

# River Corridor Closure Contract

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## 2009 River Corridor Closure Contract Revegetation and Mitigation Monitoring Report

September 2009

For Public Release

**Washington Closure Hanford**

Prepared for the U.S. Department of Energy, Richland Operations Office  
Office of Assistant Manager for River Corridor



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**Author Name:** C. T. Lindsey  
K. A. Gano  
R. D. Teel

**Approval:** J. E. Fletcher Environmental Services Manager

  
Signature

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Date

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# **2009 River Corridor Closure Contractor Revegetation and Mitigation Monitoring Report**

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## TECHNICAL SUMMARY

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* (CERCLA) cleanup of National Priorities List waste sites at Hanford. One objective of restoration is to revegetate remediated waste sites to stabilize the soil and restore the land to a native vegetation community. In addition, mitigation measures are taken to reduce impacts from the cleanup activities.

This document details the results of revegetation and mitigation monitoring conducted in 2009, including 25 revegetation/restoration projects, one revegetation/mitigation project, and three bat habitat mitigation projects. These revegetation and mitigation projects are monitored annually to ensure the objectives are accomplished; to note planting techniques that yield the greatest success; and to document successional recovery. It is important to remember that it typically takes 3 to 5 years before revegetation efforts in arid regions show signs of success.

### **Waste Sites and Monitoring Activities in 2009:**

- Fifth-year monitoring of 100-F area sites and 116-N-3 Trench in the 100 N Area;
- Fourth-year monitoring of waste sites in the 100 K Area, 100 B/C Area, the former Hanford Generating Plant, 618-4 Burial Ground shrub planting, and Horseshoe Landfill;
- Third-year monitoring of the ERDF Mitigation on the Army Loop Road, 116-N-1 Trench, 100-B/C Area, and 300-FF-1 Operable Unit sites;
- Second-year monitoring of 118-F-1 & -2, 182-F, 183-F East Clearwell, 100-F-26, 118-F-5, 118-B-1, 100-B-14, and 118-C-1.
- First-year monitoring of 118-F-6, 120-F-1, 1607-F-1, 618-7 and its container transfer area (CTA), 600-111, and 600-149.

The work conducted in 2009 is summarized here. For each project, an overview is given, and results and conclusions are discussed.

### **Revegetation/Restoration Projects:**

The majority of the **300-FF-1 Operable Unit** is within an area designated for future industrial use in the Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement (DOE/EIS-0222-F). Therefore, sites within this area were broadcast seeded with only grass species to stabilize the soil surface. To facilitate successful germination, 16.8 kg/ha polyacrylamide (water-retaining crystals) were applied during seeding. The seeded area was irrigated with 0.62 cm/ha of water, mulched with grass straw, and crimped to minimize wind erosion. The 300-8 aluminum shavings site, located in this area, was revegetated with a seed mix consisting of crested wheatgrass (*Agropyron cristatum*), which is a non-native species. Third-year monitoring was performed at this site in May 2009. Canopy cover of native species remains low; however, crested wheatgrass is becoming established, and soil stabilization is proving successful.

The **618-4 Burial Ground** is located just outside of, but adjacent to, the industrial use designated area; therefore, the 2-ha site and the area to the east of the burial ground were planted with 4000 sagebrush tubelings (*Artemisia tridentata*) the first week of February 2006. Third-year monitoring at this site showed survival at 71%, 50%, and 65% on three established transects, and shrubs beginning to bloom. It appears that sagebrush has successfully been re-established on the former burial ground. In addition, 15 native species are also re-colonizing the site.

Remediation at the **618-7 Burial Ground** began in 2007, and was completed and revegetated in December 2008. First-year monitoring was conducted at this site in May 2009. The 618-7 site was broken down into three areas for monitoring to show variation between the different portions of the plot. The CTA was treated as a separate site, and the burial ground was split to have a north and south transect. All of the areas were dominated by Russian thistle. Sandberg's bluegrass and bluebunch wheatgrass rounded out the top three canopy cover species. Species diversity across the three sites was relatively high, 25 different species, for first-year monitoring. This high diversity is likely due to the seed-bank present in the topsoil that was used to top-dress the South Topsoil area and CTA. The diversity at the North Cobble area, which did not receive a top-dressing, was notably lower, with only 12 species present. These areas will be monitored for differences in the future, but the initial impression of the site showed the South Topsoil area with

a much greater total canopy cover, at 42%, compared to 15% and 14% at the North Cobble area and CTA, respectively.

Shrub survival was very low on all three areas. It was not possible to identify enough shrubs at the North Cobble site to establish a usable transect. At the CTA, a 99-m transect was established that included 21 sagebrush and 11 bitterbrush. Of these, 11 sagebrush and 3 bitterbrush were found alive during the monitoring, for a total of 52% sagebrush survival and 27% bitterbrush survival. The South Topsoil transect had the best survival with sagebrush at 94% and bitterbrush at 62%. The reasons for this difference could be the more compacted soil at the CTA, the greater proportion of fine-grained soils at the South Topsoil site, and the later timeframe that the shrubs were planted at the CTA. The CTA also had some crushed gravel left over from the CTA installation. The area had been ripped, but sparingly, and a significant amount of soil fixative was still present on the soil surface. All of these factors may impact the success of the revegetation effort at this location.

Demolition of the **185-N Hanford Generating Plant** was completed in 2004. Revegetation began in early February and continued through mid-March 2006. Before the area disturbed by demolition activities was seeded, the compacted soils were loosened with a disk. The area was broadcast seeded with a mix of native grass seed, fertilized with 112 kg/ha Triple-16 fertilizer, and mulched with grass straw. The entire seeded area was planted with 10-in. sagebrush plugs. The revegetated area was separated into two analysis areas; the eastern half of the area had native fine-grained soil, while the western area was rocky cobble material from a nearby borrow pit.

Fourth-year monitoring took place on April 28, 2009. The canopy cover of native plants increased 5% on the topsoil site and 20% on the cobble site. Percent cover of invasive species remained extremely high on the topsoil site (120%), while dropping to only 17% on the cobble site. The cobble site showed a higher diversity of native plants, with 13 species, while 7 were recorded on the topsoil site.

The shrubs on the topsoil site showed a significant die-off between the 2006 and 2007 monitoring years, from 95% down to only 14% surviving. After that initial loss, the remaining

shrubs have done well, and monitoring in 2009 showed survival at 12%. The shrubs have grown to  $42.9 \pm 13.0$  cm, and 57% of the shrubs within the transect were blooming. Recruitment is expected in the coming years from these shrubs. Shrub survival on the cobble site was 38.8% overall, and no losses since 2008. About 16% of the shrubs on the cobble site had bloomed in the previous year, and the average height was about 33 cm.

The **116-N-3 Trench** was seeded in January 2005 with native grass species and planted with sagebrush and hopsage (*Grayia spinosa*) seedlings. Fifth-year monitoring was conducted at this site in April 2009. Native grass species dominate this site, and total native plant canopy cover is up to 85%. Non-native plant cover continued to shrink in 2009, down to 21%, from 28% in 2008. This fifth-year monitoring showed this revegetation has been successful in establishing a community dominated by native species, which provides habitat and prevents colonization by invasive species.

The **116-N-1 Crib and Trench** were revegetated in December 2006 with native grass species and planted with sagebrush at 1235 plants per hectare. Third-year vegetation monitoring was performed at the site in May 2009. The percent cover of native and invasive species recorded remained very close to that recorded in 2008, with 49% cover of native species and 13% cover of invasive species. The sagebrush at this site continues to do extremely well. The sagebrush transect monitoring showed shrub survival at 87%, with 91.5% of the shrubs monitored in 2008 still surviving. The shrubs were  $25.88 \pm 7.2$  cm tall, with an average of 9.6 cm of growth in the past year.

Several waste sites in the **100-FR-1 Operable Unit** were remediated and backfilled in the summer of 2003 and revegetated in January 2005. Approximately 34.4 ha were broadcast seeded with a mix of Sandberg's bluegrass, bluebunch wheatgrass (*Agropyron spicatum*), thickspike wheatgrass (*Agropyron dasytachyum*), Indian ricegrass (*Oryzopsis hymenoides*), prairie junegrass (*Koeleria cristata*), and needle-and-thread grass (*Stipa comata*). The remediated waste sites and the borrow area were planted with 43,500 sagebrush seedlings. The fifth (and final) year of monitoring at this site was conducted on May 14, 2009. The results showed this site has become well established as a community dominated by native species. Cheatgrass canopy cover



reduced from 54% in 2008 to only 39%, and Sandberg's bluegrass became the species with the greatest canopy cover, at 51%. Native plant cover was up 33% from 2008, and invasive cover was down slightly. Biotic crusts were beginning to form in the fine-grained soils between the cobbles. The sagebrush appears to be doing very well, and survival appears to be well over 50%. The planted tubelings are now beginning to bloom and produce seed to help to further establish sagebrush in the area. Overall, this site has become a successful revegetation, and is expected to continue to improve as the shrubs mature and bunchgrasses continue to compete with the non-native species.

The **118-F-1, 118-F-2, 182-F, 183-F East Clearwell, 100-F-26, and 118-F-5 Areas** were revegetated between December 2007 and February 2008. These sites were broadcast seeded with a mixture of native grasses including Sandberg's bluegrass, Indian ricegrass, bluebunch wheatgrass, prairie junegrass, bottlebrush squirreltail (*Sitanion hystrix*), and needle-and-thread grass. In addition, 134 kg/ha of Triple-16 fertilizer were added to the sites along with 4480 kg/ha of straw mulch that was spread and crimped into the soil surface. Sagebrush plugs were then planted into the seeded areas at 1200 plants per hectare.

Second-year monitoring was conducted at 118-F-1 in 2009. Native and invasive species canopy cover increased significantly from 2008 (+19.6% and +25.3%, respectively). This is typical of second-year monitoring results, showing native grasses becoming established, specifically Sandberg's bluegrass and bluebunch wheatgrass, and the typical second-year dominance of Russian thistle. Sagebrush survival on one of two transects was 60%, and average shrub height increased from  $12.9 \pm 3.5$  cm in 2008 to  $19.7 \pm 6.1$  cm in 2009. In contrast, none of the 52 shrubs recorded on Transect 2 in 2008 were still surviving in 2009. This is likely due to the extremely compacted soil present across much of this site, and is an excellent example of the need for more fully ripping compacted areas before revegetation efforts begin.

Second-year monitoring was performed at the 118-F-2 site on May 13, 2009. Russian thistle was the dominant plant on the site (28% cover), followed closely by Sandberg's bluegrass (23% cover). Cheatgrass only showed 5% cover across the revegetated area. Twelve native species were recorded on the site. Only 8 of the 48 sagebrush shrubs originally recorded in the

monitoring transect in 2008 were still alive (17% survival). The soil along the sagebrush transect consists of large cobbles and sand, with very little organic material. This soil type does not hold moisture well, and the plants likely died due to lack of moisture during the previous summer. The sagebrush on another portion of the site, which was used for soil staging and has much better soil conditions, appears to be doing very well, although no transect was established on this portion of the site.

Second-year monitoring was performed at the 182-F site on May 14, 2009. This site was divided into a North and South area to distinguish between the cobbled northern plot, and the more fine-grained soil on the southern plot. The South plot was used as a staging area, and had been invaded by non-native species prior to revegetation, while the North plot lacked vegetation. Cheatgrass was the dominant species observed on both sites, followed by bluebunch wheatgrass and Sandberg's bluegrass. Native species diversity was high for a second-year site, with the North showing 12 species and the South showing 11 species.

Second-year monitoring was performed at the 183-F East Clearwell site on May 14, 2009. A significant increase was recorded for invasive species cover since 2008. Russian thistle was recorded at 18% cover, and cheatgrass showed 10% cover. Russian thistle canopy cover typically falls off dramatically during the third or fourth year of monitoring. Sandberg's bluegrass was the dominant plant on the site, with 35% canopy cover, while bluebunch wheatgrass showed 17% cover. Native species diversity increased from 8 in 2008 to 15 in 2009, showing that a diverse community of native plants is already being established on this young site. Because of the relatively small size of this revegetation, no sagebrush transect was established. However, sagebrush survival appears to be extremely high. Planted tubelings are already blooming, which is relatively uncommon for a site this young.

Second-year monitoring was performed at the 100-F-26 site on May 14, 2009. Sandberg's bluegrass was the dominant species, followed closely by cheatgrass and Russian thistle. Native canopy cover was up to 54%, but non-natives showed 82% canopy cover. Eleven native species were counted on the site in 2009. The expectation is that species diversity will increase in the coming years.

Second-year monitoring was conducted at the 118-F-5 site on May 13, 2009. This area was separated into two monitoring areas, the burial ground and the soil staging area, to allow comparison of the contrasting soil types at the two sites. The burial ground was backfilled with coarse cobbles with relatively few fines, while the soil staging area was covered by fine-grained soil. The same revegetation activity was performed at both sites. Both areas were found to be dominated by non-native species. Cheatgrass and Russian thistle accounted for the majority of the vegetative cover in both areas. Bluebunch wheatgrass showed the highest native canopy cover, but at only 2% on each site. Sagebrush survival was 27% at the soil staging area, and 31% at the burial ground. The average shrub height at the soil staging area was  $20 \pm 6.1$  cm, while the average at the burial ground was  $12.3 \pm 3.5$  cm. In addition, 11 spiny hopsage were recorded on the shrub transect for the soil staging area in 2008, but only 1 was still surviving in 2009.

The **118-F-6**, **120-F-1**, and the **1607-F-1** waste sites were revegetated in November of 2008 and planted with Sandberg's bluegrass, Indian rice grass, bluebunch wheatgrass, prairie junegrass, bottlebrush squirreltail, and needle-and-thread grass. In addition, 134kg/ha of Triple-16 fertilizer was added to the sites along with 4,480 kg/ha of straw mulch that was spread and crimped into the soil surface. Sagebrush, hopsage, and bitterbrush plugs were then planted into the seeded areas at 1,200 plants/ha.

The 118-F-6 revegetation was monitored for the first time on June 1, 2009. Monitoring showed Russian thistle to be the dominant species present at 31% canopy cover. The planted native species, bluebunch wheatgrass and Sandberg's bluegrass, followed with 10% and 9% canopy cover, respectively. Shrub monitoring showed 84% of the sagebrush alive, with an average height of  $16.3 \pm 4.2$  cm, while 91% of the bitterbrush were alive, with an average height of  $24 \pm 4.4$  cm.

Monitoring was performed at 120-F-1 for the first time on May 25, 2009. Russian thistle had the greatest canopy cover, at 41%, while Sandberg's bluegrass was 10%. Species diversity was extremely high at this site for a first-year monitoring effort, due to the use of stockpiled fine-

grained soil that was used to top-dress the site. Fine-grained soil increases soil-seed contact, promoting germination of planted seeds along with existing seeds still in the soil. Sagebrush tubelings were planted, but no monitoring transect was established, due to the small size of the plot. Sagebrush was observed in 20% of the plots during this first-year monitoring.

First-year monitoring was performed at the 1607-F-1 site on May 27, 2009. Russian thistle and Sandberg's bluegrass were present in all plot-frames, and showed 60% and 14% cover, respectively. Species diversity was relatively high for a young site, at 19 combined native and non-native species. A sagebrush transect containing 33 sagebrush and 1 hopsage had 97% survival, with average sagebrush height at  $18.9 \pm 6.3$  cm.

**Waste sites 100-B-1, 128-C-1, and 600-232 in the 100 B/C Area** were revegetated in 2006. The 100-B-1 site was backfilled with borrow pit material, and a thin layer of salvaged topsoil was spread over the site. The 128-C-1 site was backfilled to grade with pit-run cobble. All three sites were broadcast seeded in the winter of 2006 with a native grass seed mix that included Sandberg's bluegrass, needle-and-thread grass, Indian ricegrass, bluebunch wheatgrass, prairie junegrass, and thickspike wheatgrass. Triple-16 fertilizer and polyacrylamide were applied with the grass seed. The entire area was irrigated with 23,400 L/ha of water, then mulched with 4.5 metric tons/ha of straw and crimped into the soil surface to prevent wind erosion. The sites were then planted with 16,000 sagebrush and 600 spiny hopsage seedlings.

Fourth-year monitoring was conducted at the 100-B-1 and 128-C-1 sites on May 7, 2009. Sandberg's bluegrass and cheatgrass continue to dominate 100-B-1, with Sandberg's increasing slightly, to 46% cover, and cheatgrass decreasing slightly, to 23% cover. Russian thistle cover remains very low at 100-B-1, at only 4%, and sagebrush is now also seen at 4% cover. Species diversity is relatively high on the site, with 13 natives recorded. This information shows the site has matured quickly, and succession is slowing. Sagebrush survival is at 54%, and 37% of the shrubs on the transect had bloomed in the previous year. Average shrub height was  $43.9 \pm 17.4$  cm, up from  $32.2 \pm 14.8$  cm in 2008. The shrubs on this site have been producing seed since 2007, and recruits are prevalent around the planted shrubs.

The 128-C-1 site showed Sandberg's bluegrass as the dominant species (34% cover) for the first time, overtaking the previously dominant cheatgrass (33% cover). Native cover remained the same at the site, while invasive species cover increased by ~13%. Sagebrush recruits were observed at this site for the first time. Native species diversity increased from 6 species in 2008 to 10 species in 2009, while non-native species diversity remained at 7 species. Shrub survival is at 55%, and no shrubs were lost since the 2008 monitoring. Average height increased from  $44.1 \pm 14.8$  cm in 2008 to  $53.11 \pm 15.5$  cm in 2009. About 65% of shrubs had bloomed in the previous year, and sagebrush recruits were observed for the first time on this site in 2009.

The following waste sites in the 100 B/C Area were revegetated in 2007: **100-B-8, a portion of 100-B-14, 100-C-9, 126-B-3, 128-B-2, 128-B-3, 118-B-2, 118-B-3, and 1607-B2**. The total area was approximately 40.5 ha (100 acres). Monitored sites include the 100-C-9 Process Sewer Pipelines and the 118-B-2 and 118-B-3 Burial Grounds. The sites were backfilled with pit-run gravel from borrow pit 24 and then revegetated by broadcast seeding with a native grass seed mix that included Sandberg's bluegrass, needle-and-thread grass, Indian ricegrass, bluebunch wheatgrass, prairie junegrass, and bottlebrush squirreltail. Triple-16 fertilizer and polyacrylamide were applied with the grass seed. Upon the completion of seeding, the entire area was mulched with 4.5 metric tons/ha of straw and crimped into the soil surface to prevent wind erosion. Upon completion of seeding, the sites were planted with sagebrush at approximately 1300 plants per hectare (530 plants per acre).

Third-year monitoring was conducted at 100-C-9 on May 5, 2009. This site was divided into three transects (T1-T3) from south to north to increase the resolution of the monitoring. Transect T1 appears to be doing the best of the three transects. Native plant canopy cover is at 40%, up 16% from 2008. Transects T2 and T3 still have very significant cheatgrass cover, 43% and 40% respectively, but native bunchgrass cover is increasing at these sites. Transect T3 showed a 30% drop in canopy cover of Russian thistle, down to only 3%, while T1 and T2 showed only 2% and 3% cover, respectively. This is a positive sign that this site is maturing and progressing toward a community dominated by native species. Sagebrush survival was 93% for T1, 95% for T2, and 68% for T3. The 2009 monitoring showed very high survival of shrubs that were alive during

the 2008 monitoring, with T1 at 98%, T2 at 100%, and T3 at 97% survival. This shows that the shrubs have become well established and are much less subject to high mortality rates.

Third-year monitoring was performed on 118-B-2 and 118-B-3 Burial Grounds in May 2009. These two sites were not monitored in 2008. Native species diversity increased from 4 in 2007 to 9 in 2009. Native species canopy cover decreased from 27% in 2007 to 12.2% in 2009. The high number in 2007 represents the high germination level of planted native grasses often seen in the first year. This number typically falls off in the second year, because the site cannot support all of the individuals that germinated, and begins to rebound in the subsequent years as individuals that survived begin to grow larger. In 2007, the dominant plant on the site was Russian thistle at 62% cover. In 2009, Russian thistle had 3% cover, while cheatgrass was observed as the dominant species (43% cover).

The **100-B-14, 118-B-1, and 118-C-1 sites** were revegetated in December 2007 and January 2008. These areas were broadcast seeded with a mixture of native grasses that included Sandberg's bluegrass, Indian ricegrass, bluebunch wheatgrass, prairie junegrass, bottlebrush squirreltail, and needle-and-thread grass. In addition, 134 kg/ha of Triple-16 fertilizer were added to the sites along with 4480 kg/ha of straw mulch that was spread and crimped into the soil surface. Sagebrush plugs were then planted into the seeded areas at 930 plants per hectare.

Second-year monitoring was performed at 100-B-14 in May 2009. The monitoring showed an increase in native species canopy cover to 15%, while non-native cover decreased from 41% in 2008 to 25%. Russian thistle remains the dominant species on the site, but cover decreased significantly from 2008. Cheatgrass cover remains very low, at only 2%. Bluebunch wheatgrass was the dominant native species with 11% cover. Succession on this site will likely be delayed due to compacted soil conditions. The two sagebrush transects on the site had 7% and 65% survival. Average shrub height at T2 was  $15.8 \pm 3.6$  cm. The low survival on Transect T1 is attributed to compacted soil conditions. Shrubs on T2 fared better, likely because the soil conditions on that portion of the plot happened to be less compacted.

Second-year monitoring at the 118-B-1 site took place on May 18, 2009. This site is separated into two monitoring areas, the soil staging area (SSA) and the burial ground (BG). The soil staging area has soil with a greater proportion of fine-grained material than the burial ground, and because the same planting treatment was performed on each site, the different soil types can be compared in terms of the vegetative community it supports over the 5 years of monitoring. Second-year monitoring showed Russian thistle as the dominant species on the BG as well as on the SSA. The dominant native species were Sandberg's bluegrass and bluebunch wheatgrass. Non-native species canopy cover increased to 42% and 43% on the BG and SSA, respectively, largely due to the dominance of Russian thistle. Sagebrush survival on the BG was 54%, with average height of  $25.3 \pm 6.6$  cm, which represented  $\sim 14$  cm of growth since 2008. The SSA had 92% shrub survival with average height at  $25.4 \pm 7.7$  cm and an average increase of  $12.1 \pm 6.7$  cm per shrub. The significant difference in survival may be due to the varying soil types of the two areas.

Second-year monitoring was conducted at the 118-C-1 site on May 11, 2009. The site was dominated by bluebunch wheatgrass at 9% cover, followed by Russian thistle at 8% cover. Native plant cover increased only slightly to 13.7%, while invasive species cover decreased 11%, to 13.5% cover. The majority of this change was the result of the decrease in Russian thistle. Cheatgrass cover remains low at the site, with only 3.5%, but it is widespread across the site, showing up in 80% of the plot-frames. The site is being naturally re-seeded with gray rabbitbrush, which was recorded in 12% of the plot-frames. The sagebrush survival was only 24%. There could be several factors that are contributing to these results, but the very low level of fine-grained material in the backfill material that was used at the site may be playing a significant role.

