013. The overall survival rate was 90.9% for sagebrush and 100% for spiny hopsage.



Figure 32. The 600-109 Site in 2016.

Above: West area with fifth-year growth.

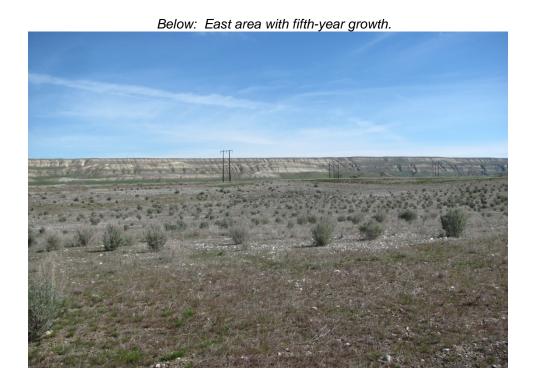


Table 25. Percent Canopy Cover and Frequency of Occurrence at the 600-109 Site in 2016. (2 Pages)

	West		East		Entire Site	
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average% Cover	Average% Frequency of Occurrence
Achillea millefolium (yarrow)	0.10	4.00	Χ	Χ	0.05	2.00
Agropyron spicatum (bluebunch wheatgrass)	0.20	8.00	2.60	24.00	1.40	16.00
Ambrosia acanthicarpa (bur ragweed)			Χ	Х	0.00	0.00
Artemisia tridentata (big sagebrush)	8.50	20.00	4.50	24.00	6.50	22.00
Bromus tectorum ^a (cheatgrass)	14.20	88.00	8.80	96.00	11.50	92.00
Erigeron pumilus (shaggy fleabane)	0.10	4.00	0.10	4.00	0.10	4.00
Erodium cicutarium ^a (storksbill)	0.10	4.00	0.30	12.00	0.20	8.00
Atriplex spinosa (spiny hopsage)	1.20	8.00	0.10	4.00	0.65	6.00
Hordeum jubatum (foxtail barley)	0.10	4.00	0.60	4.00	0.35	4.00
Lactuca seriola ^a (prickly lettuce)	4.30	40.00	0.70	8.00	2.50	24.00
Lomatium grayi (biscuitroot)	0.10	4.00			0.05	2.00
Melilotus officinalis a (sweet clover)			Χ	Х	0.00	0.00
Oryzopsis hymenoides (Indian ricegrass)	0.60	4.00	4.90	36.00	2.75	20.00
Poa bulbosa ^a (bulbous bluegrass)	0.80	32.00	1.00	20.00	0.90	26.00
Poa sandbergii (Sandberg's bluegrass)	20.00	100.00	9.70	92.00	14.85	96.00

Table 25. Percent Canopy Cover and Frequency of Occurrence at the 600-109 Site in 2016. (2 Pages)

	West		East		Entire Site	
Species	×% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average% Cover	Average% Frequency of Occurrence
Phlox longifolia (longleaf phlox)	X	Х	0.20	8.00	0.10	4.00
Salsola kali ^a (Russian thistle)	7.20	96.00	3.30	92.00	5.25	94.00
Sisymbrium altissimum ^a (tumble mustard)	1.50	20.00	0.20	8.00	0.85	14.00
Spharalcea munroana (Munro's globemallow)			Х	Х	0.00	0.00
Sporobolus cryptandrus (sand dropseed)	1.20	8.00	X	X	0.60	4.00
Triticum aestivum a (common wheat)			Χ	Χ	0.00	0.00
Artr recruits	0.20	8.00			0.10	4.00
Crust	0.50	20.00	0.20	8.00	0.35	14.00
Soil	51.20	100.00	45.70	100.00	48.45	100.00
Litter	28.90	100.00	27.20	100.00	28.05	100.00
Total canopy cover (excludes crust/soil/litter)	60.40		37.20		48.70	
Total native % cover	32.30		22.70		27.50	
Change in native % cover from 2015	+4.40		-0.80		+4.00	
Total invasive % cover	28.10		14.30		21.20	
Change in invasive % cover from 2015	-9.80		-35.30		-28.40	

^a Invasive species.

3.2.2 600-356 Site (Dumping Area)

Second-year monitoring was conducted at the 600-356 site on April 14, 2016 (Figure 33). Substrates at this site are primarily cobbly sandy loams. Total canopy cover was at 29.4%, consisting of 4.8% native cover and 24.6% invasive cover (Table 26). Cheatgrass (invasive) was the dominant species with 10.7% canopy cover. Western tansymustard was the most dominant native species with 2.5% canopy cover.

Shrub transect monitoring indicated that none of the transplanted shrubs survived; however, the presence of sagebrush and spiny hopsage were indicated in the plot surveys as present on the site.

X = present but not counted in plot frames

^{-- =} species not observed on site



Figure 33. The 600-356 Site in 2016.

Table 26. Percent Canopy Cover and Frequency of Occurrence at the 600-356 Site in 2016. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Amaranthus albus ^a (white pigweed)	0.20	8.00
Ambrosia acanthicarpa (bur ragweed)	0.70	28.00
Artemisia tridentata (big sagebrush)	0.10	4.00
Balsamorhiza careyana (Carey's balsamroot)	X	X
Bromus tectorum ^a (cheatgrass)	10.70	92.00
Bunchgrasses ^b	0.80	32.00
Chrysothamnus nauseosous (gray rabbitbrush)	X	X
Descurainia pinnata (western tansymustard)	2.50	40.00
Erodium cicutarium ^a (redstem stork's bill)	0.20	8.00
Atriplex spinosa (spiny hopsage)	X	X
Holosteum umbellatum ^a (jagged chickweed)	0.30	12.00
Hordeum murinum ^a (hare barley)	1.40	16.00
Poa bulbosa ^a (bulbous bluegrass)	2.80	32.00
Poa sandbergi (Sandberg's bluegrass)	0.70	28.00
Raphanus sativus ^a (wild radish)	0.10	4.00
Salsola kali ^a (Russian thistle)	1.90	76.00
Sisymbrium altissimum ^a (tumble mustard)	7.00	52.00
Crust	0.00	0.00
Soil	46.70	100.00
Litter	34.00	100.00
Total canopy cover (excludes crust/soil/litter)	29.40	

Table 26. Percent Canopy Cover and Frequency of Occurrence at the 600-356 Site in 2016. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Total native % cover	+4.80	
Change in native % cover from 2015	-9.90	
Total invasive % cover	24.60	
Change in invasive % cover from 2015	+9.80	

^a Invasive species.

3.2.3 600-369:3 Site (Dumping Area)

Third-year monitoring was conducted at the 600-369:3 site on April 13, 2016 (Figure 34). Two distinct substrate types were present; the inner area consists primarily of cobbles with smaller amounts of loamy sand soils, while the outer area is primarily sandy loam soils with few cobbles. To analyze vegetative development on both substrate types, the area was divided into two sections. Area 1 represents the innermost cobble-dominated area while Area 2 represents the outer sandy loam soils. Area 2 supported a larger variety of species and, in general, a higher percent cover when compared to Area 1 but has a significantly higher percentage of invasive cover as well (Table 27). Area 1 had 14.5% total canopy cover with 5.2% native cover and 9.3% invasive cover. Area 2 supported a much higher total canopy cover at 49.3% with 1.7% native cover and 47.7% invasive cover. Average canopy cover for the site was 31.9% with 3.4% native canopy cover and 28.5% invasive canopy cover. Sitewide, cheatgrass and jagged chickweed, both invasive, were the dominant species with 14.3% and 9.2%, respectively. Sandberg's bluegrass was the dominant native species with 1.8% canopy cover for the site overall.

Shrub transect monitoring indicated overall shrub survival for the site was at 53.5%, down less than 2% and equating to a 97.2% survival rate from last year. Sagebrush survival was at 60.5%. None of the transplanted antelope bitterbrush recorded in 2014 remained.

Bunchgrasses include Agropyron spicatum, Koeleria cristata, Oryzopsis hymenoides, Sitanion hystrix, Sporobolus cryptandrus, and Stipa comata.

X = present but not counted in plot frames



Figure 34. The 600-369:3 Site in 2016.

Table 27. Percent Canopy Cover and Frequency of Occurrence at the 600-369:3 Site in 2016. (2 Pages)

	Area 1 (Inner)		Area 1 (Inne		Area 2	2 (Outer)	Enti	re Site
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence		
Artemisia tridentata (big sagebrush)	2.33	26.67	0.17	6.67	1.25	16.67		
Bromus tectorum ^a (cheatgrass)	5.00	100.00	23.50	100.00	14.25	100.00		
Bunchgrasses ^b	0.50	20.00	0.17	6.67	0.33	13.33		
Chrysothamnus nauseousus (gray rabbitbrush)			Х	Х	0.00	0.00		
Holosteum umbellatum ^a (jagged chickweed)	1.50	60.00	16.83	100.00	9.17	80.00		
Hordeum leporinum ^a (hare barley)			0.17	6.67	0.08	3.33		
Lactuca serriola a (prickly lettuce)			0.67	26.67	0.33	13.33		
Poa bulbosa ^a (bulbous bluegrass)	Х	Χ	0.17	6.67	0.08	3.33		
Poa sandbergii (Sandberg's bluegrass)	2.33	93.33	1.33	53.33	1.83	73.33		
Salsola kali ^a (Russian thistle)	1.67	66.67	1.33	53.33	1.50	60.00		
Sisymbrium altissimum a (tumble mustard)	1.17	46.67	5.00	73.33	3.08	60.00		
Crust	0.33	13.33	0.50	20.00	0.42	16.67		
Soil	53.83	100.00	37.50	100.00	45.67	100.00		

	Area 1 (Inner)		Area 1 (Inner) Area 2 (Outer)		(Inner) Area 2 (Outer) Entire Site		re Site
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence	
Litter	24.67	100.00	17.83	100.00	21.25	100.00	
Total canopy cover (excludes crust/soil/litter)	14.50		49.33		31.92		
Total native % cover	5.17		1.67		3.42		
Change in native % cover from 2015	-8.50		-4.50		-6.50		
Total invasive % cover	9.33		47.67		28.50		
Change in invasive % cover from 2015	-3.50		0.00		-1.75		

Table 27. Percent Canopy Cover and Frequency of Occurrence at the 600-369:3 Site in 2016. (2 Pages)

3.2.4 600-108 Site (213-K Vault, Storage Facility, Magazine Waste Storage Cavern)

Fifth-year monitoring was conducted at the 600-108 site on April 12, 2016 (Figure 35). This site is located at the south base of Gable Mountain and is surrounded by mature vegetation. Two distinct vegetative zones have emerged at this site since initial revegetation in 2012. For the purposes of this report, they are categorized as Area 1 (inner area) and Area 2 (outer area) (Figure 36). Area 1 had higher canopy cover with 57% versus 38.7% in Area 2. However, Area 2 had slightly higher species diversity, supporting four more species than Area 1, all of which are native species. This difference in species composition is likely due to a higher content of native soils present in Area 2 that generally contain a native seed bed, as opposed to imported, vadose zone material excavated from borrow pits. Species diversity for the site overall increased slightly with 23 species noted versus 20 recorded in 2015. The average canopy cover for the site overall was 47.8% with 40.3% cover from native species and 7.5% from invasive (Table 28). Sandberg's bluegrass remained the dominant species across the site with 21.1% canopy cover. Cheatgrass remained the dominant invasive species with 6.7% cover for the site.

Shrub transect monitoring results indicated a 9.2% survival rate for the site overall, consisting of 5.7% for sagebrush and 50% for spiny hopsage. Although sagebrush survival is seemingly low, naturally establishing sagebrush, spiny hopsage, and bunchgrasses has greatly increased since the site was revegetated in 2012. The shrub transect is located in Area 1, which has historically fostered the highest amounts of cheatgrass and other invasive species on the site, likely leading to competition for available resources. However, sagebrush was present in about a third of the surveyed plots for the site this year and sagebrush recruits were recorded in several of the plots in Area 1 providing strong evidence that the species has reestablished on the site.

^a Invasive species.

^b Bunchgrasses include Agropyron spicatum, Koeleria cristata, Oryzopsis hymenoides, Sitanion hystrix, Sporobolus cryptandrus, and Stipa comata.

X = present but not counted in plot frames

^{-- =} species not observed on site



Figure 35. The 600-108 Site in 2016.

Figure 36. The 600-108 Site Pre- and Post-Remediation.

Below: Pre-remediation (2008).

Below: Post-remediation (2015).

Area 2

Area 1

(Google[™] earth © 2015 Google, Imagery Date 5/6/2015)

Table 28. Percent Canopy Cover and Frequency of Occurrence at the 600-108 Site in 2016. (2 Pages)

	Area 1	(Inner)	Area 2	(Outer)	Entir	e Site
Species	×% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
Achillea millefolium (yarrow)	Χ	Χ	0.17	6.67	0.08	3.33
Agropyron spicatum (bluebunch wheatgrass)	-		Х	X	X	Х
Amsinckia lycopsoides (tarweed fiddleneck)	X	Х			Х	Х
Artemisia tridentata (big sagebrush)	4.67	26.67	1.67	33.33	3.17	30.00
Astragalus sclerocarpus (stalked pod milkvetch)	1		1.00	6.67	0.50	3.33
Balsamorhiza Careyana (Carey's balsamroot)			0.17	6.67	0.08	3.33
Bromus tectorum ^a (cheatgrass)	10.33	93.33	3.00	86.67	6.67	90.00
Chrysothamnus nauseosus (gray rabbitbrush)			Х	Х	Х	Х
Cryptantha circumscissa (matted cryptantha)			Х	Х	Х	Х
Descurainia pinnata (western tansymustard)	Х	Х	Х	Х	Х	Х
Eriogonum niveum (snow buckwheat)	2.00	13.33	4.00	33.33	3.00	23.33
Atriplex spinosa (spiny hopsage)	5.00	13.33	1.00	6.67	3.00	10.00
Lomatium greyi (Gray's biscuitroot)			2.50	6.67	1.25	3.33
Machaeranthera canascens (hoary aster)	Χ	Х	-		Χ	Χ
Oryzopsis hymenoides (Indian ricegrass)	1.17	13.33	9.67	60.00	5.42	36.67
Phacelia linearis (threadleaf phacelia)	Χ	Χ	Χ	Χ	Χ	Χ
Poa sandbergii (Sandberg's bluegrass)	30.00	100.00	12.17	100.00	21.08	100.00
Purshia tridentata (antelope bitterbrush)			1.00	6.67	0.50	3.33
Salsola kali ^a (Russian thistle)	1.00	40.00	0.67	26.67	0.83	33.33
Sisymbrium altissimum a (tumble mustard)	Χ	X			Χ	Χ
Sphaeralcea munroana (Munro's globemallow)			Х	Х	Х	Х
Sporobolus cryptandrus (sand dropseed)	Χ	X			Χ	Χ
Stipa comata (needle-and-thread grass)	2.67	40.00	1.50	26.67	2.08	33.33
Artr recruits	0.17	6.67	0.17	6.67	0.17	6.67
Crust	0.50	20.00	1.33	53.33	0.92	36.67
Soil	30.17	100.00	52.33	100.00	41.25	100.00
Litter	20.17	100.00	13.00	100.00	16.58	100.00

	Area 1 (Inner)		Area 2 (Outer)		Entire Site	
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
Total canopy cover (excludes crust/soil/litter)	57.00		38.67		47.83	
Total native % cover	45.67		35.00		40.33	
Change in native % cover from 2015	-23.16		-27.00		-21.67	
Total invasive % cover	11.33		3.67		7.50	
Change in invasive % cover from 2015	-7.67		-9.58		-5.75	

Table 28. Percent Canopy Cover and Frequency of Occurrence at the 600-108 Site in 2016. (2 Pages)

3.2.5 600-178 Site (213-J and 213-K Guard House)

Fifth-year monitoring was conducted at the 600-178 site on April 11, 2016 (Figure 37). This site is located directly adjacent to the south of the 600-108 site. The 600-178 site represents the lower, flatter, and slightly more compacted portion of the two co-located sites. Total canopy cover for the site was 31.7% (Table 29). It consisted of 25.5% native cover, 6.2% invasive cover. Sandberg's bluegrass remained the dominant species with 15.3% canopy cover. Species diversity continued to decline to 20 species; however, the majority (16 of 20) are native species.

Shrub transect monitoring indicated overall shrub survival for the site at 29.8%. Sagebrush survival was at 40%, a decrease of 10% from 2015. Antelope bitterbrush, with only one shrub captured on the transect, remained stable at 100%. No spiny hopsage were recorded in 2015 or 2016 indicating a 0% survival rate for this species. As with 600-108, many of the shrubs installed during revegetation of the site in 2012 are being outcompeted by natural recruitment of native sagebrush and bunchgrasses; sagebrush occurred in 32% of the plots and Sandberg's bluegrass in 100%.

As noted in the 2014 report, impacts to the site occurred in 2013, resulting in approximately 0.4 ha (1 ac) of disturbance. Impacts to the site included losses of shrubs, forbs, and grasses and soil conditions unsuitable for rapid reestablishment of native vegetation. Additional mitigation measures consisted of decompacting, seeding, strawing, and replanting the area with 500 shrubs. In addition to seeding the area with a bunchgrass mix, forb seeds were hand collected and seeded including longleaf phlox, Carey's balsamroot, yarrow, snow buckwheat, stalked-pod milkvetch, turpentine wavewing, hoary aster, and Munro's globemallow. The accessible areas were also fenced off with signage to prevent future damages. A portion of the disturbed area can be seen in the bottom of Figure 37.

a Invasive species.

X = present but not counted in plot frames

^{-- =} species not observed on site



Figure 37. The 600-178 Site in 2016.

Table 29. Percent Canopy Cover and Frequency of Occurrence at the 600-178 Site in 2016. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	0.30	12.00
Ambrosia acanthicarpa (bur ragweed)	0.20	8.00
Artemisia tridentata (big sagebrush)	4.30	32.00
Astragalus sclerocarpus (stalked pod milkvetch)	X	Χ
Bromus tectorum ^a (cheatgrass)	3.70	88.00
Centaurea diffusa ^a (diffuse knapweed)	1.20	48.00
Chrysothamnus nauseosus (gray rabbitbrush)	0.10	4.00
Chrysothamnus viscidiflourus (gray rabbitbrush)	X	Χ
Cryptantha circumscissa (matted cryptantha)	0.20	8.00
Epilobium paniculatum (tall willowherb)	0.00	4.00
Eriogonum niveum (snow buckwheat)	2.10	24.00
Lomatium grayi (biscuit root)	X	Χ
Macaeranthera canascens (hoary aster)	0.00	4.00
Melilotus officinalis ^a ((sweet clover)	0.60	4.00
Oryzopsis hymenoides (Indian ricegrass)	0.20	8.00
Phlox longifolia (longleaf phlox)	X	Χ
Poa sandbergii (Sandberg's bluegrass)	15.30	100.00
Purshia tridentata (antelope bitterbrush)	0.60	4.00
Salsola kali ^a (Russian thistle)	0.70	28.00
Stipa comata (needle-and-thread grass)	1.40	16.00
Artr recruits	0.80	32.00

Table 29. Percent Canopy Cover and Frequency of Occurrence at the 600-178 Site in 2016. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Crust	0.00	0.00
Soil	66.50	100.00
Litter	14.50	100.00
Total canopy cover (excludes crust/soil/litter)	31.70	
Total native % cover	25.50	
Change in native % cover from 2015	-16.50	
Total invasive % cover	6.20	
Change in invasive % cover from 2015	-0.30	_

^a Invasive species.

3.2.6 600-379 Site (Burn Area)

Second-year monitoring was conducted at the 600-379 site on April 12, 2016 (Figure 38). Substrates at this site are primarily characterized by sandy loam soils with varying amounts of small cobbles. Data was collected from 13 plot frames to monitor the area. Total canopy cover for the site was at 43.1%, consisting of 4.8% native cover and 38.3% invasive cover (Table 30). Cheatgrass and Russian thistle were the dominant species with 30.6% cover and 6% canopy cover, respectively. Even though native vegetation canopy cover was relatively low compared to invasive cover, significantly more native species were recorded for the site this year than in 2015, 11 versus 4. Due to the small size of this site, a shrub transect was not feasible.



Figure 38. The 600-379 Site in 2016.

X = present but not counted in plot frames

Table 30. Percent Canopy Cover and Frequency of Occurrence at the 600-379 Site in 2016.

Species	% Cover	% Frequency of Occurrence
Agropyron spicatum (bluebunch wheatgrass)	0.19	7.69
Ambrosia acanthicarpa (bur ragweed)	1.15	7.69
Artemisia tridentata (big sagebrush)	0.19	7.69
Bromus tectorum ^a (cheatgrass)	30.58	92.31
Bunchgrasses ^b	0.19	7.69
Centaurea diffusa a (diffuse knapweed)	0.38	15.38
Chrysothamnus viscidiflorus (green rabbitbrush)	Х	Х
Cryptantha circumscissa (matted cryptantha)	0.19	7.69
Erigeron filifolius (threadleaf fleabane)	0.19	7.69
Erodium cicutarium ^a (redstem stork's bill)	0.77	30.77
Holosteum umbellatum ^a (jagged chickweed)	0.19	7.69
Macaeranthera canascens (hoary aster)	1.54	23.08
Phlox longifolia (longleaf phlox)	Χ	Χ
Poa sandbergii (Sandberg's bluegrass)	1.15	7.69
Salsola kali ^a (Russian thistle)	5.96	84.62
Sisymbrium altissimum ^a (tumble mustard)	0.38	15.38
Sporobolus cryptandrus (sand dropseed)	Χ	X
Crust	0.19	7.69
Soil	38.08	100.00
Litter	26.54	100.00
Total canopy cover (excludes crust/soil/litter)	43.08	
Total native % cover	4.81	
Change in native % cover from 2015	-6.15	
Total invasive % cover	38.27	
Change in invasive % cover from 2015	+22.89	

^a Invasive species.

3.2.7 600-358 Site (Gable Mountain Fringe Dump Area)

First-year monitoring was conducted at the 600-358 site on April 11, 2016 (Figure 39). This site is located near the northeast base of Gable Mountain. Substrates are primarily gravel and cobbles with varying amounts of loamy sand. Monitoring consisted of 25 plot frames and one 100-m (328-ft) transect. Canopy cover for the site was at 7.8%, consisting of 2.7% native cover and 5.1% invasive cover (Table 31). Russian thistle (invasive) was the dominant species with 2.8% canopy cover. Though canopy coverage overall was low, several native species (eight) were recorded for the site and it is surrounded by mature native vegetation that should promote natural recovery of the site. In addition, this site and neighboring sites 600-349 and SG4-477 were hand seeded with additional native forb species including matted cryptantha (*Cryptantha circumscissa*), Columbia milkvetch (*Astragalus succumbens*), woolypod milkvetch (*Astragalus sclerocarpus*), Douglas' dustymaiden (*Chaenactis douglassii*), common yarrow (*Achillea millefolium*), miraposa lily (*Calochortus macrocarpus*), Western prairie clover (*Dalea ornata*), turpentine spring-parsley (*Cymopterus terebinthinus*), shaqqy fleabane (*Erigeron pumilus*),

X = present but not counted in plot frames

longleaf phlox (*Phlox longifolia*), silverleaf phacelia (*Phacelia hastata*), wooly plantain (*Plantago patagonica*), Munro's globemallow (*Sphaeralcea munroana*), broom buckwheat (*Eriogonum vimineum*), snow buckwheat (*Eriogonum niveum*), Carey's balsamroot (*Balsamorhiza careyana*), pale evening primrose (*Oenothera pallida*), and dune scurfpea (*Psoralea lanceolata*).

One 100-m (328-ft) shrub transect was established on the site. A total of 56 sagebrush, 2 spiny hopsage, and 1 antelope bitterbrush were recorded along the transect.



Figure 39. The 600-358 Site in 2016.

Above: Overview of the larger north portion of the site.



Below: Transect area along revegetated road portion of the site.

Table 31. Percent Canopy Cover and Frequency of Occurrence at the 600-358 Site in 2016.

Species	% Cover	% Frequency of Occurrence
Agropyron spicatum (bluebunch wheatgrass)	0.60	24.00
Artemisia tridentata (big sagebrush)	0.50	20.00
Bromus tectorum ^a (cheatgrass)	1.20	48.00
Atriplex spinosa (spiny hopsage)	X	X
Lomatium grayi (biscuit root)	0.40	16.00
Machaeranthera canascens (hoary aster)	0.10	4.00
Poa sandbergii (Sandberg's bluegrass)	0.40	16.00
Purshia tridentata (antelope bitterbrush)	Х	X
Raphanus raphanistrum ^a (wild radish)	1.10	44.00
Salsola kali ^a (Russian thistle)	2.80	52.00
Stipa comata (needle-and-thread grass)	0.70	28.00
Crust	0.00	0.00
Soil	56.40	100.00
Litter	30.00	100.00
Total canopy cover (excludes crust/soil/litter)	7.80	
Total native % cover	2.70	
Total invasive % cover	5.10	

^a Invasive species.

4.0 REVEGETATION SUMMARY

The Hanford Site consists of a complex shrub-steppe ecosystem whose landscape has been shaped by climate, natural and anthropogenic disturbances, time, and other factors. As it exists today, much of the landscape is in repair, restoring from both anthropogenic and naturally occurring disturbances. Landscapes within semi-arid climates generally take decades or even centuries to naturally reestablish to functional and sustainable ecosystems after disturbances. With the widespread introduction of invasive weeds such as cheatgrass and Russian thistle into the landscape, the ability for semi-arid ecosystems to restore to their natural state is even more difficult. Invasive weeds often colonize forming monotypic stands that out-compete native grasses, forbs, and shrubs, making it difficult to reestablish the native ecosystem. Increased frequencies of wildfires in recent years have also slowed the restoration of native communities. Natural historical fires typically occurred less frequently and burned at lower intensities allowing native communities (especially shrub and bio-crust components) to reestablish before the next fire. However, more recent fires have occurred more frequently and burned at much higher intensities due to increased fuel loads from invasive weeds. In many cases post-fire, fast growing annual invasive weeds recolonize and outcompete native species before they become established. Other circumstances on the Hanford Site that have contributed to declining native communities include unrestored farmsteads and loss of sagebrush from disease.

X = present but not counted in plot frames

In some cases, compensatory mitigation has allowed us to perform additional restoration by actively preparing and revegetating sites. Washington Closure Hanford's (WCH's) goal through revegetation activities is to jumpstart the regeneration process. As described throughout this report, this is accomplished through planting and seeding of native vegetation, in addition to site preparation and other techniques. Revegetation activities have been commencing for well over a decade on the Hanford Site. During this time, various techniques have been implemented during revegetation activities to address specific site conditions and goals. It is 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. To some degree, WCH has been able to hone the revegetation process through trial and error. Factors such as substrate, moisture, adjacent topography and species composition, prescribed species and application rates, seasonal timing for planting, and proper planting and seeding techniques all influence the success of a particular revegetation site. It is for this reason that WCH's baseline revegetation prescriptions may be altered from one site to another.

Through past experiences and knowledge gained through the revegetation process, WCH is successfully restoring the Hanford Site's landscape. In only a few years, WCH has restored many of Hanford's disturbed sites back to a functioning, natural state providing vital habitat for numerous species.

5.0 REVEGETATION MITIGATION

5.1 COYOTE TOBACCO

In 2012, project activities near the 618-10 complex were planned to expand southward into the 316-4 waste site. This area was surveyed in 2004 and was found to contain approximately 32 Coyote tobacco (*Nicotiana attenuata*) plants. Per the Washington State Department of Natural Resources' Natural Heritage Program, Coyote tobacco is a state sensitive species. Per the BRMaP (DOE-RL 2013), Coyote tobacco is classified as a Level III species of concern and requires a 3:1 mitigation ratio. Although no plants were found standing in 316-4 waste site area in 2012, a theoretical population was determined based on known plant characteristics and potential seed bed.