The **116-KW-3, 116-KE-4, 100-K-55, 100-K-56, 116-K-1, and 116-K-2 sites within the 100-KR-1 Operable Unit** were revegetated in February and March 2006. The sites were broadcast seeded with a mix of native grass seed, fertilized, treated with polyacrylamide, mulched with straw, and planted with sagebrush plugs. The 116-K-2 site was broken up into four transects (T1-T4) for plot analysis in 2007 to show results on a finer scale.

Fourth-year monitoring was conducted at the 116-K-2 site (aka Mile Long Trench) in May 2009. Transect T1 was dominated by bluebunch wheatgrass (33% cover), while T2, T3, and T4 all showed Sandberg's bluegrass as the dominant species. Cheatgrass was the dominant non-native across all sites, showing 12-32% cover. Other non-natives showed almost no canopy cover on T1, T2, or T3, while T4 still sustained an 11% canopy of Russian thistle. All plots showed increases in native plant canopy cover, with T1 showing a 3% increase, T2 a 19% increase, T3 a 9% increase, and T4 a 26% increase. Sagebrush was recorded at 10% cover on T2, with a frequency of occurrence of 33%. Frequency was also high on T1 (33%) and T3 (13%). This is due in part to the increase in the size of existing shrubs, but also that there are now two age classes of sagebrush seedlings growing on the plot, which greatly increases the likelihood of encountering one in a plot-frame. Sagebrush survival was 68% at T1, 49% at T2, 78% at T3, and 18% at T4. Shrubs on the site have been blooming since 2007, and 22% of the T1 shrubs bloomed in the previous year, along with 23% of T2 shrubs, 35% of T3 shrubs, and 67% of T4 shrubs.

The **Horseshoe Landfill (HSLF)**, located on the Fitzner-Eberhardt Arid Lands Ecology Reserve (ALE), served as a military landfill for the nearby Nike missile base. The landfill underwent a secondary remedial action that was initiated in mid-May 2005, and completed with backfill of the site on December 1, 2005. The landfill was revegetated the first week of February 2006. Before Horseshoe Landfill and the soil staging area located south of the landfill were broadcast seeded, the top 23 cm of soil was loosened with a spring tooth implement. The landfill and soil staging area (approximately 1.6 ha) were seeded with Sandberg's bluegrass, Indian ricegrass, bluebunch wheatgrass, and needle-and-thread grass, and planted with sagebrush plugs. The areas were fertilized with Triple-16 fertilizer and treated with polyacrylamide to facilitate successful germination and to reduce wind erosion. The seeded areas were mulched with grass straw and crimped into the soil to prevent erosion. The landfill and soil staging area were planted with sagebrush propagated by two native plant nurseries from seed collected on the Hanford Site and grown in 10-in. containers. The landfill and soil staging area is being monitored separately, as the landfill was backfilled with Rupert sand imported from the 200 West Area, while the soil staging area contains Ritzville silt-loam that is native to this location.



Fourth-year vegetation and sagebrush monitoring was conducted at the HSLF site on June 3, 2009. Native species canopy cover was at 50% on the landfill, down 11.2% from 2008, while native species covered 62.5% at the SSA. Invasive species cover was up slightly from 2008 on the HSLF, to 12% from 4% in 2008, while it was down from 34% in 2008 to only 18% in 2009 on the SSA. The decrease in native plant cover at the HSLF was caused by a reduction in canopy cover of Sandberg's bluegrass. While it is not known specifically why the reduction occurred, the timing of the monitoring, as well as seasonal moisture levels, may have impacted had a role in it. Russian thistle was present at a 17% canopy cover on the SSA in 2008, but only showed 1.3% in 2009. This change is typical of a site that is maturing and becoming dominated by perennial native species. A single Piper's daisy (*Erigeron piperianus*), a Washington State Sensitive Species, was observed on the HSLF during the 2009 monitoring. Sagebrush survival on the landfill was 68%. Survival on the SSA was 71%. On the HSLF, 96% of shrubs had bloomed the previous winter, while 91% bloomed on the SSA. This data shows that the shrubs on the site have stabilized and have become well established, and the presence of second-year recruits indicates this is a successful sagebrush re-introduction.

The **600-111** and **600-149** in the 600-IU-2 Operable Unit were remediated in December of 2008. These areas were broadcast seeded with a mixture of native grasses including Sandberg's bluegrass, Indian rice grass, bluebunch wheatgrass, prairie junegrass, bottlebrush squirreltail, and needle-and-thread grass. In addition, 134kg/ha of Triple-16 fertilizer was added to the sites along with 4,480 kg/ha of straw mulch that was spread and crimped into the soil surface. Sagebrush and bitterbrush plugs were then planted into the seeded areas at 1,235 plants/ha.

The 600-111 site was monitored for the first time on May 18, 2009. Russian thistle was the dominant species, with 34% canopy cover. The planted bluebunch wheatgrass and Sandberg's bluegrass followed at 15% and 14% cover, respectively. These three species, along with tumbled mustard, were present in all vegetation plots that were measured. Nine native species were observed on the site, along with 10 non-native species. This number will be tracked to note changes in species diversity as the site matures. Fifty-seven sagebrush and 12 hopsage were recorded along a 97-m-long transect. Sagebrush survival was recorded at 72%, while 100% of

hopsage were alive during this first monitoring. Average sagebrush height was recorded at  $17.1 \pm 5.7$  cm, while hopsage averaged  $11.8 \pm 4.1$  cm.

The 600-149 site was monitored for the first time in May 2009. The planted native grasses, bluebunch wheatgrass, and Sandberg's bluegrass dominated the site, with 30% and 18% cover, respectively. Shrubs were planted on the plot, but because of the small area, no shrub monitoring transect was established.

### **Revegetation/Mitigation Project:**

In 2003, the Environmental Restoration Disposal Facility (ERDF) began Phase III expansion to construct cells 5 and 6. Construction of the new cells occurred entirely within the disturbed footprint of the ERDF fence. However, an area south of the perimeter fence was impacted by placement of the overburden pile. The Mitigation Action Plan for ERDF was updated to develop appropriate mitigation strategies for this and future expansions. The Plan determined that approximately 20 ha of mitigation be performed. To maximize the effectiveness of the mitigation effort, sagebrush was planted on 25 ha (62 acres) that included four 4-ha (10-acre) islands separated by 100 m (328 ft). Each island was planted at a density of 1000 plants per hectare (400 plants per acre). The areas between the islands were planted at a density of 444 plants per hectare (180 plants per acre) in an area south of ERDF that straddles the Army Loop Road. This configuration takes advantage of the Army Loop Road, which could serve as a fire break or natural location to fight a fire. In addition to planting sagebrush, 10 artificial burrowing owl nest boxes were installed in the area.

Third-year monitoring was performed in March 2009. The northeast sagebrush plot had shown significant die-off in 2008 monitoring, down to 26% survival. In 2009, 86% of the shrubs recorded in 2008 were still alive. Overall survival at the northeast plot was recorded at 22%. The southwest plot fared better, showing survival at 36%, with 95% surviving from 2009. The significant die-off seen in the second year of monitoring appears to have slowed, and the remaining shrubs on the site appear to be doing well. The burrowing owl boxes were observed

in 2009. The natural burrows that were active when the site was selected have since collapsed, and no owls were observed in the immediate area using natural or artificial burrows.

### **Bat Habitat Mitigation Projects:**

Bat mitigation projects have been conducted at the 100-D/DR and 100-F Reactor areas to mitigate for roosting habitat that was lost as a result of the Interim Safe Storage (ISS) projects at those reactors. A third mitigation project was established at the 183-F Clearwell in January 2009 to protect a large colony of more than 2000 bats that are using that facility. The facility was slated for eventual demolition, so a mitigation plan was developed to preserve the colony.

Mitigation monitoring was performed in the 190-DR tunnel on September 16, 2009 to count the number of bats in the roost and capture individuals to determine species, sex, age, and reproductive status. Video photography was used to count the total number of bats using the structure. During the entry, 2 nulliparous (individuals that have never give birth) adult females, 2 parous (individuals that have given birth) adult females, and 3 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, indicating the site is still functioning as a maternity roost. This number is 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.

Mitigation monitoring was performed at 105-F Reactor on August 31, 2009. 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 nulliparous juvenile pallid bats were captured in the mist nets, showing that this site remains an active and successful maternity colony. There is still evidence, in the form of guano, that bats are using the bat houses around the different sides of the reactor. A video camera was used to count bats emerging from two of the bat houses. No bats were observed exiting House #2, but between 19 and 34 pallid bats were observed using Box #4. Over the hour, bats were observed entering and exiting the box, so an exact count was not

possible. During monitoring at the 105-F reactor, acoustic detectors were being used to record bat echolocation calls. In addition to the pallid bats, one Yuma myotis, one small-footed myotis, and five western pipistrel (*Pipistrellus hesperus*) calls were recorded. These recorded calls show that the high level of bat activity in the area included multiple species, which is another indication of how attractive the area is for bats.

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 8 Yuma myotis and 1 small-footed myotis were captured in the mist nets; all individuals were adults. The small-footed myotis was a non-reproductive adult male. When released, the 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 this is not an indication that a second species is using the facility as a maternity roost. Using video monitoring, the total emergence was estimated to be 2640 individuals exiting the clearwell, and approximately 120 bats exiting the flume entrance. The 2009 monitoring information shows that the roost continues to support a large maternity colony. The bats appeared to be in good condition, and no sign of white nose syndrome (WNS) was observed. The importance of monitoring colonies is heightened with the emergence of WNS in the eastern United States. It is important that baselines can be established prior to any impacts from WNS, and that any evidence of WNS can be quickly identified.

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## METRIC CONVERSION CHART

<b>Into Metric Units</b>			<b>Out of Metric Units</b>		
<i>If You Know</i>	<i>Multiply By</i>	<i>To Get</i>	<i>If You Know</i>	<i>Multiply By</i>	<i>To Get</i>
<b>Length</b>			<b>Length</b>		
inches	25.4	Millimeters	Millimeters	0.039	Inches
inches	2.54	Centimeters	Centimeters	0.394	Inches
feet	0.305	Meters	Meters	3.281	feet
yards	0.914	Meters	Meters	1.094	yards
miles	1.609	Kilometers	Kilometers	0.621	miles
<b>Area</b>			<b>Area</b>		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	0.0836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	Hectares	2.47	acres
<b>Mass (weight)</b>			<b>Mass (weight)</b>		
ounces	28.35	grams	Grams	0.035	ounces
pounds	0.454	kilograms	Kilograms	2.205	pounds
ton	0.907	metric ton	metric ton	1.102	ton
<b>Volume</b>			<b>Volume</b>		
teaspoons	5	milliliters	Milliliters	0.033	fluid ounces
tablespoons	15	milliliters	Liters	2.1	pints
fluid ounces	30	milliliters	Liters	1.057	quarts
cups	0.24	liters	Liters	0.264	gallons
pints	0.47	liters	cubic meters	35.315	cubic feet
quarts	0.95	liters	cubic meters	1.308	cubic yards
gallons	3.8	liters			
cubic feet	0.028	cubic meters			
cubic yards	0.765	cubic meters			
<b>Temperature</b>			<b>Temperature</b>		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit



## 1.0 INTRODUCTION

This report contains a compilation of the results of vegetation monitoring data that were collected in the spring and summer of 2009 from the River Corridor Closure Contractor's (RCCC) revegetation and mitigation areas on the Hanford Site. The vegetation monitoring sites included in this report are the 300-FF-1 sites, 300-FF-2 sites, 618-4 sagebrush monitoring, 116-N-3, 116-N-1, Hanford Generating Plant (HGP) sites, 100-FR-1 Operable Unit revegetation area, 100 B/C sites, 100-KR-1 Operable Unit sites, Horseshoe landfill, and Environmental Restoration Disposal Facility (ERDF) Phase III Expansion mitigation. It also contains monitoring results of bat habitat mitigation projects. The locations of these sites are shown in Figure 1. The bat habitat mitigation projects are located at 100-D/DR Area and 100-F Area.

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 RCCC site restoration success. Each area will be discussed separately and will include a brief description of the revegetation activities and the results from the 2009 monitoring efforts.

This report provides fifth-year survey results for the 100-F area sites and the 116-N-3 Trench. Fourth-year survey results are included for the revegetated areas at 116-K-2 (MLT), Hanford Generating Plant at the 100 N Area, 618-4 Burial Ground sagebrush planting, Horseshoe landfill on the ALE, 128-C-1, and 100-B-1. Third-year monitoring results are included from 300-8, 618-4, 116-N-1, 100-C-9, and 118-B-2&3. Second-year monitoring was conducted at 182-F, 118-F-2, 118-F-1, 183-F East Clearwell, 100-F-26, 118-F-5, 118-C-1, 100-B-14, and 118-B-1. Finally, first-year monitoring was performed at 118-F-6, 120-F-1, 1607-F-1, 618-7, 600-111, and 600-149.

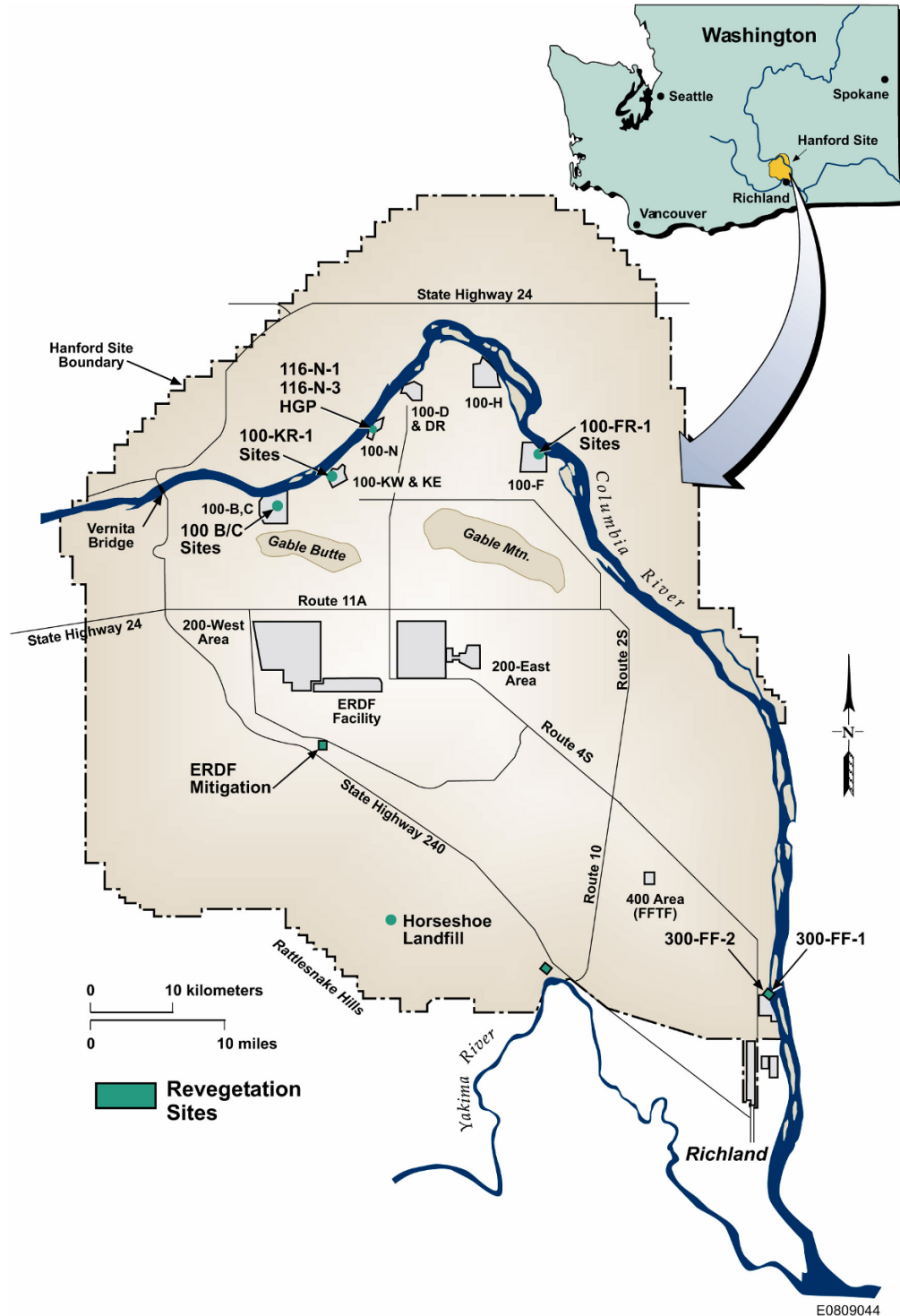
Results from previous years' monitoring are provided in reports for each respective year (Lindsey and Gano 2008, Gano and Lindsey 2007, Johnson and Gano 2006, and Johnson 2005). The data tables from the previous revegetation monitoring reports are in Appendices A, B, C, and D of this report.

### 1.1 METHODS USED TO EVALUATE VEGETATION RECOVERY

Monitoring of revegetation and mitigation areas consisted of measuring the canopy cover of all plant species found on a site, the frequency of occurrence, and the survival of transplanted sagebrush (*Artemisia tridentata*), bitterbrush (*Purshia tridentata*), and spiny hopsage (*Grayia spinosa*) seedlings. All values were then converted to percentages. 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 location, a series of plot frames were analyzed for the canopy cover of each species present. Frequency is

represented as the percentage of occurrences that a species is observed in the number of plot frames measured. For example, if a species was represented in 10 out of 25 plot frames, its frequency would be  $10/25 \times 100 = 40\%$ . Species that were observed within a revegetated area, but were not counted in a plot frame, were recorded as occurrences in the data tables.

**Figure 1. Hanford Site Showing Locations of Revegetation Sites.**



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. At sites where shrubs were planted, survival was measured by counting a representative number of plants at the site, determining if the plants were dead or alive, and then calculating the 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 E of this report. Plant identification was conducted using the nomenclature in Hitchcock and Cronquist (1973) and also in *Vascular Plants of the Hanford Site* (Sackschewsky et al. 2001).

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 objective of the revegetation effort is long term interim stabilization. The Biological Resources Management Plan (BRMaP) (DOE-RL 2001) prescribes seeding crested wheatgrass (*Agropyron cristatum*), however, to increase species diversity over the 28.3 hectare area, five additional grass species were planted. The objective of revegetation at most remedial action sites is to restore the land to plant communities that are dominated by native plants that will eventually provide wildlife habitat. Secondary objectives often include using different planting methods and techniques to improve success, while incorporating experience and knowledge gained from previous plantings.

Success criteria differ for each site with consideration of varying soil types and microclimatic conditions. For example, sandy areas promote different species with differing recovery rates and plant densities than those found in rocky soils; therefore, the criteria for judging success will be different. All sites will be evaluated based on the plant canopy cover, plant community composition, and survival and growth rates of the planted shrubs. These criteria are detailed in the *Revegetation Manual for the Environmental Restoration Contractor* (McLendon et al. 1997). A revegetation effort will be considered successful if the area is stabilized to prevent erosion and is dominated by recovering stands of native shrubs, forbs, and grasses. Areas identified for future industrial use may be stabilized with wheatgrass (*Agropyron*) varieties because of the potential for future land disturbance.

## 2.0 300 AREA

Remediation of the 618-4 burial ground was completed in 2004, along with other 300-FF-1 Operable Unit waste sites, and was planted in February 2006. Remediation in the 300-FF-2 Operable Unit began in 2004 with the remediation of the 618-2 and -3 solid waste burial grounds, the 300-8 Aluminum shavings waste site, 600-47, and the 300-18 waste sites. Remediation at the 618-7 burial ground began in 2007 and was completed and revegetated in December 2008.

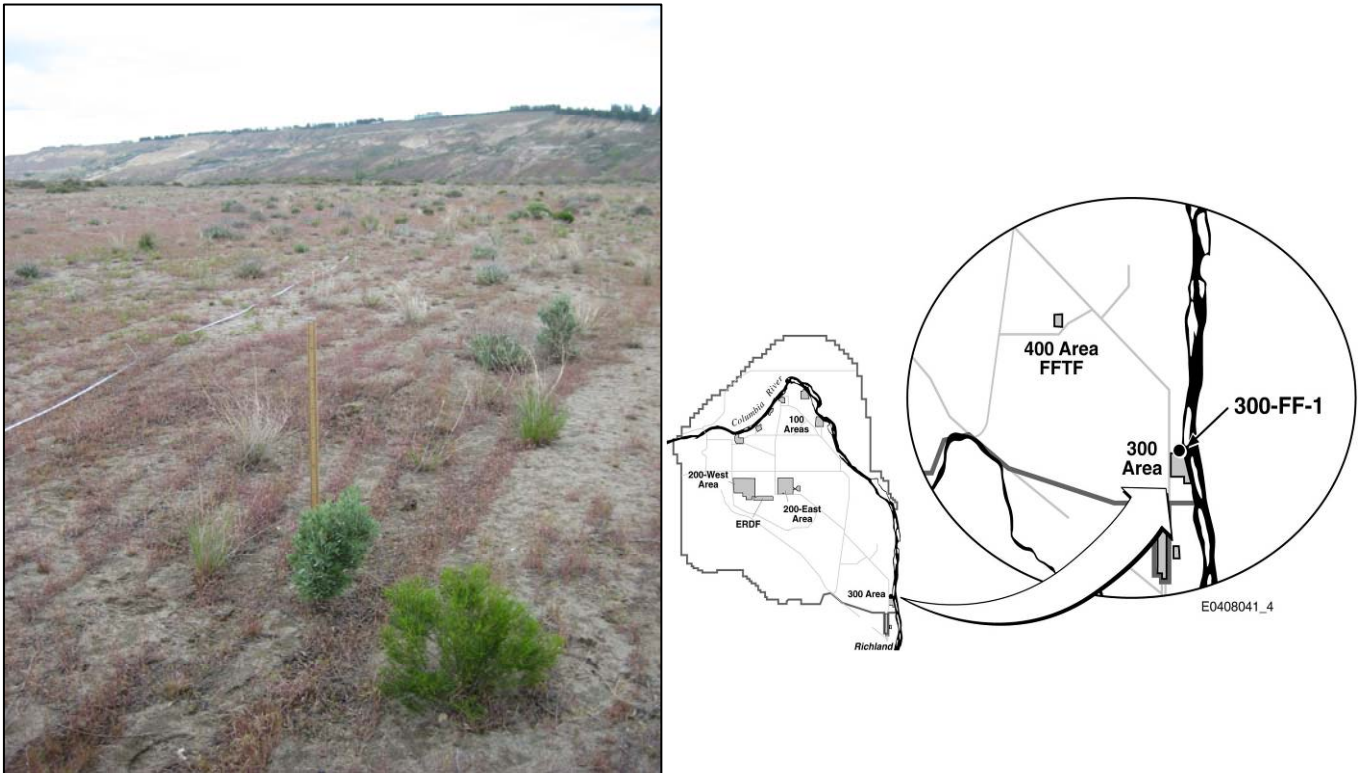
Third year monitoring was conducted in May of 2009, on the 618-4 solid waste burial ground and the 300-8 Aluminum shavings waste site. The 618-2 and -3 Burial Grounds are connected and were revegetated as one site. The vegetation at this site was removed because the area was needed to make a staging area to support additional remedial action activities in adjacent areas, it will be revegetated following the removal of the staging area.