As mitigation, approximately 70,000 Coyote tobacco seeds were collected from plants within the 618-10 project boundaries and adjacent to the 618-10 complex. The collected seeds were sent to local nurseries and 200 ~65.5-cm³ (4-in.³) plants were propagated. The plants were installed at sites 1 through 5 on the Hanford Site (Figure 40) in May 2013. Considering relatively little is known about Coyote tobacco, a variety of locations were chosen based on soil type, aspect, and disturbance history. Tobacco plants were planted in transects, composed of rows of 10 plants each with 4 transects per site. Sites were watered bi-weekly at a rate of approximately 16 ounces per plant to total three water cycles over 6 weeks.

Monitoring results indicated an overall success rate (number of plants reaching maturity) of approximately 60% for all sites combined with most plant mortalities occurring from predation from insects and ungulates. The highest success survival rate came from Site 1 with approximately 80% of the plants reaching maturity (Figure 41).

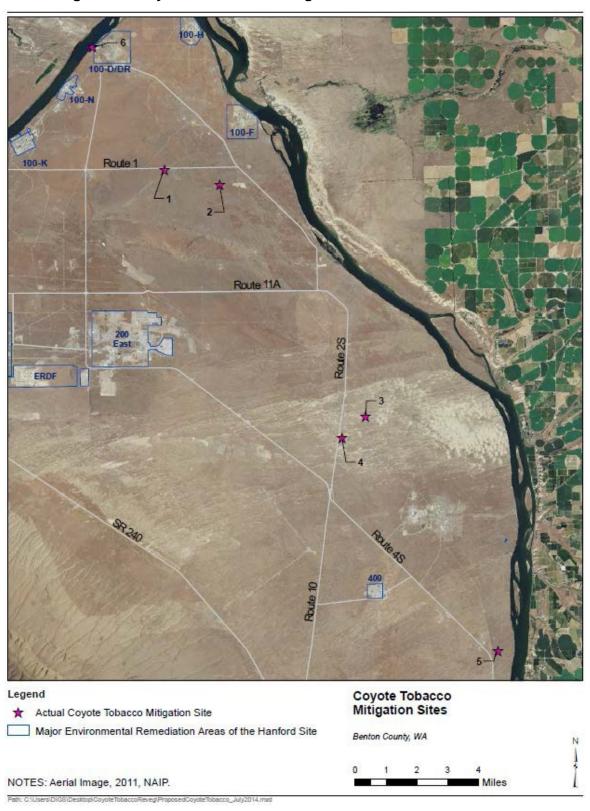


Figure 40. Coyote Tobacco Planting Locations from 2013 and 2014.



Figure 41. A Successful Coyote Tobacco Plant at Site 1 in 2013.

A second planting occurred in May 2014. This planting again consisted of 200 plugs that were installed at the 5 original locations and an additional 40 plants that were installed at site 6 (Figure 40). Plants were watered upon installation, 1 month after planting, and a final time near the end of June at a similar rate as the previous year. Monitoring results indicated an overall success rate of approximately 43% for all sites combined. The highest success survival rate came from Site 2, with approximately 74% of the plants reaching maturity.

Monitoring of Sites 1 and 4 through 6 was conducted during the summer of 2015 and 2016. No Coyote tobacco plants were observed at the monitored sites. Sites 2 and 3 were not monitored due to limited off-road access due to high fire danger.

5.2 ERDF MITIGATION

5.2.1 Vegetation

In 2003, the ERDF began Phase III expansion to construct disposal cells 5 and 6. Construction of the new cells occurred entirely within the disturbed footprint of the ERDF fence. An area south of the perimeter fence was impacted by placement of the overburden pile from the expansion, resulting in an update to the *Revised Mitigation Action Plan for the Environmental Restoration Disposal Facility* (Mitigation Action Plan) (DOE-RL 2005) to develop appropriate mitigation strategies for that and future expansions.

At the time of the initial construction of the ERDF in 1995, a majority of the 4.1-km² (1.6-mi²) area was dominated by mature sagebrush and late successional grasses and forbs, and considered high-quality, currently defined as Level III habitat in the BRMaP (DOE-RL 2013). Compensatory mitigation actions conducted for the construction of ERDF cells 1 through 4 were

based on a replacement ratio of 3:1 as appropriate for Level III sagebrush habitat. A large fire in summer 2000 burned most of the 4.1-km² (1.6-mi²) area identified for future ERDF expansion. Although the area is recovering, it is no longer dominated by an overstory of sagebrush and no longer fits the definition of Level III habitat. Late successional grasses and forbs are still present but live mature sagebrush is sparse and the area now meets the definition of Level II habitat per BRMaP. Since the understory of grasses and forbs are still intact and a small component of sagebrush is still present, some level of mitigation/rectification was needed. The Mitigation Action Plan (DOE-RL 2005) determined that the appropriate mitigation ratio for the area south and east of ERDF would be 1:1.

Construction activities at ERDF and impacts from expanding Borrow Pit 30 to supply gravel required that approximately 20 ha (50 ac) of mitigation be performed. To maximize the effectiveness of the mitigation effort, sagebrush was planted in February 2007 on 25 ha (62 ac) that included four 4-ha (10-ac) islands separated by 100 m (328 ft) in an area south of ERDF that straddles the Army Loop Road (Figure 42). Each island was planted at a density of 1,000 plants/ha (400 plants/ac) and the areas between the islands were planted at a density of 444 plants/ha (180 plants/ac). This configuration takes advantage of the Army Loop Road, which could serve as a fire break or natural location to fight a fire if one should occur in the area.

Third-year monitoring of mitigation for disposal cells 5 and 6 that was conducted in 2009 for the sagebrush transects planted along the Army Loop Road in 2007 showed survival rates of 22% and 36%. To compensate for the low survival rate, an additional 7,200 sagebrush seedlings were planted in January 2010 along with mitigation planting of 31,100 seedlings for the construction of the ERDF disposal super cell 9 and the expansion and use of Pit 30. The compensatory planting along with the super cell 9 mitigation planting were installed along the north side of the BC Cutoff road (Figure 43).

First-year monitoring of the mitigation site had mixed results. The sagebrush seedlings planted between November 30 and December 3, 2009, just before an extended period of freezing temperatures and subsequent frozen ground had dismal survival rates estimated at less than 5% and was considered a complete loss. Shrubs planted after January 4, 2010, were monitored by a vendor and showed plant survival rates ranging from 10% to 62%. To compensate for the reduced shrub survival for super cell 9 mitigation planting and construction of ERDF disposal cell 10, an additional 56,500 seedlings were planted in the fall of 2010 north of the BC Cutoff road. Monitoring in 2012 showed no surviving shrubs within established transects for the mitigation site.

Failed shrub establishment north of BC Cutoff road demonstrated the importance of site preparation prior to planting of shrubs. The planting location is composed almost entirely of cheatgrass, with few occurrences of mature sagebrush. It is likely that in addition to inadequate planting conditions, cheatgrass played a major role in shrub establishment. Cheatgrass forms monotypic stands that alter soil moisture and temperature, often outcompeting newly establishing, deep-rooted shrubs and native grasses before they develop healthy root systems. Future rectification plantings will likely have to implement additional resources to combat cheatgrass such as landscape matting around individual shrubs, prescribed fire, and/or herbicide control.

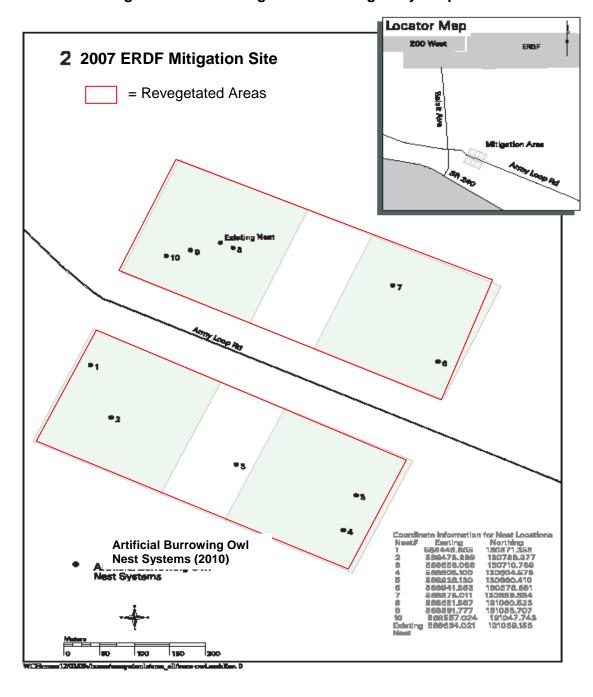


Figure 42. ERDF Mitigation Site Along Army Loop Road.



Figure 43. ERDF Mitigation Sagebrush Planting North of BC Cutoff Road in January 2010.

5.2.2 Burrowing Owls

Ten artificial burrowing owl nest boxes were installed in the Army Loop mitigation area in 2010. Burrowing owls (Athene cunicularia) had been previously observed in this area. They are a small owl (Figure 44) that breed in the Hanford region during the spring and summer and spend the winter in areas such as southern California and Mexico. They prefer open, short grass (e.g., Sandberg's bluegrass, Poa sandbergii) areas for breeding, such as the shrub-steppe habitat of the Hanford Site. During the breeding season they utilize natural burrows (e.g., badger holes) and man-made structures such as pre-Hanford irrigation piping for the laying of eggs and fledging young. Locally, available natural burrows for the breeding season are a limiting factor in their breeding success. Limited burrow availability is due to declining numbers of fossorial (i.e., burrowing) mammals, which is a result of habitat loss and predation. Burrowing owl populations are declining throughout the west due to habitat loss on their breeding and non-breeding ranges. Due to these habitat issues, burrowing owls are currently classified as a State Candidate Species by the Washington Department of Fish and Wildlife. and are federally listed as a Species of Concern by the United States Fish and Wildlife Service. Conserving suitable habitat, which includes installation and maintenance of artificial burrows for these owls, is an important key in providing a successful breeding area (Washington Department of Fish and Wildlife 2013; Dechant et al. 2002).



Figure 44. Burrowing Owl, Athene cunicularia.

The burrowing owl nest boxes were maintained and monitored during 2011, 2012, 2013, 2014, and 2015. Maintenance consisted of removing soil and debris from the entrance and opening of the tunnels to ensure an accessible burrow (Figure 45). Burrowing owl pellets were observed for the first time during the spring of 2011, indicating burrowing owl activity. No maintenance or monitoring was conducted for burrowing owls during 2016



Figure 45. Burrowing Owl Nest Box Maintenance in 2015.

6.0 BAT MITIGATION PROJECTS

Bat mitigation projects have been conducted at two reactor sites, 105-D/DR and 105-F, to mitigate for roosting habitat that was lost as a result of the Interim Safe Storage (ISS) projects at these reactors. The purpose of the ISS projects was to remove all of the ancillary structures from the reactor buildings, seal all penetrations, and install new steel roofs to prevent intrusion from animals.

Ecological reviews conducted prior to the initiation of these projects identified the presence of multiple bat species utilizing the reactors as maternity roosts to rear their young. These bats are listed as Washington State priority species at communal roosts and breeding areas and require mitigation according to the BRMaP (DOE-RL 2013). Relatively little information is available on species richness, abundance, distribution, habitat requirements, and other basic ecological information on bats occupying either the Hanford Site or the shrub-steppe ecosystem in central and eastern Washington (Christy et al. 1995, Gitzen et al. 2002). Due to their secretive and nocturnal nature, bats are difficult to study and require specialized techniques and equipment to survey populations. Consequently, few such studies have been undertaken on the Hanford Site.

About 10 species of bats have been identified on the Hanford Site since 1991 (Becker 1993, Christy et al. 1995, Fitzner and Gray 1991, Gitzen et al. 2002, Lucas 2011, and Soll et al. 1999); however, accurate identification of western bat species can be difficult because of morphologically-cryptic species (Weller et al. 2007). Increasingly, molecular techniques are being employed to discriminate among cryptic species and help define morphological characteristics useful in identifying bats (Zinck et al. 2004, Weller et al. 2007). Nonetheless, even if the accuracy of historical identifications is unknown, this apparent diversity of bats on the Hanford Site is either comparable or relatively high for that known for other areas in eastern Washington and other shrub-steppe habitats in the inland Pacific Northwest (Gitzen et al. 2002).

Major constructed facilities such as buildings, towers, and underground structures (e.g., tunnels and underground water storage basins) have been in place on the Hanford Site since about 1943. While these facilities were not intended for use by wildlife, bats routinely colonize buildings and other human-built structures for day and night roosting or even as nursery sites for rearing young (Kunz and Reynolds 2003, Lausen and Barclay 2006). Because such artificial habitat is limited on the Hanford Site, more information is needed to determine the ecological importance of these facilities and the potential effects of their closure or removal on bat populations. WCH's surveys have demonstrated that bats have readily colonized and now occupy some of these sites in high densities.

The mitigation projects conducted at the reactor sites included establishing the process water tunnels at 100-D Area as alternative roost sites and installing artificial roost boxes at the 105-F Reactor. A third mitigation project was initiated at the 183-F clearwell in July 2007 to begin investigating a colony of more than 2,000 bats that were using that facility. The facility was slated for eventual demolition; therefore, a mitigation plan was needed to determine the path forward for this facility and the bats occupying it.

6.1 BAT MITIGATION AT THE 190-D AND 190-DR PROCESS WATER TUNNELS

A bat mitigation project at the 100-D Area was initiated when a suspected maternity roost was discovered in one of the process water tunnels connected to the 105-DR Reactor. The ISS project plan included isolating the tunnels from the reactor, which would eliminate the bats' access to the tunnels and cause the loss of the maternity roost. Approval and concurrence from the U.S. Department of Energy, Richland Operations Office (DOE-RL) in CCN 060625, "Mitigation for Loss of Bat Habitat in the 105-DR Reactor Facility," (DOE-RL 1998) provided direction to maintain bat access and mitigate for roosting habitat that would be lost as a result of ISS. Alternate accesses were provided on both tunnel systems that entered the 105-DR valve pit by installing bat gates on access hatches (Figure 46). One tunnel originated at the 190-D Water Pump House as a redundant water supply, and two tunnels originated from the 190-DR Water Pump House that come together just west of the valve pit.



Figure 46. The 190-DR Bat Gate.

The original purpose of these tunnels was to provide the primary cooling water supply for the 105-DR Reactor (Figure 47). The noncontaminated process water tunnels were built with a zigzag design to allow for expansion of the piping. Each straight leg of the tunnels contained a surface hatch to provide access in case a pipe section had to be replaced. These surface hatches provide the actual roost sites for the bats because of the solar heating of the hatch covers, providing a favorable site to rear young. The bat gates were placed over hatches on both tunnel systems. The gate on the 190-D tunnel was installed in the fall of 1998 and the gate on the 190-DR tunnel system was installed in the fall of 1999.

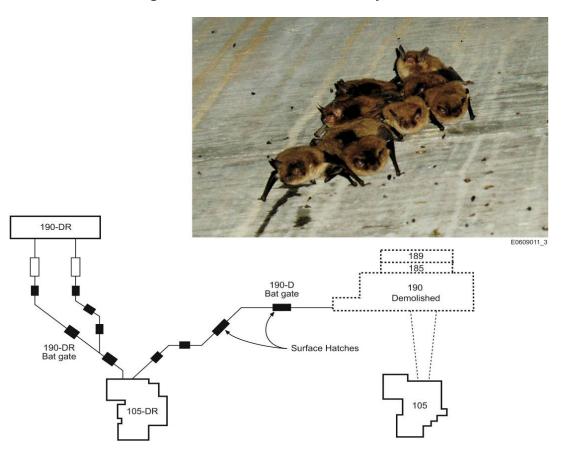


Figure 47. The 190-D/DR Tunnel System.

Monitoring of bat roosting began in July 1999. The gate on the 190-D tunnel had been installed and the tunnels were still accessible from the reactor valve pit. There were approximately 19 bats observed in the 190-D tunnel and 36 in the 190-DR tunnels. No inspection of the tunnels was made during 2000; however, a small number of bats were observed emerging from the gates in August 2000, approximately 1 hour after sundown, which verified that they had found the bat gate entrance and were continuing to use the tunnels. No observations were made during 2001.

The 190-D tunnel has not been entered since the reactor valve pit was backfilled because there is no walk-in access available. However, video recording of the emergence from the bat gate at the 190-D tunnel, using an infrared video camera, allowed for an estimation of the population using this structure. On July 7, 2010, approximately 340 individuals were observed exiting through the 190-D tunnel bat gate. This number was much higher than the 30 to 40 individuals that had been counted previously using manual counting techniques. This represents a very sizeable colony but the relationship between this colony and the colony at the 190-DR tunnels is not well understood.

The 190-DR tunnels were accessible from the 190-DR north valve house (at the west end of the tunnel) until 2005 when the valve houses were demolished along with the 190-DR facility. At the completion of the demolition project, a walk-in door was provided in the south tunnel where it connected to the valve house. Inspections of the 190-DR tunnels were conducted from

2002 to 2005, and the number of bats roosting in the hatches was counted. The numbers counted were as follows: 107 in 2002, 99 in 2003, 98 in 2004, and 97 in 2005. A second inspection was made on July 27, 2005, and a total of 170 bats were counted at that time. The bats appeared to roost at all of the hatches except the ones where the bat gates are located. Often the majority of the population would roost in the same hatch, which would contain several small clusters of mothers with their young and from 5 to 50 individuals.

In July 2006, it was discovered that someone had placed chicken wire over the entrance to the 190-DR bat gate during the previous winter, which prevented the bats from flying through the gate and roosting in the tunnel. The chicken wire was immediately removed and the tunnel was again inspected for bats on September 21, 2006. There were about 20 bats observed roosting as individuals and in small clusters. Because the roost site in 190-DR was not available to the bats for most of the summer of 2006, the bat gate on 190-D tunnel was monitored for emerging bats on August 9, 2006; 25 to 35 bats were counted emerging from the tunnel. The bats would often circle the bat gate and occasionally go back in, making it difficult to get an accurate count.

In 2007, mist netting was performed at the 190-DR process water tunnel in order to capture bats. This was done in conjunction with other bat monitoring activities being conducted in the 183-F clearwell. The purpose was to determine which species were present and to determine genetic relationships of the bats at the 100-D Area site to bats of the same species in the 183-F clearwell. Morphometric measurements and deoxyribonucleic acid (DNA) samples were collected to definitively determine the species and any genetic relationships between the two sites. The species present in the 190-DR tunnel are Yuma myotis (*Myotis yumanensis*), as determined by morphometrics, acoustic analysis, and DNA analysis. Eighteen bats were captured on August 28, 2007, and four on September 11, 2007. The population was a mix of adults and juveniles. Only three individuals were males. On September 13, 2007, a team entered the 190-DR tunnels to do a visual inspection of the bats present. Video and still photographs were taken of the bats within the roost; 108 bats were counted on the video. Several clusters of 10 to 25 bats were observed, indicating the hatches were again being used as a maternity roost.

On September 22, 2008, a walkdown was performed to assess the number of bats using the roost. A total of 67 bats were observed in the 190-DR tunnel at this time.

Monitoring in 2009 included entry into the 190-DR tunnel on September 16, 2009, to videotape bats and capture individuals. The video photography was used to count the total number of bats using the structure. Captured individuals were assessed to determine species, sex, age, and reproductive status. During the entry, two nulliparous adult females (individuals that have never given birth), two parous adult females (individuals that have given birth), and three nulliparous juveniles were captured. The presence of juveniles shows that this site remains a viable maternity roost. A total of 77 bats were observed in the 190-DR tunnel with 63 of them (roosting in several clusters) observed in one of the hatches, also indicating that the site is still functioning as a maternity roost. This number was up slightly from the number recorded in 2008, but is not near the 170 recorded in July 2007. The differing numbers may be due to the timing of the monitoring, a shift of the maternity colony to another facility, a reduction in population, or other unknown factors.

Monitoring of the 190-DR tunnel in 2010 was delayed until September 27. A total of 32 bats were observed during the walkdown. Due to the late timing of this walkdown, it is not known whether a larger colony is still using the facility or not. One nulliparous female and two males were captured and hand released (Figure 48).



Figure 48. Yuma Myotis Observed in the 190-DR Tunnel on September 27, 2010.

No monitoring was conducted during the 2011 season.

Monitoring in 2012 entailed video monitoring (with infrared lights) of the 190-DR pipe tunnel bat gate on August 7. Approximately 118 bats (Yuma myotis) were counted during emergence (Figure 49). The number appears to be consistent with previous years' counts.

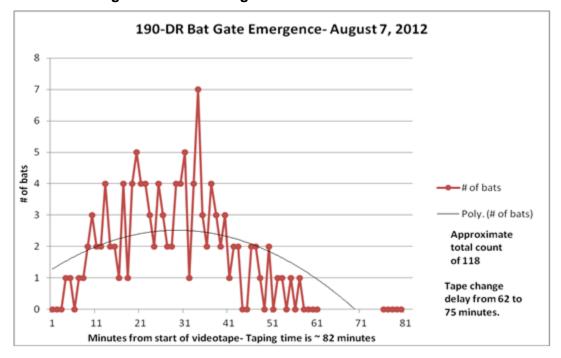


Figure 49. Bat Emergence Counts at 190-DR in 2012.

A mist netting session was conducted at the 190-D bat gate on August 7, 2012, to monitor the Yuma myotis maternity colony at that location. One juvenile Yuma myotis was captured during mist netting. The captured bat was in good condition, having normal body weight and no wing damage. The presence of a juvenile bat emerging from this roost site indicated that this site is still functioning as a maternity colony.

No monitoring occurred during the 2013 or 2014 seasons.

Monitoring in 2015 entailed video monitoring (with infrared lights) of the 190-D process tunnel bat gate on July 29, 2015, to assess usage by bats. The bat gate was moved to the next southerly tunnel access opening during the winter to facilitate remediation activities in the area. Due to technical difficulties with the camera, an accurate bat emergence count was not obtained. The video did indicate that the gate is still being used by Yuma bats despite changes to the tunnel entrance.

A remediation project was planned to remove the steel pipes within the two tunnel systems beginning in late October 2011. In 2012, it was decided that no removal of piping in the 190-D pipe tunnel would occur based upon historical process data. The potential removal of piping in the 190-DR tunnel has been deferred to final action decisions for the 100-D Area at this time.

6.2 BAT MITIGATION AT THE 183-D WATER TREATMENT PLANT

The 183-D Water Treatment Plant was scheduled for demolition beginning in FY 2013. Proposed project activities included demolition of the Headhouse, the flocculation basins, the filter building, and one of the clearwells. In preparation for demolition, a bat survey was conducted at the facility to determine whether bats were using any part of the facility as a roosting habitat. The work was started in the spring of 2009 and was completed in March 2011 (Lindsey et al. 2011). The study concluded that Yuma myotis were likely using the headhouse for a night roost and that it was very likely that an undiscovered maternity roost existed somewhere within part of the facility that was inaccessible. In addition, a maternity colony of pallid bats (*Antrozous pallidus*) was observed emerging from a crack in the cinder block wall on the south side of the headhouse. Because pallid bats are listed by the state of Washington as a Priority Species, mitigation was required according to the BRMaP (DOE-RL 2013) to maintain the viability of the colony.

To mitigate for habitat that would be lost by demolition of the facility, the north clearwell and associated flume and suction well were preserved and an alternate roost site (114-D) was constructed near the headhouse (Figures 50 and 51). This mitigation effort provided no net loss to the roosting habitat. The alternate roost construction was completed in September 2011 and was expected to provide a suitable habitat for the pallid bat maternity colony; however, it was unknown whether it would be a suitable replacement for the Yuma myotis. Leaving one of the clearwells in place was critical, as the Yuma myotis were known to night roost at that location.



Figure 50. 114-D Artificial Bat Roost at the 100-D Area Constructed in 2011.





The artificial roost was monitored during the spring and fall of 2012. On October 2, 2012, approximately three to five Myotis bats, most likely Yuma myotis, were observed roosting inside the 114-D roost structure near the roof between the ceiling roost partition wood frame and the concrete wall. No apparent pallid bat use of 114-D, as would be indicated by visual observation of the species or guano, has been observed.

Visual monitoring of the artificial roost (114-D) occurred on August 13, 2013. One Myotis bat, most likely Yuma myotis, was observed roosting on the partitioned wood frame near the ceiling. The bat moved out of sight after a couple minutes and was between the ceiling and the wood frame. Due to the frame construction, more bats could have been there than were seen at the time of this observation. The structure's concrete floor was scattered with Myotis bat guano, which would indicate increasing use by bats. As in 2012, no apparent pallid bat use of 114-D, as would be indicated by visual observation of the species or guano, was observed.

Visual monitoring of the artificial roost (114-D) occurred on June 18, 2014. A significant increase in usage, as compared to 2012 and 2013, by Myotis bats (likely Yuma myotis) was observed as indicated by bat guano on the roost floor and bats roosting (note urine stains on walls) near the ceiling of the roost (Figures 52 and 53.) Note that more bats were observed roosting near the ceiling than are shown in Figure 52; only one photograph was taken to minimize disturbance to the bats. No apparent pallid bat use was indicated for the 2014 season.



Figure 52. Bats Roosting at the 114-D Ceiling in 2014.



Figure 53. Bat Guano on the Floor of 114-D in 2014.

Visual monitoring of the artificial roost (114-D) occurred on July 29, 2015, prior to sunset. No bats were observed in the structure at this time. Evidence in the form of additional urine staining on the walls (Figure 54) and increased amounts of guano on the floor (Figure 55), as compared with observations from 2014, indicated continued usage of the roosting structure in 2015. Upon entry into the 114-D during 2015 monitoring, deceased bats were observed on the floor in addition to nesting pigeons. The absence of live bats in the structure and the carcasses on the floor were likely due to excessively high temperatures that occurred abnormally early this year. These high temperatures occurred prior to the fledging time of bat pups, which typically happens in late June to early July. Records from the Hanford Meteorological Station indicated June 2015 was the warmest on record and that there were 8 days with maximum temperatures greater than 100 °F (normally there is only one for the month). In addition, the presence of pigeons within the structure during the 2015 visit may have deterred bat usage. No apparent pallid bat use was indicated for the 2015 season.



Figure 54. Urine Stains on the Walls of 114-D in 2015.



Figure 55. Bat Guano on Floor of 114-D in 2015.

The artificial bat roost (114-D) was visually monitored inside during a visit on June 21, 2016; no bats were observed in the roost. Pigeons were observed to be nesting inside the structure and may have deterred bat usage. The bat boxes on the outside of 114-D were also visually observed for use by Pallid bats; no use was indicated.

Demolition of the 183-D filtered water plant began in 2013. To assess the status of the north clearwell, which is being left for bat use, video monitoring (with infrared lighting) along with bat call acoustic recording was conducted on July 24, 2013, at the open hatch of the north 183-D clearwell from 2100 to 2230 hours. The acoustic recorder was positioned north of the hatch approximately 15 m (50 ft). Thirty-three bats were observed exiting and 22 bats were observed entering the clearwell open hatch from video analysis. This data gives an estimate of at least 11 bats using the clearwell at this time. Bats were also observed (visually) flying in the area near the hatch. Acoustic monitoring with recorded call analysis using SonoBat™ software indicated Yuma myotis, which is believed to be the species using the clearwell.

Demolition of 183-D was completed in 2014. The north clearwell and underground flume on the west side of the clearwells were left intact for bat habitat. Access by bats to both structures was provided; an access hatch was left open on the north clearwell on the east side, and openings to the flume were provided on the north and south ends.

Bat monitoring (mist-netting and video monitoring) was conducted on July 30, 2014, on the east side of the north clearwell. No bats were captured by mist-netting during this session. An emergence count from the clearwell was conducted using a video recorder with infrared lighting. Video analysis indicated approximately 387 +/- 39 (10% count error) bats. This gave a range of 348 to 426 bats utilizing the clearwell at that time (Figure 56). This was a significant increase from the estimates derived from visual observations in 2013.

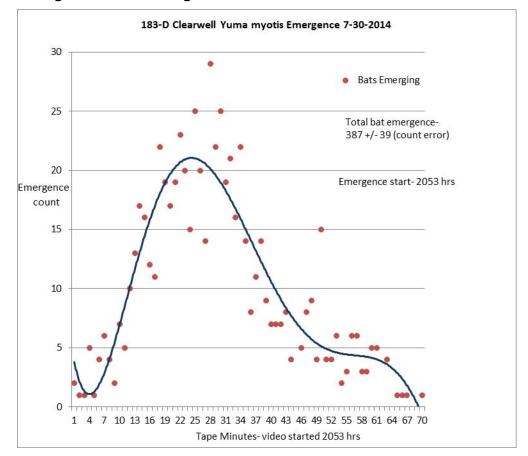


Figure 56. Bat Emergence Counts at the 183-D Clearwell in 2014.

An emergence count from the clearwell was conducted on July 29, 2015, using a video recorder with infrared lighting (Figure 57). Video analysis indicated approximately 365 +/- 37 (10% count error) bats. This gave a range of 328 to 402 bats utilizing the clearwell (Figure 58), comparable to that indicated in the 2014 monitoring.



Figure 57. Bat Emerging From 183-D Clearwell in 2015.

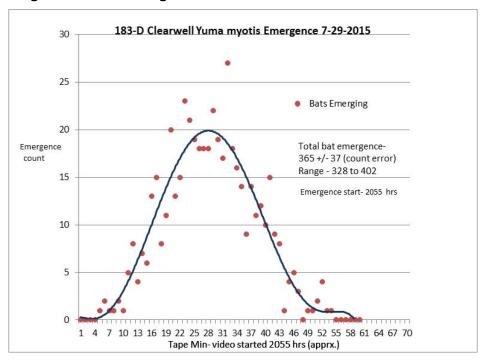


Figure 58. Bat Emergence Counts at the 183-D Clearwell in 2015.

An emergence count from the clearwell was conducted on June 21, 2016, using a video recorder with infrared lighting. Video analysis indicated approximately 1,465 +/- 147 (10% count error) bats. This gave a range of 1,319 to 1,612 bats utilizing the clearwell (Figure 59), a significant increase (~300 to 400%) over the range recorded for 2014 and 2015.

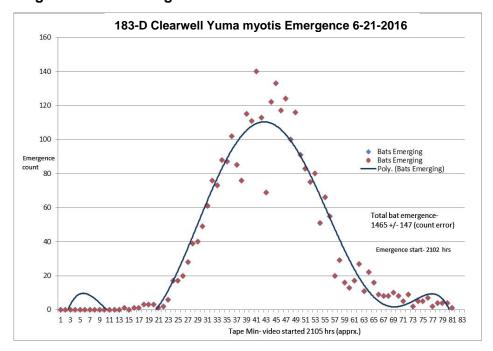


Figure 59. Bat Emergence Counts at the 183-D Clearwell in 2016.

6.3 BAT MITIGATION AT THE 100-F REACTOR

Bats were observed on several occasions roosting inside the 105-F Reactor building during the initial phases of the ISS project, which began in FY 2000. In the spring of 2003, a maternity colony of pallid bats was observed in the upper areas of the reactor building. Other species (Myotis sp.) were also observed in the reactor. The 105-F Reactor had served as both a communal roost and a breeding area for these bat species; therefore, mitigation efforts were initiated to remove the bats from the building unharmed and provide an alternate roosting habitat.

As the new roof was being completed in August 2003, steps were taken to remove the bats from the building to prevent them from being trapped inside. The main ground-floor entrance to the building was left open to serve as the only access to the building. After a week of acclimation to the new access, a piece of plywood with three 5-cm (2-in.) slots cut in it was placed over the door to narrow the entrance. The slots were fitted with landing boards mounted on the inside of the door to allow the bats to land and crawl out. The first night after the board was installed, the narrowed entrance was observed to ensure the bats could get out. The slotted door was left in place for 1 week, and on September 8, 2003, exclusion netting was installed loosely over the slotted door and stapled to the top and sides so the bats had to crawl through the slots and out the bottom of the netting to get out. Once out, they could not get back in.

Alternative roosts were provided by installing eight commercially made bat roosts (Figure 60). Bat boxes designed to house pallid bats were installed on the east side of the building (boxes #1 and #2), the south side (boxes #4 and #6), the west side of the building (box #7), and one on a utility pole approximately 50 m (164 ft) northeast of the building (box #8). Two boxes designed for Myotis bats were installed on the south side of the building (boxes #3 and #5).

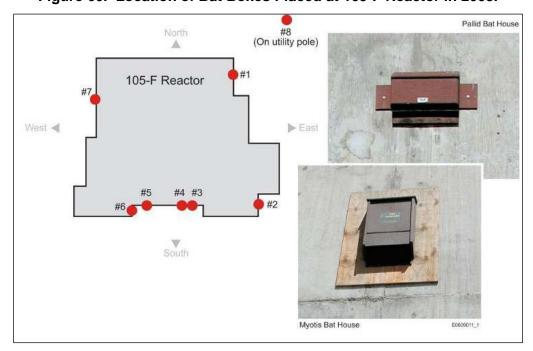


Figure 60. Location of Bat Boxes Placed at 105-F Reactor in 2003.

Follow-up surveys confirmed that the pallid bats were utilizing the boxes mounted on the building. Because of the difficulty of counting bats inside the boxes, it is impossible to get an exact count; however, it was estimated that the colony contained approximately 30 individuals in September 2003 using box #1 exclusively. Very few Myotis bats were observed roosting in the bat boxes designed for them (boxes #3 and #5).

Pallid bats returned from winter hibernation to use the boxes on the reactor the following spring. During 2004, they continued to primarily use box #1 on the northeast side of the building, but by the end of the summer they had used all of the pallid bat boxes on the reactor building (boxes #1, #2, #4, #6, and #7) but had not used the one mounted on the utility pole (box #8). Myotis continued to use boxes #3 and #5 infrequently, but not as a maternity colony.

Pallid bats began returning to the roost site at the 105-F Reactor in April 2006. Fresh pallid bat guano was observed under the boxes on April 11, 2006. During the spring months (April and May) the bats appeared to prefer the roosts on the south side of the building, probably because these sites were the warmest. As the summer progressed, they appeared to prefer boxes #1 and #2 on the east side of the building. On August 3, 2006, all boxes were inspected for the presence of bats. Boxes #1 and #2 appeared to have approximately the same number of bats present (judged by the number of bats counted by looking into the entrance from below). The emergence of bats from box #2 was observed and a total of 41 bats were counted. Assuming box #1 had approximately the same number of individuals present; the population was estimated to be about 80 individuals. This is a substantial increase since the mitigation project began in 2003 when the population was estimated to be approximately 30 specimens.

Due to the excavation of waste sites around the 105-F Reactor Building, no surveys or counts were conducted at the bat boxes in 2007; however, visual inspections, acoustic surveys, and the presence of bat guano confirmed that the pallid bats did return in 2007.

On September 25, 2008, mist netting was conducted at the 105-F Reactor to determine if the roost site was still active. Pallid bats were observed in three of the eight boxes (boxes #2, #7, and #8). Nine pallid bats and one Yuma myotis were captured in two nets. All of the pallid bats were female and some were parous (e.g., had given birth), indicating this is still a maternity colony. One of the bats captured was a recapture of an individual that was banded in September 2006.

Monitoring for 2009 was performed at the 105-F Reactor on August 31. Two mist nets were placed near the reactor, and two infrared video cameras were set up to record emergence at two of the seven bat boxes. Two juvenile pallid bats were captured in the mist nets, confirming that the site remains an active and successful maternity colony. One of the individuals was light tagged, which consists of attaching a small glo-stick to the bat to allow the bat to be identified in flight. The bat was observed entering the eave of the 105-F Reactor roof. This indicated that bats are potentially using the eaves of the 105-F Reactor roof for roosting habitat. There was also evidence (in the form of guano) that bats were continuing to use the bat boxes around the different sides of the reactor building. A video camera was placed on bat box #2 and #4 to record emergence for 1 hour. No bats were observed exiting box #2; however, between 19 and 34 pallid bats were observed using box #4. Over the course of the hour bats were observed both entering and exiting the box, making an exact count impossible.

During 2009 monitoring at the 105-F Reactor, acoustic detectors were used to record bat echolocation calls. Many pallid bat calls were recorded including several "social calls," which the bats use for communication rather than navigation. These "social calls" are diagnostic for

bats and are often the only way to tell their calls from the calls of big brown bats (*Eptesicus fuscus*). In addition, one Yuma myotis, one western small-footed Myotis (*Myotis ciliolabrum*), and five western pipistrel (*Pipistrellus hesperus*) calls were recorded on August 31, 2009. This showed that the high level of bat activity in the area included multiple species, another indication of how ideal the area is for supporting bat populations.

Monitoring for 2010 was performed at the 105-F Reactor on June 16, 2010. Between 53 and 76 pallid bats were recorded exiting one of the bat boxes at the 105-F Reactor. Due to individual specimens entering and exiting the bat boxes throughout the night, it was difficult to accurately count the number of individuals using a specific box. In addition, the many roosting areas available to the bats in this area, including the eight bat boxes and the eaves of the reactor building, was also did not make it possible to accurately assess the population size. On August 17, 2010, a triple-high mist net was deployed near the 105-F Reactor. Four pallid bats were captured; all were observed to be nulliparous juvenile females in good condition (Figure 61).



Figure 61. Female Pallid Bat Captured at the 105-F Reactor During 2010 Monitoring.

One mist-net session was conducted at the 105-F Reactor on June 22, 2011; no bats were captured, however, many were observed emerging from the bat boxes. Additional evidence in the form of fresh guano beneath all bat boxes indicated that the pallid colony was healthy and continuing to use the bat boxes.

Mist netting for pallid bats using two nets at the 105-F Reactor occurred on July 24, 2012. Five pallid bats were captured during this session, consisting of three juvenile females, one adult lactating female, and one adult parous female. In addition to the pallid bats captured, 31 Yuma myotis were captured in the same nets; it is likely the Yuma bats were from the nearby 183-F clearwell maternity colony. All captured bats (Figure 62) were in good condition (e.g., normal body weight and good wing condition). The capture of pallid bat juveniles and lactating female indicated the site was still functioning as a maternity colony for pallid bats.



Figure 62. Bat Captured at the 105-F Reactor During 2012 Monitoring.

Mitigation monitoring for the site has not been part of the WCH mitigation monitoring work scope since FY 2012.

6.4 183-F CLEARWELL MATERNITY COLONY

A bat habitat mitigation project began at the 183-F clearwell during the summer of 2007. Preliminary counts estimated the population at over 2,000 individuals, making this colony one of the largest in the state of Washington at that time. Because the clearwell is a maternity roost, it is considered a Priority Habitat by the Washington Department of Fish and Wildlife. This colony was studied because the clearwell structure was slated to be demolished and a mitigation plan needed to be developed to prevent significant impact or loss of the maternity colony.

Information needed in order to advise on mitigation actions included determining the bat species present and the habitat conditions that made the clearwell such an attractive and successful roost site. Roost sites with this many individuals are unusual, and it was important to understand how the facility was being used to determine the potential impacts from the various end state options.

A combination of morphological measurements, acoustic analysis of echolocation calls, and DNA analysis (wing membrane tissue samples collected during 2007 and 2008) were used for species determination. The initial morphological measurements and acoustic analysis indicated that the colony is composed of Yuma myotis. Results from the DNA analysis of wing membrane tissue samples confirmed the identification as Yuma myotis. The results of the study indicated that the facility is very complex and is suitable for bat roosting in many locations during different times of the year. The building supports one of the largest maternity colonies of bats in the state, and may also support some level of winter activity. For these reasons, the project report stated that the preferred mitigation for the site would be to leave the clearwell and flume in

place, and to place signs and fencing around the facility to prevent unauthorized entry (Gano et al. 2009).

In January 2009 WCH staff received correspondence from the DOE-RL stating that they intend to maintain the 183-F clearwell and flume long term. In order to allow the colony to thrive, they instructed WCH to install passive human-access restrictions to the facility including signs and fencing. The fencing and signage were constructed in April 2009.

Mitigation monitoring was performed at the 183-F clearwell and flume during August 2009. Two mist nets were set up near the clearwell hatch, and infrared cameras were placed at the clearwell hatch and flume entrance to count emergence. A total of eight Yuma myotis and one western small-footed Myotis were captured in the mist nets. There were five nulliparous female Yuma myotis and three parous female Yuma myotis; all individuals were adults. The western small-footed Myotis was a nonreproductive adult male. When released, the western small-footed Myotis was seen entering the clearwell through the open hatch. This was the first evidence of a second species using the clearwell. Adult males do not typically roost with a congregation of females, so it is unlikely that a second species is using the facility as a maternity roost.

Video monitoring was performed in 2009 for 1 hour at the clearwell hatch and 1 hour at the flume entrance beginning at the start of the emergence. A total of 2,367 bats were counted over 62 minutes of emergence at the 183-F clearwell hatch. The emergence was observed to continue for 15 minutes following the end of the video. The polynomial average was extracted out to estimate the remainder of the emergence, and the total emergence was estimated to include 2,640 individuals. Approximately 120 bats were observed exiting the flume entrance.

No mist netting was performed at the clearwell in 2010. Emergence counts were performed at the site using an infrared video camera on June 16, 2010, and again on August 17, 2010. A total of 3,539 and 3,637 bats were observed emerging from the facility on June 16 and August 17, 2010, respectively. These numbers represented the largest population recorded to date at this facility and confirmed the clearwell as the largest known colony of bats in the state of Washington at that time.

Monitoring at the clearwell in 2011 consisted of one mist-net session on August 23, 2011, and two emergence counts of 4,114 and 3,777 (videotaping with infrared lighting) on June 22 and August 23, 2011, respectively (Figure 63). These counts compared with 2009 and 2010 indicated that the colony was continuing to grow. The reason for the slight drop in the August count of approximately 300 could be from several possibilities. The expectation was that the number would be up to some degree from recruitment of new offspring into the population. It could be that some of the bats had already dispersed. Another possibility is that some may have been roosting in the flume that was not monitored during the session. Whatever the cause, the colony continued to remain strong and increasing in number from year to year.

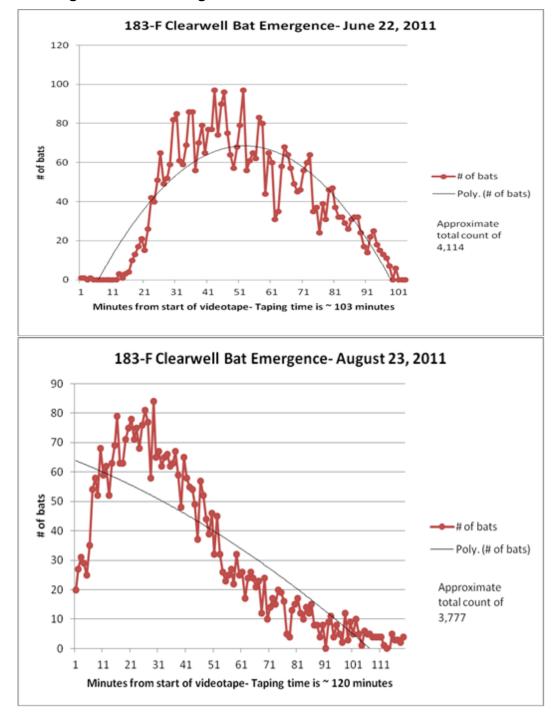


Figure 63. Bat Emergence Counts at the 183-F Clearwell in 2011.

The mist-net session in 2011 captured 30 Yuma myotis bats (Figure 64). A total of 27 females were captured (12 adults and 15 juveniles); and of the adult females, 7 were post-lactating and 5 were nulliparous. A total of three males were captured (one non-reproductive adult and two juveniles). All bats captured appeared to be in good condition with no observed health issues. The 2011 monitoring data showed that the roost continued to support a large maternity colony at that time.



Figure 64. Yuma Myotis Captured August 23, 2011, from the 183-F Clearwell.

On July 24, 2012, a mist netting session was conducted at 105-F to monitor the pallid bat colony at the reactor building. Besides pallid bats being caught, 31 Yuma myotis were captured in the same nets, consisting of 11 juvenile males, 16 juvenile females, 2 adult females, 1 adult lactating female, and 1 adult nulliparous female. The Yuma bats were likely from the nearby 183-F clearwell maternity colony. All captured bats (Figure 65) were in good condition (e.g., normal body weight and good wing condition). The captured juveniles and lactating female indicated that this site is still functioning as a maternity colony.



Figure 65. Yuma Myotis Captured July 24, 2012, from Mist Net at the Nearby 105-F Site.

Video monitoring (with infrared lights) of the 183-F Yuma myotis colony occurred on July 24, 2012, and 6,627 Yuma myotis (Figure 66) were counted during emergence. Compared with the previous years' counts, this was the highest number to date. The 183-F maternity colony appeared to be healthy and growing at that time.

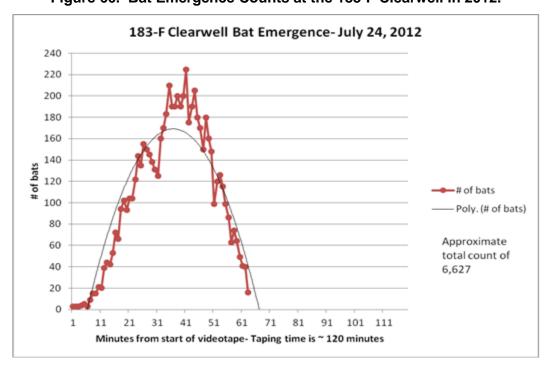


Figure 66. Bat Emergence Counts at the 183-F Clearwell in 2012.

Mitigation monitoring for the site has not been part of the WCH mitigation monitoring work scope since FY 2012. The importance of monitoring colonies is heightened with the emergence of white-nose syndrome (WNS) in the eastern United States. The disease continues to extend its range with the first case in Washington State confirmed this past March (March 2016) in a Little brown bat (*Myotis lucifugus*) near North Bend (King County) and a second case confirmed more recently in a silver haired bat (*Lasionycteris noctivagans*), also from King County (Washington Department of Fish and Wildlife 2016). It is important that baselines can be established prior to any impacts from WNS and that any emergence of WNS can be quickly identified. The continued monitoring and reporting of the conditions of these colonies is important in that it provides historical and current information that can be used for comparison from year to year to determine if there are any changes in the condition of the bats (e.g., such as the emergence of WNS) or the status of the colonies that can be addressed early on to prevent significant loss of the species.

7.0 SNAKE MITIGATION

Snake hibernacula often contain mixed species of snakes. In the Columbia Basin, species such as the western rattlesnake (*Crotalus viridis*) (Figure 67), gopher snake (*Pituophis catenifer*), yellow-belly racer (*Coluber constrictor*), and potentially the striped whipsnake (*Masticophis taeniatus*) often den together for the winter (Larsen 1997). The striped whipsnake is a Washington State Candidate species and a BRMaP (DOE-RL 2013) Level III resource. Though not often popular with the general public, snakes play an important role in a healthy ecosystem by keeping small mammal and insect populations in check. They also serve as a prey species for higher trophic species such as coyotes and raptors. The Hanford Site provides suitable habitat for the striped whipsnake, and it has been recorded on site on very rare occasions. Because the striped whipsnake will den with rattlesnakes, and because denning sites are critically important to maintaining healthy snake populations, it is important to preserve these sites (Larsen 1997).



Figure 67. Western Rattlesnake.

In November 2005, remediation of a portion of the 128-B-3 Burn Pit required excavation of an area containing several large boulders. The void spaces between the boulders contained an active snake hibernaculum (den). Several rattlesnakes were brought to the surface during the excavation of the burn pit debris. By the time the hibernaculum at the site was recognized as such, it had been damaged by the excavation activities beyond a point of preservation. However, as the remediation of the site continued, a mitigation plan was developed to reconstruct the hibernaculum. The clean boulders were segregated and stockpiled until the site was cleared for backfilling in the fall of 2006. The boulders were then pushed back into the excavation, forming several void spaces that could potentially be used by snakes. In addition to recreating a habitat for snakes, the void spaces were expected to provide habitat for numerous other species including deer mice (*Peromyscus maniculatus*), bushy-tailed woodrats (*Neotoma cinerea*), Nuttall's cottontail rabbits (*Sylvilagus nuttallii*), porcupines (*Erethizon dorsatum*), and possibly even coyotes (*Canis latrans*).

The site was monitored for wildlife usage by searching the area for tracks and scat each spring from 2007 through 2013. Evidence of Nuttall's cottontail, North American porcupine, and bushy-tailed woodrat usage has been observed, but no snakes have been seen. Because of the secretive nature of snakes, it is difficult to determine their presence. The most efficient method to determine whether a location is being used by snakes is to set up a specialized snake trap.

The site was monitored in April 2010 using a drift fence in association with funnel traps to determine if snakes had discovered the reconstructed hibernaculum. Snakes will typically enter hibernacula in late September to October and leave around mid- to late April. Monitoring is conducted in the spring when snakes are typically found leaving winter hibernacula for summer foraging areas. The drift fence was placed along one side of the boulder pit, as the purpose of this monitoring was to determine if snakes were using the hibernaculum and to assess the effectiveness of this artificial snake den in replacing the previously existing snake habitat, not to conduct a complete inventory.

Approximately 36.6 m (120 ft) of silt fencing was placed (staked) around the north side of the hibernaculum on April 13, 2010 (Figure 68). The bottom 5 cm (2 in.) of the fence was dug into the soil to prevent snakes from going under the fence. Four funnel traps (Row and Blouin-Demers 2006) were placed down the length of the fence. Theoretically, snakes leaving the hibernaculum would encounter and move along the fence, potentially going into the funnel traps. The drift trap was open for 5 trap-nights and closed/removed on April 22, 2010. No snakes were captured during this study's trapping period. Additional monitoring is needed to determine the extent of use by snakes, if any, at this mitigation site.

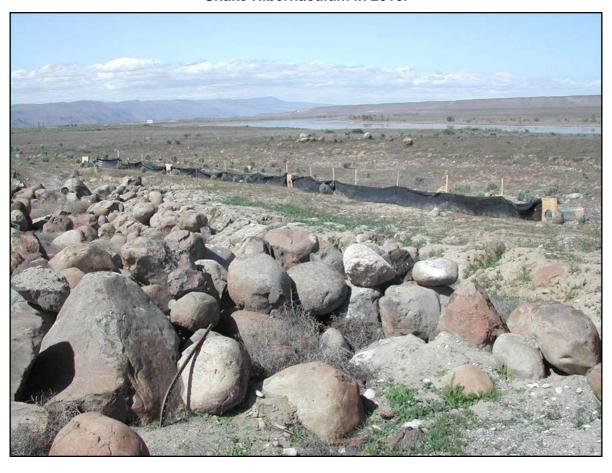


Figure 68. Monitoring at the 128-B-3 Artificial Snake Hibernaculum in 2010.

In August 2011, a snake hibernaculum was constructed at the Waste Information Data System site, 600-109 (Figure 69) to take advantage of available materials. This project did not replace an impacted den site but was created as additional habitat. This hibernaculum was built in an east-west orientation with a southern aspect and is approximately 12 m (40 ft) long and 1.5 m (5 ft) deep. It was constructed of cobbles and boulders. The rock was placed in a manner to create void spaces down to a depth of 1.5 m (5 ft) to provide adequate winter hibernation conditions (above 0 °C) while also providing pathways near the surface and openings for springtime sunning and emergence.

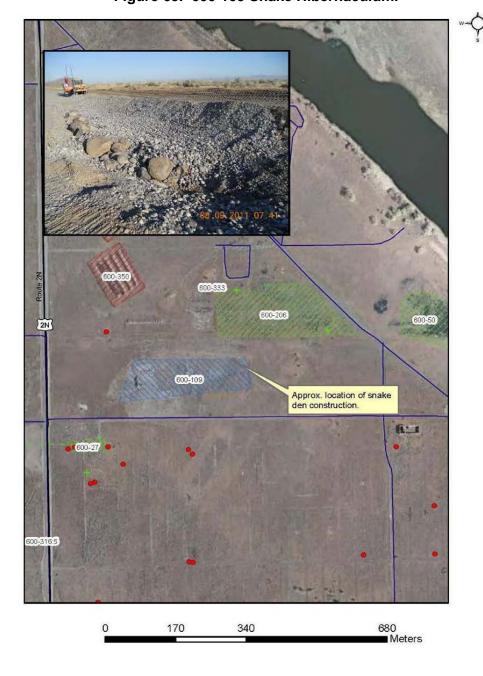


Figure 69. 600-109 Snake Hibernaculum.

A snake hibernaculum mitigation project of similar design, but using smaller diameter rock, was constructed at Waste Information Data System site 600-3 (Figure 70) in the fall of 2011 to mitigate for a western rattlesnake den that was discovered in March 2010 during remediation operations at 600-3. Visual monitoring of these sites has been conducted during routine revegetation monitoring; however, no emergence monitoring of these two sites has occurred to date. No snakes have been observed at these locations during visual monitoring.

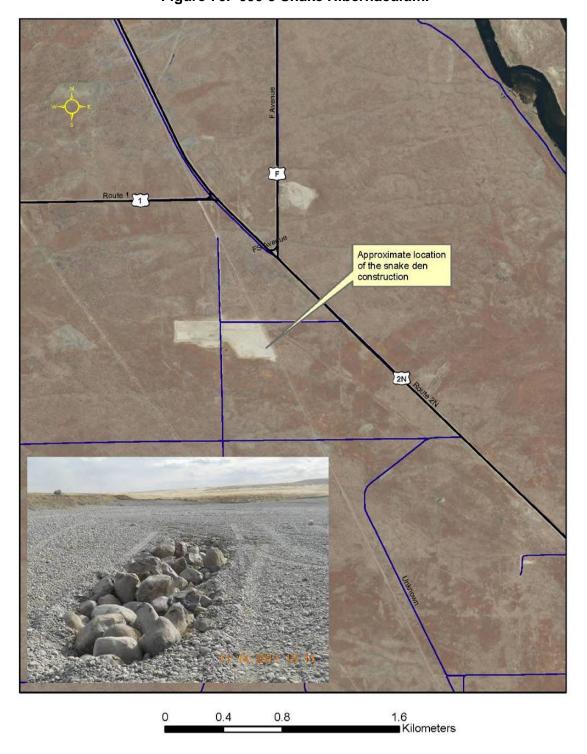


Figure 70. 600-3 Snake Hibernaculum.

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APPENDIX A 2012 – 2015 REVEGETATION MONITORING RESULTS

APPENDIX A

2012 - 2015 REVEGETATION MONITORING RESULTS

Table A-1. Percent Canopy Cover and Frequency of Occurrence at the 100-C-7 Site in 2015.

	W	est	Е	ast	Entire	e Site
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
Agropyron spicatum (bluebunch wheatgrass)	7.60	68.00	8.30	92.00	7.95	80.00
Artemisia tridentata (big sagebrush)	1.50	20.00	3.10	28.00	2.30	24.00
Atriplex spinosa (spiny hopsage)	1.30	12.00	0.70	8.00	1.00	10.00
Bromus tectorum ^a (cheatgrass)	3.20	68.00	1.20	48.00	2.20	58.00
Centaurea diffusa a (diffuse knapweed)	0.10	4.00	0.20	8.00	0.15	6.00
Lactuca serriola ^a (prickly lettuce)	Χ	Х	0.20	8.00	0.10	4.00
Kochia scoparia ^a (kochia)	0.10	4.00	0.10	4.00	0.10	4.00
Machaeranthera canescens (hoary aster)	Х	Х			Χ	Х
Melilotus officinalis ^a (sweetclover)	Х	Х			Χ	Х
Poa sandbergii (Sandberg's bluegrass)	0.90	36.00	1.50	40.00	1.20	38.00
Purshia tridentata (antelope bitterbrush)	Χ	Χ		-	Χ	X
Salsola kali ^a (Russian thistle)	5.50	100.00	6.90	100.00	6.20	100.00
Sisymbrium altissimum a (tumble mustard)	2.10	28.00	1.40	36.00	1.75	32.00
Sitanion hystrix (bottlebrush squirreltail)	3.10	44.00	0.20	8.00	1.65	26.00
Sporobolus cryptandrus (sand dropseed)	0.10	4.00			0.05	2.00
Triticum sp. ^a (wheat)	0.20	8.00	Χ	Χ	0.10	4.00
Tragopogon dubius ^a (yellow salsify)	Χ	Χ	Χ	Χ	Χ	Х
Crust	0.20	8.00	0.40	16.00	0.30	12.00
Soil	66.30	100.00	68.50	100.00	67.40	100.00
Litter	25.00	100.00	23.10	100.00	24.05	100.00
Total canopy cover (excludes crust/soil/litter)	25.70		23.80		24.75	
Total native % cover	14.50		13.80		14.15	
Change in native % cover from 2014	+3.40		-2.70		+0.35	
Total invasive % cover	11.20		10.00		10.60	
Change in invasive % cover from 2014	-36.30		-6.60		-21.45	

^a Invasive species.