The 300-8 site is zoned industrial, and was therefore revegetated with a seed mix that consisted mostly of crested wheatgrass (*Agropyron cristatum*), which is a non-native species. So although native species percent cover remains low, this revegetation was designed to stabilize soils to prevent erosion, and with the crested wheatgrass canopy cover increasing, this effort is proving successful (Table 1).

The 618-4 burial ground is located outside of the area that was zoned for industrial use, therefore this site was planted with sagebrush tubelings during the first week of February, 2006 (Figure 2). Three shrub survival monitoring transects (T1, T2, T3) were established in April of 2006 to capture baseline survival counts. Transect T1 showed 100% of the shrubs still surviving that were recorded as alive in 2008, and 71% survival since the baseline survey. Average height of shrubs fell slightly (-2.4cm), and no shrubs were blooming in T1. Transect T2 showed 50% overall survival, with 83% surviving from the previous year's survey. Average height fell 3.0 cm at T2 from 2008 to 2009, and 13% of the shrubs had bloomed in the previous year. Transect T3 had 100% survival of the 2008 surviving shrubs still alive, with 65% overall survival.

The 618-4 sagebrush planting described above is showing very promising results. With high survival across all three transects, and shrubs beginning to bloom, it appears that the revegetation has successfully re-established sagebrush on the former burial ground. In addition, many native species are also re-colonizing the site, including green rabbitbrush, gray rabbitbrush, antelope bitterbrush, bluebunch wheatgrass, thickspike wheatgrass, Sandberg's bluegrass, Indian ricegrass, needle-and-thread grass, snow buckwheat, pale evening primrose, hoary aster, dune scurfpea, whiteleaf scorpionweed, Columbia cutleaf, and bur ragweed. Ongoing monitoring will determine if the planted shrubs are producing seedlings.

**Figure 2. 300 Area and 618-4 Burial Ground Sagebrush Monitoring.**



Sagebrush transect at 618-4 in May 2009.



Sagebrush transect and vegetation at 618-4 during May 2009.

**Table 1. Percent Canopy Cover and Frequency of Occurrence at 300-8 in 2009.**

Species	% Cover	Freq of Occ %
<i>Bromus tectorum</i> * (cheatgrass)	48.8	96.0
<i>Agropyron cristatum</i> (crested wheatgrass)	18.3	96.0
<i>Holosteum umbellatum</i> * (jagged chickweed)	2.9	56.0
<i>Poa sandbergii</i> (Sandberg's bluegrass)	2.7	68.0
<i>Salsola kali</i> * (Russian thistle)	2.3	72.0
<i>Draba verna</i> * (spring whitflow)	1.7	48.0
<i>Festuca octoflora</i> (slender sixweeks)	0.9	16.0
<i>Machaeranthera canescens</i> (hoary aster)	0.7	8.0
<i>Sisymbrium altissimum</i> * (tumble mustard)	0.5	20.0
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	0.3	12.0
<i>Oryzopsis hymenoides</i> (indian ricegrass)	0.1	4.0
<i>Epilobium paniculatum</i> (tall willowherb)	0.1	4.0
<i>Erodium cicutarium</i> (storksbill)	0.1	4.0
<i>Artemisa tridentata</i> (big sagebrush)	0.1	4.0
<i>Tragopogon dubius</i> (yellow salsify)	X	X
<i>Chondrilla juncea</i> (rush skeletonweed)	X	X
<i>Astragalus caricinus</i> (buckwheat milkvetch)	X	X
<i>Hymenopappus filifolius</i> (Columbia cutleaf)	X	X
<i>Oryzopsis hymenoides</i> (indian ricegrass)	X	X
<i>Chrysothamnus viscidiflorus</i> (green rabbitbrush)	X	X
<i>Petalostemon ornatum</i> (western prairieclover)	X	X
<i>Poa bulbosa</i> (bulbous bluegrass)	X	X
<i>Achillea millefolium</i> (yarrow)	X	X
<i>Centaurea diffusa</i> (diffuse knapweed)	X	X
<i>Oenothera pallida</i> (pale eveningprimrose)	X	X
<i>Balsamorhiza careyana</i>	X	X
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	X	X
Biotic crust	2.1	44.0
Bare soil	52.1	96.0
Litter	42.8	96.0
<b>Total canopy cover (litter not included)</b>	<b>79.5</b>	

\* Invasive species

X=present but not counted in plot frames

Change in Native Cover from 2009	-1.6
Total Invasive % Cover	74.5
Total Native % Cover	+5.0

## 618-7

The 618-7 site was broken down into three areas for monitoring, to show variation between the different portions of the plot. The container transfer area (CTA) was treated as a separate site, and the burial ground was split to have a north and south transect. The north transect has a ground surface consisting of fist-sized cobbles, while the south transect received a top-dressing of fine-grained soil that was salvaged from the CTA area prior to the installation of the CTA.



These areas were broadcast seeded with a mixture of native grasses including Sandberg's bluegrass, Indian rice grass, bluebunch wheatgrass, prairie junegrass, bottlebrush squirreltail, and needle-and-thread grass. In addition, 134kg/ha of Triple-16 fertilizer was added to the sites along with 4,480 kg/ha of straw mulch that was spread and crimped into the soil surface. Sagebrush and bitterbrush plugs were then planted into the seeded areas at 1,235 plants/ha.

First year monitoring was conducted at these three areas during May of 2009. All of the areas were dominated by Russian thistle, in terms of canopy cover. Sandberg's bluegrass and bluebunch wheatgrass, native grasses that were included in the seed mix on the site, rounded out the top three canopy cover species. Species diversity across the three sites was relatively high, at 25, for first year monitoring. This is likely due to the seed-bank present in the topsoil that was used to top-dress the South Topsoil and CTA areas. The diversity at the North Cobble area, which did not receive a top-dressing, was notably lower, with only 12 species present. These areas will be monitored for differences in the future, but the initial impression of the site showed the South Topsoil area with a much greater total canopy cover, at 42%, compared to 15% and 14% at the North Cobble and CTA areas, respectively (Tables 2 & 3). The differences between the sites will be monitored for the next four years, and the findings will help shape future revegetation efforts.

Shrub monitoring transects were established in the CTA and South Topsoil areas to monitor for survival, growth, and reproductive success in the coming years. It was not possible to identify enough shrubs at the North Cobble site to establish a usable transect. It appeared to be an almost complete loss of planted shrubs. On the CTA, a 99 meter transect was established that included 21 sagebrush and 11 bitterbrush. Of these, 11 sagebrush and 3 bitterbrush were found alive during the monitoring, for a total of 52% sagebrush survival and 27% bitterbrush survival at the CTA. The South Topsoil transect included 34 sagebrush and 13 bitterbrush, and was 100.3 meters long. Shrub survival was better at this plot, compared to the CTA, with sagebrush showing 94% survival, and bitterbrush showing 62% survival. The reasons for this difference could be the more compacted soil at the CTA, the greater proportion of fine-grained soils at the South Topsoil site, and the later timeframe that the shrubs were planted at the CTA. The CTA also had some crushed gravel left over from the CTA installation, although the majority was removed. The area was ripped, but sparingly, and a significant amount of soil fixative was still present on the soil surface. All of these factors may impact the success of the revegetation effort at this location.

**Figure 3. 618-7 North, South, and CTA.**



Planted Sagebrush at 618-7, 2009.



Vegetation monitoring at the  
618-7 CTA, 2009.



South Topsoil portion of the 618-7  
burial ground, 2009.



North Cobble portion of the 618-7  
burial ground, 2009.

**Table 2. Percent Canopy Cover at 618-7 BG  
North, South, and CTA in 2009.**

Species	% Cover North Cobble	% Cover South Topsoil	% Cover CTA
<i>Salsola kali</i> * (Russian thistle)	8.4	19.3	10.0
<i>Poa sandbergii</i> (Sandberg's bluegrass)	3.4	13.2	1.2
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	2.9	7.3	2.1
<i>Bromus tectorum</i> * (cheatgrass)	0.3	1.4	0.1
<i>Sisymbrium altissimum</i> * (tumble mustard)	0.3	0.3	0.1
<i>Ambrosia acanthicarpa</i> (bur ragweed)	X	0.3	0.2
<i>Erodium cicutarium</i> * (storksbill)	--	0.2	X
<i>Triticum aestivum</i> (wheat)	0.1	--	X
<i>Holosteum umbellatum</i> * (jagged chickweed)	--	0.1	--
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	--	0.1	X
<i>Machaeranthera canescens</i> (hoary aster)	--	0.1	--
<i>Chenopodium album</i> * (lamb's quarters)	X	0.1	X
<i>Artemisia tridentata</i> (big sagebrush)	--	X	--
<i>Purshia tridentata</i> (antelope bitterbrush)	--	X	X
<i>Nama densum</i> (purplemat)	--	X	--
<i>Gilia leptomeria</i> (Great Basin gilia)	--	X	--
<i>Mentzelia albicaulis</i> (whitestem stickleaf)	--	X	--
<i>Melilotus alba</i> * (white sweetclover)	--	X	--
<i>Descurainia pinnata</i> (western tansymustard)	--	X	--
<i>Vulpia myuros</i> * (rattail fescue)	X	X	--
<i>Latuca serriola</i> * (prickly lettuce)	X	X	X
<i>Kochia scoparia</i> (kochia)	X	X	X
<i>Chorispora tenella</i> * (blue mustard)	X	X	--
<i>Achillea millefolium</i> (yarrow)	--	--	X
<i>Eriogonum niveum</i> (snowbuckwheat)	--	--	X
Biotic crust	0.0	0.0	0.0
Bare soil	66.5	66.5	67.7
Litter	28.4	28.4	30.6
<b>Total canopy cover (litter not included)</b>	15.4	42.4	13.7
* Invasive species			
X=present but not counted in plot frames			
Total Invasive % Cover	9.1	21.4	10.2
Total Native % Cover	6.3	21.0	3.5

**Table 3. Percent Frequency of Occurrence at 618-7 BG  
North, South, and CTA in 2009.**

Species	Freq. of Occ. % North Cobble	Freq. of Occ. % South Topsoil	Freq. of Occ. % CTA
<i>Salsola kali</i> * (Russian thistle)	100.0	100.0	80.0
<i>Poa sandbergii</i> (Sandberg's bluegrass)	96.0	100.0	48.0
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	96.0	100.0	64.0
<i>Bromus tectorum</i> * (cheatgrass)	12.0	36.0	4.0
<i>Sisymbrium altissimum</i> * (tumble mustard)	12.0	12.0	4.0
<i>Ambrosia acanthicarpa</i> (bur ragweed)	X	12.0	8.0
<i>Erodium cicutarium</i> * (storksbill)	--	8.0	X
<i>Triticum aestivum</i> (wheat)	4.0	--	X
<i>Holosteum umbellatum</i> * (jagged chickweed)	--	4.0	--
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	--	4.0	X
<i>Machaeranthera canescens</i> (hoary aster)	--	4.0	--
<i>Chenopodium album</i> * (lamb's quarters)	X	4.0	X
<i>Artemisia tridentata</i> (big sagebrush)	--	X	--
<i>Purshia tridentata</i> (antelope bitterbrush)	--	X	X
<i>Nama densum</i> (purplemat)	--	X	--
<i>Gilia leptomeria</i> (Great Basin gilia)	--	X	--
<i>Mentzelia albicaulis</i> (whitestem stickleaf)	--	X	--
<i>Melilotus alba</i> * (white sweetclover)	--	X	--
<i>Descurainia pinnata</i> (western tansymustard)	--	X	--
<i>Vulpia myuros</i> * (rattail fescue)	X	X	--
<i>Latuca serriola</i> (prickly lettuce)	X	X	X
<i>Kochia scoparia</i> (kochia)	X	X	X
<i>Chrispora tenella</i> * (blue mustard)	X	X	--
<i>Achillea millefolium</i> (yarrow)	--	--	X
<i>Erogonum niveum</i> (snowbuckwheat)	--	--	X
Biotic crust	0.0	0.0	0.0
Bare soil	100.0	100.0	100.0
Litter	100.0	100.0	100.0

\* Invasive species

X=present but not counted in plot frames

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## 3.0 100 AREA SITES

### 3.1 HANFORD GENERATING PLANT

Energy Northwest Inc. worked on demolition of the 185-N Hanford Generating Plant complex from 2001 through 2004. The remedial action objectives and goals were attained for the sites in accordance with the 100-N Area Ancillary Facilities Action Memorandum (Ecology 1999) and in accordance with the Interim Remedial Action Record of Decision for the 100-NR-1 Operable Unit (Ecology 2000) and Removal Action Work plan for the Hanford Generating Plant Ancillary Facilities (DOE-RL 1999).

The Hanford Generating Plant was transferred from Energy Northwest Inc. to the Environmental Restoration Contractor in August 2004 and included into the River Corridor Closure Contractor work scope in August 2006. Revegetation of the area disturbed during the demolition and remediation activities was initiated in early February and continued through mid-March 2006. Prior to seeding, the compacted soils were loosened with a disk. The area was broadcast seeded with a mix of native grass seed that included Sandberg's bluegrass, Indian ricegrass, thickspike wheatgrass, bluebunch wheatgrass, prairie junegrass (*Koeleria cristata*), and needle-and-thread grass. Triple-16 fertilizer and polyacrylamide (water retaining crystals) were applied during seeding. The seeded area was mulched with straw and planted with sagebrush seedlings that were grown in 10-in tubes from seed collected on the Hanford site (Figure 4).

The planted area was separated into two areas for analysis; the eastern half of the area has native fine grained topsoil that was not removed during the demolition activities while the western area has rocky cobble backfill material from a nearby borrow pit. Fourth year monitoring was conducted in both areas on April 28, 2009. The canopy cover of native plants increased 5% on the topsoil site, and 20% on the cobble site. Percent cover of invasive species remained extremely high on the topsoil site (120%), while dropping to only 17% on the cobble site (Table 4). Cheatgrass cover on both sites continued to fall, while the Sandberg's bluegrass remained the dominant plant and increased canopy cover on both sites. The cobble site showed a higher diversity of native plants, with 13 species, while seven were recorded on the topsoil site.

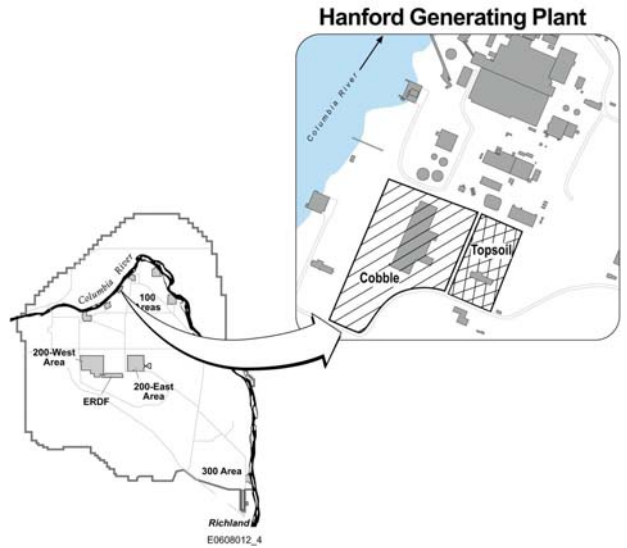
The one sagebrush transect on the topsoil site, and two on the cobble site, were monitored for survival again in 2009. The shrubs on the topsoil site showed a significant die-off between the 2006 and 2007 monitoring years, from 95% down to only 14% surviving. After that initial loss, the remaining shrubs have done well, and monitoring in 2009 showed survival at 12%. The shrubs have grown to  $42.9 \pm 13.0$ cm, and 57% of the shrubs within the transect were blooming. So although survival at this site was low, we expect to see recruitment in the coming years from the shrubs that have already begun to put out seed. The shrubs on the cobble site have fared better, with survival at 38.8% overall, and with no shrubs lost since monitoring in 2008. About 16% of the shrubs on the cobble site had bloomed in the previous year, and the average height was about 33cm.

Although the shrubs on the cobble site have shown higher survival rates, the topsoil site shrubs have grown larger and are blooming earlier. The comparison between these two adjacent sites, with different soil types, continues to be a valuable tool for planning future revegetations.

**Figure 4. Hanford Generating Plant.**



Sagebrush transect at the Hanford Generating Plant  
Cobble Site April 2009.



Revegetated Topsoil area at Hanford Generating Plant May 2009.

**Table 4. Percent Canopy Cover and Frequency of Occurrence at the Hanford Generating Plant West Cobble and East Topsoil Sites in 2009.**

Species	% Cover	% Cover	Freq of Occ %	Freq of Occ %
	E. Topsoil	W. Cobble	E. Topsoil	W. Cobble
<i>Poa sandbergii</i> (Sandberg's bluegrass)	51.0	58.9	100.0	96.0
<i>Bromus tectorum</i> * (cheatgrass)	43.2	10.7	100.0	100.0
<i>Holosteum umbellatum</i> * (jagged chickweed)	41.9	0.9	96.0	32.0
<i>Chorispora tenella</i> * (blue mustard)	10.7	--	80.0	--
<i>Sisymbrium altissimum</i> * (tumble mustard)	7.4	0.7	76.0	28.0
<i>Draba verna</i> * (spring whitlow)	5.8	0.8	28.0	36.0
<i>Salsola kali</i> * (Russian thistle)	3.9	2.7	96.0	88.0
<i>Ranunculus testiculatus</i> * (bur buttercup)	3.6	0.1	52.0	4.0
<i>Erodium cicutarium</i> * (storksbill)	3.0	0.9	28.0	16.0
<i>Festuca octoflora</i> (six-weeks fescue)	1.3	0.9	12.0	40.0
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	1.0	4.5	12.0	44.0
<i>Chondrilla juncea</i> * (rush skeletonweed)	0.9	--	4.0	--
<i>Centaurea diffusa</i> * (diffuse knapweed)	0.8	0.8	12.0	56.0
<i>Artemisia tridentata</i> (sagebrush)	0.7	0.8	8.0	12.0
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	0.3	6.4	12.0	48.0
<i>Lactuca serriola</i> * (prickly lettuce)	0.2	0.4	12.0	0.8
<i>Achillea millefolium</i> (yarrow)	0.1	0.8	4.0	4.0
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	2.9	X	44.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	--	2.4	--	8.0
<i>Epilobium paniculatum</i> (tall willowherb)	--	0.3	--	20.0
<i>Melilotus alba</i> * (white sweetclover)	--	X	--	X
<i>Descurainia pinnata</i> (western tansymustard)	--	X	--	X
<i>Machaeranthera canescens</i> (hoary aster)	--	X	--	X
<i>Eriogonum niveum</i> (snow buckwheat)	--	X	--	X
<i>Verbascum thapsus</i> * (common mullein)	--	X	--	X
Biotic Crust	15.9	25.8	96.0	84.0
Bare Soil	15.4	39.9	100.0	100.0
Litter	75.0	38.0	100.0	100.0
<b>Total canopy cover (litter not included)</b>	<b>175.8</b>	<b>95.9</b>		

\* Invasive species

X=present but not counted in plot frames

-- species not observed on site

Total Invasive % Cover	121.4	18.0
Total Native % Cover	54.2	77.9
Change in Native % Cover from 2008 to 2009	+5.2	+19.7

### 3.2 116-N-3

The 116-N-3 crib, trench, and pipeline were remediated to Remedial Action Objectives, Remedial Action Goals, and closure performance standards established by the EPA and Ecology in concurrence with RL. The goals and objections are documented in the *100-NR-1 Interim Remedial Action Record of Decision* (Ecology 2000) and *Remedial Design Report / Remedial Action Work Plan for the 100-NR-1 Treatment, Storage, and Disposal Units* (DOE-RL 2000B).

The area in and around the 116-N-3 trench contain unusual depositional features referred to as giant ripples, created by cataclysmic floods from 20,000 to 10,000 years ago. These features appear as small hills north and east of N Reactor and portions of the project area were located within these features. This area is known as *Mooli Mooli* (stacked hills) to local Native American Tribes, and is significant as an area that contains legends, stories, and spiritual power that remains important to their religion, traditions, and cultural heritage. The 116-N-3 trench was constructed within a portion of *Mooli Mooli* (Figure 5). The *Mooli Mooli* within the trench construction and remediation boundary were removed leaving a flat linear structure within the traditional cultural area. Because of the significance of *Mooli Mooli* to local Native American Tribes, Environmental Restoration Contractor's Remedial Action and Cultural Resources staff, in conjunction with tribal members developed a backfill recontour design to restore the previously removed portions of *Mooli Mooli*. Backfill and recontour operations were initiated in August and continued through the end of December 2004. Revegetation activities on the 116-N-3 area were initiated in mid-January 2005 and continued for five weeks. Revegetation of the trench included broadcast seeding a native grass seed mix consisting of Sandberg's bluegrass, Indian ricegrass, prairie junegrass, bluebunch wheatgrass, thickspike wheatgrass, and needle-and-thread grass with a hydroseeder. The seeds were originally collected on the Hanford site and grown under agricultural conditions for seed production or cultivars of species occurring onsite purchased from a local seed producer. Triple-16 fertilizer was applied during seeding, as the material used as backfill was excavated from depths up to 9 m below grade and was nutrient deficient. Industry standard hydromulch was added to the tank mix at 225 kg/ha to help ensure even seed distribution. Upon the completion of seeding, the entire area was irrigated with 23,400 L/ha and then mulched with 4.5 metric tons/ha grass straw which was crimped into the soil surface to help hold it in place.

Sagebrush and spiny hopsage (*Grayia spinosa*) seedlings were grown by a native plant nursery from seed collected on the Hanford Site. There were 13,050 shrubs; 11,500 sagebrush and 1,550 spiny hopsage planted across the remediated waste site and a small area adjacent to the trench that was used for backfill material.

Fifth year monitoring was conducted at the 116-N-3 Trench in April of 2009. This was the final year of monitoring at this location, and the results were very good. Native grass species dominate this site, and total native plant canopy cover is up to 85% (Table 5). Non-native plant cover continued to shrink in 2009, down to 21%, from 28% in 2008. Another sign of this site maturing is the presence of a biotic crust for the first time this year, covering about 13% of the ground surface. This crust helps to maintain soil moisture levels and impedes non-native species from becoming established. This fifth year monitoring has shown that this revegetation has been successful in establishing a community dominated by native species, which provides habitat and prevents colonization by invasive species.