X = present but not counted in plot frames
-- = species not observed on site

Table A-2. Percent Canopy Cover and Frequency of Occurrence at the 100-C-7 Site in 2014.

Species	% Cover East	% Cover West	% Frequency of Occurrence East	% Frequency of Occurence West
Agropyron spicatum (bluebunch wheatgrass)	2.2	11.5	48.0	88.0
Artemisia tridentata (big sagebrush)	0.1	0.1	4.0	4.0
Bromus tectorum ^a (cheatgrass)	0.3	0.3	12.0	12.0
Centaurea diffusa a (diffuse knapweed)	Χ	Χ	X	Х
Gnaphalium sp(cudweed)	Χ		X	-
Grayi spinosa (spiny hopsage)	Χ	Χ	X	Х
Melilotus alba ^a (sweetclover)	Χ	Χ	X	X
Orysopsis hymenoides (Indian ricegrass)	0.1	Χ	4.0	X
Poa bulbosa a (bulbous bluegrass)	Χ	-	X	-
Poa sandbergii (Sandberg's bluegrass)	1.3	0.9	52.0	36.0
Purshia tridentata (antelope bitterbrush)	0.1	0.1	4.0	4.0
Salsola kali ^a (Russian thistle)	44.3	16.0	100.0	100.0
Sisymbrium altissimum a (tumble mustard)	2.9	0.3	20.0	12.0
Sitanion hystrix (bottlebrush squirreltail)	7.3	3.7	56.0	72.0
Sporobolus cryptandrus (sand dropseed)	-	0.2	-	8.0
Tragopogon dubius ^a (yellow salsify)	Χ	-	X	-
Crust	1.6	1.9	64.0	76.0
Soil	59.0	42.6	100.0	92.0
Litter	37.7	57.2	100.0	100.0
Total canopy cover (litter not included)	58.6	33.1		
Total native % cover	11.1	16.5		
Change in native % cover from 2013	-1.6	- 5.7		
Total invasive % cover	47.5	16.6		
Change in invasive % cover from 2013	+35.7	+12.4		

a Invasive species.

X = present but not counted in plot frames
-- = species not observed on site

Table A-3. Percent Canopy Cover and Frequency of Occurrence at the 100-C-7 Site in 2013.

Species	% Cover East	% Cover West	% Frequency of Occurrence East	% Frequency of Occurrence West
Poa sandbergii (Sandberg's bluegrass)	3.0	4.2	86.7	73.3
Bromus tectorum ^a (cheatgrass)	0.5	0.3	20.0	13.3
Salsola kali ^a (Russian thistle)	9.3	3.2	86.7	60.0
Agropyron spicatum (bluebunch wheatgrass)	5.0	5.7	100.0	100.0
Sisymbrium altissimum ^a (tumblemustard)	0.7	0.2	26.7	6.7
Lactuca seriola ^a (prickly lettuce)	X	Х	X	Х
Hordeum leporinuma (hare barley)	1.3		53.3	
Artemisia tridentata (big sagebrush)	X	2.0	X	46.7
Purshia tridentata (antelope bitterbrush)	X	Х	X	Х
Melilotus alba ^a (sweetclover)	X		Х	
Sitanion hystrix (bottlebrush squirreltail)	4.2	10.2	40.0	80.0
Oryzopsis hymenoides (Indian ricegrass)		0.2		6.7
Triticum ^a	X	0.3	X	13.3
Erodium cicutariuma (storksbill)		0.2		6.7
Chenopodium leptophyllum (slimleaf goosefoot)	0.2		6.7	
Amsinckia lycopsoides (tarweed fiddleneck)	X		Х	
Descurainia pinnata (western tansymustard)	0.3		13.3	
Crust		0.7		26.7
Soil	41.5	36.0	100.0	100.0
Litter	58.5	64.0	100.0	100.0
Total canopy cover (litter not included)	24.5	26.3		
Total invasive % cover	11.8	4.2		
Total native % cover	12.7	22.2		

^a Invasive species.

X = present but not counted in plot frames
-- = species not observed on site

Table A-4. Percent Canopy Cover and Frequency of Occurrence at the 100-C-7:1 Site in 2015. (2 Pages)

		ide vation		tside vation	Entir	e Site
	Exca		Exta	O O		–
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
Achillea millefolium (yarrow)			0.09	0.57	0.06	0.40
Agropyron spicatum (bluebunch wheatgrass)	4.40	69.33	2.61	53.71	3.15	58.40
Amsinckia lycopsoides (tarweed fiddleneck)			0.10	1.14	0.07	0.80
Artemisia tridentata (big sagebrush)	2.27	17.33	1.16	9.14	1.49	11.60
Astragalus purshii (woolypod milkvetch)			0.36	2.86	0.25	2.00
Atriplex spinosa (spiny hopsage)			Х	Х	Х	Х
Bromus tectorum a (cheatgrass)	1.17	40.00	5.49	77.14	4.19	66.00
Centaurea diffusa a (diffuse knapweed)	Х	Х	0.89	10.29	0.62	7.20
Chrysothamnus nauseousus (gray rabbitbrush)			Х	Х	Х	Х
Descurainia pinnata (western tamsymustard)			0.03	1.14	0.02	0.80
Erigeron sp. (fleabane)	0.23	2.67	0.07	2.86	0.06	2.40
Erodium cicutarium ^a (common stork's bill)			0.03	1.14	0.02	0.80
Festuca octoflora (small six weeks)			0.19	4.57	0.20	4.00
Hordeum leporinum ^a (hare barley)	0.87	21.33	0.49	16.57	0.60	18.00
Koeleria cristata (prairie junegrass)	Х	Х			0.00	0.00
Lactuca serriola ^a (prickly lettuce)	Х	Х	0.74	12.57	0.52	8.80
Lamium amplexicaule a (henbit deadnettle)	0.03	1.33	0.09	0.57	0.07	0.80
Machaeranthera canescens (hoary aster)			Х	Х	Х	Х
Medicago sativa a (alfalfa)	Х	Х	0.01	1.14	0.01	0.80
Melilotus officinalis a (sweetclover)			0.09	0.57	0.06	0.40
Oryzopsis hymenoides (Indian ricegrass)	9.07	97.33	0.93	28.57	3.37	49.20
Poa bulbosa a (bulbous bluegrass)			0.04	0.57	0.03	0.40
Poa sandbergii (Sandberg's bluegrass)	0.83	26.67	7.41	65.71	5.44	54.00
Purshia tridentata (antelope bitterbrush)	0.00	0.00	Χ	Χ	Χ	X
Salsola kali ^a (Russian thistle)	8.63	100.00	17.13	97.14	14.58	98.00
Sisymbrium altissimum ^a (tumble mustard)	3.57	49.33	7.81	55.43	6.54	53.60
Sitanion hystrix (bottlebrush squirreltail)			0.04	1.71	0.03	1.20
Sporobolus cryptandrus (sand dropseed)			0.11	1.71	0.08	1.20
Stipa comata (needle-and-thread grass)	Х	X	0.03	1.14	0.02	0.80
Tragopogon dubius ^a (yellow salsify)	0.03	1.33	0.33	7.43	0.24	5.60
Triticum aestivum a (common wheat)			0.09	0.57	0.06	0.40
Verbena bracteata (big-bract verbena)			Х	Х	Х	X
Crust	0.00	0.00	0.01	0.57	0.01	0.40
Soil	72.37	100.00	69.97	100.00	70.69	100.00
Litter	27.13	100.00	21.76	100.00	23.37	100.00

Table A-4. Percent Canopy Cover and Frequency of Occurrence at the 100-C-7:1 Site in 2015. (2 Pages)

		Inside Excavation		Outside Excavation		e Site
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
Total canopy cover (excludes crust/soil/litter)	31.13		46.34		41.78	
Total native % cover	16.83		13.13		14.24	
Change in native % cover from 2014	+12.90		+0.33		+4.04	
Total invasive % cover	14.30		33.21		27.54	
Change in invasive % cover from 2014	+0.38		+0.71		+0.59	

^a Invasive species.

Table A-5. Percent Canopy Cover and Frequency of Occurrence at the 100-C-7:1 Site in 2014. (2 Pages)

		Inside Excavation		side /ation	Entire Site	
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)			Х	Х	Х	X
Amaranthus albus ^a (white pigweed)	0.03	1.33	0.03	1.33	0.03	1.33
Amborsia acanthicarpa (bur ragweed)			Х	Х	Х	X
Amsinckia lycopsoides (tarweed fiddleneck)	X	Х	Х	Х	Х	X
Artemisia tridentata (big sagebrush)	X	Х	0.16	6.29	0.16	6.29
Bromus tectorum ^a (cheatgrass)	3.00	60.00	1.69	40.00	2.08	46.00
Bunchgrasses ^o	3.80	88.00	8.61	92.57	7.17	91.20
Centaurea diffusa a (diffuse knapweed)	0.05	2.00	0.28	8.00	0.23	6.50
Chenopodium leptophyllum (slimleaf goosefoot)	Х	Х	0.03	1.00	0.02	0.67
Chorispora tenella ^a (blue mustard)	X	Х	0.04	1.71	0.03	1.33
Chrysothamnus nauseosus (gray rabbitbrush)			0.01	0.57	0.01	0.40
Cirsium vulgare ^a (bull thistle)	-		0.03	1.14	0.02	0.80
Descurania pinnata (western tansymustard)			0.26	4.57	0.18	3.20
Erodium cicutarium ^a (common stork's bill)	Х	Χ	0.02	0.67	0.01	0.50
Festuca microstachys (small sixweeks)			1.14	17.71	0.80	12.40
Galium aparine(common cleavers)	Х	Х	0.10	1.14	0.10	1.14
Gnaphalium chilense (cottonbatting cudweed)			Х	Χ	Х	Х
Hordeum leporinum ^a (hare barley)			0.08	3.00	0.04	1.71

X = present but not counted in plot frames

^{-- =} species not observed on site

Table A-5. Percent Canopy Cover and Frequency of Occurrence at the 100-C-7:1 Site in 2014. (2 Pages)

		side vation		side ⁄ation	Entir	e Site
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence
Lactuca serriola ^a (prickly lettuce)	X	Χ	0.20	8.00	0.15	6.00
Lamium amplexicaule ^a (henbit deadnettle)	0.07	2.67	0.05	2.00	0.06	2.22
Melilotus alba ^a (sweetclover)	Х	Х	0.06	2.40	0.05	2.00
Poa bulbosa ^a (bulbous bluegrass)			Х	Χ	Х	Χ
Poa sandbergii (Sandberg's bluegrass)	0.13	5.33	2.47	54.29	1.77	39.60
Polygonum aviculare ^a (prostrate knotweed)			0.01	0.57	0.01	0.40
Purshia tridentata (antelope bitterbrush)	Х	Х	Х	Χ	Х	Χ
Raphanus raphanistrum ^a (wild radish)	0.20	1.33	0.73	16.00	0.56	11.11
Salsola kali ^a (Russian thistle)	8.20	80.00	26.74	97.71	21.18	92.40
Sisymbrium altissimum a (tumble mustard)	1.87	17.33	2.50	41.71	2.31	34.40
Sonchus oleraceus ^a (common sow-thistle)	Х	Χ	-	-	X	Χ
Triticum aestivum a (common wheat)	0.50	20.00	0.06	2.29	0.19	7.60
Verbena bracteata (big-bract verbena)			Χ	Χ	Х	Χ
Crust	0.67	26.67	1.57	57.14	1.30	48.00
Soil	59.27	98.67	51.87	97.14	54.09	97.60
Litter	40.70	100.00	48.06	100.00	45.85	100.00
Total canopy cover (litter not included)	17.85		45.31		37.15	
Total native % cover	3.93		12.78		10.20	
Total invasive % cover	13.92		32.52		26.95	

^a Invasive species.

Table A-6. Percent Canopy Cover and Frequency of Occurrence at Pit 24 Site (Upland Areas) in 2015. (2 Pages)

	Combined Upland Areas				
Species	Average % Cover	Average % Frequency of Occurrence			
Achillea millefolium (yarrow)	0.84	1.74			
Agropyron spicatum (bluebunch wheatgrass)	1.48	37.74			
Amaranthus albus ^a (white pigweed)	0.02	0.52			
Ambrosia acanthicarpa (bur ragweed)	X	X			
Artemisia tridentata (big sagebrush)	0.39	14.61			
Atriplex spinosa (spiny hopsage)	0.13	5.22			
Bromus tectorum a (cheatgrass)	1.11	32.52			
Bunchgrasses ^b	3.83	76.52			

 ^b Bunchgrasses include Agropyron spicatum, Koeleria cristata, Oryzopsis hymenoides, Sitanion hystrix, Sporobolus cryptandrus, and Stipa comata.

X = present but not counted in plot frames

^{-- =} species not observed on site

Table A-6. Percent Canopy Cover and Frequency of Occurrence at Pit 24 Site (Upland Areas) in 2015. (2 Pages)

	Combined Upland Areas					
Species	Average % Cover	Average % Frequency of Occurrence				
Centaurea diffusa a (diffuse knapweed)	0.33	8.70				
Chenopodium album (lambs quarters)	Х	X				
Chrysothamnus nauseousus (gray rabbitbrush)	0.54	4.35				
Conyza canadensis (horseweed)	Х	X				
Cornus stolonifera (Redosier dogwood)	Х	X				
Descurainia pinnata (western tansymustard)	0.09	3.48				
Eriogonum vimineum (broom buckwheat)	0.02	0.87				
Holosteum ^a umbellatum (jagged chickweed)	0.02	0.87				
Lactuca serriola ^a (prickly lettuce)	X	X				
Lamium amplexicaule ^a (henbit deadnettle)	Х	X				
Machaeranthera canescens (hoary aster)	Х	X				
Medicago sativa a (alfalfa)	Х	X				
Melilotus officinalis ^a (sweetclover)	0.24	3.83				
Phalaris arundinacea a (Reed canary-grass)	0.02	0.87				
Phragmites australis a (common reed)	Х	X				
Poa bulbosa a (bulbous bluegrass)	Χ	1.74				
Poa sandbergii (Sandberg's bluegrass)	0.09	2.09				
Populus trichocarpa (black cottonwood)	Х	X				
Potentilla paradoxa (bushy cinquefoil)	0.02	0.87				
Purshia tridentata (antelope bitterbrush)	Х	X				
Raphanus sativus ^a (wild radish)	0.04	1.39				
Rumex cripsus ^a (curly dock)	0.02	0.52				
Salix exigua (coyote willow)	0.04	1.39				
Salsola kali ^a (Russian thistle)	3.33	51.83				
Sisymbrium altissimum ^a (tumble mustard)	0.41	11.48				
Sitanion hystrix (bottlebrush squirreltail)	0.02	0.87				
Sonchus oleraceus a (annual sow thistle)	Х	X				
Stipa comata (needle-and-thread grass)	0.04	1.74				
Triticum aestivum a (common wheat)	Х	X				
Verbascum thapsus ^a (common mullein)	Х	X				
Verbena bracteata (big-bract verbena)	Х	Х				
Artr recruits	Х	Х				
Crust	Х	X				
Soil	57.48	100.00				
Litter	44.26	100.00				
Total canopy cover (excludes crust/soil/litter)	13.08					
Total native % cover	7.51					
Total invasive % cover	5.54					

a Invasive species.
b Bunchgrasses include *Agropyron spicatum, Koeleria cristata, Oryzopsis hymenoides, Sitanion hystrix, Sporobolus cryptandrus, and Stipa comata.*X = present but not counted in plot frames

Table A-7. Percent Canopy Cover and Frequency of Occurrence at the Pit 24 Site (Riparian Areas) in 2015.

	East Pond Area		Α	Pond rea	Riparia	bined n Areas
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
Amaranthus albus ^a (white pigweed)	2.19	45.83	0.42	16.67	1.43	33.33
Carex aperta (Columbia sedge)	0.73	29.17	0.14	5.56	0.48	19.05
Carex vulpinoidea (fox sedge)			2.50	72.22	1.07	30.95
Cornus stolonifera (redosier dogwood)	Х	Х	Χ	Х	Χ	X
Conyza canadensis (horseweed)	0.10	4.17	0.14	5.56	0.12	4.76
Cyperus erythrorhizos (redroot flatsedge)	X	Х	Χ	Х	Χ	X
Digitaria sanguinalis a (hairy crabgrass)	1.04	20.83	3.33	50.00	2.02	33.33
Elymus repens ^a (quackgrass)	1.35	12.50			0.77	7.14
Euphorbia maculata (spotted spurge)	1.25	8.33			0.71	4.76
Juncus tenuis (slender rush)	0.42	16.67	0.14	5.56	0.30	11.90
Kochia scoparia ^a (kochia)			0.97	11.11	0.42	4.76
Lactuca serriola ^a (prickly lettuce)	Χ	X	Χ	Χ	Χ	X
Melilotus officinalis ^a (sweetclover)	Χ	X	Χ	Χ	Χ	Χ
Phragmites australis ^a (common reed)	3.75	87.50	0.42	16.67	2.32	57.14
Polygonum persicaria a (spotted ladysthumb)	0.21	8.33	1.11	16.67	0.60	11.90
Populus trichocarpa (black cottonwood)	Х	X	Χ	Χ	Χ	Х
Potentilla paradoxa (bushy cinquefoil)	0.31	12.50	3.33	50.00	1.61	28.57
Rosa woodsii (Woods' rose)	Χ	Χ	Χ	Χ	Χ	Χ
Rumex crispus (curly dock)	Х	X	Χ	Χ	Χ	Х
Salix amygdaloides (peach-leaf willow)	Х	Х	Х	Х	Χ	Х
Salix exigua (coyote willow)	Х	Х	2.08	5.56	0.89	2.38
Salsola kali ^a (Russian thistle)	6.15	45.83	4.31	61.11	5.36	52.38
Scirpus acutus (hard-stem bulrush)	Х	Х	Х	Х	Χ	Х
Scirpus tabernaemontani (soft-stem bulrush)	2.81	29.17	Х	Х	1.61	16.67
Sitanion hystrix (bottlebrush squirreltail)			0.14	5.56	0.06	2.38
Tamarix parviflora ^a (tamarisk)	Х	Х			Χ	Х
Verbascum thapsus a (common mullein)	0.73	8.33	Х	Х	0.42	4.76
Verbena bracteata (big bract verbena)	0.10	4.17	1.39	27.78	0.65	14.29
Saexr (SAEX recruits)	0.31	12.50	0.42	16.67	0.36	14.29
Crust	3.23	45.83	0.00	0.00	1.85	26.19
Soil	91.77	100.00	91.25	100.00	91.55	100.00
Litter	4.58	100.00	3.19	100.00	3.99	100.00
Total canopy cover (excludes crust/soil/litter)	21.46		20.83		21.19	
Total native % cover	6.04		10.28		7.86	
Total invasive % cover	15.42		10.56		13.33	

^a Invasive species.

X = present but not counted in plot frames
-- = species not observed on site

Table A-8. Percent Canopy Cover and Frequency of Occurrence at the 100-K-95 Site in 2015.

	Are (Nonst	ea 1 rawed)		ea 2 wed)	Entir	e Site
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
Achillea millefolium (yarrow)			0.10	4.00	0.05	2.00
Artemisia tridentata (big sagebrush)	0.38	16.00	1.10	24.00	0.74	20.00
Amaranthus albus ^a (white pigweed)	2.75	80.00	1.10	44.00	1.93	62.00
Bromus tectorum ^a (cheatgrass)	32.88	100.00	43.10	100.00	37.99	100.00
Centaurea diffusa a (diffuse knapweed)	0.13	4.00	0.10	4.00	0.11	4.00
Chenopodium leptophyllum (slimleaf goosefoot)			0.60	4.00	0.30	2.00
Chondrilla juncea a (rush skeletonweed)	Χ	Χ		-	Χ	Χ
Holosteum umbellatum a (jagged chickweed)	0.50	20.00	1.20	28.00	0.85	24.00
Lactuca serriola ^a (prickly lettuce)	Χ	X			Χ	Х
Poa sandbergii (Sandberg's bluegrass)	0.25	12.00	0.70	8.00	0.48	10.00
Salsola kali a (Russian thistle)	13.88	100.00	10.80	100.00	12.34	100.00
Sisymbrium altissimum a (tumble mustard)	12.00	76.00	8.10	56.00	10.05	66.00
Stipa comata (needle-and-thread grass)			0.10	4.00	0.05	2.00
Crust	0.00	0.00	0.00	0.00	0.00	0.00
Soil	70.38	100.00	52.60	100.00	61.49	100.00
Litter	5.00	100.00	19.40	100.00	12.20	100.00
Total canopy cover (excludes crust/soil/litter)	62.75		67.00		64.88	
Total native % cover	0.63		2.60		1.61	
Change in native % cover from 2014	-1.68		-6.10		-4.19	
Total invasive % cover	62.13		64.40		63.26	
Change in invasive % cover from 2014	+16.83		+23.80		+20.56	

^a Invasive species.

X = present but not counted in plot frames
-- = species not observed on site

Table A-9. Percent Canopy Cover and Frequency of Occurrence at the 100-K-95 Site in 2014.

		rea 1 strawed)	Area 2 (S	2 (Strawed) Entire Site		
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence
Artemisia tridentata (big sagebrush)	0.3	10.0	0.1	4.0	0.2	6.7
Amaranthus albus ^a (white pigweed)	0.1	5.0	Х	Х	0.06	2.2
Bromus tectorum a (cheatgrass)	22.5	95.0	19.9	80.0	21.1	86.7
Bunchgrasses ^b	1.4	55.0	7.8	96.0	4.9	77.8
Chaenactis douglasii (hoary falseyarrow)	0.1	5.0	-	-	0.06	2.2
Chenopodium album a (lamb's quarters)			0.1	4.0	0.06	2.2
Chenopodium leptophyllum (slimleaf			0.1	4.0	0.06	2.2
Chondrilla juncea a (rush skeletonweed)			Х	Х	Х	Х
Chrysothamnus nauseosus (gray			Х	Χ	Χ	Χ
Draba verna a (spring whitlowgrass)	1		0.1	4.0	0.06	2.2
Erodium cicutarium ^a (storksbill)			Х	Χ	Χ	Χ
Holosteum umbellatum ^a (jagged chickweed)	0.3	10.0	0.2	8.0	0.2	8.9
Lactuca serriola ^a (prickly lettuce)	0.1	5.0	Χ	Χ	0.06	2.2
Lomatium canbyi (Canby's desert-parsley)			Х	Χ	Χ	Χ
Microsteris gracilis (pink microsteris)	0.1	5.0	0.1	4.0	0.1	4.4
Poa bulbosa a (bulbous bluegrass)			Х	Χ	Χ	Χ
Poa sandbergii (Sandberg's bluegrass)	0.4	15.0	0.6	24.0	0.5	20.0
Purshia tridentata (antelope bitterbrush)	Χ	X			Χ	Χ
Salsola kali ^a (Russian thistle)	19.0	100.0	18.5	92.0	18.7	95.6
Sisymbrium altissimum a (tumblemustard)	3.1	75.0	1.8	32.0	2.4	51.1
Tragopogon dubius ^a (yellow salsify)	0.1	5.0	Х	Χ	0.06	2.2
Crust	3.1	100.0	3.0	60.0	3.1	77.8
Soil	82.6	100.0	27.6	92.0	52.1	95.6
Litter	17.4	100.0	72.2	100	47.8	100.0
Total canopy cover (litter not included)	47.5		49.3		48.5	
Total native % cover	2.3		8.7		5.8	
Total invasive % cover	45.3		40.6		42.7	

a Invasive species.
b Bunchgrasses include Agropyron spicatum, Koeleria cristata, Oryzopsis hymenoides, Sitanion hystrix, Sporobolus cryptandrus, and Stipa comata.

X = present but not counted in plot frames

^{-- =} species not observed on site

Table A-10. Percent Canopy Cover and Frequency of Occurrence at the 128-K-2 Site in 2015.

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	Х	X
Agropyron spicatum (bluebunch wheatgrass)	1.70	28.00
Artemisia tridentata (big sagebrush)	3.10	24.00
Bromus tectorum ^a (cheatgrass)	7.00	100.00
Centaurea diffusa a (diffuse knapweed)	0.80	12.00
Lactuca serriola ^a (prickly lettuce)	0.10	4.00
Poa sandbergii (Sandberg's bluegrass)	5.60	84.00
Salsola kali ^a (Russian thistle)	12.60	100.00
Sisymbrium altissimum a (tumble mustard)	2.90	20.00
Sphaeralcea munroana (Munro's globemallow)	1.50	4.00
Sporoboous crytandrus (sand dropseed)	Х	X
Stipa comata (needle-and-thread grass)	0.10	4.00
Tragopogon dubius ^a (yellow salsify)	0.10	4.00
Triticum aestivum a (common wheat)	Х	X
Crust	0.00	0.00
Soil	60.90	100.00
Litter	25.00	100.00
Total canopy cover (excludes crust/soil/litter)	35.50	
Total native % cover	12.00	
Change in native % cover from 2014	+0.90	
Total invasive % cover	23.50	
Change in invasive % cover from 2014	-18.90	
a Invasive species		

^a Invasive species.

Table A-11. Percent Canopy Cover and Frequency of Occurrence at the 128-K-2 Site in 2014. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	X	X
Agropyron spicatum (bluebunch wheatgrass)	1.3	52.0
Artemisia tridentata (big sagebrush)	0.1	4.0
Bromus tectorum ^a (cheatgrass)	6.1	68.0
Centaurea diffusa ^a (diffuse knapweed)	Х	X
Chenopodium leptophyllum (slimleaf goosefoot)	X	X
Chrysothamnus nauseosus (gray rabbitbrush)	Х	X
Cymopterus terebinthinus (turpentine wavewing)	Х	X
Draba verna ^a (spring whitlowgrass)	0.2	8.0
Gnaphalium chilense (cottonbatting cudweed)	Х	X
Holosteum umbellatum ^a (jagged chickweed)	0.1	4.0
Lamium amplexicaule ^a (henbit deadnettle)	0.1	4.0
Poa bulbosa ^a (bulbous bluegrass)	0.1	4.0
Poa sandbergii (Sandberg's bluegrass)	8.9	84.0

X = present but not counted in plot frames

Table A-11. Percent Canopy Cover and Frequency of Occurrence at the 128-K-2 Site in 2014. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Salsola kali ^a (Russian thistle)	34.5	100.0
Sisymbrium altissimum a (tumblemustard)	1.3	52.0
Sitanion hystrix (bottlebrush squirreltail)	0.7	8.0
Sphaeralcea munroana (Munro's globemallow)	0.1	4.0
Sporobolus cryptandrus (sand dropseed)	X	X
Crust	1.9	56.0
Soil	49.4	96.0
Litter	50.3	92
Total canopy cover (litter not included)	53.5	
Total native % cover	11.1	
Change in native % cover from 2013	+4.2	
Total invasive % cover	42.4	
Change in invasive % cover from 2013	+2.2	

^a Invasive species.