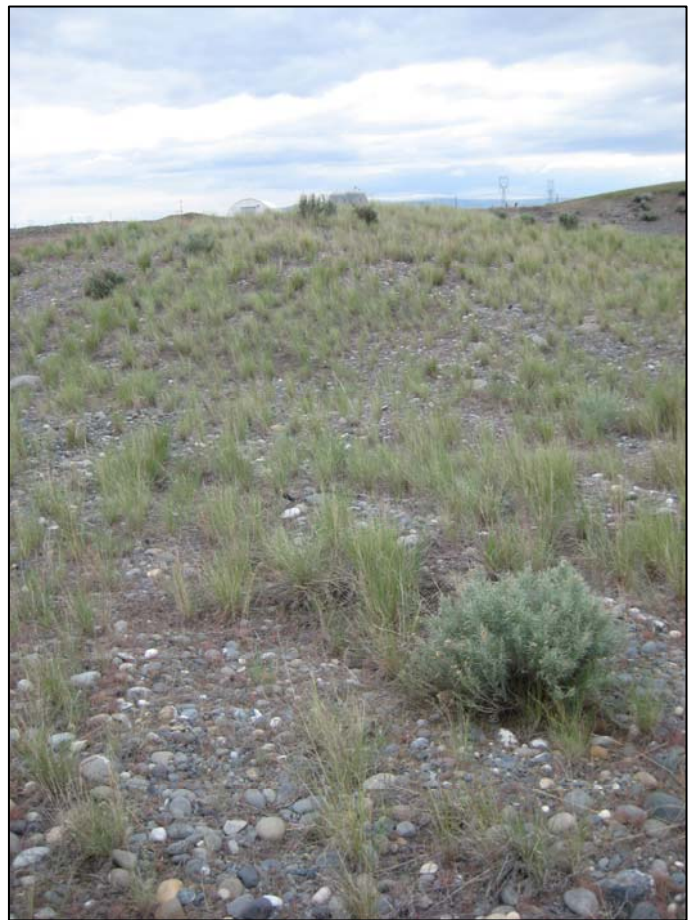
**Figure 5. 116-N-3 Before and After Photos.**



Planting performed in 2005.



Second year monitoring in 2006.



Fifth year monitoring in 2009.

**Table 5. Percent Canopy Cover and Frequency of Occurrence at 116-N-3 in 2009.**

Species	% Cover	Freq of Occ %
<i>Poa sandbergii</i> (Sandberg's bluegrass)	53.1	100.0
<i>Festuca octoflora</i> (slender sixweeks)	18.4	0.0
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	12.8	52.0
<i>Salsola kali</i> * (Russian thistle)	7.7	100.0
<i>Bromus tectorum</i> * (cheatgrass)	5.6	84.0
<i>Tragopogon dubius</i> * (yellow salsify)	3.3	0.0
<i>Sisymbrium altissimum</i> * (tumble mustard)	1.4	36.0
<i>Draba verna</i> * (spring whitlow)	1.0	20.0
<i>Holosteum umbellatum</i> * (jagged chickweed)	0.9	36.0
<i>Melilotus alba</i> * (white sweetclover)	0.8	12.0
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	0.5	0.0
<i>Centaurea diffusa</i> * (diffuse knapweed)	0.5	36.0
<i>Lactuca serriola</i> * (prickly lettuce)	0.2	4.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.1	4.0
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	0.1	4.0
<i>Achillea millefolium</i> (yarrow)	0.1	0.0
<i>Machaeranthera canescens</i> (hoary aster)	X	X
<i>Chondrilla juncea</i> (rush skeletonweed)	X	X
<i>Chaenactis douglasii</i> (hoary falseyarrow)	X	X
<i>Agropyron cristatum</i> (crested wheatgrass)	X	X
<i>Erigeron poliospermus</i> (cushion fleabane)	X	X
Biotic crust	12.5	84.0
Bare soil	60.9	100.0
Litter	32.0	100.0
<b>Total canopy cover (litter not included)</b>	<b>106.2</b>	

\* Invasive species

X=present but not counted in plot frames

<sup>b</sup>Includes Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, needle-and-thread grass, and prairie junegrass seedlings.

Total Invasive % Cover	21.2
Total Native % Cover	85.0
Change in Native Cover from 2008	+40.3

### 3.3 116-N-1

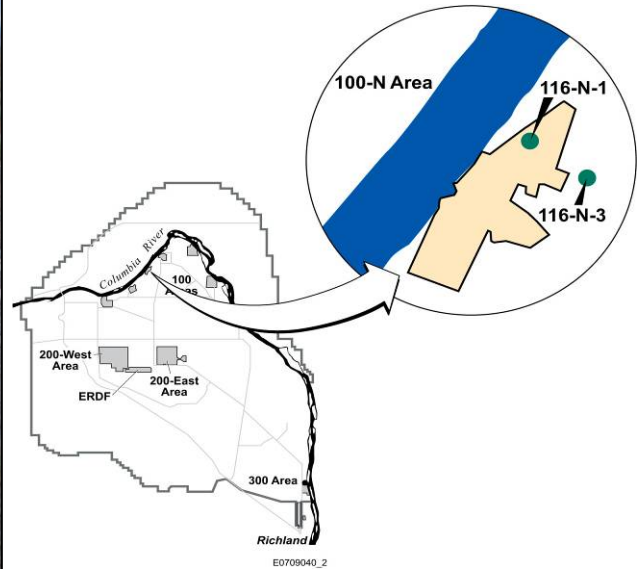
The 116-N-1 Crib and Trench were remediated to Remedial Action Objectives, Remedial Action Goals, and closure performance standards established by the EPA and Ecology in concurrence with RL. The goals and objectives are documented in the *100-NR-1 Interim Remedial Action Record of Decision* (Ecology 2000) and *Remedial Design Report/Remedial Action Work Plan for the 100-NR-1 Treatment, Storage, and Disposal Units* (DOE-RL 2000B).

Revegetation activities on the 116-N-1 crib and trench were conducted in December 2006. Native grass species were planted along with sagebrush at 1235 plants/hectare.

Third year vegetation monitoring was performed at the site in May of 2009. The percent cover of native and invasive species recorded in 2009 stayed very close to those from the 2008 monitoring, with 49% cover of native species and 13% cover of invasives (Table 6). The dominant non-native species transitioned from Russian thistle to cheatgrass, which is common of sites that are this age. Russian thistle is typically dominant in the first and second year, but becomes nearly non-existent on these revegetated areas as native plant cover increases in the third, fourth, and fifth years. It is expected that as bunchgrasses and shrubs become better established on the site, the overall canopy cover of invasives will continue to diminish.

The sagebrush at this site continue to do extremely well, as can be seen in the photos in Figure 6. The sagebrush transect monitoring showed shrub survival at 87%, with 91.5% of the shrubs monitored in 2008 still surviving. The shrubs were  $25.88 \pm 7.2$  cm tall, with an average of 9.6 cm of growth in the past year.

**Figure 6. 116-N-1 Revegetation and Sagebrush Monitoring.**



Sagebrush at 116-N-1 in April 2009.



Vegetation monitoring at 116-N-1 in April 2009.

**Table 6. Percent Canopy Cover and Frequency of Occurrence at 116-N-1 in 2009.**

Species	% Cover	Freq of Occ %
<i>Poa sandbergii</i> (Sandberg's bluegrass)	36.1	96.0
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	9.8	84.0
<i>Bromus tectorum</i> * (cheatgrass)	9.2	96.0
<i>Sisymbrium altissimum</i> * (tumble mustard)	2.4	76.0
<i>Artemisia tridentata</i> (big sagebrush)	1.7	28.0
<i>Salsola kali</i> * (Russian thistle)	1.1	44.0
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	0.7	8.0
<i>Lactuca serriola</i> * (prickly lettuce)	0.3	12.0
<i>Holosteum umbellatum</i> * (jagged chickweed)	0.1	4.0
<i>Draba verna</i> * (spring whitlow)	0.1	4.0
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	0.1	4.0
<i>Epilobium paniculatum</i> (tall willowherb)	0.1	4.0
<i>Achillea millefolium</i> (yarrow)	X	X
<i>Erigeron poliospermus</i> (cushion fleabane)	X	X
<i>Tragopogon dubius</i> * (yellow salsify)	X	X
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Agropyron cristatum</i> * (crested wheatgrass)	X	X
<i>Centaurea diffusa</i> * (diffuse knapweed)	X	X
Biotic crust	0.0	0.0
Bare soil	45.2	96.0
Litter	60.5	100.0
<b>Total canopy cover (litter not included)</b>	61.7	
* Invasive species		
X=present but not counted in plot frames		
Total Invasive % Cover	13.2	
Total Native % Cover	48.5	
Change in Native Cover from 2008	-0.6	

### 3.4 100 F AREA SITES

Remedial action of several waste sites within the 100-FR-1 Operable Unit in the 100-F Area was initiated in 2000. The remedial action objectives and goals were established by the U.S. Environmental Protection Agency and the Washington State Department of Ecology, in concurrence with the U. S. Department of Energy, Richland Operations Office and documented in the *Amendment to the Interim Action Record of Decision for the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units* (ROD) (EPA 1997) and the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2000A). The sites were excavated to the extent required to meet specified soil cleanup levels, the contaminated materials were disposed of at the ERDF, and the sites were backfilled with material from a local borrow source and contoured to match the adjacent area in the fall 2003. The borrow area used for fill material is located 732 meters northwest of the 105-F Reactor and is within the 100-F Area perimeter road. The area was used as a borrow site in the 1970s. Since the 1970s, the former borrow area, consisting of exposed rocky cobble with some coarse sand, had started to naturally recover but was noted as having

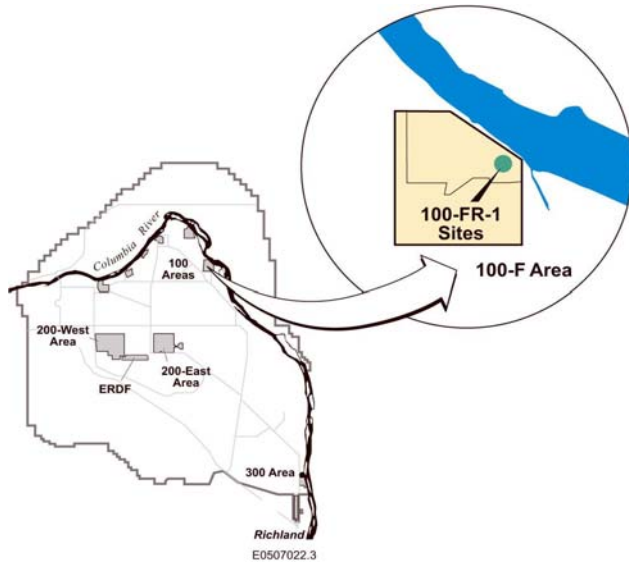
only a very sparse stand of small stature gray rabbitbrush with scattered understory species, with the total cover of less than 5%. The borrow pit was expanded to the west of previously mined area to accommodate waste site backfill requirements. The expansion area had been lightly disturbed but recovered to a community dominated by cheatgrass and Sandberg's bluegrass (DOE/EA-1454). Prior to expanding the borrow area, the top 30.5 cm of topsoil was stockpiled. Following the completion of borrow pit operations, the topsoil was redistributed across the excavated areas. The borrow area was broadcast seeded with native grasses and planted with sagebrush seedlings.

The backfilled and re-contoured waste sites were revegetated in January 2005. The objective of revegetating the area was to stabilize the soil, and to show successional vegetation trends toward a native-plant dominated community.

A native seed mix was broadcast with a hydroseeder across all the sites. The seed mix included Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, prairie junegrass, and needle-and-thread grass. The seed comprising the mix was grown on contract from seed collected on the Hanford Site or cultivars purchased from a local seed producer. Triple-16 fertilizer was applied with the grass seed mixture. Industry standard hydromulch was added to the tank mix at 225 kg/ha to help ensure an even seed distribution. Upon the completion of seeding, the entire area was irrigated with 23,400 L/ha then mulched with 4.5 metric tons/ ha of straw and crimped into the soil surface to prevent wind erosion. Sagebrush seedlings were grown in 4-in tubes from seed collected on the Hanford Site and fifty-five thousand sagebrush plants were planted across the remediated waste sites and borrow area. (Figure 7).

The fifth and final year of monitoring was performed on this site on May 14, 2009. The results of this monitoring were very promising, and showed that this site has become well established as a community dominated by native species. Cheatgrass canopy cover reduced from 54% in 2008 to only 39%, and Sandberg's bluegrass became the species with the greatest canopy cover, at 51% (Table 7). Native plant cover was up 33% from the 2008 results, and invasive cover was down slightly. The soil in this area consists of gravels and cobbles, due to the backfill used, but biotic crusts were beginning to form in the fine-grained soils between the cobbles. Although no monitoring transect for sagebrush was established on this site, the sagebrush present appear to be doing very well, and survival appears to be well over 50%. The planted tubelings are now beginning to bloom and produce seed to help to further establish sagebrush in the area. Overall, this site has become a successful revegetation, and is expected to continue to improve as the shrubs mature and bunchgrasses continue to compete with the non-native species present.

**Figure 7. 100-F Area.**



Sagebrush at 100-F area sites May 2009.



Revegetation monitoring at 100-F area sites May, 2009.

**Table 7. Percent Canopy Cover and Frequency of Occurrence at 100-F Area Sites in 2009.**

Species	% Cover	Freq of Occ %
<i>Poa sandbergii</i> (Sandberg's bluegrass)	46.1	100.0
<i>Bromus tectorum</i> * (cheatgrass)	25.7	97.1
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	16.7	77.1
<i>Salsola kali</i> * (Russian thistle)	4.3	97.1
<i>Erodium cicutarium</i> * (storksbill)	2.9	17.1
<i>Artemesia tridentata</i> (sagebrush)	2.4	14.3
<i>Holosteum umbellatum</i> * (jagged chickweed)	1.8	17.1
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	1.5	20.0
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	1.3	22.9
<i>Achillea millefolium</i> (yarrow)	1.0	11.4
<i>Poa bulbosa</i> * (bulbous blugrass)	0.9	5.7
<i>Sisymbrium altissimum</i> * (tumble mustard)	0.3	11.4
<i>Machaeranthera canescens</i> (hoary aster)	0.1	2.9
<i>Centaurea diffusa</i> * (diffuse knapweed)	0.1	2.9
<i>Festuca octoflora</i> (six-weeks fescue)	0.1	2.9
<i>Lactuca serriola</i> (prickly lettuce)	0.1	2.9
<i>Tragopogon dubius</i> (yellow salsify)	X	X
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Erigeron pumilus</i> (shaggy fleabane)	X	X
<i>Astragalus sclerocarpus</i> (stalk-pod milkvetch)	X	X
<i>Agoseris heterophylla</i> (showy mountain dandelion)	X	X
<i>Astragalus succumbens</i> (crouching milkvetch)	X	X
Biotic crust	1.8	40.0
Bare Soil	54.9	97.1
Litter	46.9	100.0
<b>Total canopy cover (litter not included)</b>	<b>105.2</b>	

\* Introduced species.

X = Species present on the site but not counted in a plot frame.

Total Introduced % Cover 2009	36.0
Total Native % Cover 2009	69.3
Change in Native % Cover from 2008	22.7



### 3.5 100-F SITES PLANTED IN 2008

Areas that were revegetated between December 2007 and February 2008, and were monitored in 2009, include the 118-F-1, 118-F-2, 182-F, 183-F East Clearwell, 100-F-26, and 118-F-5. 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* (RDR/RAWP) (DOE-RL 2005A) and in the Declaration of the Record of Decision for the selected Interim Remedial Action for the 100 Area Remaining Sites: 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-CE-3 Operable Units, CCN 071363, (EPA 1999). These sites were broadcast seeded with a mixture of native grasses including Sandberg's bluegrass, Indian rice grass, bluebunch wheatgrass, prairie junegrass, bottlebrush squirreltail, and needle-and-thread grass. In addition, 134kg/ha of Triple-16 fertilizer was added to the sites along with 4,480 kg/ha of straw mulch that was spread and crimped into the soil surface. Sagebrush plugs were then planted into the seeded areas at 1,200 plants/ha.

#### 118-F-1

Second year monitoring was conducted at 118-F-1 in 2009 (Figure 8). Native and invasive species canopy cover increased significantly from the 2008 monitoring data (+19.6% and +25.3% respectively). This is typical of second year monitoring results, showing native grasses becoming established, specifically Sandberg's bluegrass and bluebunch wheatgrass, and the typical second-year dominance of Russian thistle (Table 8). It is expected that monitoring in the upcoming years will show a decrease in Russian thistle cover, which is an annual, and perennial bunchgrasses and shrubs will begin to dominate the site.

Sagebrush monitoring was also conducted on this site in 2009. Transect 1, which had 50 shrubs alive when established in 2008, had 30 shrubs still surviving in 2009, for a 60% survival rate. Average shrub height increased from  $12.9 \pm 3.5$ cm in 2008 to  $19.7 \pm 6.1$ cm in 2009. In contrast, none of the 52 shrubs recorded on Transect 2 in 2008 were still surviving in 2009. This is likely due to the extremely compacted soil that is present across much of this site, and is an excellent example of the necessity of ripping compacted areas prior to initiating revegetation efforts.

#### 118-F-2

Second year monitoring was performed at the 118-F-2 site in 2009 (Figure 8). Russian thistle was the dominant plant on the site (28% cover), followed closely by Sandberg's bluegrass (23% cover). This is a positive sign for this site, as the perennial Sandberg's bluegrass will likely outcompete the annual Russian thistle for available resources in the coming years. Cheatgrass only showed 5% cover across the revegetated area (Table 9). Twelve native species were recorded on the site, this number may increase in the coming year, as seeds dispersing from adjacent areas are able to establish on the site.

The sagebrush transect on this was monitored for survival in 2009. Only 8 of the 48 shrubs originally recorded in the transect were still alive (17% survival). The soil along the sagebrush transect consists of large cobbles and sand, with very little organic material. This soil type does not hold moisture well, and the plants likely died due to lack of moisture during the previous summer. The sagebrush on another portion of the site, which was used for soil staging and has much better soil conditions, appear to be doing very well, although no transect was established on this portion of the site.

**Figure 8. 118-F-1 and 118-F-2 Sites in 2009.**



Sagebrush transect at 118-F-1  
looking north.



Shrubs growing in area with better soil  
conditions on 118-F-2.



Hopsage tubeling growing at the 118-F-2 site.

**Table 8. Percent Canopy Cover and Frequency of Occurrence at 118-F-1 in 2009.**

<b>Species</b>	<b>% Cover</b>	<b>Freq of Occ %</b>
<i>Salsola kali</i> * (Russian thistle)	26.8	100.0
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	12.7	84.0
<i>Poa sandbergii</i> (Sandberg's bluegrass)	10.3	100.0
<i>Sisymbrium altissimum</i> * (tumble mustard)	0.6	24.0
<i>Bromus tectorum</i> * (cheatgrass)	0.5	20.0
<i>Holosteum umbellatum</i> * (jagged chickweed)	0.3	12.0
<i>Draba verna</i> * (spring whitlow)	0.3	12.0
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	0.2	8.0
<i>Descurainia pinnata</i> (western tansymustard)	0.1	4.0
<i>Lactuca serriola</i> * (prickly lettuce)	0.1	4.0
<i>Poa bulbosa</i> * (bulbous bluegrass)	0.1	4.0
<i>Erodium cicutarium</i> * (storksbill)	X	X
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	X
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Achillea millefolium</i> (yarrow)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	X	X
Biotic crust	0.0	0.0
Bare soil	50.3	100.0
Litter	52.3	100.0
<b>Total canopy cover (litter not included)</b>	<b>52.0</b>	

\* Invasive species

X=present but not counted in plot frames

Total Invasive % Cover	28.7
Total Native % Cover	23.3
Change in Native % Cover from 2008	+19.6

**Table 9. Percent Canopy Cover and Frequency of Occurrence at 118-F-2 in 2009.**

Species	% Cover	Freq of Occ %
<i>Salsola kali</i> * (Russian thistle)	28.1	96.0
<i>Poa sandbergii</i> (Sandberg's bluegrass)	22.8	100.0
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	6.7	92.0
<i>Sisymbrium altissimum</i> * (tumble mustard)	5.6	52.0
<i>Bromus tectorum</i> * (cheatgrass)	4.8	40.0
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	2.4	20.0
<i>Holosteum umbellatum</i> * (jagged chickweed)	0.4	16.0
<i>Draba verna</i> * (spring whitflow)	0.4	16.0
<i>Lactuca serriola</i> * (prickly lettuce)	0.2	8.0
<i>Phacelia linearis</i> (threadleaf scorpionweed)	0.1	4.0
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	0.1	4.0
<i>Descurainia pinnata</i> (western tansymustard)	0.1	4.0
<i>Poa bulbosa</i> (bulbous bluegrass)	X	X
<i>Machaeranthera canescens</i> (hoary aster)	X	X
<i>Lepidium perfoliatum</i> (clasping pepperweed)	X	X
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Cardaria draba</i> * (whitetop)	X	X
<i>Phacelia linearis</i> (threadleaf scorpionweed)	X	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
Biotic crust	0.0	0.0
Bare soil	49.3	92.0
Litter	42.1	100.0
<b>Total canopy cover (litter not included)</b>	<b>71.7</b>	
* Invasive species		
X=present but not counted in plot frames		
Total Invasive % Cover	39.5	
Total Native % Cover	32.2	
Change in Native cover from 2008	+13.0	

### 182-F

This site was divided into a North and South area, to distinguish between the cobbled northern plot, and the more fine grained soil on the southern plot (Figure 9). The South plot was used as a staging area, and had been invaded by non-native species prior to revegetation, while the North plot lacked vegetation. Second year monitoring was performed at the 182-F site during May of 2009. Cheatgrass was the dominant species observed on both sites, followed by bluebunch wheatgrass and Sandberg's bluegrass. Native species diversity was high for a second year site, with the North showing 12 species and the South showing 11 species (Table 10).

The planted bluebunch wheatgrass has been much more successful on the North site (33% cover) than on the South site (6% cover). This represents the largest observed variable between the two sites during the 2009 monitoring. Factors that likely influenced the variance were the high level

of competition on the south site during planting, and the differing soil types on the two sites. The high level of competition on the south site may have impeded germination, or caused seedlings to die due to lack of available resources, while the low level of competition on the north site allowed the seedlings to become established. The South site also has finer grained soils, while the soil on the North site consists mostly of coarse sand and cobble. The fine grained soil on the South site is more easily invaded by weedy species but sometimes supports more native forbs, while the sand/cobble soil typically supports less of the weedy species. The difference between these two sites will continue to provide interesting and valuable information during upcoming monitoring events.

**Table 10. Percent Canopy Cover and Frequency of Occurrence  
at 182-F North and South in 2009.**

Species	% Cover North	% Cover South	Freq of Occ % North	Freq of Occ % South
<i>Bromus tectorum</i> * (cheatgrass)	44.5	49.3	100.0	88.0
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	32.5	5.6	100.0	72.0
<i>Poa sandbergii</i> (Sandberg's bluegrass)	24.0	19.8	73.3	92.0
<i>Poa bulbosa</i> * (bulbous bluegrass)	10.3	5.9	60.0	24.0
<i>Salsola kali</i> * (Russian thistle)	2.2	6.2	86.7	92.0
<i>Sporobolus cryptandrus</i> (sanddrop seed)	1.0	4.1	6.7	32.0
<i>Erodium cicutarium</i> * (storksbill)	0.3	1.2	13.3	28.0
<i>Sisymbrium altissimum</i> * (tumble mustard)	0.7	0.8	26.7	32.0
<i>Festuca octoflora</i> (slender sixweeks)	0.7	0.3	26.7	12.0
<i>Draba verna</i> * (spring whitlow)	0.5	0.5	20.0	20.0
<i>Artemesia tridentata</i> (sagebrush)	0.5	X	20.0	X
<i>Holosteum umbellatum</i> * (jagged chickweed)	--	0.4	--	16.0
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	0.3	--	13.3	--
<i>Centaurea diffusa</i> * (diffuse knapweed)	X	0.3	X	12.0
<i>Artemesia campestris</i> (pacific sage)	0.2	X	6.7	X
<i>Descurainia pinnata</i> (western tansymustard)	--	0.1	--	4.0
<i>Verbena bracteata</i> * (big-bract verbena)	--	X	--	X
<i>Lactuca serriola</i> * (prickly lettuce)	--	X	--	X
<i>Achillea millefolium</i> (yarrow)	X	X	X	X
<i>Astragalus succumbens</i> (crouching milkvetch)	X	X	X	X
<i>Vicia cracca</i> * (bird vetch)	X	X	X	X
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X	X	X
<i>Machaeranthera canescens</i> (hoary aster)	X	--	X	--
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	--	X	--
Biotic crust	1.0	0.3	40.0	12.0
Bare soil	41.8	17.7	93.3	96.0
Litter	57.8	77.0	100.0	100.0
<b>Total canopy cover (litter not included)</b>	<b>117.7</b>	<b>94.5</b>		

\* Invasive species

X=present but not counted in plot frames

-- species not recorded

Total Invasive % Cover	58.5	64.6
Total Native % Cover	59.2	29.9
Change in Native % Cover from 2008	+11.9	-6.1

### **183-F East Clearwell**

The 183-F East Clearwell revegetation was monitored for the second year on May 14, 2009. This monitoring showed a significant increase in invasive species cover above that seen in 2008 (Figure 9). The first year monitoring performed in 2008 was done shortly after the area was planted. The seeds of the planted species had germinated, but no invasives had become established yet. As is typical of these revegetated areas, invasives quickly establish in the disturbance left behind by the backfilling activity. As such, Russian thistle was recorded at 18% cover and cheatgrass showed 10% cover (Table 11). Russian thistle canopy cover typically falls off dramatically during the third or fourth year of monitoring, so this change will be watched for during upcoming monitoring. Sandberg's bluegrass was the dominant plant on the site, with 35% canopy cover, while bluebunch wheatgrass showed 17% cover. These perennial bunchgrasses are typically responsible for out-competing the annual Russian thistle. Also, although native species diversity was considered relatively high in 2008, with 8 species present, the 15 native species present in 2009 was a marked improvement and shows that a diverse community of native plants is already being established on this young site.

Due to the relatively small size of this revegetation, no sagebrush transect was established on the site. However, sagebrush survival appears to be extremely high at the site. Planted tubelings are already blooming, which is relatively uncommon for a site that is this young. These shrubs will likely become an important seed source in the coming years, and could help to establish sagebrush in areas adjacent to the site. The site will be surveyed for seedlings during future monitoring.

**Figure 9. 182-F and 183-F East Clearwell Sites in 2009.**



182-F North looking north toward the Wahluke Slope.



*Astragalus succumbens* at 182-F South looking South toward the 105-F Reactor.



183 East Clearwell looking west showing planted sagebrush in 2009.



**Table 11. Percent Canopy Cover and Frequency of Occurrence at 183-F East in 2009.**

Species	% Cover	Freq of Occ %
<i>Poa sandbergii</i> (Sandberg's bluegrass)	34.8	93.3
<i>Salsola kali</i> * (Russian thistle)	17.8	100.0
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	16.8	93.3
<i>Bromus tectorum</i> * (cheatgrass)	10.3	60.0
<i>Ranunculus testiculatus</i> * (bur buttercup)	1.7	33.3
<i>Festuca octoflora</i> (slender sixweeks)	1.3	20.0
<i>Artemisia tridentata</i> (big sagebrush)	1.2	13.3
<i>Sisymbrium altissimum</i> * (tumble mustard)	1.0	40.0
<i>Erodium cicutarium</i> * (storksbill)	0.5	20.0
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	0.5	20.0
<i>Draba verna</i> * (spring whitlow)	0.3	13.3
<i>Poa bulbosa</i> * (bulbous bluegrass)	0.3	13.3
<i>Holosteum umbellatum</i> * (jagged chickweed)	0.2	6.7
<i>Achillea millefolium</i> (yarrow)	0.2	6.7
<i>Machaeranthera canescens</i> (hoary aster)	0.2	6.7
<i>Chorispota tenella</i> * (blue mustard)	0.2	6.7
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Melilotus alba</i> * (white sweetclover)	X	X
<i>Astragalus sclerocarpus</i> (stalked-pod milkvetch)	X	X
<i>Plantago patagonica</i> (Indian wheat)	X	X
<i>Ambrosia acanthicarpa</i> (bur ragweed)	X	X
<i>Grayia spinosa</i> (spiny hosphate)	X	X
<i>Lactuca serriola</i> * (prickly lettuce)	X	X
<i>Lepidium perfoliatum</i> (clasping pepperweed)	X	X
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
Biotic crust	0.0	0.0
Bare soil	48.5	100.0
Litter	46.7	100.0
<b>Total canopy cover (litter not included)</b>	<b>87.3</b>	

\* Invasive species

X=present but not counted in plot frames

Total Invasive % Cover	32.3
Total Native % Cover	55.0
Change in Native % Cover from 2008	+1.5

**100-F-26**

Second year monitoring was performed at the 100-F-26 site on May 14, 2009. Sandberg's bluegrass was the dominant species on the site, followed closely by cheatgrass and Russian thistle (Table 12). Native canopy cover was up to 54%, but non-natives showed 82% canopy cover. This is typical for second year monitoring, as Russian thistle takes advantage of readily available resources due to the small stature of young bunchgrasses and shrubs. It is expected that Russian thistle canopy cover will decrease drastically in the coming years, and that native bunchgrasses and shrubs will begin to outcompete the annual invasives for resources. Eleven native species were counted on the site in 2009. The expectation is that species diversity will increase in the coming years.

**Table 12. Percent Canopy Cover and Frequency of Occurrence at 100-F26 in 2009.**

Species	% Cover	Freq of Occ %
<i>Poa sandbergii</i> (Sandberg's bluegrass)	39.5	93.3
<i>Bromus tectorum</i> * (cheatgrass)	35.5	93.3
<i>Salsola kali</i> * (Russian thistle)	34.7	86.7
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	11.0	93.3
<i>Sisymbrium altissimum</i> * (tumble mustard)	8.5	53.3
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	3.0	53.3
<i>Poa bulbosa</i> * (bulbous bluegrass)	2.5	6.7
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	0.3	13.3
<i>Holosteum umbellatum</i> * (jagged chickweed)	0.2	6.7
<i>Draba verna</i> * (spring whitlow)	0.2	6.7
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	0.2	6.7
<i>Artemisia tridentata</i> (big sagebrush)	0.2	6.7
<i>Ranunculus testiculatus</i> * (bur buttercup)	0.2	6.7
<i>Descurainia pinnata</i> (western tansymustard)	0.2	6.7
<i>Lactuca serriola</i> * (prickly lettuce)	0.2	6.7
<i>Machaeranthera canescens</i> (hoary aster)	X	X
<i>Chenopodium album</i> (lamb's quarters)	X	X
<i>Erodium cicutarium</i> * (storksbill)	X	X
<i>Melilotus alba</i> (white sweetclover)	X	X
<i>Grayia spinosa</i> (spiny hopsage)	X	X
Biotic crust	3.0	20.0
Bare soil	37.8	86.7
Litter	62.5	100.0
<b>Total canopy cover (litter not included)</b>	<b>136.2</b>	

\* Invasive species

X=present but not counted in plot frames

Total Invasive % Cover	81.9
Total Native % Cover	54.3
Change in Native % Cover from 2008	+31.2

### **118-F-5**

Second year monitoring was conducted at the 118-F-5 site on May 13, 2009. This area is separated into two monitoring areas, the burial ground and the soil staging area, so that a comparison can be made between the contrasting soil types at the two sites (Figure 10). The burial ground was backfilled with coarse cobbles with relatively few fines, while the soil staging area is covered by fine-grained soil. Both sites had the same revegetation effort performed.

Both of the areas were found to be dominated by non-native species during the 2009 monitoring. Cheatgrass and Russian thistle accounted for the majority of the vegetative cover in both areas. Bluebunch wheatgrass showed the highest native canopy cover, but at only 2% on each site (Table 13). The dominance of non-native species is to be expected in a site of this age.

Sagebrush survival was monitored at one transect on the soil staging area and one transect at the burial ground. Sagebrush survival was 27% at the soil staging area, and 31% at the burial ground. The average shrub height at the soil staging area was  $20 \pm 6.1$  cm, while the average at the burial ground was  $12.3 \pm 3.5$  cm. In addition, 11 spiny hopsage were recorded on the shrub transect for the soil staging area in 2008, but only 1 was still surviving in 2009.

These two sites appear relatively similar after two years of monitoring. The native cover and shrub survival at the two sites are very similar, with the greatest difference being the greater canopy cover of non-natives growing in the fine-grained soil of the soil staging area. The changes to be seen in the coming years across the two areas will add to the knowledge base about how to most effectively revegetate at the Hanford Site.

**Figure 10. 118-F-5 in 2009.**



Sagebrush Transect with 105-F  
in the background.



Showing vegetative cover at 118-F-5.



Sagebrush transect at 118-F-5.

**Table 13. Percent Canopy Cover and Frequency of Occurrence at 118-F-5 Soil Staging Area and Burial Ground in 2009.**

Species	% Cover SSA	% Cover BG	Freq of Occ % SSA	Freq of Occ % BG
<i>Bromus tectorum</i> * (cheatgrass)	75.0	46.3	100.0	93.3
<i>Salsola kali</i> * (Russian thistle)	28.5	21.8	93.3	100.0
<i>Draba verna</i> * (spring whitlow)	7.8	--	26.7	--
<i>Holosteum umbellatum</i> * (jagged chickweed)	2.7	--	13.3	--
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	1.8	2.5	40.0	100.0
<i>Poa sandbergii</i> (Sandberg's bluegrass)	0.3	1.5	13.3	26.7
<i>Sisymbrium altissimum</i> * (tumble mustard)	1.3	0.2	53.3	6.7
<i>Microsteris gracilis</i> (pink microsteris)	1.3	--	20.0	--
<i>Poa bulbosa</i> * (bulbous bluegrass)	0.7	0.5	26.7	20.0
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	--	0.5	--	20.0
<i>Plantago patagonica</i> (Indian wheat)	0.5	--	20.0	--
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	0.3	X	13.3
<i>Artemisia tridentata</i> (big sagebrush)	0.2	0.3	6.7	13.3
<i>Achillea millefolium</i> (common yarrow)	0.3	X	13.3	X
<i>Ambrosia acanthicarpa</i> (bur ragweed)	0.3	--	13.3	--
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.3	--	13.3	--
<i>Epilobium paniculatum</i> (tall willowherb)	--	0.2	--	6.7
<i>Machaeranthera canescens</i> (hoary aster)	--	X	--	X
<i>Hordeum leporinum</i> * (hare barley)	--	X	--	X
<i>Grayia spinosa</i> (spiny hopsage)	X	--	X	--
Biotic crust	2.3	2.2	93.3	86.7
Bare soil	27.7	55.3	93.3	100.0
Litter	61.0	39.7	100.0	100.0
<b>Total Canopy Cover</b> (litter not included)	121.2	74.2		

\* Introduced species.

X = Species present but not counted in a plot frame

-- species not observed on site

Total Introduced % Cover	116.0	68.8
Total Native % Cover	5.2	5.3
Change in Native % Cover from 2008	-13.3	+0.3

### 3.6 2009 REVEGETATION AT 100-F

The 118-F-6, 120-F-1, and the 1607-F-1 waste sites were revegetated in November 2008 and planted with Sandberg's bluegrass, Indian rice grass, bluebunch wheatgrass, prairie junegrass, bottlebrush squirreltail, and needle-and-thread grass. In addition, 134kg/ha of Triple-16 fertilizer was added to the sites along with 4,480 kg/ha of straw mulch that was spread and crimped into the soil surface. Sagebrush, hopsage, and bitterbrush plugs were then planted into the seeded areas at 1,200 plants/ha.

**118-F-6**

The 118-F-6 revegetation was monitored for the first time on June 1, 2009 (Figure 11). Monitoring showed Russian thistle to be the dominant species present, with a 31% canopy cover across the site. The planted native species bluebunch wheatgrass and Sandberg’s bluegrass, followed with 10% and 9% canopy cover, respectively (Table 14). This is a very young site that is currently dominated by a non-native species, as is typical in an area with recent disturbance. As the site matures and perennial natives become established, the dominance of non-natives is expected to reduce. This site will be monitored again in 2010, and monitoring will continue through 2013.

A shrub monitoring transect was established on the plot and monitored for tubeling survival. Planted sagebrush and antelope bitterbrush were recorded on the transect. In total, 43 sagebrush and 11 bitterbrush were recorded along the 75 meter transect. Results of the first year monitoring showed 84% of the sagebrush alive, with an average height of  $16.3 \pm 4.2$  cm, while 91% of the bitterbrush were alive, with an average height of  $24 \pm 4.4$  cm. This provides a baseline for the site, but also shows that some shrubs have died between the planting and the monitoring. The shrubs on this transect will be monitored for the next four years to track survival, growth, and whether they are blooming and producing seedlings.

**Table 14. Percent Canopy Cover and Frequency of Occurrence at 118-F-6 in 2009.**

Species	% Cover	Freq of Occ %
<i>Salsola kali</i> * (Russian thistle)	30.9	92.0
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	10.4	72.0
<i>Poa sandbergii</i> (Sandberg's bluegrass)	8.7	92.0
<i>Bromus tectorum</i> * (cheatgrass)	1.6	44.0
<i>Sisymbrium altissimum</i> * (tumble mustard)	1.5	40.0
<i>Artemisia tridentata</i> (big sagebrush)	0.1	4.0
<i>Lactuca serriola</i> * (prickly lettuce)	0.1	4.0
<i>Poa bulbosa</i> * (bulbous bluegrass)	0.1	4.0
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	0.1	4.0
<i>Cardaria draba</i> * (whitetop)	X	X
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Purshia tridentata</i> (antelope bitterbrush)	X	X
Biotic crust	0.0	0.0
Bare soil	65.6	100.0
Litter	31.3	96.0
<b>Total canopy cover (litter not included)</b>	<b>53.5</b>	

\* Invasive species

X=present but not counted in plot frames

Total Invasive % Cover 34.2

Total Native % Cover 19.3

**Figure 11. 118-F-6 in 2009.**



First year monitoring transect at 118-F-6.



Monitoring area at 118-F-6.



Transect marker and plot area during first year monitoring.

### **120-F-1**

Vegetation monitoring was performed at 120-F-1 for the first time on May 27, 2009. Russian thistle was recorded with the greatest canopy cover, at 41%, while the native species with the greatest canopy cover was Sandberg's bluegrass, at 10% (Table 15). Species diversity was extremely high at this site for a first year monitoring effort, due to the use of stockpiled fine-grained soil that was used to top-dress the site. This soil had an existing seed bank, and has increased soil-seed contact to promote germination of planted seeds. The presence of the fine-grained soil on this site will provide an interesting data point as years progress, as it is sometimes associated with invasion by non-native species as well.

Sagebrush tubelings were planted on the site, but no monitoring transect was established due to the small size of the plot. Sagebrush was observed in 20% of the plots during this first monitoring. This provides a baseline for comparison in following years.



**Table 15. Percent Canopy Cover and Frequency of Occurrence at 120-F-1 in 2009.**

Species	% Cover	Freq of Occ %
<i>Salsola kali</i> * (Russian thistle)	40.5	100.0
<i>Bromus tectorum</i> * (cheatgrass)	11.8	86.7
<i>Poa sandbergii</i> (Sandberg's bluegrass)	9.7	93.3
<i>Holosteum umbellatum</i> * (jagged chickweed)	6.3	66.7
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	4.0	93.3
<i>Sisymbrium altissimum</i> * (tumble mustard)	2.5	66.7
<i>Draba verna</i> * (spring whitlow)	1.5	60.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	1.2	13.3
<i>Chenopodium leptophyllum</i> * (slimleaf goosefoot)	0.7	26.7
<i>Artemisia tridentata</i> (big sagebrush)	0.5	20.0
<i>Ambrosia acanthicarpa</i> (bur ragweed)	0.3	13.3
<i>Plantago patagonica</i> (Indian wheat)	0.3	13.3
<i>Achillea millefolium</i> (yarrow)	0.2	6.7
<i>Sphaeralcea munroana</i> (Munro's globemallow)	0.2	6.7
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	0.2	6.7
<i>Polemonium micranthum</i> (annual Jacob's ladder)	X	X
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	X	X
<i>Astragalus sclerocarpus</i> (stalked-pod milkvetch)	X	X
<i>Chrysothamnus viscidiflorus</i> (green rabbitbrush)	X	X
<i>Phlox longifolia</i> (longleaf phlox)	X	X
<i>Astragalus caricinus</i> (buckwheat milkvetch)	X	X
<i>Microsteris gracilis</i> (pink microsteris)	X	X
<i>Stipa comata</i> (needle and thread grass)	X	X
<i>Phacelia linearis</i> (threadleaf scorpionweed)	X	X
<i>Oenothera pallida</i> (pale eveningprimrose)	X	X
Biotic crust	0.0	0.0
Bare soil	64.2	100.0
Litter	35.8	100.0
<b>Total canopy cover (litter not included)</b>	<b>79.8</b>	

\* Invasive species

X=present but not counted in plot frames

Total Invasive % Cover 63.3

Total Native % Cover 16.5

**1607-F-1**

First year revegetation monitoring was performed on the 1607-F-1 site on May 27, 2009 (Figure 12). Russian thistle and Sandberg's bluegrass were present in all plotframes, and showed 60% and 14% cover, respectively (Table 16). Species diversity was relatively high for a small, young site, at 19 combined native and non-native species.

**Table 16. Percent Canopy Cover and Frequency of Occurrence at 1607-F1 in 2009.**

Species	% Cover	Freq of Occ %
<i>Salsola kali</i> * (Russian thistle)	60.2	100.0
<i>Poa sandbergii</i> (Sandberg's bluegrass)	13.8	100.0
<i>Sisymbrium altissimum</i> * (tumble mustard)	5.7	93.3
<i>Bromus tectorum</i> * (cheatgrass)	4.3	73.3
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	2.0	80.0
<i>Erodium cicutarium</i> * (storksbill)	0.5	20.0
<i>Draba verna</i> * (spring whitlow)	0.3	13.3
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	0.3	13.3
<i>Festuca octoflora</i> (slender sixweeks)	0.3	13.3
<i>Conyza canadensis</i> * (horseweed)	X	X
<i>Sporobolus cryptandrus</i> (sand dropseed)	X	X
<i>Holosteum umbellatum</i> * (jagged chickweed)	X	X
<i>Lactuca serriola</i> * (prickly lettuce)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	X	X
<i>Grayia spinosa</i> (spiny hosphate)	X	X
<i>Sphaeralcea munroana</i> (Munrow's globemallow)	X	X
<i>Verbena bracteata</i> * (big-bract verbena)	X	X
<i>Tragopogon dubius</i> * (yellow salsify)	X	X
<i>Poa scabrella</i> (pine bluegrass)	X	X
Biotic crust	0.0	0.0
Bare soil	62.2	100.0
Litter	42.3	100.0
<b>Total canopy cover (litter not included)</b>	<b>87.5</b>	

\* Invasive species

X=present but not counted in plot frames

Total Invasive % Cover	71.0
Total Native % Cover	16.5

**Figure 12. 1607-F-1 in 2009.**



Vegetation plot, sagebrush transect marker, and revegetated area at 1607-F-1.

A sagebrush monitoring transect was established and monitored for the first time on May 27, 2009. The transect was set up to be 100.5 meters long, with 33 sagebrush and 1 hopsage recorded along the length. Thirty-two of the 33 sagebrush were alive during the monitoring, for a survival percentage of 97%. The hopsage was also alive. Average sagebrush height was  $18.9 \pm 6.3$  cm. These shrubs will be monitored for the following four years, to determine annual survival, growth, and reproductive success.

### 3.7 100 B/C SITES PLANTED IN 2006

In 2006, waste sites 100-B-1, 128-C-1, and 600-232 in the 100 B/C Area were revegetated after completion of remedial actions to meet the objectives for interim closure as established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area (RDR/RAWP)* (DOE-RL 2005A) and 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* (EPA 1999). The remediated sites that required backfill used material from borrow pit 24, located west of the 100 B/C Area. The 100-B-1 site was backfilled with borrow pit material, then a thin layer of topsoil that was salvaged from the waste staging pile area was spread over the borrow pit material. The 128-C-1 site was backfilled to grade with pit run cobble. The 600-232 site did not require backfill as the site was primarily surface debris that was picked up, with only the top 12 inches of soil being removed from a portion of the site. All three sites were broadcast seeded in winter of 2006 with a native grass seed mix that included Sandberg's bluegrass, needle-and-thread grass, Indian ricegrass, bluebunch wheatgrass, prairie junegrass, and thickspike wheatgrass. Triple-16 fertilizer and polyacrylamide was applied with the grass seed. Upon the completion of seeding, the entire area was irrigated with 23,400 L/ha then mulched with 4.5 metric tons/ha straw and crimped into the soil surface to prevent wind erosion. The sites were then planted with 16,000 sagebrush and 600 spiny hopsage seedlings (Figure 13).

Fourth year vegetation analysis was performed at the 100-B-1 and 128-C-1 sites on May 7, 2009. Sandberg's bluegrass and cheatgrass continued to dominate 100-B-1, with Sandberg's increasing slightly, to 46% cover, and cheatgrass decreasing slightly, to 23% cover (Table 17). Russian thistle cover remains very low at 100-B-1, at only 4%, and sagebrush is now also seen at 4% cover. Species diversity is relatively high on the site, with 13 natives being recorded in 2009. Overall, this information shows that this site has matured quickly, and succession is slowing.

The 128-C-1 site showed Sandberg's bluegrass as the dominant species (34% cover) for the first time, overtaking the previously dominant cheatgrass (33% cover). Native cover remained the same at the site, while invasive species cover increased by ~13% (Table 17). Sagebrush recruits were observed at this site for the first time this year. Native species diversity increased from 6 species in 2008 to 10 species in 2009, while non-native species diversity remained at 7 species.

A sagebrush transect was also monitored at both sites in 2009. At 100-B-1, all sagebrush were surviving that were alive during the 2008 monitoring, and 97% are still alive from 2007. Overall survival is at 54%, and 37% of the shrubs on the transect had bloomed in the previous year. Average shrub height was  $43.9 \pm 17.4$  cm., up from  $32.2 \pm 14.8$  cm. in 2008. The shrubs on this

site have been producing seed since 2007, and recruits are prevalent around the planted shrubs. At 128-C-1 survival is at 55%, and no shrubs were lost since the 2008 monitoring. Average height increased from  $44.1 \pm 14.8$  cm. in 2008 to  $53.11 \pm 15.5$  in 2009. About 65% of shrubs had bloomed in the previous year, and sagebrush recruits were observed for the first time on this site in 2009.