Table A-12. Percent Canopy Cover and Frequency of Occurrence at the 128-K-2 Site in 2013. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Agropyron spicatum (bluebunch wheatgrass)	0.3	12.0
Artemisia tridentata (big sagebrush)	0.3	12.0
Bromus tectorum a (cheatgrass)	6.6	32.0
Centaurea diffusa ^a (diffuse knapweed)	0.1	4.0
Chenopodium album (lamb's quarters)	0.1	4.0
Holosteum umbellatum ^a (jagged chickweed)	0.1	4.0
Lactuca serriola ^a (prickly lettuce)	0.1	4.0
Poa sandbergii (Sandberg's bluegrass)	6.0	60.0
Salsola kali ^a (Russian thistle)	32.3	100.0
Sisymbrium altissimum ^a (tumblemustard)	1.0	20.0
Sitanion hystrix (bottlebrush squirreltail)	0.1	4.0
Stipa comata (needle-and-thread grass)	0.1	4.0
Triticum aestivum ^a (common wheat)	Х	4.0
Crust	0.1	4.0
Soil	38.9	92.0
Litter	31.3	100

X = present but not counted in plot frames

Table A-12. Percent Canopy Cover and Frequency of Occurrence at the 128-K-2 Site in 2013. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Total canopy cover (litter not included)	47.1	
Total native % cover	6.9	
Total invasive % cover	40.2	

^a Invasive species.

Table A-13. Percent Canopy Cover and Frequency of Occurrence at the 181-N Waste Site in 2015.

Species	% Cover	% Frequency of Occurrence
Agropyron spicatum (bluebunch wheatgrass)	6.33	53.33
Artemisia tridentata (big sagebrush)	0.17	6.67
Bromus tectoruma (cheatgrass)	3.00	53.33
Carex sp. (sedge)	0.17	6.67
Centaurea diffusa ^a (diffuse knapweed)	Х	X
Cornus stolonifera (redosier dogwood)	Х	X
Poa sandbergii (Sandberg's bluegrass)	0.67	26.67
Populus trichocarpa (black cottonwood)	2.00	13.33
Ribes aureum (golden currant)	Х	X
Salix exigua (coyote willow)	1.00	6.67
Salsola kalia (Russian thistle)	7.00	86.67
Sitanion hystrix (bottlebrush squirreltail)	0.17	6.67
Triticum aestivuma (common wheat)	1.00	6.67
Verbascum thapsusa (common mullein)	Х	X
Artr recruit	0.17	6.67
Crust	0.00	0.00
Soil	86.33	100.00
Litter	11.17	100.00
Total canopy cover (excludes crust/soil/litter)	21.67	
Total native % cover	10.67	
Change in native % cover from 2014	+7.47	
Total invasive % cover	11.00	
Change in invasive % cover from 2014	+8.50	

^a Invasive species

X = present but not counted in plot frames

X = present but not counted in plot frames

Table A-14. Percent Canopy Cover and Frequency of Occurrence at the 181-N Waste Site in 2014.

Species	% Cover	% Frequency of Occurrence
Agropyron spicatum (bluebunch wheatgrass)	2.2	53.3
Centaurea diffusa ^a (diffuse knapweed)	0.3	13.3
Cornus stolonifera (red-osier dogwood)	Х	Х
Lactuca serriola ^a (prickly lettuce)	Х	Х
Melilotus alba ^a (sweetclover)	Х	Х
Poa sandbergii (Sandberg's bluegrass)	0.2	6.7
Populus trichocarpa (black cottonwood)	0.2	6.7
Prunus virginiana (chokecherry)	Х	Х
Ribes aureum (golden currant)	Х	X
Rosa gymnocarpa (wood rose)	Х	X
Salix amygdaloides (peach-leaf willow)	Х	X
Salix exigua (coyote willow)	0.2	6.7
Salsola kalia (Russian thistle)	2.2	86.7
Sitanion hystrix (bottlebrush squirreltail)	0.5	20.0
Crust	0.2	6.7
Soil	85.0	100.0
Litter	14.3	73.3
Total canopy cover (litter not included)	5.7	
Total native % cover	3.2	
Total invasive % cover	2.5	

^a Invasive species

Table A-15. Percent Canopy Cover and Frequency of Occurrence at the 181-NE/1908-NE Waste Site in 2015. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Agropyron spicatum (bluebunch wheatgrass)	9.70	72.00
Artemisia tridentata (big sagebrush)	1.20	8.00
Bromus tectorum ^a (cheatgrass)	2.20	48.00
Centaurea diffusa ^a (diffuse knapweed)	1.20	8.00
Lactuca serriola ^a (prickly lettuce)	0.10	4.00
Melilotus officinalis ^a (sweetclover)	0.10	4.00
Morus alba ^a (white mulberry)	1.30	12.00
Phalaris arundinacea ^a (reed canary-grass)	0.60	4.00
Poa sandbergii (Sandberg's bluegrass)	0.70	28.00
Populus trichocarpa (black cottonwood)	1.50	4.00
Ribes aureum (golden currant)	0.60	4.00
Salix exigua (coyote willow)	2.70	12.00
Salsola kalia (Russian thistle)	0.30	12.00
Sitanion hystrix (bottlebrush squirreltail)	3.60	44.00
Verbascum thapsus ^a (common mullein)	1.50	4.00

X = present but not counted in plot frames

Table A-15. Percent Canopy Cover and Frequency of Occurrence at the 181-NE/1908-NE Waste Site in 2015. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Crust	5.90	40.00
Soil	78.70	100.00
Litter	13.90	100.00
Total canopy cover (excludes crust/soil/litter)	27.30	
Total native % cover	20.00	
Change in native % cover from 2014	+8.90	
Total invasive % cover	7.30	
Change in invasive % cover from 2014	+1.30	

^a Invasive species

Table A-16. Percent Canopy Cover and Frequency of Occurrence at the 1908-N and 181-NE Waste Site in 2014. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Agropyron spicatum (bluebunch wheatgrass)	7.6	88.0
Artemisia tridentata (big sagebrush)	Х	X
Bromus tectorum ^a (cheatgrass)	1.4	36.0
Chenopodium leptophyllum (slimleaf goosefoot)	Х	X
Cornus stolonifera (red-osier dogwood)	Х	X
Epilobium paniculatum (tall willowherb)	0.1	4.0
Lactuca serriola ^a (prickly lettuce)	Х	X
Melilotus alba ^a (sweetclover)	Х	X
Morus alba ^a (white mulberry)	0.1	4.0
Plantago lanceolata (English plantain)	Х	Х
Poa sandbergii (Sandberg's bluegrass)	0.2	8.0
Populus trichocarpa (black cottonwood)	Х	X
Prunus virginiana (chokecherry)	Х	Х
Ribes aureum (golden currant)	Х	Х
Rosa gymnocarpa (wood rose)	Х	Х
Salix amygdaloides (peach-leaf willow)	Х	Х
Salix exigua (coyote willow)	Х	Х
Salsola kalia (Russian thistle)	4.5	68.0
Sisymbrium altissimuma (tumblemustard)	Х	Х
Sitanion hystrix (bottlebrush squirreltail)	3.2	52.0
Stipa comata (needle-and-thread grass)	Х	Х
Tragopogon dubius ^a (yellow salsify)	Х	X
Verbascum thapsus ^a (common mullein)	Х	X
Crust	0.0	0.0
Soil	59.3	96.0
Litter	40.6	100.0

Table A-16. Percent Canopy Cover and Frequency of Occurrence at the 1908-N and 181-NE Waste Site in 2014. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Total canopy cover (litter not included)	17.1	
Total native % cover	11.1	
Total invasive % cover	6.0	

^a Invasive species

Table A-17. Percent Canopy Cover and Frequency of Occurrence at the 100-N-47 Site in 2015.

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	X	X
Agropyron cristatum ^a (crested wheatgrass)	X	Χ
Agropyron spicatum (bluebunch wheatgrass)	5.20	32.00
Amsinckia lycopsoides (tarweed fiddleneck)	Х	Χ
Artemisia tridentata (big sagebrush)	2.70	12.00
Bromus tectoruma (cheatgrass)	24.90	100.00
Centaurea diffusa ^a (diffuse knapweed)	X	Χ
Chenopodium leptophyllum (slimleaf goosefoot)	X	Χ
Convolvulus arvensisa (field bindweed)	1.20	8.00
Descurainia pinnata (western tansymustard)	0.10	4.00
Holosteum umbellatuma (jagged chickweed)	0.20	8.00
Kochia scoparia ^a (kochia)	X	X
Lactuca serriola ^a (prickly lettuce)	0.20	8.00
Plantago patagonica (Indian wheat)	0.40	16.00
Poa sandbergii (Sandberg's bluegrass)	14.30	92.00
Salsola kalia (Russian thistle)	8.30	100.00
Sisymbrium altissimum ^a (tumble mustard)	2.90	36.00
Sphaeralcea munroana (Munro's globemallow)	2.50	4.00
Sporobolus cryptandrus (sand dropseed)	X	X
Stipa comata (needle-and-thread grass)	0.60	4.00
Tragopogon dubius ^a (yellow salsify)	0.10	4.00
Triticum ^a (wheat)	0.70	8.00
Crust	0.10	4.00
Soil	57.90	100.00
Litter	38.60	100.00
Total canopy cover (excludes crust/soil/litter)	64.30	
Total native % cover	25.80	
Change in native % cover from 2014	+12.50	
Total invasive % cover	38.50	
Change in invasive % cover from 2014	-3.00	

^a Invasive species

X = present but not counted in plot frames

X = present but not counted in plot frames

Table A-18. Percent Canopy Cover and Frequency of Occurrence at the 100-N-47 Site in 2014.

at the 100-N-47 Site in 2014.				
Species	% Cover	% Frequency of Occurrence		
Achillea millefolium (yarrow)	X	Χ		
Agropyron spicatum (bluebunch wheatgrass)	2.7	48.0		
Ambrosia acanthicarpa (bur ragweed)	0.1	4.0		
Artemisia tridentata (big sagebrush)	0.1	4.0		
Bromus tectoruma (cheatgrass)	9.9	52.0		
Centaurea diffusa ^a (diffuse knapweed)	Х	4.0		
Chenopodium leptophyllum (slimleaf goosefoot)	0.1	4.0		
Chorispora tenellaa (blue mustard)	Х	Х		
Chrysothamnus nauseosus (gray rabbitbrush)	Х	Х		
Convolvulus arvensis ^a (field bindweed)	Х	Х		
Descurainia pinnata (western tansymustard)	Х	Х		
Macaeranthera canascens (hoary aster)	Х	Х		
Microsteris gracilis (pink microsteris)	0.3	12.0		
Poa bulbosa ^a (bulbous bluegrass)	0.7	8.0		
Poa sandbergii (Sandberg's bluegrass)	7.9	64.0		
Purshia tridentata (antelope bitterbrush)	Х	Х		
Salsola kalia (Russian thistle)	30.5	100.0		
Sisymbrium altissimum ^a (tumblemustard)	0.4	16.0		
Sitanion hystrix (bottlebrush squirreltail)	1.1	24.0		
Sphaeralcea munroana (Munro's globemallow)	0.1	4.0		
Sporobolus cryptandrus (sand dropseed)	0.1	4.0		
Stipa comata (needle-and-thread grass)	0.8	12.0		
Tragopogon dubius ^a (yellow salsify)	X	Χ		
Verbena bracteata (big-bract verbena)	X	Χ		
Crust	1.5	60.0		
Soil	35.6	92.0		
Litter	64.2	100.0		
Total canopy cover (litter not included)	54.8			
Total native % cover	13.3			
Change in native % cover from 2013	-2.6			
Total invasive % cover	41.5			
Change in invasive % cover from 2013	-2.2			

a Invasive species
 X = present but not counted in plot frames

Table A-19. Percent Canopy Cover and Frequency of Occurrence at the 100-N-47 Site in 2013.

Species	% Cover	% Frequency of Occurrence		
Poa sandbergii (Sandberg's bluegrass)	14.5			
Bromus tectorum ^a (cheatgrass)	9.3	64		
Salsola kalia (Russian thistle)	32.5	100.0		
Triticum ^a (wheat)	X	Χ		
Agropyron spicatum (bluebunch wheatgrass)	0.4	0.0		
Sporobolus cryptandrus (sand dropseed)	0.3	0.0		
Sisymbrium altissimum ^a (tumblemustard)	1.4	36.0		
Holosteum umbellatum ^a (jagged chickweed)	0.1	4.0		
Erodium cicutarium ^a (storksbill)	0.1	4.0		
Achillea millefolium (yarrow)	0.1	4.0		
Artemisia tridentata (big sagebrush)	0.3	12.0		
Tragopogon dubiusa (yellow salsify)	Х	Х		
Sphaeralcea munroana (Munro's globemallow)	Х	Х		
Amsinckia lycopsoides (tarweed fiddleneck)	Х	Х		
Lactuca seriola ^a (prickly lettuce)	0.2	8.0		
Plantago patagonica(Indian wheat)	0.1	4.0		
Convolvulus arvensis ^a (field bindweed)	0.1	4.0		
Purshia tridentata (antelope bitterbrush)	0.1	4.0		
Chenopodium leptophyllum (slimleaf goosefoot)	0.1	4.0		
Crust	0.0	100.0		
Soil	24.0	100.0		
Litter	46.4	100.0		
Total canopy cover (litter not included)	59.6			
Total invasive % cover	43.7			
Total native % cover	15.9			

^a Invasive species

Table A-20. Percent Canopy Cover and Frequency of Occurrence at the 100-D-8 Site in 2015. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	Χ	Χ
Agropyron spicatum (bluebunch wheatgrass)	5.80	56.00
Artemisia biennis (biennial wormwood)	2.20	12.00
Artemisia tridentata (big sagebrush)	1.80	12.00
Bromus tectorum ^a (cheatgrass)	6.00	84.00
Carex sp. (sedge)	0.10	4.00
Centaurea diffusa ^a (diffuse knapweed)	1.30	12.00
Cirsium arvense ^a (Canada thistle)	0.10	4.00
Coreopsis atkinsoniana (Columbia tickweed)	0.10	4.00
Cornus stolonifera (redosier dogwood)	0.10	4.00
Eriogonum niveum (snow buckwheat)	0.10	4.00
Festuca octoflora (slender sixweeks)	0.10	4.00
Lactuca serriola (prickly lettuce)	0.20	8.00

X = present but not counted in plot frames

Table A-20. Percent Canopy Cover and Frequency of Occurrence at the 100-D-8 Site in 2015. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Morus alba ^a (white mulberry)	0.10	4.00
Plantago lanceolata (English plantain)	X	Χ
Poa sandbergii (Sandberg's bluegrass)	1.80	52.00
Populus trichocarpa (black cottonwood)	0.60	4.00
Prunus virginiana (chokecherry)	X	Χ
Purshia tridentata (antelope bitterbrush)	0.10	4.00
Rosa woodsii (Woods' rose)	X	Χ
Salix exigua (coyote willow)	0.70	8.00
Salsola kalia (Russian thistle)	12.10	64.00
Sitanion hystrix (bottlebrush squirreltail)	0.10	4.00
Sporobolus cryptandrus (sand dropseed)	0.20	8.00
Stipa comata (needle-and-thread)	0.90	16.00
Triticum aestivum ^a (common wheat)	0.30	12.00
Verbascum thapsus ^a (common mullein)	0.60	4.00
Crust	2.30	16.00
Soil	60.70	100.00
Litter	29.70	100.00
Total canopy cover (excludes crust/soil/litter)	35.40	
Total native % cover	14.90	
Change in native % cover from 2014	+5.50	
Total invasive % cover	20.50	
Change in invasive % cover from 2014	-20.20	

^a Invasive species

Table A-21. Percent Canopy Cover and Frequency of Occurrence at the 100-D-8 Site in 2014. (2 Pages)

Species	% Cover	% Frequency of Occurrence		
Agropyron spicatum (bluebunch wheatgrass)	7.6	88.0		
Ambrosia acanthicarpa (bur ragweed)	X	X		
Artemisia biennis (biennial wormwood)	Χ	X		
Artemisia tridentata (big sagebrush)	0.1	4.0		
Bromus tectorum ^a (cheatgrass)	0.4	16.0		
Centaurea diffusa ^a (diffuse knapweed)	0.1	4.0		
Cornus stolonifera (redosier dogwood)	Χ	X		
Eriogonum niveum (snow buckwheat)	Χ	X		
Melilotus albaa (sweetclover)	Χ	X		
Morus alba ^a (white mulberry)	Χ	X		
Poa bulbosa ^a (bulbous bluegrass)	0.1	4.0		
Poa sandbergii (Sandberg's bluegrass)	1.1	44.0		
Populus trichocarpa (black cottonwood)	Х	Х		

X = present but not counted in plot frames

Table A-21. Percent Canopy Cover and Frequency of Occurrence at the 100-D-8 Site in 2014. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Prunus virginiana (chokecherry)	X	Χ
Purshia tridentata (antelope bitterbrush)	X	X
Ribes aureum (golden currant)	X	X
Rosa gymnocarpa (woods rose)	X	X
Salix amygdaloides (peach-leaf willow)	X	X
Salix exigua (coyote willow)	X	X
Salsola kalia (Russian thistle)	38.6	96.0
Sisymbrium altissimuma (tumble mustard)	0.2	8.0
Stipa comata (needle-and-thread)	0.6	24.0
Triticum eastivuma (common wheat)	1.3	32.0
Crust	0.2	8.0
Soil	49.1	100.0
Litter	50.9	100.0
Total canopy cover (litter not included)	50.1	
Total native % cover	9.4	
Total invasive % cover	40.7	

^a Invasive species

Table A-22. Percent Canopy Cover and Frequency of Occurrence at the 100-D-65 and 100-D-66 Outfalls Site in 2015. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	1.20	8.00
Agropyron spicatum (bluebunch wheatgrass)	16.90	88.00
Artemisia biennis (biennial wormwood)	0.10	4.00
Artemisia tridentata (big sagebrush)	1.40	16.00
Bromus japonicus ^a (Japanese brome)	3.00	60.00
Bromus tectorum ^a (cheatgrass)	3.60	24.00
Centaurea diffusa ^a (diffuse knapweed)	3.60	24.00
Chrysothamnus nauseosa (gray rabbitbrush)	0.10	4.00
Cirsium arvense ^a (Canada thistle)	0.30	12.00
Cymopterus terebinthinus (turpentine wavewing)	0.10	4.00
Festuca arundinaceus ^a (tall fescue)	0.10	4.00
Festuca octoflora (slender sixweeks)	0.10	4.00
Morus alba ^a (white mulberry)	0.40	16.00
Phalaris arundinacea ^a (reed canary-grass)	X	X
Plantago lanceolata (English plantain)	0.10	4.00
Poa sandbergii (Sandberg's bluegrass)	0.50	20.00
Prunus virginiana (chokecherry)	Х	X
Ribes aureum (golden currant)	1.40	16.00
Rosa woodsii (Woods' rose)	0.70	8.00

X = present but not counted in plot frames

Table A-22. Percent Canopy Cover and Frequency of Occurrence at the 100-D-65 and 100-D-66 Outfalls Site in 2015. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Salix amygdaloides (peach-leaf willow)	0.10	4.00
Salix exigua (coyote willow)	0.60	4.00
Salsola kalia (Russian thistle)	1.60	8.00
Sitanion hystrix (bottlebrush squirreltail)	0.50	20.00
Sporobolus cryptandrus (sand dropseed)	0.60	4.00
Triticum aestivum ^a (common wheat)	1.10	24.00
Verbascum thapsus ^a (common mullein)	2.10	24.00
Crust	0.00	0.00
Soil	47.30	100.00
Litter	36.20	100.00
Total canopy cover (excludes crust/soil/litter)	40.20	
Total native % cover	24.40	
Change in native % cover from 2014	-0.30	
Total invasive % cover	15.80	
Change in invasive % cover from 2014	-1.10	

^a Invasive species

Table A-23. Percent Canopy Cover and Frequency of Occurrence at the 100-D-65 and 100-D-66 Outfalls in 2014. (2 Pages)

Species	% Cover	% Frequency of Occurrence	
Achillea millefolium (yarrow)	Х	X	
Agropyron spicatum (bluebunch wheatgrass)	18.5	72.0	
Artemisia biennis (biennial wormwood)	0.2	8.0	
Artemisia tridentata (big sagebrush)	0.8	12.0	
Bromus tectoruma (cheatgrass)	3.3	36.0	
Centaurea diffusa ^a (diffuse knapweed)	3.7	32.0	
Cornus stolonifera (red-osier dogwood)	Х	X	
Cymopterus terebinthinus (turpentine spring	0.1	4.0	
Festuca octoflora (slender sixweeks)	0.1	4.0	
Lupinus lepidus (prairie lupine)	Х	X	
Melilotus albaa (sweetclover)	0.1	4.0	
Morus alba ^a (white mulberry)	0.6	24.0	
Plantago lanceolata (English plantain)	0.3	12.0	
Poa sandbergii (Sandberg's bluegrass)	0.3	12.0	
Populus trichocarpa (black cottonwood)	Х	X	
Prunus virginiana (chokecherry)	Х	X	
Ribes aureum (golden currant)	0.1	4.0	
Rosa gymnocarpa (woods rose)	Х	X	
Salix amygdaloides (peach-leaf willow)	Х	X	
Salix exigua (coyote willow)	Х	X	

X = present but not counted in plot frames

Table A-23. Percent Canopy Cover and Frequency of Occurrence at the 100-D-65 and 100-D-66 Outfalls in 2014. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Salsola kalia (Russian thistle)	8.0	56.0
Sitanion hystrix (bottlebrush squirreltail)	3.5	40.0
Sporobolus cryptandrus (sand dropseed)	0.6	4.0
Stipa comata (needle-and-thread grass)	0.2	8.0
Triticum eastivuma (common wheat)	0.9	16.0
Verbascum thapsus ^a (common mullein)	0.3	12.0
Crust	0.3	12.0
Soil	24.2	96.0
Litter	75.7	100.0
Total canopy cover (litter not included)	41.6	
Total native % cover	24.7	
Total invasive % cover	16.9	

a Invasive species

Table A-24. Percent Canopy Cover and Frequency of Occurrence at the 600-30 Site in 2015. (2 Pages)

	Area 1 (South and East)					Entire Site	
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence	
Achillea millefolium (yarrow)	4.60	48.00	0.60	4.00	2.60	26.00	
Agropyron spicatum (bluebunch wheatgrass)	Χ	Х	2.30	16.00	1.15	8.00	
Ambrosia acanthicarpa (bur ragweed)	0.10	4.00			0.05	2.00	
Amsinckia lycopsoides (tarweed fiddleneck)	0.10	4.00	X	Χ	0.05	2.00	
Artemisia tridentata (big sagebrush)	4.50	12.00	0.60	4.00	2.55	8.00	
Balsamorhiza careyana (Carey's balsamroot)	1.60	8.00		ŀ	0.80	4.00	
Bromus tectoruma (cheatgrass)	14.70	100.00	10.40	100.00	12.55	100.00	
Centaurea diffusa ^a (diffuse knapweed)	0.20	8.00	0.30	12.00	0.25	10.00	
Chaenactis douglaiii (dustymaiden)			0.10	4.00	0.05	2.00	
Chondrilla juncea ^a (rush skeletonweed)	0.60	4.00			0.30	2.00	
Chrysothamnus neaseosus (gray rabbitbrush)	Χ	Χ			0.00	0.00	
Descurainia pinnata (western tansymustard)			0.10	4.00	0.05	2.00	
Draba verna ^a (spring whitlowgrass)	0.60	24.00	Х	Χ	0.30	12.00	
Erigeron filifolius (threadleaf fleabane)			Х	Χ	0.00	0.00	
Holosteum umbellatuma (jagged chickweed)	1.30	52.00	0.10	4.00	0.70	28.00	
Machaeranthera canescens (hoary aster)	1.90	36.00	Х	Х	0.95	18.00	
Microsteris gracilis (pink microsteris)	0.10	4.00			0.05	2.00	
Oryzopsis hymendoides (Indian ricegrass)			0.60	4.00	0.30	2.00	

X = present but not counted in plot frames

Table A-24. Percent Canopy Cover and Frequency of Occurrence at the 600-30 Site in 2015. (2 Pages)

		l (South East)		(North West)	Entir	e Site
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
Plantago patagonica (Indian wheat)	1.80	12.00			0.90	6.00
Poa sandbergii (Sandberg's bluegrass)	5.50	100.00	12.00	100.00	8.75	100.00
Salsola kalia (Russian thistle)	2.50	80.00	8.50	100.00	5.50	90.00
Sisymbrium altissimum ^a (tumble mustard)	2.50	20.00	1.90	36.00	2.20	28.00
Sitanion hystrix (bottlebrush squirreltail)	Χ	Χ	X	Χ	0.00	0.00
Sphaeralcea munroana (Munro's globemallow)	9.10	36.00	Х	Χ	4.55	18.00
Stipa comata (needle-and-thread grass)	Χ	Χ		-	0.00	0.00
Tragopogon dubius ^a (yellow salsify)	0.10	4.00	1.20	8.00	0.65	6.00
Crust	0.00	0.00	0.00	0.00	0.00	0.00
Soil	0.00	0.00	74.40	100.00	37.20	50.00
Litter	0.00	0.00	15.50	100.00	7.75	50.00
Total canopy cover (excludes crust/soil/litter)	51.80		38.70		45.25	
Total native % cover	29.30		16.30		22.80	
Change in native % cover from 2014	+7.40		-0.60	-	+3.40	_
Total invasive % cover	22.50		22.40		22.45	
Change in invasive % cover from 2014	-0.20		-12.70		-6.45	

^a Invasive species

Table A-25. Percent Canopy Cover and Frequency of Occurrence at the 600-30 Site in 2014. (2 Pages)

	Are (South a	a 1 nd East)		ea 2 nd West)	Entii	re Site
Species	% Cover for S+E	% Frequency of Occurrence for S+E	% Cover for N+W	% Frequency of Occurrence for N+W	Average % Cover	Average % Frequency of Occurrence
Achillea millefolium (yarrow)	6.0	48.0	0.3	12.0	3.15	30.0
Agropyron spicatum (bluebunch	1.1	24.0	2.2	28.0	1.65	26.0
Ambrosia acanthicarpa (bur ragweed)	Х	Х			Χ	Χ
Artemisia tridentata (big sagebrush)	Х	Х	0.1	4.0	0.05	2.0
Astragalus sclerocarpus (stalked-pod milk-	Х	Х			Х	Χ
Balsamorhiza careyana (Carey's	0.6	4.0			0.30	2.0
Bromus tectoruma (cheatgrass)	10.0	92.0	15.5	92.0	12.75	92.0
Centaurea diffusa ^a (diffuse knapweed)	X	X			Χ	Χ

X = present but not counted in plot frames

^{-- =} species not observed on site

Table A-25. Percent Canopy Cover and Frequency of Occurrence at the 600-30 Site in 2014. (2 Pages)

	Are (South a	a 1 nd East)	Are (North a	ea 2 nd West)	Entir	e Site
Species	% Cover for S+E	% Frequency of Occurrence for S+E	% Cover for N+W	% Frequency of Occurrence for N+W	Average % Cover	Average % Frequency of Occurrence
Chaenactis douglassi (hoary falseyarrow)	0.1	4.0			0.05	2.0
Chenopodium leptophyllum (slimleaf	0.1	4.0			0.05	2.0
Chondrilla juncea ^a (rush skeletonweed)	Χ	Χ			Χ	Χ
Chrysothamnus neaseosus (gray	Χ	Χ			Χ	Χ
Erigeron filifolius (threadleaf fleabane)	1.2	8.0	Х	Х	0.60	4.0
Erigeron poliospermus (cushion fleabane)	Χ	Χ			Χ	Χ
Erigeron pumilus (shaggy fleabane)	0.2	8.0	Х	Χ	0.10	4.0
Holosteum umbellatum ^a (jagged chickweed)			0.1	4.0	0.05	2.0
Machaeranthera canescens (hoary aster)	0.9	16.0	0.1	4.0	0.50	10.0
Mentzelia albicaulis (whitestem blazingstar)	Х	Х			Χ	Χ
Microsteris gracilis (pink microsteris)	Х	Х			Χ	Χ
Oryzopsis hymendoides (Indian ricegrass)			0.6	4.0	0.30	2.0
Phlox longifolia (long-leaf phlox)	Х	Х			Χ	Χ
Plantago patagonica (Indian wheat)	8.0	12.0			0.40	6.0
Poa bulbosa ^a (bulbous bluegrass)	Х	Х	Х	Х	Х	Χ
Poa sandbergii (Sandberg's bluegrass)	3.5	80.0	11.4	88.0	7.45	84.0
Polygonum aviculare ^a (prostrate knotweed)			Х	Χ	Χ	Χ
Salsola kalia (Russian thistle)	12.6	96.0	19.3	100.0	15.95	98.0
Sisymbrium altissimum ^a (tumblemustard)	0.1	4.0	0.2	8.0	0.15	6.0
Sitanion hystrix (bottlebrush squirreltail)	1.3	12.0	1.0	20.0	1.15	16.0
Sphaeralcea munroana (Munro's	4.6	28.0	1.2	8.0	2.90	18.0
Stipa comata (needle-and-thread grass)	1.5	4.0			0.75	2.0
Tragopogon dubiusa (yellow salsify)	Х	Χ	Х	Χ	Χ	Χ
Crust	2.2	88.0	4.1	88.0	3.15	88.0
Soil	76.7	96.0	74.1	100.0	75.40	98.0
Litter	23.2	100.0	25.9	100.0	24.55	100.0
Total canopy cover (litter not included	44.6		52.0		48.3	
Total native % cover	21.9		16.9		19.4	
Change in native % cover from 2013					-16.2	
Total invasive % cover	22.7		35.1		28.9	
Change in invasive % cover from 2013					+3.6	

a Invasive species

X = present but not counted in plot frames

^{-- =} species not observed on site

Table A-26. Percent Canopy Cover and Frequency of Occurrence at the 600-30 Site in 2013.

Species	% Cover	% Frequency of Occurence
Poa sandbergii (Sandberg's bluegrass)	22.3	100.0
Bromus tectoruma (cheatgrass)	18.3	100.0
Salsola kalia (Russian thistle)	3.8	92.0
Agropyron spicatum (bluebunch wheatgrass)	3.1	44.0
Sisymbrium altissimum ^a (tumble mustard)	0.8	12.0
Descurainia pinnata (western tansymustard)	1.1	44.0
Holosteum umbellatuma (jagged chickweed)	0.5	20.0
Draba verna ^a (spring whitlowgrass)	1.1	44.0
Erodium cicutarium ^a (storksbill)	Χ	X
Centaurea diffusa ^a (diffuse knapweed)	0.1	4.0
Achillea millefolium (yarrow)	1.8	32.0
Artemisia tridentata (big sagebrush)	0.9	16.0
Chrysothamnus neaseosus (gray rabbitbrush)	Х	X
Chaenactis douglassi (hoary falseyarrow)	Х	X
Tragopogon dubius ^a (yellow salsify)	Χ	X
Machaeranthera canescens (hoary aster)	0.9	16.0
Mentzelia albicaulis (whitestem blazingstar)	Х	X
Sphaeralcea munroana (Munro's globemallow)	1.4	16.0
Sitanion hystrix (bottlebrush squirreltail)	1.5	20.0
Oryzopsis hymendoides (Indian ricegrass)	1.2	8.0
Amsinckia lycopsoides (tarweed fiddleneck)	Χ	X
Lactuca seriola ^a (prickly lettuce)	Χ	X
Balsamorhiza careyana (Carey's balsamroot)	0.8	12
Poa bulbosa ^a (bulbous bluegrass)	0.7	8
Chondrilla juncea ^a (rush skeletonweed)	Χ	X
Erigeron poliospermus (cushion fleabane)	Х	X
Erigeron pumilus (shaggy fleabane)	Χ	X
Astragalus purshii (woollypod milkvetch)	Х	Х
Hordeum leporinuma (hare barley)	Х	X
Stephanomeria paniculata (stiff wirelettuce)	0.6	4
Crust	10	96
Soil	49.1	100
Litter	49.4	100
Total canopy cover (litter not included)	60.9	
Total invasive % cover	25.3	
Change in invasive % cover from 2012	-41.5	
Total native % cover	35.6	
Change in native % cover from 2012	-35.6	

a Invasive species
X = present but not counted in plot frames

Table A-27. Percent Canopy Cover and Frequency of Occurrence at the 600-30 Site in 2012.

Species	% Cover	% Frequency of Occurrence
Poa sandbergii (Sandberg's bluegrass)	52.9	100.0
Bromus tectorum ^a (cheatgrass)	26.3	84.0
Salsola kali ^a (Russian thistle)	23.1	100.0
Agropyron spicatum (bluebunch wheatgrass)	6.8	76.0
Sisymbrium altissimum ^a (tumble mustard)	11.6	64.0
Holosteum umbellatum ^a (jagged chickweed)	1.8	32.0
Draba verna ^a (spring whitlowgrass)	1.3	32.0
Erodium cicutarium ^a (storksbill)	0.8	12.0
Centaurea diffusa ^a (diffuse knapweed)	0.2	8.0
Achillea millefolium (yarrow)	2.1	28.0
Artemisia tridentata (big sagebrush)	0.8	12.0
Chaenactis douglassi (hoary falseyarrow)	0.1	4.0
Tragopogon dubiusa (yellow salsify)	0.1	4.0
Machaeranthera canescens (hoary aster)	0.4	16.0
Eriogonum niveum (snow buckwheat)	0.1	4.0
Microsteris gracilis (pink microsteris)	0.2	8.0
Eriogonum vimineum (broom buckwheat)	0.6	4.0
Mentzelia albicaulis (whitestem blazingstar)	0.1	4.0
Draba verna ^a (spring witlowgrass)	1.6	8.0
Plantago patagonica (Indian wheat)	0.2	8.0
Sphaeralcea munroana (Munro's globemallow)	0.1	4
Sitanion hystrix (bottlebrush squirreltail)	0.3	12
Amsinckia lycopsoides (tarweed fiddleneck)	X	X
Lactuca seriolaa (prickly lettuce)	Χ	X
Balsamorhiza careyana (Carey's balsamroot)	X	X
Lepidium perfoliatum ^a (clasping pepperweed)	Χ	X
Chenopodium leptophyllum (slimleaf goosefoot)	X	X
Ambrosia acanthicarpa (bur ragweed)	Χ	X
Galium aparine (Cleavers)	Χ	X
Crust	2.4	100
Soil	32.6	100
Litter	69.4	100
Total canopy cover (litter not included)	131.5	
Total invasive % cover	66.8	
Total native % cover	64.7	

a Invasive species
 X = present but not counted in plot frames

Table A-28. Percent Canopy Cover and Frequency of Occurrence at the 118-D-2 Site in 2015.

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	0.20	1.33
Amsinckia lycopsoides (tarweed fiddleneck)	X	X
Artemisia tridentata (big sagebrush)	0.23	2.67
Bromus tectorum ^a (cheatgrass)	6.57	69.33
Bunchgrasses ^b	0.07	2.67
Centaurea diffusa ^a (diffuse knapweed)	Χ	X
Chenopodium leptophyllum (slimleaf goosefoot)	0.03	1.33
Chondrilla juncea ^a (rush skeletonweed)	Χ	X
Holosteum umbellatum ^a (jagged chickweed)	0.13	5.33
Hordeum leporinum ^a (hare barley)	0.10	4.00
Lactuca seriolaa (prickly lettuce)	0.23	2.67
Microsteris gracilis (pink microsteris)	0.23	2.67
Plantago patagonica (Indian wheat)	Χ	X
Poa sandbergii (Sandberg's bluegrass)	10.57	66.67
Salsola kalia (Russian thistle)	19.40	100.00
Sisymbrium altissimum ^a (tumble mustard)	6.57	42.67
Sphaeralcea munroana (Munro's globemallow)	0.40	2.67
Sporobolus cryptandrus (sand dropseed)	1.17	8.00
Tragopogon dubius ^a (yellow salsify)	X	X
Crust	0.00	0.00
Soil	40.90	66.67
Litter	33.43	100.00
Total canopy cover (excludes crust/soil/litter)	45.90	
Total native % cover	12.87	
Change in native % cover from 2014	8.77	
Total invasive % cover	33.00	
Change in invasive % cover from 2014	-15.70	

Table A-29. Percent Canopy Cover and Frequency of Occurrence at the 118-D-2 Site in 2014. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	0.04	3.3
Amsinckia lycopsoides (tarweed fiddleneck)	Х	X
Artemisia tridentata (big sagebrush)	0.04	3.3
Bromus tectorum ^a (cheatgrass)	2.4	32.8
Bunchgrasses ^b	2.7	60.7
Calochortus macrocarpus (sagebrush mariposa	Х	X
Centaurea diffusa ^a (diffuse knapweed)	0.08	4.9

Invasive species
 Bunchgrasses include Sporobolus cryptandrus, Agropyron spicatum, Koeleria cristata, Oryzopsis hymenoides, Stipa comota, and Sitanion hystrix

⁼ present but not counted in plot frames

Table A-29. Percent Canopy Cover and Frequency of Occurrence at the 118-D-2 Site in 2014. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Cryptantha torreyana (Torrey's crypthantha)	X	X
Chrysothamnus neaseosus (gray rabbitbrush)	X	X
Epilobium paniculatum (tall willowherb)	X	X
Atriplex spinosa (spiny hopsage)	0.04	1.6
Lactuca seriola ^a (prickly lettuce)	Х	X
Machaeranthera canescens (hoary aster)	Х	Х
Microsteris gracilis (pink microsteris)	0.04	1.6
Melilotus alba ^a (sweetclover)	Х	X
Poa bulbosa ^a (bulbous bluegrass)	Х	X
Poa sandbergii (Sandberg's bluegrass)	1.2	47.5
Purshia tridentata (antelope bitterbrush)	Х	X
Raphanus raphanistruma (wild radish)	0.04	1.6
Salsola kalia (Russian thistle)	45.5	100.0
Sisymbrium altissimum ^a (tumblemustard)	0.7	27.9
Sphaeralcea munroana (Munro's globemallow)	0.08	3.3
Tragopogon dubiusa (yellow salsify)	Х	X
Crust	1.8	73.8
Soil	62.9	96.7
Litter	37.0	100.0
Total canopy cover (litter not included)	52.8	
Total native % cover	4.1	
Total invasive % cover	48.7	

Table A-30. Percent Canopy Cover and Frequency of Occurrence at the 600-151 Site in 2015. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Agropyron spicatum (bluebunch wheatgrass)	Х	X
Artemisia tridentata (big sagebrush)	2.50	6.67
Bromus tectorum ^a (cheatgrass)	19.00	93.33
Bunchgrasses ^b	0.17	6.67
Centaurea diffusa ^a (diffuse knapweed)	1.33	20.00
Hordeum leporinuma (hare barley)	0.17	6.67
Lepidium perfoliatuma (clasping pepperweed)	43.33	86.67
Poa sandbergii (Sandberg's bluegrass)	1.00	40.00
Salsola kalia (Russian thistle)	1.50	60.00
Sisymbrium altissimum ^a (tumble mustard)	1.50	26.67
Sphaeralcea munroana (Munro's globemallow)	1.00	6.67

a Invasive species
b Bunchgrasses include Sporobolus cryptandrus, Agropyron spicatum, Koeleria cristata,
Oryzopsis hymenoides, Stipa comota, and Sitanion hystrix

⁼ present but not counted in plot frames

Table A-30. Percent Canopy Cover and Frequency of Occurrence at the 600-151 Site in 2015. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Artr recruits	X	6.67
Crust	0.00	0.00
Soil	60.17	100.00
Litter	21.50	100.00
Total canopy cover (excludes crust/soil/litter)	71.50	
Total native % cover	4.67	
Change in native % cover from 2014	-7.33	
Total invasive % cover	66.83	
Change in invasive % cover from 2014	-15.87	

Table A-31. Percent Canopy Cover and Frequency of Occurrence at the 600-151 Site in 2014.

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	X	X
Agropyron spicatum (bluebunch wheatgrass)	3.0	20.0
Bromus tectorum ^a (cheatgrass)	45.3	80.0
Centaurea diffusa ^a (diffuse knapweed)	X	X
Chrysothamnus nauseosus (gray rabbitbrush)	X	X
Descurainia pinnata (western tansymustard)	X	X
Lepidium perfoliatum ^a (clasping pepperweed)	29.0	80.0
Oryzopsis hymenoides (Indian ricegrass)	X	X
Poa bulbosa ^a (bulbous bluegrass)	0.3	13.3
Poa sandbergii (Sandberg's bluegrass)	8.0	66.7
Salsola kalia (Russian thistle)	8.0	93.3
Sisymbrium altissimum ^a (tumblemustard)	X	X
Sitanion hystrix (bottlebrush squirreltail)	1.0	6.7
Sphaeralcea munroana (Munro's globemallow)	X	X
Crust	1.5	60.0
Soil	38.8	100.0
Litter	61.2	100.0
Total canopy cover (litter not included)	94.7	
Total native % cover	12.0	
Change in native % cover from 2012	-7.7	
Total invasive % cover	82.7	
Change in invasive % cover from 2012	+16.8	

a Invasive species

a Invasive species
b Bunchgrasses include *Sporobolus cryptandrus*, *Agropyron spicatum*, *Koeleria cristata*,

Oryzopsis hymenoides, Stipa comota, and Sitanion hystrix

X = present but not counted in plot frames

⁼ present but not counted in plot frames

Table A-32. Percent Canopy Cover and Frequency of Occurrence at the 600-151 Site in 2013. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Poa sandbergii (Sandberg's bluegrass)	11.6	72.7
Bromus tectorum ^a (cheatgrass)	58.2	90.9
Salsola kalia (Russian thistle)	0.9	36.4
Agropyron spicatum (bluebunch wheatgrass)	2.7	18.2
Sisymbrium altissimum ^a (tumblemustard)	0.2	9.1
Holosteum umbellatuma (jagged chickweed)	0.0	0.0
Draba verna ^a (spring whitlowgrass)	0.2	9.1
Artemisia tridentata (big sagebrush)	1.4	9.1
Lepidium perfoliatum ^a (clasping pepperweed)	5.9	54.5
Descurainia sophia ^a (herb sophia)	0.2	9.1
Descurainia pinnata (western tansymustard)	0.0	0.0
Sitanion hystrix (bottlebrush squirreltail)	1.6	18.2
Achillea millefolium (yarrow)	0.2	9.1
Chrysothamnus nauseosus (gray rabbitbrush)	Х	X
Centaurea diffusa ^a (diffuse knapweed)	Х	X
Hordeum leporinuma (hare barley)	0.2	9.1
Sphaeralcea munroana (Munro's globemallow)	0.2	9.1
Crust	2.3	90.9
Soil	22.7	90.9
Litter	71.6	100.0
Total canopy cover (litter not included)	83.6	
Total invasive % cover	65.9	
Change in invasive % cover from 2012	-28.6	
Total native % cover	17.7	
Change in native % cover from 2012	-18.3	

^a Invasive species

Table A-33. Percent Canopy Cover and Frequency of Occurrence at the 600-151 Site in 2012. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Poa sandbergii (Sandberg's bluegrass)	31.0	100.0
Bromus tectoruma (cheatgrass)	43.7	100.0
Salsola kalia (Russian thistle)	10.8	100.0
Agropyron spicatum (bluebunch wheatgrass)	4.0	60.0
Sisymbrium altissimum ^a (tumblemustard)	14.0	80.0
Holosteum umbellatuma (jagged chickweed)	10.5	73.3
Draba verna ^a (spring whitlowgrass)	0.3	13.3
Artemisia tridentata (big sagebrush)	0.3	13.3
Lepidium perfoliatuma (clasping pepperweed)	13.8	40.0

X = present but not counted in plot frames

Table A-33. Percent Canopy Cover and Frequency of Occurrence at the 600-151 Site in 2012. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Descurainia sophia ^a (herb sophia)	1.3	20.0
Sitanion hystrix (bottlebrush squirreltail)	0.7	26.7
Chenopodium leptophyllum (slimleaf goosefoot)	X	X
Chenopodium album ^a (lambsquarters)	Х	X
Achillea millefolium (yarrow)	Х	X
Crust	3.2	93.3
Soil	45.3	100.0
Litter	55.5	100.0
Total canopy cover (litter not included)	130.5	
Total invasive % cover	94.5	
Total native % cover	36.0	

a Invasive species

Table A-34. Percent Canopy Cover and Frequency of Occurrence at the 600-152 Site in 2015. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Ambrosia acanthicarpa (bur ragweed)	0.17	6.67
Amsinckia lycopsoides (tarweed fiddleneck)	0.33	13.33
Artemisia tridentata (big sagebrush)	6.67	13.33
Bromus tectoruma (cheatgrass)	28.67	100.00
Bunchgrasses ^b	0.17	6.67
Chrysothamnus nauseosus (gray rabbitbrush)	X	X
Descurainia pinnata (western tansymustard)	0.17	6.67
Holosteum umbellatum ^a (jagged chickweed)	0.17	6.67
Lepidium perfoliatuma (clasping pepperweed)	11.17	86.67
Poa sandbergii (Sandberg's bluegrass)	8.67	80.00
Salsola kali ^a (Russian thistle)	2.67	73.33
Sisymbrium altissimum ^a (tumble mustard)	4.00	60.00
Sphaeralcea munroana (Munro's globemallow)	0.17	6.67
Crust	0.17	6.67
Soil	61.17	100.00
Litter	16.17	100.00
Total canopy cover (excludes crust/soil/litter)	63.00	
Total native % cover	16.33	

X = present but not counted in plot frames

Table A-34. Percent Canopy Cover and Frequency of Occurrence at the 600-152 Site in 2015. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Change in native % cover from 2014	-4.37	
Total invasive % cover	46.67	
Change in invasive % cover from 2014	-8.63	

Table A-35. Percent Canopy Cover and Frequency of Occurrence at the 600-152 Site in 2014. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	Х	Х
Agropyron spicatum (bluebunch wheatgrass)	1.0	6.7
Artemisia tridentata (big sagebrush)	X	X
Bromus tectorum ^a (cheatgrass)	26.8	93.3
Centaurea diffusa ^a (diffuse knapweed)	Х	Х
Chrysothamnus nauseosus (gray rabbitbrush)	Х	Х
Cryptantha leucophaea (gray cryptantha)	X	X
Lepidium perfoliatum ^a (clasping pepperweed)	0.8	33.3
Poa sandbergii (Sandberg's bluegrass)	19.2	93.3
Salsola kalia (Russian thistle)	26.3	100.0
Sisymbrium altissimum ^a (tumblemustard)	1.3	20.0
Sitanion hystrix (bottlebrush squirreltail)	0.2	6.7
Sporobolus cryptandrus (sand dropseed)	0.3	13.3
Crust	2.0	80.0
Soil	49.0	93.3
Litter	50.8	100.0
Total canopy cover (litter not included)	76.0	
Total native % cover	20.7	
Change in native % cover from 2013	-13.7	
Total invasive % cover	55.3	
Change in Invasive % cover from 2013	+6.7	

^a Invasive species

a Invasive species
b Bunchgrasses include *Sporobolus cryptandrus, Agropyron spicatum, Koeleria cristata,* Oryzopsis hymenoides, Stipa comota, and Sitanion hystrix

⁼ present but not counted in plot frames

⁼ present but not counted in plot frames

Table A-36. Percent Canopy Cover and Frequency of Occurrence at the 600-152 Site in 2013.

Species	% Cover	% Frequency of Occurrence
Poa sandbergii (Sandberg's bluegrass)	29.3	93.3
Bromus tectorum ^a (cheatgrass)	41.8	100.0
Salsola kalia (Russian thistle)	1.2	46.7
Agropyron spicatum (bluebunch wheatgrass)	0.8	33.3
Sisymbrium altissimum ^a (tumblemustard)	0.7	26.7
Lepidium perfoliatum ^a (clasping pepperweed)	5.0	40.0
Amsinckia lycopsoides (tarweed fiddleneck)	0.3	13.3
Artemisia tridentata (big sagebrush)	2.0	13.3
Descurainia pinnata (western tansymustard)	1.2	46.7
Machaeranthera canascens (hoary aster)	0.2	6.7
Sitanion hystrix (bottlebrush squirreltail)	0.3	13.3
Centaurea diffusa ^a (diffuse knapweed)	X	X
Chrysothamnus nauseosus (rabbitbrush)	0.2	6.7
Erodium cicutariuma (storksbill)	X	X
Crust	4.5	86.7
Soil	38.7	100.0
Litter	57.3	100.0
Total canopy cover (litter not included)	83.0	
Total invasive % cover	48.7	
Change in invasive % cover from 2012	-29.1	
Total native % cover	34.3	
Change in native % cover from 2012	-36.9	

^a Invasive species

Table A-37. Percent Canopy Cover and Frequency of Occurrence at the 600-152 Site in 2012. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Poa sandbergii (Sandberg's bluegrass)	60.3	100.0
Bromus tectorum ^a (cheatgrass)	35.0	100.0
Salsola kalia (Russian thistle)	14.3	93.3
Agropyron spicatum (bluebunch wheatgrass)	6.2	80.0
Sisymbrium altissimum ^a (tumblemustard)	26.2	93.3
Lepidium perfoliatum ^a (clasping pepperweed)	2.2	20.0
Amsinckia lycopsoides (tarweed fiddleneck)	0.5	20.0
Artemisia tridentata (big sagebrush)	0.2	6.7
Descurainia pinnata (western tansymustard)	0.2	6.7
Hordeum leporinum ^a (hare barley)	0.2	6.7
Sitanion hystrix (bottlebrush squirreltail)	3.8	53.3
Lactuca serriolaa (prickly lettuce)	Х	Х

X = present but not counted in plot frames

 Table A-37. Percent Canopy Cover and Frequency of Occurrence
 at the 600-152 Site in 2012. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Crust	2.5	100.0
Soil	29.0	100.0
Litter	71.8	100.0
Total canopy cover (litter not included)	149.0	
Total invasive % cover	77.8	
Total native % cover	71.2	_

Table A-38. Percent Canopy Cover and Frequency of Occurrence at the 128-H-1 Site in 2015. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	0.60	4.00
Agropyron spicatum (bluebunch wheatgrass)	1.40	16.00
Artemisia tridentata (big sagebrush)	2.70	12.00
Atriplex spinosa (spiny hopsage)	0.60	4.00
Bromus tectoruma (cheatgrass)	6.60	88.00
Centaurea diffusaa (diffuse knapweed)	0.90	16.00
Chrysothamnus nauseosus (gray rabbitbrush)	X	X
Lactuca seriola ^a (prickly lettuce)	0.10	4.00
Lepidium perfoliatum ^a (clasping pepperweed)	2.80	16.00
Macaeranthera canascens (hoary aster)	0.20	8.00
Poa bulbosa ^a (bulbous bluegrass)	1.20	28.00
Poa sandbergii (Sandberg's bluegrass)	5.90	76.00
Salsola kalia (Russian thistle)	11.10	96.00
Sisymbrium altissimum ^a (tumble mustard)	5.00	48.00
Sphaeralcea munroana (Munro's globemallow)	2.90	20.00
Sporobolus cryptandrus (sand dropseed)	0.60	4.00
Stipa comata (needle-and-thread grass)	X	X
Tragopogon dubius ^a (yellow salsify)	0.70	8.00
Chyna recruits	X	X
Artr recruits	X	X
Crust	0.00	0.00
Soil	0.00	0.00
Litter	0.60	4.00
Total canopy cover (litter not included)	43.30	
Total native % cover	14.90	

a Invasive species

X = present but not counted in plot frames

Table A-38. Percent Canopy Cover and Frequency of Occurrence at the 128-H-1 Site in 2015. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Change in native % cover from 2014	-1.30	
Total invasive % cover	28.40	
Change in invasive % cover from 2014	-15.50	

^a Invasive species

Table A-39. Percent Canopy Cover and Frequency of Occurrence at the 128-H-1 Site in 2014.

at the 120-11-1 Site i		% Frequency of
Species	% Cover	Occurrence
Achillea millefolium (yarrow)	X	X
Agropyron spicatum (bluebunch wheatgrass)	5.1	48.0
Ambrosia acanthicarpa (bur ragweed)	0.2	8.0
Artemisia tridentata (big sagebrush)	0.1	4.0
Astragalus caricinus (buckwheat milk-vetch)	X	X
Bromus tectorum ^a (cheatgrass)	7.6	56.0
Centaurea diffusa ^a (diffuse knapweed)	0.2	8.0
Erodium cicutarium ^a (storksbill)	X	X
Atriplex spinosa (spiny hopsage)	0.1	4.0
Lepidium perfoliatum ^a (clasping pepperweed)	2.3	16.0
Machaeranthera canascens (hoary aster)	X	X
Poa bulbosa ^a (bulbous bluegrass)	1.2	28.0
Poa sandbergii (Sandberg's bluegrass)	6.4	76.0
Purshia tridentata (antelope bitterbrush)	X	Х
Salsola kalia (Russian thistle)	31.4	100.0
Sisymbrium altissimum ^a (tumblemustard)	0.6	24.0
Sphaeralcea munroana (Munro's globemallow)	1.9	16.0
Sporobolus cryptandrus (sand dropseed)	X	X
Stipa comata (needle-and-thread grass)	2.4	36.0
Tragopogon dubius ^a (yellow salsify)	0.1	4.0
Triticum aestivuma (common wheat)	0.5	20.0
Crust	2.0	80.0
Soil	56.2	100.0
Litter	44.7	100.0
Total canopy cover (litter not included)	60.1	
Total native % cover	16.2	
Change in native cover since 2013	-11.3	
Total invasive % cover	43.9	
Change in invasive cover since 2013	+21.6	

^a Invasive species

X = present but not counted in plot frames

X = present but not counted in plot frames

Table A-40. Percent Canopy Cover and Frequency of Occurrence at the 128-H-1 Site in 2013.

Species	% Cover	% Frequency of Occurrence
Poa sandbergii (Sandberg's bluegrass)	16.8	90.0
Bromus tectoruma (cheatgrass)	0.3	10.0
Salsola kalia (Russian thistle)	18.3	100.0
bunchgrasses	8.3	80.0
Sisymbrium altissimum ^a (tumblemustard)	1.8	70.0
Poa bulbosa ^a (bulbous bluegrass)	Х	X
Chenopodium leptophyllum (slimleaf goosefoot)	0.3	10.0
Artemisia tridentata (big sagebrush)	Х	X
Descurainia pinnata (western tansymustard)	0.3	10.0
Purshia tridentata (antelope bitterbrush)	Х	X
Triticum aestivuma (common wheat)	2.0	80.0
Atriplex spinosa (spiny hopsage)	Х	X
Sphaeralcea munroana (Munro's globemallow)	2.0	30.0
Agropyron cristatuma (crested wheatgrass)	Х	X
Lepidium perfoliatum ^a (clasping pepperweed)	Х	X
Crust	0.0	0.0
Soil	23.0	70.0
Litter	71.5	100.0
Total canopy cover (litter not included)	49.8	
Total invasive % cover	22.3	
Total native % cover	27.5	

^a invasive species

Table A-41. Percent Canopy Cover and Frequency of Occurrence at the 600-146 Site in 2014. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Agropyron spicatum (bluebunch wheatgrass)	0.2	6.7
Ambrosia acanthicarpa (bur ragweed)	0.2	6.7
Artemisia tridentata (big sagebrush)	X	X
Bromus tectoruma (cheatgrass)	8.8	93.3
Chrysothamnus nauseosus (gray rabbitbrush)	X	X
Cryptantha circumscissa (matted cryptantha)	0.5	20.0
Erigeron pumilis (shaggy fleabane)	Х	X
Atriplex spinosa (spiny hopsage)	Х	X
Holosteum umbellatuma (jagged chickweed)	Х	X
Microsteris gracilis (pink microsteris)	0.2	6.7
Oryzopsis hymenoides (Indian ricegrass)	1.0	6.7
Poa sandbergii (Sandberg's bluegrass)	12.3	86.7
Ranunculus testiculatus ^a (bur buttercup)	0.2	6.7
Salsola kalia (Russian thistle)	12.0	100.0

X = present but not counted in plot frames

Table A-41. Percent Canopy Cover and Frequency of Occurrence at the 600-146 Site in 2014. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Sitanion hystrix (bottlebrush squirreltail)	1.0	6.7
Sporobolus cryptandrus (sand dropseed)	1.0	6.7
Stipa comata (needle-and-thread grass)	0.3	13.3
Crust	9.3	80.0
Soil	37.2	100.0
Litter	67.5	100.0
Total canopy cover (litter not included)	37.7	
Total native % cover	16.7	
Change in native % cover from 2013	-23.3	
Total invasive % cover	21.0	
Change in invasive % cover from 2013	-42.6	

 Table A-42. Percent Canopy Cover and Frequency of Occurrence
 at the 600-146 Site in 2013. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Poa sandbergii (Sandberg's bluegrass)	38.0	86.7
Bromus tectoruma (cheatgrass)	49.3	100.0
Salsola kalia (Russian thistle)	2.0	80.0
Sisymbrium altissimum ^a (tumblemustard)	0.7	26.7
Holosteum umbellatuma (jagged chickweed)	4.3	46.7
Draba verna ^a (spring whitlowgrass)	7.3	73.3
Chrysothamnus nauseosus (gray rabbitbrush)	X	X
Artemisia tridentata (big sagebrush)	X	X
Sitanion hystrix (bottlebrush squirreltail)	X	X
Microsteris gracilis (pink microsteris)	1.5	60.0
Erigeron pumilis (shaggy fleabane)	Х	Х
Lomatium macrocarpum (bigseed desert parsley)	Х	Х
Hordeum leporinum ^a (hare barley)	X	X
Cryptantha circumscissa (matted cryptantha)	0.2	6.7
Stipa comata (needle-and-thread grass)	0.2	6.7
Atriplex spinosa (spiny hopsage)	X	X
Ambrosia acanthicarpa (bur ragweed)	0.2	6.7
Crust	3.2	93.3
Soil	18.3	100.0
Litter	80.2	100.0
Total canopy cover (litter not included)	103.6	
Total invasive % cover	63.6	
Change in invasive % cover from 2012	+15.7	
Total native % cover	40.0	

a invasive species
X = present but not counted in plot frames

Table A-42. Percent Canopy Cover and Frequency of Occurrence at the 600-146 Site in 2013. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Change in native % cover from 2012	-0.5	

^a invasive species

Table A-43. Percent Canopy Cover and Frequency of Occurrence at the 600-146 Site in 2012.