**Figure 13. 100-B-1 and 128-C-1 Sites.**



Sagebrush at the 100-B-1 site, showing 105-B Reactor in the background.



Munro's Globemallow growing at the 128-C-1 site.



Sagebrush recruits from seed produced by planted shrubs at 128-C-1.

**Table 17. Percent Canopy Cover and Frequency of Occurrence  
at 100-B-1 and 128-C-1 in 2009.**

Species	% Cover 100-B-1	% Cover 128-C-1	100-B-1 Freq of Occ %	128-C-1 Freq of Occ %
<i>Poa sandbergii</i> (Sandberg's bluegrass)	46.1	34.2	100.0	100.0
<i>Bromus tectorum</i> * (cheatgrass)	22.9	33.3	100.0	93.3
<i>Salsola kali</i> * (Russian thistle)	4.1	7.2	88.0	86.7
<i>Sisymbrium altissimum</i> * (tumble mustard)	3.6	1.5	48.0	60.0
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	3.5	0.3	24.0	40.0
<i>Draba verna</i> * (spring whitlow)	--	3.5	--	13.3
<i>Artemisia tridentata</i> (big sagebrush)	3.5	1.3	8.0	20.0
<i>Erodium cicutarium</i> * (storksbill)	0.0	X	4.0	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.2	--	8.0	--
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	0.1	3.3	4.0	33.3
<i>Microsteris gracilis</i> (pink microsteris)	0.3	--	12.0	--
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	--	0.3	--	13.3
<i>Machaeranthera canescens</i> (hoary aster)	--	0.2	--	6.7
<i>Lactuca serriola</i> * (prickly lettuce)	0.1	X	4.0	X
<i>Grayia spinosa</i> (spiny hopsage)	0.1	--	4.0	--
<i>Tragopogon dubius</i> (yellow salsify)	X	X	X	X
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	X	--	X	--
<i>Lomatium macrocarpum</i> (bigseed desertparsley)	X	--	X	--
<i>Poa scabrella</i> (pine bluegrass)	X	--	X	--
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X	X	X
<i>Astragalus succumbens</i> (crouching milkvetch)	X	--	X	--
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	--	X	--	X
<i>Verbena bracteata</i> * (big-bract verbena)	--	X	--	X
<i>Chondrilla juncea</i> * (rush skeletonweed)	--	X	--	X
Biotic crust	15.8	0.0	100.0	0.0
Bare soil	46.3	27.7	100.0	100.0
Litter	43.4	61.0	100.0	100.0
<b>Total canopy cover (litter not included)</b>	<b>84.5</b>	<b>85.2</b>		

\* Invasive species

X=present but not counted in plot frames

-- species not present on site

Total Invasive % Cover	30.7	45.5
Total Native % Cover	53.8	39.7
Total Change in Native Cover from 2007	+6.5	0.0

### 3.8 100 B/C SITES PLANTED IN 2007

In 2007, the following waste sites in the 100 B/C Area were revegetated: 100-B-8, a portion of 100-B-14, 100-C-9, 126-B-3, 128-B-2, 128-B-3, 118-B-2, 118-B-3, and 1607-B-2. 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* (RDR/RAWP) (DOE-RL 2005A) and in the Declaration of the Record of Decision for the selected Interim Remedial Action for the 100 Area Remaining Sites: 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-CE-3 Operable Units, CCN 071363, (EPA 1999).

The total area that was revegetated was approximately 100 acres. The sites were backfilled with pit-run gravel from borrow pit 24 and then revegetated by broadcast seeding with a native grass seed mix that included Sandberg's bluegrass, needle-and-thread grass, Indian ricegrass, bluebunch wheatgrass, prairie junegrass, and bottlebrush squirreltail. Triple-16 fertilizer and polyacrylamide was applied with the grass seed. Upon the completion of seeding, the entire area was mulched with 4.5 metric tons/ha straw and crimped into the soil surface to prevent wind erosion. Upon completion of seeding, the sites were planted with sagebrush at approximately 1,300 plants/ha (530 plants/ac).

Third year vegetation monitoring was performed at the 100-C-9 site on May 5, 2009. This site was broken out into three transects to increase the resolution of the monitoring. Transect T1 appears to be doing the best of the three transects. Native plant canopy cover is at 40%, up 16% from 2008 (Table 18). Transects T2 and T3 still have very significant cheatgrass cover, 43% and 40% respectively, but native bunchgrass cover is increasing at these sites. T3 showed a 30% drop in canopy cover of Russian thistle, down to only 3%, while T1 and T2 showed only 2% and 3% cover, respectively. This is a positive sign that this site is maturing and progressing toward a community dominated by native species.

Sagebrush monitoring showed overall survival at 93% for T1, 95% for T2, and 68% for T3. The 2009 monitoring showed very high survival of shrubs that were still alive during the 2008 monitoring, with T1 at 98%, T2 at 100% and T3 at 97% survival. This shows that the shrubs have become well established and are at this point much less subject to high mortality rates (Figure 14). Because of this, it appears that the sagebrush survival at these plots will well exceed the 50% survival goal, but monitoring will continue for two more years to note any changes, and to record the number of blooming shrubs and recruitment.



**Figure 14. 100-C-9 Sagebrush Transects.**



Sagebrush monitoring transect at 100-C-9 T1.



Sagebrush monitoring transect at 100-C-9 T2.

**Table 18. Percent Canopy Cover and Frequency of Occurrence at 100-C-9 in 2009.**

Species	T1 % Cover	T2 % Cover	T3 % Cover	T1 Freq of Occ.	T2 Freq of Occ.	T3 Freq of Occ.
<i>Bromus tectorum</i> * (cheatgrass)	11.7	43.2	39.7	86.7	100.0	100.0
<i>Poa sandbergii</i> (Sandberg's bluegrass)	30.3	10.0	15.0	93.3	100.0	93.3
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	5.2	0.8	1.5	80.0	33.3	60.0
<i>Sisymbrium altissimum</i> * (tumble mustard)	0.3	1.2	4.7	13.3	46.7	86.7
<i>Salsola kali</i> * (Russian thistle)	2.0	3.3	3.0	80.0	100.0	86.7
<i>Holosteum umbellatum</i> * (jagged chickweed)	0.5	3.2	1.7	20.0	33.3	33.3
<i>Artemisia tridentata</i> (big sagebrush)	2.5	0.2	2.0	33.3	6.7	13.3
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	1.3	0.5	0.5	53.3	20.0	20.0
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	--	0.7	1.3	--	26.7	20.0
<i>Centaurea diffusa</i> * (tumble knapweed)	--	0.2	1.3	--	6.7	20.0
<i>Draba verna</i> * (spring whitlow)	0.3	0.7	0.8	13.3	26.7	33.3
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	--	0.5	--	--	20.0	--
<i>Erodium cicutarium</i> * (storksbill)	--	0.3	0.5	--	13.3	20.0
<i>Lactuca serriola</i> * (prickly lettuce)	--	--	0.5	--	--	20.0
<i>Descurainia pinnata</i> (western tansymustard)	0.2	--	0.3	6.7	--	13.3
<i>Eriogonum vimineum</i> (broom buckwheat)	--	0.3	--	--	13.3	--
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	0.2	0.2	--	6.7	6.7	--
<i>Sporobolus cryptandrus</i> (sand dropseed)	--	0.2	--	--	6.7	--
<i>Poa bulbosa</i> * (bulbous bluegrass)	--	0.2	--	--	6.7	--
<i>Epilobium paniculatum</i> (tall willowherb)	--	0.2	--	--	6.7	--
Biotic crust	0.0	0.0	0.0	0.0	0.0	0.0
Bare soil	62.7	57.0	55.5	100.0	100.0	100.0
Litter	34.7	36.7	39.8	93.3	100.0	100.0
<b>Total canopy cover (litter not included)</b>	<b>54.5</b>	<b>65.7</b>	<b>72.8</b>			

\* Invasive species

X=present but not counted in plot frames

Total Invasive % Cover	14.8	52.2	52.2
Total Native % Cover	39.7	13.5	20.7
Change in Native % Cover from 2008	+15.9	+4.7	-6.5

The 118-B-2 and 118-B-3 Burial Grounds were not monitored in 2008, but monitoring was performed again in 2009 (Figure 15). The data for 2009 will be compared to information collected in 2007. Native species diversity increased from 4 in 2007 to 9 in 2009. Native species canopy cover decreased from 27% in 2007 to 12.2% in 2009 (Table 19). The high number in 2007 represents the high germination level of planted native grasses often seen in the first year. This number typically falls off in the second year, because the site cannot support all of the individuals that germinated, and begins to rebound in the subsequent monitorings as individuals that survived begin to grow larger. In 2007 the dominant plant on the site was Russian thistle at 62% cover, in 2009 Russian thistle had 3% cover, while cheatgrass was observed as the dominant species (43% cover).

**Figure 15. 118-B-2 and 118-B-3.**



Vegetation at 118-B-2&3, looking toward 105-B



Vegetation at 118-B-2&3, looking toward 105-C

**Table 19. Percent Canopy Cover and Frequency of Occurrence  
at 118-B-2 and 118-B-3 in 2009.**

Species	% Cover	Freq of Occ %
<i>Bromus tectorum</i> * (cheatgrass)	43.2	100.0
<i>Poa sandbergii</i> (Sandberg's bluegrass)	10.0	100.0
<i>Salsola kali</i> * (Russian thistle)	3.3	100.0
<i>Holosteum umbellatum</i> * (jagged chickweed)	3.2	33.3
<i>Sisymbrium altissimum</i> * (tumble mustard)	1.2	46.7
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	0.8	33.3
<i>Draba verna</i> * (spring whitlow)	0.7	26.7
<i>Achillea millefolium</i> (yarrow)	0.5	20.0
<i>Lactuca serriola</i> * (prickly lettuce)	0.5	20.0
<i>Erodium cicutarium</i> * (storksbill)	0.3	13.3
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	0.2	6.7
<i>Centaurea diffusa</i> * (tumble knapweed)	0.2	6.7
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.2	6.7
<i>Artemisia tridentata</i> (big sagebrush)	0.2	6.7
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	0.2	6.7
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	0.2	6.7
<i>Chaenactis douglasii</i> (hoary falseyarrow)	X	X
Biotic crust	0.5	20.0
Bare soil	57.7	100.0
Litter	56.2	100.0
<b>Total canopy cover (litter not included)</b>	<b>64.5</b>	

\* Invasive species

X=present but not counted in plot frames

<sup>b</sup>Includes Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, needle-and-thread grass, and prairie junegrass seedlings.

Total Invasive % Cover	52.5
Total Native % Cover	12.2
Change in Native % Cover from 2008	-14.5

### 3.9 100 B/C SITES PLANTED IN 2008

In December 2007 and January 2008 the 100-B-14, 118-B-1, and 118-C-1 sites were revegetated. 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 (RDR/RAWP)* (DOE-RL 2005A) and in the Declaration of the Record of Decision for the selected Interim Remedial Action for the 100 Area Remaining Sites: 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-CE-3 Operable Units, CCN 071363, (EPA 1999). These areas were broadcast seeded with a mixture of native grasses including Sandberg's bluegrass, Indian rice grass, bluebunch wheatgrass, prairie junegrass, bottlebrush squirreltail, and needle-and-thread grass. In addition, 134kg/ha of Triple-16 fertilizer was added to the sites along with 4,480 kg/ha of straw mulch that was spread and crimped into the soil surface. Sagebrush plugs were then planted into the seeded areas at 930 plants/ha.

Second year monitoring was performed at 100-B-14 during May of 2009. The monitoring showed an increase in native species canopy cover to 15%, while non-native cover decreased from 41% in 2008 to 25% in 2009 (Table 20). Russian thistle remains the dominant species on the site, but cover decreased significantly from 2008. Cheatgrass cover remains very low, at only 2% cover. This is atypical for a newly revegetated site, and is likely due to the machine-compacted soil conditions on the site. Bluebunch wheatgrass was the dominant native on the site, with 11% cover. Succession on this site will likely be delayed due to the compacted soil conditions. The area will be monitored to observe how these changes will impact the vegetative community on the site.

Two sagebrush transects were established in May of 2008 on the site. These transects were monitored for survival and shrub height in 2009. Transect T1 showed 7% survival and T2 showed 65% survival. Average shrub height at T2 was  $15.8 \pm 3.6$  cm. Transect T1 survival is extremely low for a second year monitoring, and the reason for the low survival is certainly the compacted soil conditions. Tubelings would have struggled to establish root systems in the compacted soils, and moisture penetration into the hard surfaces is likely minimal. Shrubs on T2 fared better, likely because the soil conditions on that portion of the plot happened to be less compacted. The comparison between the two transects is valuable, and is representative of the patchy distribution of compacted and non-compacted areas across this site.

**Table 20. Percent Canopy Cover and Frequency of Occurrence at 100-B-14 in 2009.**

Species	% Cover	Freq of Occ %
<i>Salsola kali</i> * (Russian thistle)	15.8	100.0
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	10.6	96.0
<i>Sisymbrium altissimum</i> * (tumble mustard)	4.3	76.0
<i>Poa sandbergii</i> (Sandberg's bluegrass)	2.4	96.0
<i>Bromus tectorum</i> * (cheatgrass)	2.3	72.0
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	1.6	64.0
<i>Holosteum umbellatum</i> * (jagged chickweed)	1.5	40.0
<i>Draba verna</i> * (spring whitflow)	0.7	28.0
<i>Lactuca serriola</i> * (prickly lettuce)	0.3	12.0
<i>Chorispora tenella</i> (blue mustard)	0.2	8.0
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	0.1	4.0
<i>Centaurea diffusa</i> * (tumble knapweed)	0.1	4.0
<i>Artemisia tridentata</i> (big sagebrush)	0.1	4.0
<i>Epilobium paniculatum</i> (tall willowherb)	0.1	4.0
<i>Tragopogon dubius</i> * (yellow salsify)	0.1	4.0
<i>Festuca octoflora</i> (slender sixweeks)	0.1	4.0
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	0.1	4.0
Biotic crust	0.0	0.0
Bare soil	59.8	96.0
Litter	36.5	96.0
<b>Total canopy cover (litter not included)</b>	<b>40.4</b>	
* Invasive species		
X=present but not counted in plot frames		
Total Invasive % Cover	25.1	
Total Native % Cover	15.3	
Change in Native % Cover from 2008	+7.5	

### 118-B-1

On May 18, 2009, second year vegetation monitoring was performed at the 118-B-1 site (Figure 16). This site is separated into two monitoring areas, the soil staging area (SSA) and burial ground (BG), so that differences can be observed. The soil staging area has soil with a greater proportion of fine-grained material than the burial ground, and because the same planting treatment was performed on each site, the different soil types can be compared in terms of the vegetative community it supports over the 5 years of monitoring.

Second year monitoring showed Russian thistle as the dominant species on the BG as well as on the SSA. The dominant native species were Sandberg's bluegrass and bluebunch wheatgrass (Table 21). Non-native species canopy cover increased to 42% and 43% on the BG and SSA respectively, largely due to the dominance of Russian thistle. This is typical of second year monitoring results. The Russian thistle canopy cover will likely decrease significantly in the next 1-2 years of monitoring, as typically occurs at these revegetated areas. The BG and SSA

plots are relatively weedy, supporting 10 and 11 non-native species respectively. As perennial shrubs and native grasses continue to grow and compete for resources, it is expected that the presence of non-natives will diminish.

Sagebrush monitoring transects are in place on the BG and SSA. The BG sagebrush transect showed 54% survival. Average shrub height was  $25.3 \pm 6.6$  cm which represented ~14 cm of growth since 2008. The SSA transect showed 92% survival. Average shrub height was  $25.4 \pm 7.7$  cm, with an average increase of  $12.1 \pm 6.7$  cm per shrub. The significant difference in survival may be due to the varying soil types of the two areas, further monitoring will help to better define the differences between the two sites.

### **118-C-1**

Second year monitoring was conducted at the 118-C-1 site on May 11, 2009. The site was dominated by bluebunch wheatgrass at 9% cover, followed by Russian thistle at 8% cover (Table 22). Native plant cover increased only slightly from 2008, to 13.7%, while invasive species cover decreased 11%, to 13.5% cover. The majority of this change was the result of the decrease in canopy cover of Russian thistle. Cheatgrass cover remains low at the site, with only 3.5% cover, but it is widespread across the site, showing up in 80% of the plotframes. The site is being naturally reseeded with gray rabbitbrush, which was recorded in 12% of the plotframes.

The sagebrush transect that was established on the site in 2008 was monitored for the second time in 2009. The 2009 monitoring showed overall survival at only 24%, which is low for a second year result. This seems to coincide with the relatively low canopy cover of both native and non-native plants at the plot. There could be several factors that are contributing to these results, but the very low level of fine-grained soil in the backfill material that was used at the site may be playing a significant role. Continued monitoring at the site will show if plants able to become better established at the site over time.

**Figure 16. 118-B-1 in 2009.**



Beginning of the sagebrush transect at 118-B-1 BG looking west.



**Table 21. Percent Canopy Cover and Frequency of Occurrence  
at the 118-B-1 Burial Ground and Soil Staging Area 2009.**

Species	% Cover	% Cover	Freq of Occ %	Freq of Occ %
	BG	SSA	BG	SSA
<i>Salsola kali</i> * (Russian thistle)	33.3	31.1	96.0	96.0
<i>Poa sandbergii</i> (Sandberg's bluegrass)	10.6	6.4	96.0	96.0
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	7.4	8.6	68.0	76.0
<i>Bromus tectorum</i> * (cheatgrass)	6.3	7.3	60.0	60.0
<i>Festuca octoflora</i> (slender sixweeks)	1.7	0.3	12.0	12.0
<i>Sisymbrium altissimum</i> * (tumble mustard)	1.0	2.4	40.0	56.0
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	0.8	0.1	12.0	4.0
<i>Draba verna</i> * (spring whitlow)	0.7	0.1	8.0	4.0
<i>Vulpia myuros</i> * (rattail fescue)	0.1	0.7	4.0	8.0
<i>Melilotus alba</i> * (white sweetclover)	X	0.6	X	4.0
<i>Poa bulbosa</i> * (bulbous bluegrass)	0.3	--	12.0	--
<i>Lactuca serriola</i> * (prickly lettuce)	0.3	0.2	12.0	8.0
<i>Holosteum umbellatum</i> * (jagged chickweed)	0.1	0.3	4.0	12.0
<i>Erodium cicutarium</i> * (storksbill)	--	0.2	--	8.0
<i>Koeleria cristata</i> (prairie junegrass)	0.1	0.1	4.0	4.0
<i>Artemisia tridentata</i> (big sagebrush)	X	0.1	X	4.0
<i>Epilobium paniculatum</i> (tall willowherb)	0.1	--	4.0	--
<i>Centaurea diffusa</i> * (tumble knapweed)	--	0.1	--	4.0
<i>Eriogonum niveum</i> (snow buckwheat)	--	0.1	--	4.0
<i>Lepidium perfoliatum</i> (clasping pepperweed)	--	0.1	--	4.0
<i>Agoseris heterophylla</i> (annual mountain dandelion)	--	0.1	--	4.0
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	X	--	X	--
<i>Machaeranthera canescens</i> (hoary aster)	X	--	X	--
<i>Achillea millefolium</i> (yarrow)	X	X	X	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	--	X	--
<i>Erodium cicutarium</i> * (storksbill)	X	--	X	--
<i>Verbena bracteata</i> * (big-bract verbena)	--	X	--	X
Biotic crust	0.0	0.0	0.0	0.0
Bare soil	45.9	64.6	96.0	100.0
Litter	50.4	30.4	100.0	92.0
<b>Total canopy cover (litter not included)</b>	<b>62.8</b>	<b>58.9</b>		

\* Invasive species

X=present but not counted in plot frames

--=species not observed in area

Total Invasive % Cover	42.1	43
Total Native % Cover	20.7	15.9
Change in Native % Cover from 2008	+9.4	+1.0

**Table 22. Percent Canopy Cover and Frequency of Occurrence at 118-C-1 in 2009.**

Species	% Cover	Freq of Occ %
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	9.2	100.0
<i>Salsola kali</i> * (Russian thistle)	7.6	96.0
<i>Poa sandbergii</i> (Sandberg's bluegrass)	3.8	92.0
<i>Bromus tectorum</i> * (cheatgrass)	3.5	80.0
<i>Sisymbrium altissimum</i> * (tumble mustard)	0.8	32.0
<i>Holosteum umbellatum</i> * (jagged chickweed)	0.6	24.0
<i>Lactuca serriola</i> * (prickly lettuce)	0.6	24.0
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	0.3	12.0
<i>Draba verna</i> * (spring whitlow)	0.2	8.0
<i>Epilobium paniculatum</i> (tall willowherb)	0.2	8.0
<i>Erodium cicutarium</i> * (storksbill)	0.1	4.0
<i>Artemisia tridentata</i> (big sagebrush)	0.1	4.0
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	0.1	4.0
<i>Tragopogon dubius</i> * (yellow salsify)	0.1	4.0
<i>Hordeum leporinum</i> (hare barley)	X	X
<i>Achillea millefolium</i> (yarrow)	X	X
Biotic crust	0.0	100.0
Bare soil	50.3	100.0
Litter	52.3	100.0
<b>Total canopy cover (litter not included)</b>	<b>27.2</b>	

\* Invasive species

X=present but not counted in plot frames

Total Invasive % Cover	13.5
Total Native % Cover	13.7
Change in Native % Cover from 2008	+3.8

### 3.10 100 K AREA

Remedial action of the large liquid waste sites; 116-KE-3, 116-KW-4, 116-K-1, 100-K-55, 100-K-56, and 116-K-2 in the 100-KR-1 Operable Unit was initiated in October 2002, and continued through October 2005. Remediation of the sites was in accordance with the *Amendment to the Interim Action Record of Decision for the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units, Hanford Site, Benton County, Washington* (EPA 1997). Remedial action objectives (RAOs) and remedial action goals (RAGs) for these sites are documented in the *Interim Action Record of Decision for the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units, Hanford Site, Benton County, Washington* (EPA 1995) and the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2005A). The selected remedial action involved (1) excavating the sites to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at the ERDF in the 200 Area of the Hanford Site, and (3) backfilling the sites with clean soil to adjacent grade

elevations. The sites meet cleanup standards and have been reclassified as "interim closed out" in accordance with the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1998) and the Waste Site Reclassification Guideline TPA-MP-14 (RL-TPA-90-0001) (DOE-RL 1998).

In late February 2006, the backfilled sites were broadcast seeded with a mix of native grass seed that included Sandberg's bluegrass, needle-and-thread grass, Indian ricegrass, bluebunch wheatgrass, prairie junegrass, and thickspike wheatgrass. Triple-16 fertilizer and polyacrylamide was applied at the time of seeding. The seeded areas were mulched with 4.5 metric tons/ha straw and crimped into the soil surface to prevent wind erosion. Upon completion of seeding, the sites were planted with 37,000 sagebrush and 600 spiny hopsage seedlings.

The 116-K-2 site was broken up into four transects (T1-T4), for vegetation analysis in order to show results on a finer scale (Figure 17). The transects each extend approximately 100 meters and are laid out along the 116-K-2 (a.k.a., Mile Long Trench) to represent the entire site. Fourth year monitoring was conducted at the site during May of 2009. Transect T1 was dominated by bluebunch wheatgrass (33% cover), while T2, T3, and T4 all showed Sandberg's bluegrass as the dominant species. Cheatgrass was the dominant non-native across all sites, showing 12-32% cover (Tables 23 & 24). Other non-natives show almost no canopy cover on T1, T2, or T3, while T4 still sustained an 11% canopy of Russian thistle. Sagebrush was recorded at 10% cover on T2, with a frequency of occurrence of 33%. Frequency was also high on T1 (33%) and T3 (13%). This is due in part to the increase in the size of existing shrubs, but also that there are now two age classes of sagebrush seedlings growing on the plot, which greatly increases the likelihood of encountering one in a plotframe. All plots showed increases in native plant canopy cover, with T1 showing a 3% increase, T2 a 19% increase, T3 a 9% increase, and T4 a 26% increase.

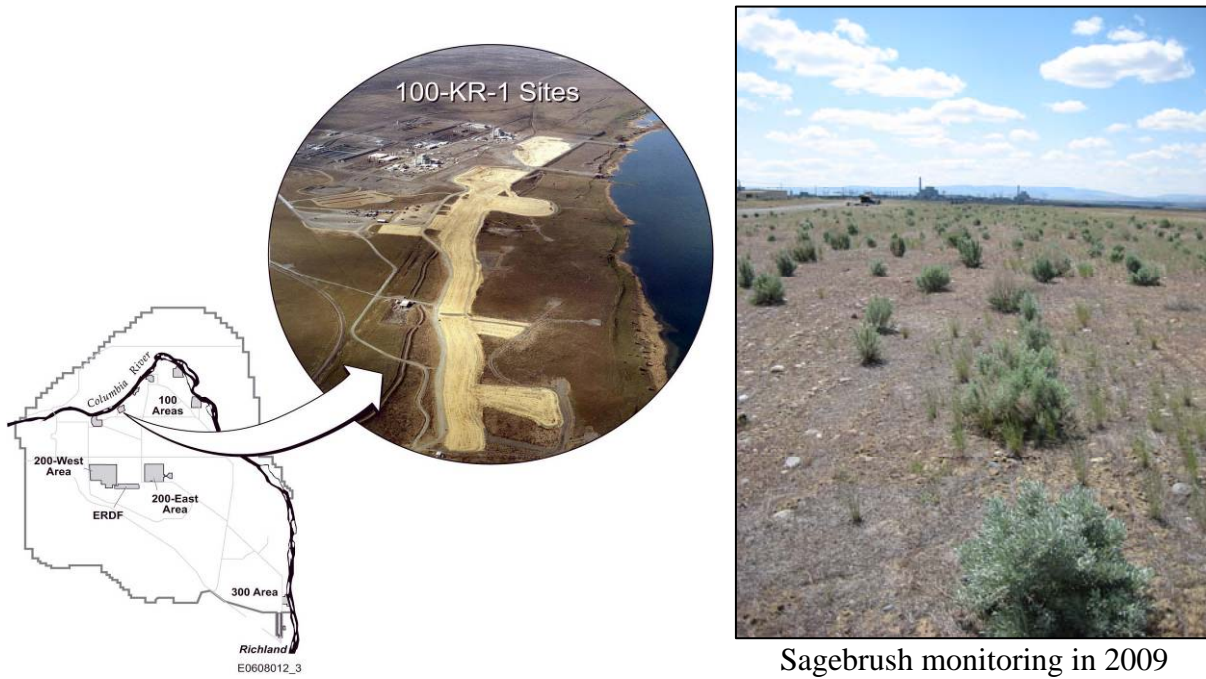
Sagebrush monitoring was performed for the fourth year on these plots. Survival at T1 was at 68%, T2 was at 49%, T3 was 78%, and T4 showed 18% survival. Change in shrub height from 2008 to 2009 was monitored for all transects, but changes were non-normal with large standard deviations. The number of shrubs that died on the transects since the 2008 monitoring was very low, with T1 showing 96% of shrubs monitored in 2008 still alive in 2009, T2 had 96%, T3 had 100%, and T4 had 88%. This shows that the shrubs on the site have become well established, and the remaining shrubs are likely to live and continue to produce seed. Shrubs on the site have been blooming since 2007, and 22% of the T1 shrubs bloomed in the previous year, along with 23% of T2 shrubs, 35% of T3 shrubs, and 67% of T4 shrubs.

The observation was made at these plots that many of the shrubs that died since the 2008 monitoring had bloomed and put on a heavy seed load during the winter following the 2008 monitoring. This is thought to have used up resources needed to make it through to the next season, but was likely responsible for many of the seedlings observed in the plot during the 2009 monitoring. This is potentially a survival strategy designed for the overall success of the sagebrush community.

Overall, T1, T2 and T3 appear to be very successful revegetation efforts. The plots are dominated by native species with relatively few non-natives. The sagebrush survival was high across these plots, and the planted shrubs are producing seed that is germinating successfully on

the plot. These factors make this one of the most successful revegetation efforts to date under this monitoring program. T4 is an outlier in this group. The soil type is mostly gravel and remains compacted even after 4 years. It is also possible that there are some persistent herbicides in the area that may be keeping vegetation from becoming established on portions of the plot. The site does continue to improve and will be monitored for the last time in 2010.

**Figure 17. 100-KR-1 Sites in 2009.**



Revegetated area looking west toward 105-K and 105-KR along the Mile Long Trench, 2009

**Table 23. Percent Canopy Cover at the 116-K-2 (MLT) in 2009.**

<b>Species</b>	<b>T1 % Cover</b>	<b>T2 % Cover</b>	<b>T3 % Cover</b>	<b>T4 % Cover</b>
<i>Poa sandbergii</i> (Sandberg's bluegrass)	6.5	36.3	37.2	33.2
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	32.5	13.0	18.7	11.2
<i>Bromus tectorum</i> * (cheatgrass)	12.8	19.8	11.5	31.8
<i>Sisymbrium altissimum</i> * (tumble mustard)	1.2	0.8	1.2	1.8
<i>Holosteum umbellatum</i> * (jagged chickweed)	0.8	0.7	1.8	0.7
<i>Artemisia tridentata</i> (big sagebrush)	1.7	9.7	1.2	X
<i>Salsola kali</i> * (Russian thistle)	1.7	2.3	2.0	11.3
<i>Centaurea diffusa</i> * (diffuse knapweed)	1.7	0.8	1.2	1.2
<i>Draba verna</i> * (spring whitlow)	1.3	1.0	1.2	5.3
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	--	0.5	1.2	--
<i>Epilobium paniculatum</i> (tall willowherb)	0.5	0.2	0.2	0.3
<i>Lactuca serriola</i> (prickly lettuce)	--	0.3	--	0.3
<i>Microsteris gracilis</i> (pink microsteris)	0.3	--	--	--
<i>Agoseris heterophylla</i> (mountain dandelion)	0.3	0.2	--	0.2
<i>Microsteris gracilis</i> (pink microsteris)	--	0.2	0.2	0.3
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	--	--	0.2	0.3
<i>Tragopogon dubius</i> * (yellow salsify)	0.2	X	X	
<i>Achillea millefolium</i> (yarrow)	X	X	0.2	0.2
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	--	--	0.2	X
<i>Descurainia pinnata</i> (western tansymustard)	--	--	0.2	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	--	--	X
<i>Chondrilla juncea</i> (rush skeletonweed)	X	X	--	--
<i>Machaeranthera canescens</i> (hoary aster)	--	X	--	--
<i>Plantago lanceolata</i> (English plantain)	X	--	--	--
<i>Ambrosia acanthicarpa</i> (bur ragweed)	X	--	--	--
<i>Lupinus spp.</i> (Unknown lupine)	--	--	X	--
<i>Koeleria cristata</i> (prairie junegrass)	--	--	X	--
<i>Astragalus caricinus</i> (buckwheat milkvetch)	--	--	X	--
<i>Chaenactis douglasii</i> (hoary falseyarrow)	--	--	--	X
<i>Hordeum leporinum</i> (hare barley)	--	--	--	X
Biotic crust	8.3	11.0	18.7	0.2
Bare soil	49.8	42.7	42.2	38.2
Litter	46.8	49.2	53.8	61.5
<b>Total canopy cover (litter not included)</b>	<b>61.5</b>	<b>85.8</b>	<b>78.0</b>	<b>98.2</b>

\* Invasive species

X=present but not counted in plot frames

-- species not recorded

Total Invasive % Cover	19.7	25.5	18.8	52.2
Total Native % Cover	41.8	60.3	59.2	46.0
Change in Native Cover from 2007	+2.6	+19.3	+9.4	+25.5

**Table 24. Frequency of Occurrence at the 116-K-2 (MLT) in 2009.**

<b>Species</b>	<b>T1 Freq of Occ.</b>	<b>T2 Freq of Occ.</b>	<b>T3 Freq of Occ.</b>	<b>T4 Freq of Occ.</b>
<i>Poa sandbergii</i> (Sandberg's bluegrass)	93.3	100.0	100.0	93.3
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	93.3	80.0	80.0	66.7
<i>Bromus tectorum</i> * (cheatgrass)	100.0	93.3	80.0	100.0
<i>Sisymbrium altissimum</i> * (tumble mustard)	46.7	33.3	46.7	40.0
<i>Holosteum umbellatum</i> * (jagged chickweed)	33.3	26.7	40.0	26.7
<i>Artemisia tridentata</i> (big sagebrush)	33.3	33.3	13.3	X
<i>Salsola kali</i> * (Russian thistle)	66.7	93.3	80.0	100.0
<i>Centaurea diffusa</i> * (diffuse knapweed)	66.7	33.3	46.7	46.7
<i>Draba verna</i> * (spring whitlow)	53.3	40.0	46.7	53.3
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	--	20.0	13.3	X
<i>Epilobium paniculatum</i> (tall willowherb)	20.0	6.7	6.7	13.3
<i>Lactuca serriola</i> (prickly lettuce)	--	13.3	--	13.3
<i>Microsteris gracilis</i> (pink microsteris)	13.3	--	--	--
<i>Agoseris heterophylla</i> (mountain dandelion)	13.3	6.7	--	6.7
<i>Microsteris gracilis</i> (pink microsteris)	--	6.7	6.7	13.3
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	--	--	6.7	13.3
<i>Tragopogon dubius</i> * (yellow salsify)	6.7	X	X	--
<i>Achillea millefolium</i> (yarrow)	X	X	6.7	6.7
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	--	--	6.7	X
<i>Descurainia pinnata</i> (western tansymustard)	--	--	6.7	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	--	--	--
<i>Chondrilla juncea</i> (rush skeletonweed)	X	X	--	--
<i>Machaeranthera canescens</i> (hoary aster)	--	X	--	--
<i>Plantago lanceolata</i> (English plantain)	X	--	--	--
<i>Ambrosia acanthicarpa</i> (bur ragweed)	X	--	--	--
<i>Lupinus spp.</i> (Unknown lupine)	--	--	X	--
<i>Koeleria cristata</i> (prairie junegrass)	--	--	X	--
<i>Astragalus caricinus</i> (buckwheat milkvetch)	--	--	X	--
<i>Chaenactis douglasii</i> (hoary falseyarrow)	--	--	--	X
<i>Hordeum leporinum</i> (hare barley)	--	--	--	X
Biotic crust	73.3	80.0	80.0	6.7
Bare soil	100.0	100.0	100.0	100.0
Litter	100.0	100.0	100.0	100.0

## 4.0 HORSESHOE LANDFILL

The Horseshoe Landfill is located on the Fitzner-Eberhardt Arid Lands Ecology Reserve and served as a military landfill for the nearby Nike missile base. Figure 18 provides a map of the Horseshoe Landfill location. The Horseshoe Landfill is a former CERCLA waste site that was part of the 1100-IU-1 Operable Unit. In 1994, approximately 1,911 m<sup>3</sup> of soil contaminated with DDT and other hazardous material and debris were excavated from the landfill (DOE-RL 1996). It was remediated as part of the activities outlined in the ROD for the 1100 Area National Priorities List site (EPA 1993) and was removed from the National Priorities List in 1996 (61 *Federal Register* 51019). The primary contaminant of concern at this site was dichlorodiphenyltrichloroethane (DDT).

Post-closure biota sampling and soil sampling performed between 1998 and 2003 at the site indicated that concentrations of DDT and its breakdown products dichlorodiphenyldichloroethylene (DDE) and dichlorodiphenyldichloroethane (DDD) were present in low concentrations within the landfill surface soils exceeding the 1994 cleanup criteria of 1 mg/kg (DOE-RL 2002).

The May 2005, remediation of the Horseshoe Landfill was initiated in response to post-closure surface soil sampling performed between 1998 and 2003 that indicated the presence of residual DDT contamination exceeding the cleanup criteria of 1 mg/kg that was established for the original 1994 cleanup activities (EPA 1993). The original cleanup level for DDT was based on *Washington Administrative Code* [WAC] 173-340-740, Method A. However, for this additional remediation, the DDT was removed to meet the more stringent ecological soil indicator concentration for protection of terrestrial plants and animals for total DDT/DDE/DDD of 0.75 mg/kg (WAC 173-340, Table 749-3).

Remediation of the Horseshoe Landfill was initiated on May 17, 2005, and completed on August 24, 2005. Approximately 4,935 bulk cubic meters (bcm) of contaminated soil was excavated from the landfill and disposed of at the ERDF. On the return trip, the remediation contractor hauled clean soil (excavated during ERDF construction) back to the Horseshoe Landfill and stockpiled it for use as backfill material. Prior to stockpiling, the top 46 cm of native soil was pushed to the side for redistribution across the soil staging area upon completion of the project.

The Horseshoe Landfill (HSLF) and clean soil staging area (SSA) were revegetated with native species the first week of February 2006. In preparation for broadcast seeding the area, the top 23 cm of soil was loosened with a spring tooth implement. The Horseshoe Landfill and soil staging area were seeded with Sandberg's bluegrass, Indian ricegrass, bluebunch wheatgrass, and needle-and-thread grass. The areas were fertilized with triple-16 fertilizer and treated with polyacrylamide to facilitate successful germination and to reduce wind erosion. The seeded areas were mulched with grass straw and crimped into the soil to prevent the straw from blowing away. The landfill and soil staging area were planted with sagebrush seedlings propagated by two native plant nurseries from seed collected on the Hanford Site and grown in 10-in containers.



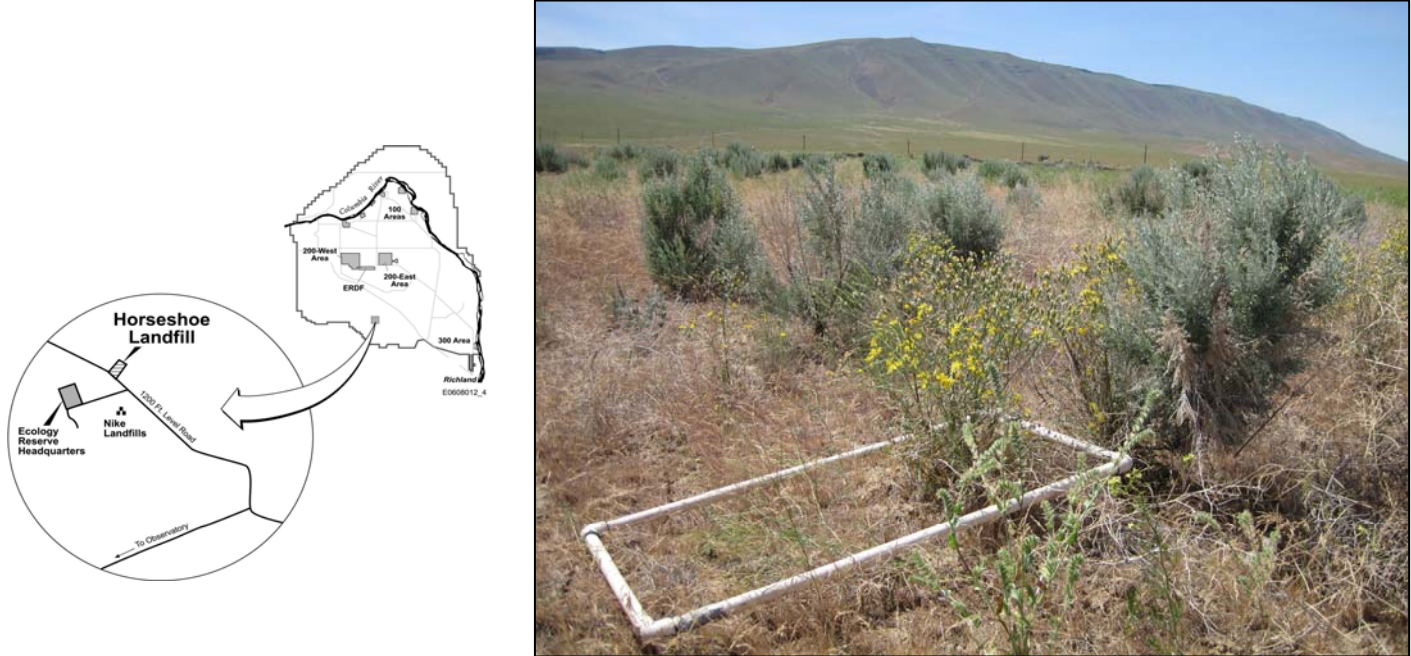
The landfill and soil staging area are being monitored separately as the landfill was backfilled with Rupert sand imported from the 200 West Area while the soil staging area has Ritzville silt-loam that is native to this location.

Fourth year vegetation and sagebrush monitoring was conducted on the HSLF site on June 3, 2009. Native vegetation dominated non-native species on both the landfill and staging area. Native species canopy cover was at 50% on the landfill, down 11.2% from 2008, while native species covered 62.5% at the SSA (Table 25). Invasive species cover was up slightly from 2008 on the HSLF, to 12% from 4% in 2008, while it was down from 34% in 2008 to only 18% in 2009 on the SSA. The decrease in native plant cover at the HSLF was caused by a reduction in canopy cover of Sandberg's bluegrass, it is not known why the reduction occurred, but the timing of the monitoring, as well as seasonal moisture levels, may have impacted this result. Russian thistle was present at a 17% canopy cover on the SSA in 2008, but only showed 1.3% in 2009. This change is typical of a site that is maturing and becoming dominated by perennial native species.

A single Piper's daisy (*Erigeron piperianus*) was observed on the HSLF during the 2009 monitoring. Piper's daisy is on the Washington State Sensitive Species List, thus this plant, and any potential offspring, will be observed and recorded during the 2010 monitoring.

Sagebrush monitoring was also performed at the two plots in 2009. Four sagebrush transects are monitored at the sites, T1/T2 at the landfill, and T3/T4 at the SSA. Combined survival at the T1/T2 transects was 68%, down only slightly from the 71% survival observed in 2008. Survival at the T3/T4 sites was 71%, while 2008 monitoring showed 72% survival. On the HSLF, 96% of shrubs had bloomed the previous winter, while 91% bloomed on the SSA. This data shows that the shrubs on the site have stabilized and become well established, and the presence of second year recruits (Figure 18) reinforces that this is a successful sagebrush re-introduction.

**Figure 18. Horseshoe Landfill and Soil Staging Area Sites.**



Slender hawksbeard at the Soil Staging Area with Rattlesnake Mountain, 2009.



Sagebrush recruits at the Soil Staging Area, 2009.



Horseshoe Landfill revegetation showing sagebrush and lupines, 2009.

**Table 25. Percent Canopy Cover at the Horseshoe Landfill and Soil Staging Area in 2009.**

Species	HSLF % cover	SSA % cover	HSLF Freq of Occ	SSA Freq of Occ
<i>Poa sandbergii</i> (Sandberg's bluegrass)	42.7	45.1	96.0	100.0
<i>Artemisia tridentata</i> (big sagebrush)	2.3	12.3	32.0	56.0
<i>Bromus tectorum</i> * (cheatgrass)	10.5	11.2	92.0	96.0
<i>Sisymbrium altissimum</i> * (tumble mustard)	0.3	5.6	12.0	68.0
<i>Lupinus leucophyllus</i> (velvet lupine)	X	1.9	X	20.0
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	1.8	--	32.0	--
<i>Crepis artrabarba</i> (slender hawkbeard)	--	1.5	--	4.0
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	1.3	0.8	32.0	12.0
<i>Salsola kali</i> * (Russian thistle)	1.1	1.3	44.0	52.0
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	1.1	X	24.0	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	--	0.5	--	20.0
<i>Machaeranthera canescens</i> (hoary aster)	0.4	--	16.0	--
<i>Lactuca serriola</i> * (prickly lettuce)	0.2	--	8.0	--
<i>Epilobium paniculatum</i> (tall willowherb)	0.1	0.2	4.0	8.0
<i>Festuca octoflora</i> (slender sixweeks)	--	0.2	--	8.0
<i>Agropyron cristatum</i> (crested wheatgrass)	0.1	--	4.0	--
<i>Tragopogon dubius</i> (yellow salsify)	0.1	X	4.0	X
<i>Chondrilla juncea</i> (rush skeletonweed)	X	--	X	--
<i>Erigeron filifolius</i> (threadleaf fleabane)	X	--	X	--
<i>Bromus japonicus</i> (Japanese brome)	X	--	X	--
<i>Erigeron piperianus</i> (piper's daisy)	X	--	X	--
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	--	X	--
<i>Phlox longifolia</i> (longleaf phlox)	--	X	--	X
<i>Achillea millefolium</i> (yarrow)	--	X	--	X
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	--	X	--	X
Biotic crust	0.0	31.0	0.0	96.0
Bare soil	75.8	39.7	100.0	100.0
Litter	14.1	38.2	100.0	100.0
<b>Total canopy cover (litter not included)</b>	<b>62.0</b>	<b>80.6</b>		

\* Invasive species

X=present but not counted in plot frames

Total Invasive % Cover	12.1	18.1
Total Native % Cover	49.9	62.5
Change in Native % Cover from 2008	-11.2	+0.2

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## 5.0 600 AREA SITES

Remedial action of waste sites 600-111 and 600-149 within the 600-IU-2 Operable Unit were initiated in 2008. The remedial action objectives and goals were established by the U.S. Environmental Protection Agency and the Washington State Department of Ecology, in concurrence with the U. S. Department of Energy, Richland Operations Office and documented in the *Declaration of the Record of Decision for the selected Interim Remedial Action for the 100 Area Remaining Sites: 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-CE-3 Operable Units*, (EPA 1999). The sites were excavated to the extent required to meet specified soil cleanup levels, the contaminated materials were disposed of at the ERDF, and the sites were backfilled and contoured to match the adjacent area in December 2008. These areas were broadcast seeded with a mixture of native grasses including Sandberg's bluegrass, Indian rice grass, bluebunch wheatgrass, prairie junegrass, bottlebrush squirreltail, and needle-and-thread grass. In addition, 134kg/ha of Triple-16 fertilizer was added to the sites along with 4,480 kg/ha of straw mulch that was spread and crimped into the soil surface. Sagebrush and bitterbrush plugs were then planted into the seeded areas at 1,235 plants/ha.