Species	% Cover	% Frequency of Occurrence
Poa sandbergii (Sandberg's bluegrass)	36.5	100.0
Bromus tectorum ^a (cheatgrass)	29.5	100.0
Salsola kalia (Russian thistle)	17.3	86.7
Agropyron spicatum (bluebunch wheatgrass)	0.3	13.3
Sisymbrium altissimuma (tumblemustard)	0.2	6.7
Holosteum umbellatuma (jagged chickweed)	0.2	6.7
Draba verna ^a (spring whitlowgrass)	0.2	6.7
Chrysothamnus nauseosus (gray rabbitbrush)	0.2	6.7
Artemisia tridentata (big sagebrush)	0.2	6.7
Sitanion hystrix (bottlebrush squirreltail)	3.0	53.3
Microsteris gracilis (pink microsteris)	0.2	6.7
Amsinckia lycopsoides (tarweed fiddleneck)	0.2	6.7
Centaurea repensa (Russian Knapweed)	0.3	13.3
Tragopogon dubius ^a (yellow salsify)	Х	X
Cryptantha pterocarpa (wingnut cryptantha)	Х	X
Cleome lutea (beeplant)	Х	X
Erigeron pumilis (shaggy fleabane)	Х	X
Taeniatherum caput-medusaea (medusahead)	Х	X
Crust	11.2	100.0
Soil	19.8	100.0
Litter	81.5	100.0
Total canopy cover (litter not included)	88.2	
Total invasive % cover	47.7	
Total native % cover	40.5	

^a invasive species

X = present but not counted in plot frames

X = present but not counted in plot frames

Table A-44. Percent Canopy Cover and Frequency of Occurrence at the 600-108 Site in 2015. (2 Pages)

	Area 1 (Inner) Area 2 (Outer)			(Outer)	e) Entire Site		
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence	
Achillea millefolium (yarrow)	0.17	6.67	0.17	6.67	0.17	6.67	
Agropyron spicatum (bluebunch			V	Х	0.00	0.00	
wheatgrass)	7.00	40.00	X				
Artemisia tridentata (big sagebrush) Astragalus sclerocarpus (stalked pod milkvetch)	7.33	40.00	19.17 X	93.33 X	0.00	0.00	
Atriplex spinosa (spiny hopsage)	10.83	20.00	1.00	6.67	5.92	13.33	
Balsamorhiza Careyana (Carey's balsamroot)			1.00	6.67	0.50	3.33	
Bromus tectorum ^a (cheatgrass)	13.00	100.00	5.83	100.00	9.42	100.00	
Centaurea diffusa ^a (diffuse knapweed)	1.17	13.33	0.50	20.00	0.83	16.67	
Chrysothamnus nauseosus (gray rabbitbrush)			1.00	6.67	0.50	3.33	
Descurainia pinnata (western tansymustard)			0.17	6.67	0.08	3.33	
Eriogonum niveum (snow buckwheat)	1.33	20.00	1.33	20.00	1.33	20.00	
Hordeum leporinuma (hare barley)			Χ	Χ	0.00	0.00	
Lactuca seriola ^a (prickly lettuce)	X	X			0.00	0.00	
Lomatium greyi (Gray's biscuitroot)			Χ	Χ	0.00	0.00	
Machaeranthera canascens (hoary aster)			0.17	6.67	0.08	3.33	
Oryzopsis hymenoides (Indian ricegrass)	8.50	53.33	10.00	80.00	9.25	66.67	
Poa sandbergii (Sandberg's bluegrass)	32.83	100.00	0.00	0.00	16.42	50.00	
Purshia tridentata (antelope bitterbrush)			13.00	100.00	6.50	50.00	
Salsola kalia (Russian thistle)	4.83	66.67	1.17	46.67	3.00	56.67	
Sisymbrium altissimum ^a (tumble mustard)	Х	X			0.00	0.00	
Sphaeralcea munroana (Munro's globemallow)			Х	X	0.00	0.00	
Sporobolus cryptandrus (sand	_	_				_	
dropseed)	0.17	6.67			0.08	3.33	
Stipa comata (needle-and-thread grass)	5.17	13.33	8.17	66.67	6.67	40.00	
Tragopogon dubius ^a (yellow salsify)	X	X			0.00	0.00	
Artr recruits	2.50	100.00	Х	Х	1.25	50.00	
Crust	70.00	100.00	2.50	100.00	36.25	100.00	
Soil	20.67	100.00	82.00	100.00	51.33	100.00	
Litter	0.00	0.00	13.67	100.00	6.83	50.00	

Table A-44. Percent Canopy Cover and Frequency of Occurrence at the 600-108 Site in 2015. (2 Pages)

	Area 1 (Inner)		Area 2 (Outer)		Entire Site	
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
Total canopy cover (excludes crust/soil/litter)	87.83		62.67		75.25	
Total native % cover	68.83		55.17		62.00	
Change in native % cover from 2014	+28.13		+27.17		+27.60	
Total invasive % cover	19.00		7.50		13.25	
Change in invasive % cover from 2014	+1.30		-1.80		-0.25	

^a Invasive species

Table A-45. Percent Canopy Cover and Frequency of Occurrence at the 600-108 Site in 2014. (2 Pages)

at the 000-100 Site in 2014. (21 ages)						
	Area 1	1 (Inner) Area 2 (Outer)		2 (Outer)	Entire Site	
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	1.2	13.3	0.3	13.3	8.0	13.3
Agropyron spicatum (bluebunch wheatgrass)	1.2	13.3	0.7	26.7	0.9	20.0
Ambrosia acanthicarpa (bur ragweed)	0.5	20.0	0.3	13.3	0.4	16.7
Artemisia tridentata (big sagebrush)	3.8	53.3	3.0	53.3	3.4	53.3
Astragalus sclerocarpus (stalked pod	1.0	6.7	1.0	6.7	1.0	6.7
Balsamorhiza Careyana (Carey's			Х	Х	X	Х
Bromus tectorum ^a (cheatgrass)	5.7	93.3	3.7	80.0	4.7	86.7
Chrysothamnus nauseosus (gray			Χ	X	Χ	Χ
Cryptantha affinis (slender cryptantha)			0.2	6.7	0.1	3.3
Cymopterus terrabinthinus (wavewing)			1.0	6.7	0.5	3.3
Descurainia pinnata (western tansymustard)			Χ	X	Χ	Χ
Eriogonum niveum (snow buckwheat)	0.3	13.3	1.2	13.3	8.0	13.3
Atriplex spinosa (spiny hopsage)	1.0	6.7	Χ	X	0.5	6.7
Machaeranthera canascens (hoary aster)	Χ	Х	0.3	13.3	0.2	10.0
Microsteris gracilis (pink microsteris)			0.2	6.7	0.1	3.3
Oenothera pallida (pale evening primrose)			Χ	Х	Χ	Χ
Oryzopsis hymenoides (Indian ricegrass)	9.3	53.3	7.5	73.3	8.4	63.3
Poa sandbergii (Sandberg's bluegrass)	18.5	100.0	9.3	86.7	13.9	93.3

X = present but not counted in plot frames

^{-- =} species not observed on site

Table A-45. Percent Canopy Cover and Frequency of Occurrence at the 600-108 Site in 2014. (2 Pages)

	Area 1 (Inner)		nner) Area 2 (Outer)		er) Entire Site	
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence
Purshia tridentata (antelope bitterbrush)	Х	Х	Χ	Х	Χ	Χ
Salsola kalia (Russian thistle)	12.0	100.0	5.7	100.0	8.8	100.0
Sitanion hystrix (bottlebrush squirreltail)			0.2	6.7	0.1	3.3
Stipa comata (needle-and-thread grass)	3.8	26.7	2.8	46.7	3.3	36.7
Tragopogon dubius ^a (yellow salsify)			Χ	Χ	Χ	Χ
Crust	7.2	93.3	12.7	100.0	9.9	96.7
Soil	34.8	93.3	67.2	100.0	51.0	96.7
Litter	66.5	100.0	32.8	100.0	49.7	100.0
Total canopy cover (litter not included)	58.3		37.3		47.9	
Total native % cover	40.7		28.0		34.4	
Change in native % cover from 2013					+3.7	
Total invasive % cover	17.7		9.3		13.5	
Change in invasive % cover from 2013					-21.7	

^a invasive species

Table A-46. Percent Canopy Cover and Frequency of Occurrence at the 600-108 Site in 2013. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Poa sandbergii (Sandberg's bluegrass)	15.0	96.0
Bromus tectorum ^a (cheatgrass)	33.0	100.0
Salsola kalia (Russian thistle)	1.9	76.0
Agropyron spicatum (bluebunch wheatgrass)	1.3	32.0
Achillea millefolium (yarrow)	1.0	20.0
Artemisia tridentata (big sagebrush)	3.5	60.0
Descurainia pinnata (western tansymustard)	0.4	16.0
Purshia tridentata (antelope bitterbrush)	Χ	X
Oryzopsis hymenoides (Indian ricegrass)	5.5	64.0
Atriplex spinosa (spiny hopsage)	0.1	4.0
Sitanion hystrix (bottlebrush squirreltail)	0.4	16.0
Ambrosia acanthicarpa (bur ragweed)	0.1	4.0
Eriogonum niveum (snow buckwheat)	0.9	16.0
Astragalus sclerocarpus (stalked pod milkvetch)	0.1	4.0
Draba verna ^a (spring whitlowgrass)	0.2	8.0
Microsteris gracilis (pink microsteris)	0.1	4.0
Gilia leptomeria (Great Basin gilia)	Χ	X
Phacelia linearis (threadleaf phacelia)	Χ	X

X = present but not counted in plot frames

Table A-46. Percent Canopy Cover and Frequency of Occurrence at the 600-108 Site in 2013. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Oenothera pallida (pale evening primrose)	0.2	8.0
Cryptantha pterocarya (wingnut cryptantha)	X	X
Melilotus albus (sweet clover)	X	X
Machaeranthera canascens (hoary aster)	X	X
Lactuca serriola ^a (prickly lettuce)	0.1	4.0
Epilobium paniculatum (tall willowherb)	0.2	8.0
Stipa comata (needle-and-thread grass)	1.8	32.0
Astragalus purshii (woolly-pod milkvetch)	X	X
Chaenactis douglasii (hoary falseyarrow)	X	X
Balsamorhiza Careyana (Carey's balsamroot)	X	X
Crust	6.9	96.0
Soil	21.7	96.0
Litter	72.7	100.0
Total canopy cover (litter not included)	65.8	
Total invasive % cover	35.2	
Change in invasive % cover from 2012	+8.0	
Total native % cover	30.6	
Change in native % cover from 2012	-5.5	

^a invasive species

Table A-47. Percent Canopy Cover and Frequency of Occurrence at the 600-108 Site in 2012. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Poa sandbergii (Sandberg's bluegrass)	4.3	96.0
Bromus tectoruma (cheatgrass)	22.5	96.0
Salsola kalia (Russian thistle)	4.2	68.0
Agropyron spicatum (bluebunch wheatgrass)	24.2	100.0
Sisymbrium altissimum ^a (tumble mustard)	0.2	8.0
Chrysothamnus nauseosus (gray rabbitbrush)	0.1	4.0
Achillea millefolium (yarrow)	0.3	12.0
Artemisia tridentata (big sagebrush)	2.9	76.0
Descurainia pinnata (western tansymustard)	0.3	12.0
Purshia tridentata (antelope bitterbrush)	0.1	4.0
Oryzopsis hymenoides (Indian ricegrass)	0.5	20.0
Atriplex spinosa (spiny hopsage)	0.1	4.0
Sitanion hystrix (bottlebrush squirreltail)	1.7	68.0
Hordeum leporinuma (hare barley)	0.2	8.0
Ambrosia acanthicarpa (bur ragweed)	0.6	24.0
Eriogonum niveum (snow buckwheat)	0.3	12
Cryptantha circumscissa (matted cryptantha)	0.1	4
Poligonum prolificum (prolific knotweed)	0.2	8

X = present but not counted in plot frames

Table A-47. Percent Canopy Cover and Frequency of Occurrence at the 600-108 Site in 2012. (2 Pages)

Species	% Cover	% Frequency of Occurrence		
Festuca octoflora (slender sixweeks)	0.1	4		
Cryptantha scoparia (desert cryptantha)	0.1	4		
Astragalus sclerocarpus (stalked pod milkvetch)	0.2	8		
Draba verna ^a (spring whitlowgrass)	0.1	4		
Amsinckia lycopsoides (tarweed fiddleneck)	Χ	X		
Microsteris gracilis (pink microsteris)	Χ	X		
Mentzelia albicaulis (whitestem blazingstar)	Х	X		
Gilia leptomeria (Great Basin gilia)	Χ	X		
Phacelia linearis (threadleaf phacelia)	Χ	X		
Chenopodium leptophyllum (slimleaf goosefoot)	Х	X		
Oenothera pallida (pale evening primrose)	Χ	X		
Kochia scopariaa (kochia)	Χ	X		
Cryptantha pterocarya (wingnut cryptantha)	Х	X		
Cryptantha leucophaea (gray cryptantha)	Χ	X		
Cymopterus terrabinthinus (wavewing)	Χ	X		
Chorispora tenella (blue mustard)	Χ	X		
Crust	4	100		
Soil	27.3	100		
Litter	62.3	100		
Total canopy cover (litter not included)	63.3			
Total invasive % cover	27.2			
Total native % cover	36.1			

^a invasive species

Table A-48. Percent Canopy Cover and Frequency of Occurrence at the 600-178 Site in 2015. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	0.30	12.00
Ambrosia acanthicarpa (bur ragweed)	1.80	52.00
Artemisia tridentata (big sagebrush)	7.30	40.00
Astragalus sclerocarpus (stalked pod milkvetch)	Χ	X
Balsamorhiza careyana (Carey's balsamroot)	X	X
Brodiaea sp. (clusterlily)	Χ	X
Bromus tectoruma (cheatgrass)	4.50	84.00
Centaurea diffusa ^a (diffuse knapweed)	0.40	16.00
Chaenactis douglasii (hoary falseyarrow)	0.60	4.00
Chrysothamnus nauseosus (gray rabbitbrush)	0.60	4.00
Epilobium paniculatum (tall willowherb)	X	X
Eriogonum niveum (snow buckwheat)	4.40	24.00
Festuca octoflora (sixweeks fescue)	0.20	8.00
Macaeranthera canascens (hoary aster)	Χ	X

X = present but not counted in plot frames

Table A-48. Percent Canopy Cover and Frequency of Occurrence at the 600-178 Site in 2015. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Microsteris gracilis (pink microsteris)	0.10	4.00
Oryzopsis hymenoides (Indian ricegrass)	7.80	44.00
Plantago patagonica (woolly plaintain)	0.10	4.00
Poa sandbergii (Sandberg's bluegrass)	17.70	96.00
Purshia tridentata (antelope bitterbrush)	X	Х
Salsola kalia (Russian thistle)	1.60	64.00
Stipa comata (needle-and-thread grass)	1.10	24.00
Crust	1.50	60.00
Soil	74.40	100.00
Litter	12.60	100.00
Total canopy cover (excludes crust/soil/litter)	48.50	
Total native % cover	42.00	
Change in native % cover from 2014	+11.00	
Total invasive % cover	6.50	
Change in invasive % cover from 2014	-4.90	

Table A-49. Percent Canopy Cover and Frequency of Occurrence at the 600-178 Site in 2014. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	0.6	24.0
Agropyron spicatum (bluebunch wheatgrass)	0.2	8.0
Ambrosia acanthicarpa (bur ragweed)	1.4	56.0
Amsinckia lycopsoides (tarweed fiddleneck)	0.1	4.0
Artemisia tridentata (big sagebrush)	1.7	28.0
Astragalus sclerocarpus (stalked pod milkvetch)	0.1	4.0
Bromus tectorum ^a (cheatgrass)	4.0	84.0
Chaenactis douglasii (hoary falseyarrow)	0.1	4.0
Chorispora tenellaa (blue mustard)	X	X
Chrysothamnus nauseosus (gray rabbitbrush)	0.2	8.0
Chrysothamnus viscidiflorus (green rabbitbrush)	X	X
Draba verna ^a (spring whitlowgrass)	0.2	8.0
Epilobium paniculatum (tall willowherb)	0.1	4.0
Eriogonum niveum (snow buckwheat)	0.3	12.0
Atriplex spinosa (spiny hopsage)	0.1	4.0
Holosteum umbellatum ^a (jagged chickweed)	0.2	8.0
Machaeranthera canascens (hoary aster)	0.4	16.0
Microsteris gracilis (pink microsteris)	0.1	4.0
Oenothera pallida (pale evening primrose)	0.2	8.0
Oryzopsis hymenoides (Indian ricegrass)	8.5	68.0
Phlox longifolia (longleaf phlox)	0.2	8.0

a Invasive species
X = present but not counted in plot frames

Table A-49. Percent Canopy Cover and Frequency of Occurrence at the 600-178 Site in 2014. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Poa sandbergii (Sandberg's bluegrass)	16.2	84.0
Purshia tridentata (antelope bitterbrush)	0.1	4.0
Salsola kalia (Russian thistle)	6.9	100.0
Sisymbrium altissimum ^a (tumblemustard)	0.1	4.0
Sitanion hystrix (bottlebrush squirreltail)	0.2	8.0
Stipa comata (needle-and-thread grass)	0.2	8.0
Swainsona salsulaa (alkali swainsonpea)	X	X
Tragopogon dubius ^a (yellow salsify)	X	X
Crust	6.8	80.0
Soil	56.2	100.0
Litter	41.1	100.0
Total canopy cover (litter not included)	42.4	
Total native % cover	31.0	
Change in native % cover from 2013	+1.6	
Total invasive % cover	11.4	
Change in invasive % cover from 2013	-17.8	

^a invasive species

Table A-50. Percent Canopy Cover and Frequency of Occurrence at the 600-178 Site in 2013. (2 Pages)

Species	% Cover	% Frequency of Occurrence	
Poa sandbergii (Sandberg's bluegrass)	20.3	96.0	
Bromus tectoruma (cheatgrass)	23.9	100.0	
Salsola kalia (Russian thistle)	3.6	88.0	
Agropyron spicatum (bluebunch wheatgrass)	1.6	64.0	
Sisymbrium altissimum ^a (tumble mustard)	0.5	20.0	
Chrysothamnus nauseosus (gray rabbitbrush)	0.1	4.0	
Achillea millefolium (yarrow)	1.9	36.0	
Artemisia tridentata (big sagebrush)	1.0	40.0	
Descurainia pinnata (western tansymustard)	0.2	8.0	
Purshia tridentata (antelope bitterbrush)	X	X	
Oryzopsis hymenoides (Indian ricegrass)	3.0	60.0	
Atriplex spinosa (spiny hopsage)	0.2	8.0	
Sitanion hystrix (bottlebrush squirreltail)	0.1	4.0	
Ambrosia acanthicarpa (bur ragweed)	0.5	20.0	
Eriogonum niveum (snow buckwheat)	0.3	12.0	
Cryptantha circumscissa (matted cryptantha)	X	X	
Festuca octoflora (slender sixweeks)	0.1	4.0	
Astragalus sclerocarpus (stalked pod milkvetch)	Х	Х	
Draba verna ^a (spring whitlowgrass)	0.3	12.0	

X = present but not counted in plot frames

Table A-50. Percent Canopy Cover and Frequency of Occurrence at the 600-178 Site in 2013. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Amsinckia lycopsoides (tarweed fiddleneck)	X	X
Oenothera pallida (pale evening primrose)	X	X
Cymopterus terrabinthinus (wavewing)	X	X
Machaeranthera canascens (hoary aster)	X	X
Balsamorhiza careyana (Carey's balsamroot)	X	X
Astragalus purshii (woollypod milkvetch)	X	X
Chaenactis douglasii (hoary falseyarrow)	X	X
Lomatium macrocarpum (bigseed desert parsley)	X	X
Plantago patagonica (indian wheat)	X	X
Holosteum umbellatuma (jagged chickweed)	0.3	12.0
Lactuca serriola ^a (prickly lettuce)	0.5	20.0
Epilobium paniculatum (tall willowherb)	0.1	4.0
Chondrilla juncea ^a (rush skeletonweed)	X	X
Tragopogon dubius ^a (yellow salsify)	0.1	4.0
Phlox longifolia (longleaf phlox)	X	X
Crust	1.1	96.0
Soil	3.1	100.0
Litter	3.5	100.0
Total canopy cover (litter not included)	58.6	
Total invasive % cover	29.2	
Change in invasive % cover from 2012	+13.7	
Total native % cover	29.4	
Change in native % cover from 2012	-1.8	

^a invasive species

Table A-51. Percent Canopy Cover and Frequency of Occurrence at the 600-178 Site in 2012. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Poa sandbergii (Sandberg's bluegrass)	4.4	96.0
Bromus tectoruma (cheatgrass)	11.1	96.0
Salsola kalia (Russian thistle)	3.6	68.0
Agropyron spicatum (bluebunch wheatgrass)	18.0	100.0
Sisymbrium altissimum ^a (tumble mustard)	0.6	4.0
Chrysothamnus nauseosus (gray rabbitbrush)	0.2	8.0
Achillea millefolium (yarrow)	0.9	36.0
Artemisia tridentata (big sagebrush)	2.3	72.0
Oryzopsis hymenoides (Indian ricegrass)	0.1	4.0
Balsamorhiza careyana (Carey's balsamroot)	0.4	16.0
Sitanion hystrix (bottlebrush squirreltail)	1.9	76.0
Epilobium paniculatum (tall willowherb)	0.1	4.0
Machaeranthera canescens (hoary aster)	0.3	12.0

X = present but not counted in plot frames

Table A-51. Percent Canopy Cover and Frequency of Occurrence at the 600-178 Site in 2012. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Hordeum leporinum ^a (hare barley)	0.2	8.0
Ambrosia acanthicarpa (bur ragweed)	1.0	40.0
Eriogonum niveum (snow buckwheat)	0.6	24.0
Mentzelia albicaulis (whitestem blazingstar)	0.1	4.0
Polygonum prolificum (prolific knotweed)	0.4	16.0
Phlox longifolia (longleaf phlox)	0.1	4.0
Gilia leptomeria (Great Basin gilia)	0.1	4.0
Phacelia linearis (threadleaf phacelia)	0.1	4.0
Oenothera pallida (pale evening primrose)	0.1	4.0
Astragalus sclerocarpus (stalked pod milkvetch)	0.1	4.0
Amsinckia lycopsoides (tarweed fiddleneck)	Х	X
Lactuca seriolaa (prickly lettuce)	X	X
Atriplex spinosa (spiny hopsage)	Х	X
Cryptantha circumscissa (matted cryptantha)	X	X
Triticum (wheat)	X	X
Amaranthus albus ^a (white pigweed)	X	X
Chaenactis douglassi (hoary falseyarrow)	X	X
Microsteris gracilis (pink microsteris)	X	X
Astragalus caricinus (buckwheat milkvetch)	Х	X
Cryptantha pterocarya (wingnut cryptantha)	X	X
Polygonum avicularea (prostrate knotweed)	X	X
Crust	1.1	44.0
Soil	29.5	96.0
Litter	65.2	100.0
Total canopy cover (litter not included)	46.7	
Total invasive % cover	15.5	
Total native % cover	31.2	

Table A-52. Percent Canopy Cover and Frequency of Occurrence at the 600-379 Site in 2015. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Ambrosia acanthicarpa (bur ragweed)	1.15	7.69
Artemisia tridentata (big sagebrush)	3.27	23.08
Bromus tectorum ^a (cheatgrass)	6.92	53.85
Bunchgrasses ^b	6.35	100.00
Macaeranthera canascens (hoary aster)	0.19	7.69
Salsola kalia (Russian thistle)	8.46	76.92
Crust	2.50	100.00
Soil	66.35	100.00
Litter	40.00	100.00

a invasive speciesX = present but not counted in plot frames

Table A-52. Percent Canopy Cover and Frequency of Occurrence at the 600-379 Site in 2015. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Total canopy cover (excludes crust/soil/litter)	26.35	
Total native % cover	10.96	
Total invasive % cover	15.38	

^a Invasive species

Table A-53. Percent Canopy Cover and Frequency of Occurrence at the 600-369:3 Site in 2015.

	Area 1 (Inner)		Area 1 (Inner) Area 2 (Outer)		Entire Site	
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
Artemisia tridentata (big sagebrush)	1.50	26.67	0.67	26.67	1.08	26.67
Atriplex spinosa (spiny hopsage)	0.17	6.67			0.08	3.33
Bromus tectoruma (cheatgrass)	6.67	100.00	24.67	100.00	15.67	100.00
Bunchgrasses ^b	9.67	93.33	2.50	66.67	6.08	80.00
Chrysothamnus nauseousus (gray rabbitbrush)			Х	Х	0.00	0.00
Holosteum umbellatuma (jagged chickweed)	0.33	13.33	1.33	53.33	0.83	33.33
Hordeum leporinum ^a (hare barley)	1		Х	Х	0.00	0.00
Lactuca serriola ^a (prickly lettuce)	1		Χ	Χ	0.00	0.00
Melilotus officinalis ^a (sweetclover)	Χ	Х	-		0.00	0.00
Poa bulbosa ^a (bulbous bluegrass)			0.17	6.67	0.08	3.33
Poa sandbergii (Sandberg's bluegrass)	2.33	93.33	3.00	53.33	2.67	73.33
Salsola kalia (Russian thistle)	2.50	100.00	3.33	100.00	2.92	100.00
Sisymbrium altissimum ^a (tumble mustard)	3.33	40.00	18.17	93.33	10.75	66.67
Crust	0.00	0.00	0.00	0.00	0.00	0.00
Soil	58.83	100.00	57.33	100.00	58.08	100.00
Litter	35.00	100.00	25.50	100.00	30.25	100.00
Total canopy cover (excludes crust/soil/litter)	26.50		53.83		40.17	
Total native % cover	13.67		6.17		9.92	
Change in native % cover from 2014	-9.03		-14.83		-11.88	
Total invasive % cover	12.83		47.67		30.25	
Change in invasive % cover from 2014	-3.97		+2.37		-0.95	

^a Invasive species

^b Bunchgrasses include Agropyron spicatum, Koeleria cristata, Oryzopsis hymenoides, Sitanion hystrix, Sporobolus cryptandrus, and Stipa comata

^b Bunchgrasses include *Sporobolus cryptandrus*, *Agropyron spicatum*, *Koeleria cristata*, *Oryzopsis hymenoides*, *Stipa comota*, and *Sitanion hystrix*

X = present but not counted in plot frames

^{-- =} species not observed on site

Table A-54. Percent Canopy Cover and Frequency of Occurrence at the 600-369:3 Site in 2014.

	Area	1 (Inner)	Area 2	(Outer)	Entire	Site
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
Artemisia tridentata (big sagebrush)	Χ	Χ	Χ	Χ	Χ	X
Bromus tectorum ^a (cheatgrass)	1.5	60.0	4.8	93.3	3.2	76.7
Bunchgrasses°	19.3	100.0	16.2	100.0	17.8	100.0
Draba verna ^a (spring whitlowgrass)	-	-	0.2	6.7	0.2	3.3
Atriplex spinosa (spiny hopsage)	Х	Χ	Х	Х	Χ	Х
Heliotropium curassavicum (salt						
heliotrope)	-	-	X	Х	Х	X
Holosteum umbellatuma (jagged					.,	
chickweed)	-	-	Х	Х	X	X
Lactuca serriola ^a (prickly lettuce)	0.2	6.7	-	-	0.08	3.3
Lamium amplexicaule ^a (henbit deadnettle)	0.2	6.7	-	-	0.08	3.3
Poa sandbergii (Sandberg's bluegrass)	3.3	100.0	4.8	93.3	4.1	96.7
Purshia tridentata (antelope bitterbrush)	-	-	Х	Х	Х	X
Raphanus raphanistrum ^a (wild radish)	0.3	13.3	0.5	20.0	0.4	16.7
Salsola kalia (Russian thistle)	13.8	100.0	28.7	93.3	21.3	96.7
Sisymbrium altissimum ^a (tumble mustard)	8.0	33.3	11.0	80.0	5.9	56.7
Tragopogon dubius ^a (yellow salsify)	-	-	0.2	6.7	0.08	3.3
Crust	0.8	33.3	0.5	20.0	0.7	26.7
Soil	60.3	100.0	50.7	93.3	55.5	96.7
Litter	39.7	100.0	49.2	100.0	44.4	100.0
Total canopy cover (litter not included)	39.5		66.3		53.0	
Total native % cover	22.7		21.0		21.8	
Total invasive % cover	16.8		45.3		31.2	

^a Invasive species

Table A-55. Percent Canopy Cover and Frequency of Occurrence at the 600-100 Site in 2015. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	0.10	4.00
Agoseris heterophylla (mountain dandelion)	X	X
Amsinckia lycopsoides (tarweed fiddleneck)	X	X
Artemisia tridentata (big sagebrush)	7.10	16.00
Bromus tectorum ^a (cheatgrass)	8.80	88.00

^b Bunchgrasses include Sporobolus cryptandrus, Agropyron spicatum, Koeleria cristata, Oryzopsis hymenoides, Stipa comota, and Sitanion hystrix

X = present but not counted in plot frames

^{-- =} species not observed on site

Table A-55. Percent Canopy Cover and Frequency of Occurrence at the 600-100 Site in 2015. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Centaurea diffusa ^a (diffuse knapweed)	0.70	28.00
Coldenia nuttallii (coldenia)	0.10	4.00
Cryptantha affinis (slender cryptantha)	0.20	8.00
Eriogonum niveum (snow buckwheat)	0.40	16.00
Hordeum leporinum ^a (hare barley)	0.90	16.00
Machaeranthera canascens (hoary aster)	0.10	4.00
Microsteris gracilis (pink microsteris)	0.10	4.00
Oenothera pallida (pale eveningprimrose)	X	X
Oryzopsis hymenoides (Indian ricegrass)	X	X
Poa sandbergii (Sandberg's bluegrass)	6.40	76.00
Salsola kalia (Russian thistle)	5.50	100.00
Sisymbrium altissimum ^a (tumble mustard)	0.80	12.00
Sporobolus cryptandrus (sand dropseed)	0.60	4.00
Stipa comata (needle-and-thread grass)	3.20	28.00
Crust	0.00	0.00
Soil	80.20	100.00
Litter	4.50	100.00
Total canopy cover (excludes crust/soil/litter)	35.00	
Total native % cover	18.30	
Change in native % cover from 2014	+6.80	
Total invasive % cover	16.70	
Change in invasive % cover from 2014	-47.60	

^a Invasive species

Table A-56. Percent Canopy Cover and Frequency of Occurrence at the 600-100 Site in 2014. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	X	X
Agropyron spicatum (bluebunch wheatgrass)	0.1	4.0
Ambrosia acanthicarpa (bur ragweed)	0.4	16.0
Amsinckia lycopsoides (tarweed fiddleneck)	0.2	8.0
Artemisia tridentata (big sagebrush)	Х	Х
Bromus tectorum ^a (cheatgrass)	2.4	76.0
Chenopodium leptophyllum (slimleaf goosefoot)	0.1	4.0
Descurainia pinnata(western tansymustard)	0.8	12.0
Epilobium paniculatum (tall willowherb)	Х	Х
Eriogonum vimineum (broom buckwheat)	Х	Х
Gilia sp.	Х	Х
Atriplex spinosa (spiny hopsage)	Х	Х
Oenothera pallida (pale eveningprimrose)	2.1	8.0
Phacelia linearis (threadleaf phacelia)	0.1	4.0

X = present but not counted in plot frames

Table A-56. Percent Canopy Cover and Frequency of Occurrence at the 600-100 Site in 2014. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Poa sandbergii (Sandberg's bluegrass)	2.7	84.0
Salsola kalia (Russian thistle)	57.1	96.0
Sisymbrium altissimum ^a (tumblemustard)	4.8	4.0
Sitanion hystrix (bottlebrush squirreltail)	1.8	32
Sporobolus cryptandrus (sand dropseed)	X	X
Stipa comata (needle-and-thread grass)	3.2	32
Tragopogon dubius ^a (yellow salsify)	X	X
Crust	1.8	16.0
Soil	88.0	100.0
Litter	12.0	100.0
Total canopy cover (litter not included)	75.8	
Total native % cover	11.5	
Change in native % cover from 2013	-26.3	
Total invasive % cover	64.3	
Change in invasive % cover from 2013	+39.3	

^a Invasive species

Table A-57. Percent Canopy Cover and Frequency of Occurrence at the 600-100 Site in 2013. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Poa sandbergii (Sandberg's bluegrass)	24.0	93.3
Bromus tectorum ^a (cheatgrass)	12.0	93.3
Salsola kalia (Russian thistle)	10.3	86.7
Agropyron spicatum (bluebunch wheatgrass)	3.0	53.3
Sisymbrium altissimum ^a (tumblemustard)	2.2	20.0
Sitanion hystrix (bottlebrush squirreltail)	9.2	73.3
Artemisia tridentata (big sagebrush)	0.3	13.3
Atriplex spinosa (spiny hopsage)	X	X
Lactuca seriola ^a (prickly lettuce)	0.3	13.3
Taeniatherum caput-medusaea (medusahead)	X	X
Ambrosia acanthicarpa (bur ragweed)	0.2	6.7
Oenothera pallida (pale eveningprimrose)	0.3	13.3
Amsinckia lycopsoides (tarweed fiddleneck)	0.2	6.7
Machaeranthera canascens (hoary aster)	0.3	13.3
Oryzopsis hymenoides (Indian ricegrass)	0.3	13.3
Erodium cicutarium ^a (storksbill)	0.2	6.7
Crust	4.8	93.3
Soil	55.3	100.0
Litter	33.7	100.0

X = present but not counted in plot frames

Table A-57. Percent Canopy Cover and Frequency of Occurrence at the 600-100 Site in 2013. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Total canopy cover (litter not included)	62.8	
Total invasive % cover	25.0	
Change in invasive % cover from 2012	-6.8	
Total native % cover	37.8	
Change in native % cover from 2012	+10.8	

a Invasive species

Table A-58. Percent Canopy Cover and Frequency of Occurrence at the 600-100 Site in 2012.

Species	% Cover	% Frequency of Occurrence
Poa sandbergii (Sandberg's bluegrass)	15.3	93.3
Bromus tectoruma (cheatgrass)	13.8	93.3
Salsola kalia (Russian thistle)	15.2	93.3
Agropyron spicatum (bluebunch wheatgrass)	1.2	53.3
Sisymbrium altissimum ^a (tumblemustard)	2.7	13.3
Sitanion hystrix (bottlebrush squirreltail)	10.3	86.7
Artemisia tridentata (big sagebrush)	0.2	6.7
Lactuca serriolaa (prickly lettuce)	0.2	6.7
Taeniatherum caput-medusae (medusahead)	X	Х
Ambrosia acanthicarpa (bur ragweed)	X	Х
Oenothera pallida (pale eveningprimrose)	X	X
Amsinckia lycopsoides (tarweed fiddleneck)	X	X
Crust	2.3	93.3
Soil	65.8	100.0
Litter	35.0	100.0
Total canopy cover (litter not included)	58.8	
Total invasive % cover	31.8	
Total native % cover	27.0	

a Invasive species

Table A-59. Percent Canopy Cover and Frequency of Occurrence at the 600-301 Site in 2015. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Achillea millefolium (yarrow)	X	X
Amaranthus albus ^a (white pigweed)	0.20	8.00
Amsinckia lycopsoides (tarweed fiddleneck)	X	X
Artemisia tridentata (big sagebrush)	1.80	12.00

X = present but not counted in plot frames

X = present but not counted in plot frames

Table A-59. Percent Canopy Cover and Frequency of Occurrence at the 600-301 Site in 2015. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Atriplex spinosa (spiny hopsage)	0.20	8.00
Bromus tectorum ^a (cheatgrass)	10.90	100.00
Centaurea diffusa ^a (diffuse knapweed)	Χ	X
Holosteum umbellatum ^a (jagged chickweed)	0.10	4.00
Kochia scoparia ^a (kochia)	X	X
Lactuca seriola ^a (prickly lettuce)	0.80	12.00
Melilotus officinalus ^a (sweetclover)	Χ	X
Oryzopsis hymenoides (Indian ricegrass)	1.80	32.00
Plantago patagonica (Indian wheat)	0.10	4.00
Poa sandbergii (Sandberg's bluegrass)	2.90	76.00
Salsola kalia (Russian thistle)	25.80	100.00
Sisymbrium altissimum ^a (tumble mustard)	6.60	52.00
Sphaeralcea munroana (Munro's globemallow)	Χ	X
Sporobolus cryptandrus (sand dropseed)	3.00	60.00
Stipa comata (needle-and-thread grass)	0.10	4.00
Tragopogon dubius ^a (yellow salsify)	0.20	8.00
Crust	0.10	4.00
Soil	60.30	100.00
Litter	26.80	100.00
Total canopy cover (excludes crust/soil/litter)	54.50	
Total native % cover	9.90	
Change in native % cover from 2014	-7.70	
Total invasive % cover	44.60	
Change in invasive % cover from 2014	+5.90	

^a Invasive species

Table A-60. Percent Canopy Cover and Frequency of Occurrence at the 600-301 Site in 2014. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Ambrosia acanthicarpa (bur ragweed)	0.2	8.0
Amsinckia lycopsoides (tarweed fiddleneck)	X	X
Artemisia tridentata (big sagebrush)	X	X
Bromus tectorum ^a (cheatgrass)	2.6	64.0
Bunchgrasses°	12.8	100.0
Chenopodium albuma (lambsquarters)	X	X
Chrysothamnus nauseosus (gray rabbitbrush)	X	X
Descruainia pinnata (western tansymustard)	0.7	8.0
Erodium cicutarium ^a (storksbill)	X	X
Atriplex spinosa (spiny hopsage)	X	X
Holosteum umbellatuma (jagged chickweed)	0.1	4.0
Lepidium densiflorum (common pepperweed)	X	X

X = present but not counted in plot frames

Table A-60. Percent Canopy Cover and Frequency of Occurrence at the 600-301 Site in 2014. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Melilotus alba ^a (sweetclover)	0.1	4.0
Poa bulbosa ^a (bulbous bluegrass)	0.1	4.0
Poa sandbergii (Sandberg's bluegrass)	3.9	40.0
Purshia tridentata (antelope bitterbrush)	X	X
Salsola kalia (Russian thistle)	33.7	96.0
Sisymbrium altissimum ^a (tumble mustard)	2.1	24.0
Sphaeralcea munroana (Munro's globemallow)	X	X
Tragopogon dubius ^a (yellow salsify)	X	X
Crust	6.1	72.0
Soil	67.5	100.0
Litter	32.5	100.0
Total canopy cover (litter not included)	56.3	
Total native % cover	17.6	
Total invasive % cover	38.7	

^a Invasive species

Table A-61. Percent Canopy Cover and Frequency of Occurrence at the 600-109 Site in 2015. (2 Pages)

	W	est	Ea	ıst	Entire	Site
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average% Cover	Average% Frequency of Occurrence
Achillea millefolium (yarrow)	0.10	4.00	Χ	Χ	0.05	2.00
Agropyron spicatum (bluebunch wheatgrass)	0.10	4.00	2.50	24.00	1.30	14.00
Artemisia tridentata (big sagebrush)	6.20	20.00	10.10	24.00	8.15	22.00
Atriplex spinosa (spiny hopsage)	1.20	8.00	0.60	4.00	.0.90	6.00
Bromus tectorum ^a (cheatgrass)	29.50	100.00	33.70	96.00	31.60	98.00
Centaurea diffusa ^a (diffuse knapweed)		-	Χ	Χ	Χ	Χ
Descurainia pinnata (western tansymustard)		1	Х	Х	X	X
Erigeron pumilus (shaggy fleabane)	X	Χ	1	ŀ	Χ	Χ
Erodium cicutarium ^a (storksbill)	X	Χ	Χ	Χ	Χ	Χ
Hordeum jubatum (foxtail barley)	X	Χ	0.70	8.00	0.35	4.00
Lactuca seriola ^a (prickly lettuce)	X	Χ	Χ	Χ	Χ	X
Lepidum perfoliatum ^a (clasping pepperweed)	Х	Х			Х	Х
Macaeranthera canescens (hoary aster)			Х	Х	Х	Х

^b Bunchgrasses include Sporobolus cryptandrus, Agropyron spicatum, Koeleria cristata, Oryzopsis hymenoides, Stipa comota, and Sitanion hystrix

X = present but not counted in plot frames

Table A-61. Percent Canopy Cover and Frequency of Occurrence at the 600-109 Site in 2015. (2 Pages)

	W	est	Ea	ıst	Entire	Site
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average% Cover	Average% Frequency of Occurrence
Oryzopsis hymenoides (Indian ricegrass)	0.80	12.00	Х	Χ	0.40	6.00
Poa bulbosa ^a (bulbous bluegrass)	4.70	48.00	10.60	44.00	7.65	46.00
Poa sandbergii (Sandberg's bluegrass)	19.40	100.00	2.20	48.00	10.80	74.00
Salsola kalia (Russian thistle)	1.30	52.00	13.70	96.00	7.50	74.00
Sisymbrium altissimum ^a (tumble mustard)	2.40	20.00	3.30	92.00	2.85	56.00
Sitanion hystrix (bottlebrush squirreltail)			2.40	20.00	1.20	10.00
Spharalcea munroana (Munro's globemallow)			X	Х	Х	X
Sporobolus cryptandrus (sand dropseed)	0.10	4.00	Χ	Χ	0.05	2.00
Stipa comata (needle-and-thread grass)			0.60	4.00	0.30	2.00
Tragopogon dubius ^a (yellow salsify)	Χ	Χ	Χ	Χ	Χ	Х
Verbena bracteata (big-bract verbena)			Х	Χ	Χ	Х
Artr recruits			Х	Χ	Χ	Х
Crust	8.00	88.00	6.50	100.00	7.25	94.00
Soil	62.50	100.00	44.70	100.00	53.60	100.00
Litter	27.40	100.00	30.90	100.00	29.15	100.00
Total canopy cover (excludes crust/soil/litter)	65.80		80.40		73.10	
Total native % cover	27.90		19.10		23.50	
Change in native % cover from 2014	-8.60		-23.90		-16.30	
Total invasive % cover	37.90		61.30		49.60	
Change in invasive % cover from 2014	-5.60		+19.70		+7.00	

^a Invasive species

Table A-62. Percent Canopy Cover and Frequency of Occurrence at the 600-109 Site in 2014. (2Pages)

	West		Ea	est	Entire Site	
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average% Cover	Average% Frequency of Occurrence
Achillea millefolium (yarrow)	Х	Х	Х	Х	Х	Х
Agropyron spicatum (bluebunch	4.2	48.0	10.2	64.0	7.2	56.0
wheatgrass)						
Artemisia tridentata (big sagebrush)	0.6	4	X	X	0.3	2.0

X = present but not counted in plot frames

^{-- =} species not observed on site

Table A-62. Percent Canopy Cover and Frequency of Occurrence at the 600-109 Site in 2014. (2Pages)

	W	est	Ea	ıst	Entire	e Site
Species	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average% Cover	Average% Frequency of Occurrence
Bromus tectorum ^a (cheatgrass)	23.0	100.0	25.3	96.0	24.2	98.0
Centaurea diffusa ^a (diffuse knapweed)		-	Χ	Χ	Χ	Χ
Descurania pinnata (western tansymustard)			0.1	4.0	0.05	2.0
Erodium cicutarium ^a (storksbill)	0.1	4.0	0.1	4.0	0.1	4.0
Atriplex spinosa (spiny hopsage)	Х	Χ	Х	Х	Х	Χ
Holosteum umbellatuma (jagged	0.1	4.0			0.05	2.0
chickweed)						
Macaeranthera canescens (hoary aster)		-	X	X	X	Χ
Melilotus alba ^a (sweetclover)		I	Х	X	Х	Х
Oryzopsis hymenoides (Indian ricegrass)	3.9	24.0	11.5	40.0	7.7	32.0
Poa bulbosa ^a (bulbous bluegrass)	0.5	20.0	2.5	24.0	1.5	22.0
Poa sandbergii (Sandberg's bluegrass)	26.7	80.0	17.4	60.0	22.1	70.0
Salsola kalia (Russian thistle)	15.6	100.0	13.4	96.0	14.5	98.0
Sisymbrium altissimum ^a (tumblemustard)	4.2	52.0	0.2	8.0	2.2	30.0
Sitanion hystrix (bottlebrush squirreltail)	1.0	20.0	3.7	52.0	2.4	36.0
Spharalcea munroana (Munro's		-	Χ	Х	Х	Χ
Sporobolus cryptandrus (sand dropseed)	Х	Χ	0.1	4.0	0.05	2.0
Stipa comata (needle-and-thread grass)	0.1	4.0			0.05	2.0
Tragopogon dubius ^a (yellow salsify)	Х	Х	0.1	4.0	0.05	2.0
Verbena bracteata (big-bract verbena)			Х	Х	Х	Х
Crust	2.2	68.0	2.8	72.0	2.5	70.0
Soil	58.0	100.0	34.8	100.0	46.4	100.0
Litter	42.0	100.0	65.2	100.0	53.6	100.0
Total canopy cover (litter not included)	80.0		84.6		82.3	
Total native % cover	36.5		43.0		39.8	
Change in native % cover from 2013					+12.8	
Total invasive % cover	43.5		41.6		42.6	
Change in invasive % cover from 2013					+5.5	

^a Invasive species

X = present but not counted in plot frames

^{-- =} species not observed on site

Table A-63. Percent Canopy Cover and Frequency of Occurrence at the 600-109 Site in 2013.

Species	% Cover	% Freq uency of Occurrence
Poa sandbergii (Sandberg's bluegrass)	16.3	88.0
Bromus tectoruma (cheatgrass)	23.6	100.0
Salsola kalia (Russian thistle)	4.3	92.0
Agropyron spicatum (bluebunch wheatgrass)	3.7	48.0
Sisymbrium altissimum ^a (tumble mustard)	4.1	48.0
Draba verna ^a (spring whitlowgrass)	0.1	4.0
Achillea millefolium (yarrow)	0.1	4.0
Artemisia tridentata (big sagebrush)	0.9	16.0
Oryzopsis hymenoides (Indian ricegrass)	3.3	52.0
Atriplex spinosa (spiny hopsage)	X	Х
Sitanion hystrix (bottlebrush squirreltail)	2.7	52.0
Ambosia acanthicarpa (bur ragweed)	Х	Χ
Hoerdeum leporinuma (hare barley)	Х	Х
Poa bulbosa ^a (bulbous bluegrass)	4.4	60.0
Melilotus alba ^a (sweetclover)	Х	Х
Sonchus arvensis ^a (perennial sowthistle)	Х	Х
Lactuca seriola ^a (prickly lettuce)	0.4	16.0
Amsinckia lycopsoides (tarweed fiddleneck)	X	Х
Erodium cicutarium ^a (storksbill)	0.1	4.0
Holosteum umbellatuma (jagged chickweed)	0.1	4.0
Diodia (buttonweed)	X	Χ
Convolvulus arvensis (field bindweed)	X	X
Macaeranthera canescens (hoary aster)	X	X
Centaurea diffusa ^a (diffuse knapweed)	X	Х
Verbina bracteata (bigbract verbena)	X	X
Centaurea solstitialisa (yellow starthistle)	X	Х
Crust	5.5	84.0
Soil	34.5	100.0
Litter	61.5	100.0
Total canopy cover (litter not included)	64.1	
Total invasive % cover	37.1	
Change in invasive % cover from 2012	+9.3	
Total native % cover	27.0	
Change in native % cover from 2012	-20.0	

a Invasive species
 X = present but not counted in plot frames
 -- = species not observed on site

Table A-64. Percent Canopy Cover and Frequency of Occurrence at the 600-109 Site in 2012.

Species	% Cover	% Frequency of Occurrence
Poa sandbergii (Sandberg's bluegrass)	29.8	100.0
Bromus tectorum ^a (cheatgrass)	9.0	88.0
Salsola kalia (Russian thistle)	2.7	52.0
Agropyron spicatum (bluebunch wheatgrass)	15.8	92.0
Sisymbrium altissimum ^a (tumble mustard)	13.8	92.0
Draba verna ^a (spring whitlowgrass)	0.1	4.0
Achillea millefolium (yarrow)	0.1	4.0
Artemisia tridentata (big sagebrush)	0.1	4.0
Oryzopsis hymenoides (Indian ricegrass)	0.1	4.0
Atriplex spinosa (spiny hopsage)	0.2	8.0
Sitanion hystrix (bottlebrush squirreltail)	0.8	32.0
Ambosia acanthicarpa (bur ragweed)	0.1	4.0
Hoerdeum leporinum ^a (hare barley)	0.1	4.0
Poa bulbosa ^a (bulbous bluegrass)	1.5	20.0
Melilotus alba ^a (sweetclover)	0.3	12.0
Amaranthus ^a (pigweed)	0.1	4.0
Sonchus arvensis ^a (perennial sowthistle)	0.2	8.0
Lactuca seriola ^a (prickly lettuce)	Х	X
Amsinckia lycopsoides (tarweed fiddleneck)	Х	X
Erodium cicutarium ^a (storksbill)	Х	X
Holosteum umbellatuma (jagged chickweed)	Х	X
Triticum ^a (wheat)	Х	Х
Crust	1.8	100.0
Soil	34.0	100.0
Litter	67.9	100.0
Total canopy cover (litter not included)	74.8	
Total invasive % cover	27.8	
Total native % cover	47.0	
a Invasive species	•	•

^a Invasive species

Table A-65. Percent Canopy Cover and Frequency of Occurrence at the 600-370 Site in 2015. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Artemisia tridentata (big sagebrush)	1.80	12.00
Bromus tectorum ^a (cheatgrass)	13.50	96.00
Chonodrilla juncea ^a (rush skeletonweed)	X	X
Holosteum umbellatuma (jagged chickweed)	0.50	20.00
Lactuca serriola ^a (prickly lettuce)	X	X
Oenothera pallida (pale eveningprimrose)	X	X
Poa sandbergii (Sandberg's bluegrass)	3.90	76.00

X = present but not counted in plot frames

Table A-65. Percent Canopy Cover and Frequency of Occurrence at the 600-370 Site in 2015. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Psoralea lanceolata (scurf-pea)	1.20	8.00
Salsola kalia (Russian thistle)	19.70	100.00
Sisymbrium altissimum ^a (tumble mustard)	0.70	28.00
Sitanion hystrix (bottlebrush squirreltail)	0.20	8.00
Crust	0.00	0.00
Soil	66.00	100.00
Litter	22.90	100.00
Total canopy cover (excludes crust/soil/litter)	41.50	
Total native % cover	7.10	
Change in native % cover from 2014	-7.60	
Total invasive % cover	34.40	
Change in invasive % cover from 2014	+3.00	

^a Invasive species

Table A-66. Percent Canopy Cover and Frequency of Occurrence at the 600-356 Site in 2015.

Species	% Cover	% Frequency of Occurrence
Ambrosia acanthicarpa (bur ragweed)	Χ	X
Artemisia tridentata (big sagebrush)	0.70	28.00
Balsamorhiza careyana (Carey's balsamroot)	Χ	Χ
Bromus tectorum ^a (cheatgrass)	1.00	20.00
Bunchgrasses ^b	13.70	100.00
Chrysothamnus nauseosous (gray rabbitbrush)	0.10	4.00
Descurainia pinnata (western tansymustard)	0.20	8.00
Poa bulbosa ^a (bulbous bluegrass)	0.10	4.00
Purshia tridentata (antelope bitterbrush)	Χ	Χ
Raphanus sativus ^a (wild radish)	Χ	X
Salsola kalia (Russian thistle)	11.60	84.00
Sisymbrium altissimum ^a (tumble mustard)	2.10	44.00
Triticum sp. ^a (wheat)	Χ	X
Crust	2.40	96.00
Soil	61.80	100.00
Litter	47.90	100.00
Total canopy cover (excludes crust/soil/litter)	29.50	
Total native % cover	14.70	
Total invasive % cover	14.80	

^a Invasive species

X = present but not counted in plot frames

^b Bunchgrasses include Agropyron spicatum, Koeleria cristata, Oryzopsis hymenoides, Sitanion hystrix, Sporobolus cryptandrus, and Stipa comata

X = present but not counted in plot frames

APPENDIX B

NAME CHANGES INCLUDED IN INTEGRATED TAXONOMIC INFORMATION SYSTEM

APPENDIX B

NAME CHANGES INCLUDED IN INTEGRATED TAXONOMIC INFORMATION SYSTEM

Name changes included in Integrated Taxonomic Information System.

The following list includes recent name changes for species mentioned in this report. The first name is that used in *Flora in the Pacific Northwest* (Hitchcock and Cronquist 1973) and the second is the more recent version.

Agropyron spicatum = Pseudoroegneria spicata

Atriplex spinosa = Grayia spinosa

Chrysothamnus nauseosus = Ericameria nauseosa var. nauseosa

Coldenia nuttallii = Tiquilia nuttallii

Cornus stolonifera = Cornus sericea

Cymopterus terebinthinus = Pteryxia terebinthina var. terebinthina

Cyperus aristatus = Cyperus squarrosus

Epilobium paniculatum = Epilobium brachycarpum

Festuca arundinaceus = Schedonorus arundinaceus

Festuca microstachys = Vulpia microstachys

Festuca octoflora = Vulpia octoflora var. octoflora

Kochia scoparia = Bassia scoparia

Koeleria cristata = Koeleria macrantha

Oryzopsis hymenoides = Achnatherum hymenoides

Poa sandbergii = Poa secunda

Psoralea lanceolata = Psoralidium lanceolatum

Ranunculus testiculatus = Ceratocephala testiculata

Scirpus acutus = Schoenoplectus acutus

Scirpus validua = Schoenoplectus tabernaemontani

Sitanion hystrix = Elymus elymoides ssp. elymoides

Stipa comata = Hesperostipa comata ssp. comata

Reference

Hitchcock, C. L., and A. Cronquist, 1973, *Flora of the Pacific Northwest*, University of Washington Press, Seattle, Washington.

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