### 600-111

The revegetation at the 600-111 site was monitored for the first time on May 18, 2009 (Figure 19). As is the case in most first year monitoring at revegetated sites, Russian thistle was the dominant species, with 34% canopy cover across the sites (Table 26). The planted bluebunch wheatgrass and Sandberg's bluegrass followed, in terms of greatest canopy cover, at 15% and 14%, respectively. These three species, along with tumbled mustard, were present in all vegetation plots that were measured. Cheatgrass showed 8% cover, and other native and non-native species were present in small numbers. Nine native species were observed on the site, along with 10 non-native species. This number will be tracked to note changes in species diversity as the site matures.

A shrub monitoring transect was established this year to provide a reference for shrub survival across the plot. Planted sagebrush and spiny hopsage tubelings were recorded along the transect. Fifty-seven sagebrush and 12 hopsage were recorded along the 97 meter long transect. Sagebrush survival was recorded at 72%, while 100% of hopsage were alive during this first monitoring. Average sagebrush height was recorded at  $17.1 \pm 5.7$  cm, while hopsage averaged  $11.8 \pm 4.1$  cm. Monitoring of these shrubs will continue for the next four years.

**Figure 19. Site 600-111 in 2009.**



Vegetation Monitoring at 600-111.



Transect area at 600-111.



Vegetation at 600-111 during the first year of monitoring.



Revegetated area at 600-111.



Vegetation Monitoring at 600-111.

**Table 26. Percent Canopy Cover and Frequency of Occurrence at 600-111 in 2009.**

<b>Species</b>	<b>% Cover</b>	<b>Freq of Occ %</b>
<i>Salsola kali</i> * (Russian thistle)	34.0	100.0
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	15.3	100.0
<i>Poa sandbergii</i> (Sandberg's bluegrass)	13.8	100.0
<i>Sisymbrium altissimum</i> * (tumble mustard)	8.2	100.0
<i>Bromus tectorum</i> * (cheatgrass)	7.8	86.7
<i>Draba verna</i> * (spring whitlow)	0.7	26.7
<i>Holosteum umbellatum</i> * (jagged chickweed)	0.3	13.3
<i>Poa bulbosa</i> * (bulbous bluegrass)	0.3	13.3
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	0.3	13.3
<i>Achillea millefolium</i> (yarrow)	0.2	6.7
<i>Artemisia tridentata</i> (big sagebrush)	0.2	6.7
<i>Ambrosia acanthicarpa</i> (bur ragweed)	0.2	6.7
<i>Polemonium micranthum</i> (annual Jacob's ladder)	X	X
<i>Chenopodium leptophyllum</i> * (slimleaf goosefoot)	X	X
<i>Melilotus alba</i> * (white sweetclover)	X	X
<i>Descurainia pinnata</i> (western tansymustard)	X	X
<i>Lepidium perfoliatum</i> * (clasping pepperweed)	X	X
<i>Triticum aestivum</i> * (wheat)	X	X
<i>Stipa comata</i> (needle-and-thread grass)	X	X
Biotic crust	0.0	0.0
Bare soil	56.8	100.0
Litter	41.5	100.0
<b>Total canopy cover (litter not included)</b>	<b>81.3</b>	
* Invasive species		
X=present but not counted in plot frames		
Total Invasive % Cover	51.3	
Total Native % Cover	30.0	

**600-149**

The revegetation effort on 600-149 site was monitored for the first time on June 1, 2009. The planted native grasses, bluebunch wheatgrass and Sandberg's bluegrass dominated the site, with 30% and 18% cover respectively (Table 27). This is likely the over-germination often seen following a revegetation effort, these numbers will likely fall off next year, as the site will not be able to support such a high number of individuals. This is the typical trend. The site will continue to be monitored to determine if it matures as expected, or if it varies from the norm.

Shrubs were planted on the plot, but because of the small area that was planted, no shrub monitoring transect was established. The shrubs are expected to be recorded in vegetation monitoring plots in the coming years.

**Table 27. Percent Canopy Cover and Frequency of Occurrence at 600-149 in 2009.**

Species	% Cover	Freq of Occ %
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	29.5	100.0
<i>Poa sandbergii</i> (Sandberg's bluegrass)	17.8	100.0
<i>Salsola kali</i> * (Russian thistle)	13.7	93.3
<i>Sisymbrium altissimum</i> * (tumble mustard)	4.3	73.3
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	1.5	60.0
<i>Bromus tectorum</i> * (cheatgrass)	1.2	46.7
<i>Draba verna</i> * (spring whitlow)	1.2	46.7
<i>Chenopodium album</i> * (lamb's quarters)	0.3	13.3
<i>Melilotus alba</i> * (white sweetclover)	0.3	13.3
<i>Plantago patagonica</i> (Indian wheat)	0.2	6.7
<i>Lactuca serriola</i> * (prickly lettuce)	0.2	6.7
<i>Chorispora tenella</i> * (blue mustard)	X	X
<i>Descurainia pinnata</i> (western tansymustard)	X	X
<i>Vulpia myuros</i> * (rattail fescue)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	X	X
<i>Grayia spinosa</i> (spiny hopsage)	X	X
Biotic crust	0.0	0.0
Bare soil	45.8	100.0
Litter	50.7	100.0
<b>Total canopy cover (litter not included)</b>	<b>70.2</b>	

\* Invasive species

X=present but not counted in plot frames

Total Invasive % Cover	21.2
Total Native % Cover	49.0

## 6.0 REVEGETATION MITIGATION

In 2003, the Environmental Restoration Disposal Facility (ERDF) began Phase III expansion to construct cells 5 and 6. Construction of the new cells occurred entirely within the disturbed footprint of the ERDF fence. However, an area south of the perimeter fence was impacted by placement of the overburden pile. The Mitigation Action Plan for ERDF was updated to develop appropriate mitigation strategies for this and future expansions (DOE-RL 2005B).

At the time of the initial construction of the ERDF in 1995, a majority of the 4.1 km<sup>2</sup> (1.6 mi<sup>2</sup>) area was dominated by mature sagebrush and late successional grasses and forbs and considered high quality, Level III habitat, as defined in BRMaP (DOE-RL 2001). 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. The large fire in the summer of 2000 burned most of the 4.1 km<sup>2</sup> (1.6 mi<sup>2</sup>) area identified for future ERDF expansion. Although the area has started to recover, 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, however, live mature sagebrush are sparse and the area now meets the definition of Level II habitat. However, since the understory of grasses and forbs are still intact and a small component of sagebrush still exists, some level of mitigation/rectification was needed. The Mitigation Action Plan 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 acres) of mitigation be performed.

To maximize the effectiveness of the mitigation effort, sagebrush was planted on 25-ha (62 acres) that included four 4-ha (10 acre) islands separated by 100 meters (328 ft) in February 2007. Each island was planted at a density of 1,000 plants per hectare (400 plants/acre). The areas between the islands were planted at a density of 444 plants per hectare (180 plants/acre) in an area south of ERDF that straddles the Army Loop Road (Figure 20). This configuration takes advantage of the Army Loop Road, which could serve as fire break or natural location to fight a fire if one should threaten this area.

In addition to planting sagebrush, ten artificial burrowing owl nest boxes were installed in the area (Figure 21). Burrowing owls have been observed in this area previously, and this will increase the opportunity for nesting pairs to become established in the area.





The burrowing owl nest boxes were maintained and monitored during 2009. There is some information in the available literature that shows that disturbance around the entry of an artificial burrow may attract owls. So during maintenance, which typically involves removing soil and debris from the opening of the tunnels, soil was dug out in front of the entry to imitate the soil mound at the opening of a badger burrow (Figure 21). Subsequent monitoring showed no burrowing owl activity in the area during the spring/summer of 2009.

**Figure 21. Burrowing Owl Nest Box Maintenance.**



Burrowing Owl nest box entrance before maintenance.



Burrowing owl nest box entrance after maintenance.

Third year monitoring was performed at the two sagebrush transects during March of 2009 (Figure 22). The northeast plot had shown significant die-off in 2008 monitoring, down to 26% survival. In 2009, 86% of the shrubs recorded in 2008 were still alive. Overall survival at the northeast plot was recorded at 22%. The southwest plot has fared better, showing survival at 36%, with 95% surviving from 2009. The significant die-off seen in the second year of monitoring appears to have slowed, and the remaining shrubs on the site appear to be doing well. The shrubs will likely begin to produce seed, and potentially recruits, during the next two years of monitoring. The success of this revegetation may be considered low, with regard to sagebrush survival, but these shrubs are the only sagebrush that exist within a very large area around the plot. Establishing some sagebrush in the area now could some help sagebrush obligate species use this area in the future, where otherwise no shrubs may have reseeded naturally.

**Figure 22. ERDF Mitigation on Army Loop Road.**



Side-blotched lizard (*Uta stansburiana*) observed during monitoring.



Planted sagebrush with existing native understory at the Army Loop Mitigation Site.

## 7.0 BAT MITIGATION PROJECTS

Bat mitigation projects have been conducted at 2 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, where they 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 2001). The mitigation projects conducted at the reactor sites included establishing the process water tunnels at D Area as alternative roost sites and installing artificial roost boxes at 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 are using that facility. The facility is slated for eventual demolition, so a mitigation plan was needed to determine the path forward for this facility and the bats occupying it.

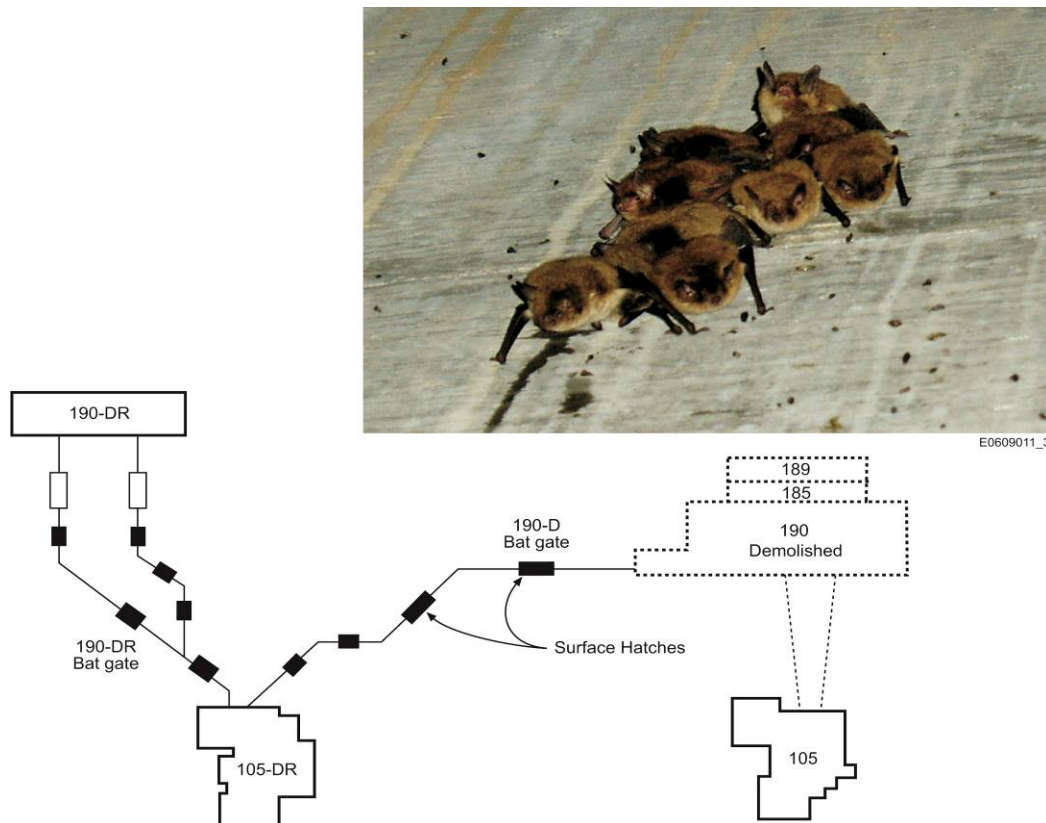
### **Bat Mitigation at 100-D Area**

The mitigation project at 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 in a letter from James D. Goodenough to S. D. Liedle, dated July 28, 1998, (CCN# 060625) 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 23). 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. The original purpose of these tunnels was to provide the primary cooling water supply for the 105-DR Reactor (Figure 24). The non-contaminated process water tunnels are built with a zig-zag design to allow for expansion of the piping. Each straight leg of the tunnels contains 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 23. 190-DR Bate Gate.**



**Figure 24. 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 the year 2000; however a small number of bats were observed emerging from the gates in August 2000 approximately 1 hour after sun-down 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. 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 have been conducted from 2002 to 2005 and the number of bats roosting in the hatches was counted. The numbers counted were: 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. The bats appeared to roost at all 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 ranging from 5 to 50. These clusters are maternity colonies consisting of mothers with their young.

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 found roosting as individuals and 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, and 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.

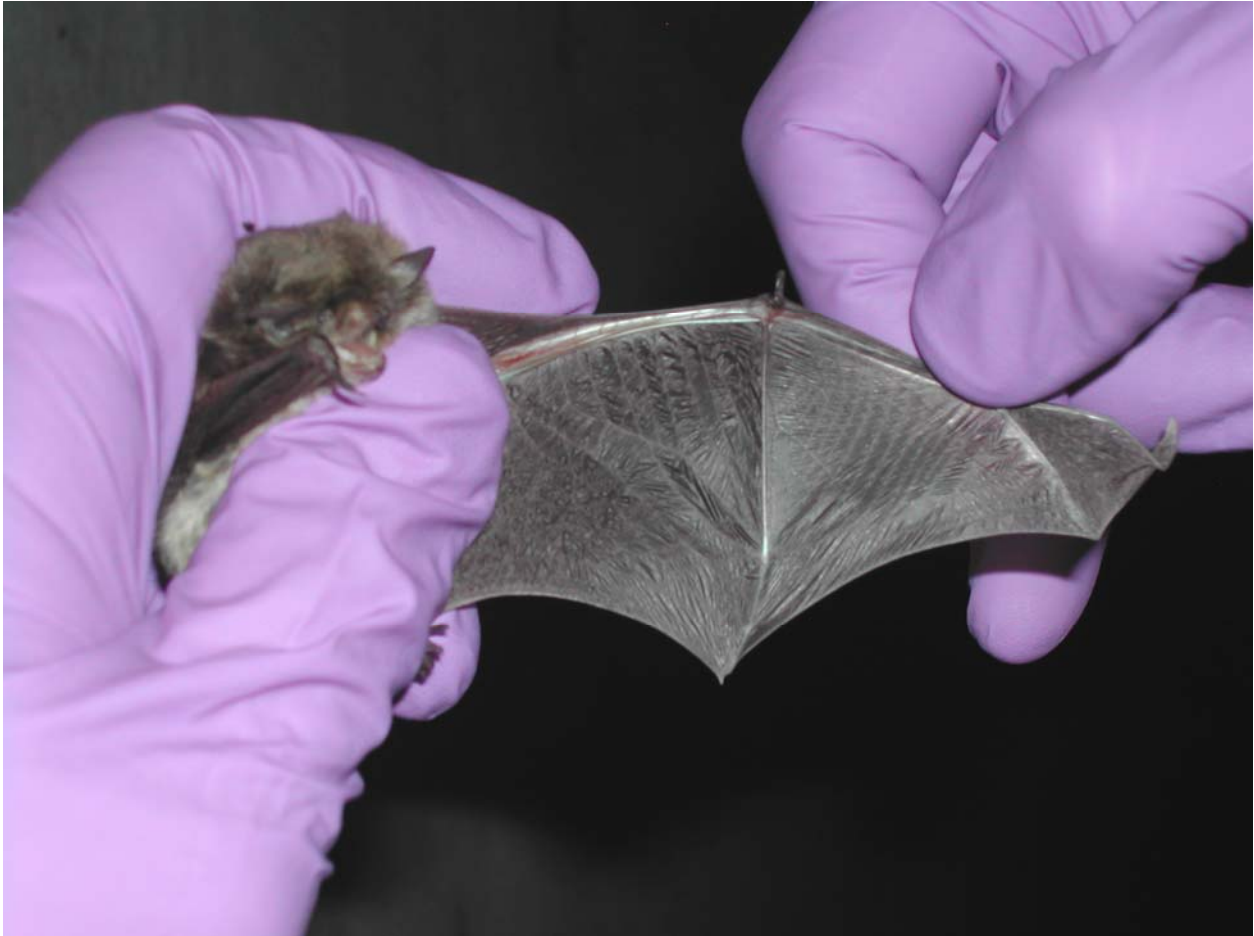
In 2007, mist netting was performed at the 190-DR process water tunnel, in order to capture bats. This was done in conjunction with other bat monitoring activities going on the 183-F Clearwell. The purpose was to determine which species were present and to determine genetic relationships of the bats at the D Area site to bats of the same species in the 183-F Clearwell. Morphometric measurements and DNA samples were collected to definitively determine the species and any genetic relationships between the 2 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 4 on September 11, 2007 (Figure 25). The population was a mix of adults and juveniles, and only 3 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 and 108 bats were counted on the video. Several clusters of 10-25 bats were observed, indicating the hatches are again being used as a maternity roost. Two data loggers were deployed during the same entrance; they will log temperature/relative humidity data at the roost sites. This data will be compared to that found in the 183-F Clearwell, to see how the temperature trends compare between the structures.

A walkdown was performed to assess the number of bats using the roost on September 22, 2008. The total number of bats observed in the 190-DR tunnel was 67.

Monitoring in 2009 included entry into the 190-DR tunnel, on September 16, 2009, to video-tape bats and capture individuals. The video photography is used to count the total number of bats using the structure, and captured individuals are assessed to determine species, sex, age, and reproductive status. During the entry, 2 nulliparous adult females (individuals that have never give birth), 2 parous adult females (individuals that have given birth), and 3 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, indicating the site is still functioning as a maternity roost. This number is up slightly from the number recorded in 2008, but is not near the 170 recorded in July of 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.



**Figure 25. 190-DR Tunnel Entry.**



Yuma myotis captured during the monitoring entry at 190-DR.

The status of bats and their roost sites in the 100-D Area is becoming increasingly complex. In addition to the two known roost sites in the two tunnel systems, bat activity has recently been discovered at the 183-D Water Treatment Facility. It is unknown at this time if an additional roost site exists within the 183-D facility. Monitoring at this site will continue during the next year. Further monitoring may help to establish if existing colonies are shifting to new locations, if one colony is supplying recruits to the new roost site, or if colonies are unrelated.

#### **Bat Mitigation at 100-F Reactor**

Bats had been 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 (*Antrozous pallidus*) 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 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 2-inch 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 insure the bats could get out. The slotted door was left in place for one 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 8 commercially made bat roosts (Figure 26). Bat boxes designed to house pallid bats were installed on the east side of the building (boxes 1 & 2), the south side (boxes 4 & 6), the west side of the building (box 7), and one on a utility pole approximately 50 m NE of the building (box 8). Two boxes designed for *Myotis* bats were installed on the south side of the building (boxes 3 & 5).

Follow-up surveys confirmed that the pallid bats were utilizing the houses mounted on the building. Because of the difficulty in 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 number 1 exclusively. Very few *Myotis* bats were observed roosting in bat boxes designed for them (boxes 3 and 5).

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

In 2006, the pallid bats began returning to the roost site at 105-F Reactor in April. Fresh pallid bat guano was observed under the boxes on April 11, 2006. During the spring months (April & 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 & 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 how many could be 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 could have been as high as 80 individuals. This is a substantial increase since the mitigation project began in 2003 when the population was estimated to be approximately 30.

Due to the excavation of waste sites around the 105-F Reactor building, no surveys or counts were conducted at the bat houses in 2007. Visual inspections, as well as acoustic surveys and the presence of bat guano confirmed that the Pallid bats did return in 2007.

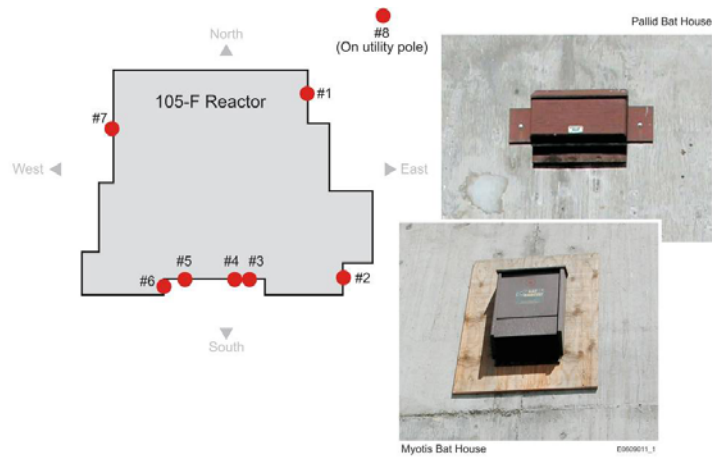
On September 25, 2008, mist netting was conducted at the 105-F Reactor to determine if the roost site was still active. Pallid bats were observed in 3 of the 8 boxes (boxes 2, 7, and 8). Nine pallid bats and one *Myotis yumanensis* were captured in two nets. All of the pallid bats were

female and some appeared to have given birth this year indicating this is still a successful 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 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 nulliparous juvenile pallid bats were captured in the mist nets (Figure 26), showing that this 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 calls of the bat were recorded, as intended, but the bat was also observed entering the eave of the 105-F reactor roof. This shows that bats may potentially be using the eaves of the 105-F reactor roof for roosting habitat. There is still evidence, in the form of guano, that bats are using the bat houses around the different sides of the reactor. A video camera was placed on Bat Houses #2 and #4 to record emergence for 1 hour. No bats were observed exiting House #2, but between 19 and 34 pallid bats were observed using Box #4. Over the hour, bats were observed entering and exiting the box, so an exact count was not possible.

During monitoring at the 105-F reactor, acoustic detectors were being used to record bat echolocation calls. Many pallid bat calls were recorded, including several “social calls” which the bats are using for communication rather than navigation. These “social calls” are diagnostic of pallid 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 small-footed myotis, and five western pipistrel (*Pipistrellus hesperus*) calls were recorded on August 31, 2009. This shows the high level of bat activity in the area included multiple species, which is another indication of how ideal the area is for supporting bats.

**Figure 26. Mitigation Monitoring at 105-F Reactor.**



Location of bat houses placed around the 105-F Reactor.



Female pallid bat captured at the 105-F during 2009 monitoring.

### **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. 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 make 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 endstate options.

A combination of morphological measurements, acoustic analysis of echolocation calls, and DNA analysis was performed on bats collected during 2007 and 2008, and this data was used for species determination. The initial morphological measurements and acoustic analysis indicated that the colony is composed of Yuma Myotis (*Myotis yumanensis*). Results from the DNA analysis of skin tissue samples confirmed the identification as Yuma Myotis.

The results of the bat study at the 183-F clearwell showed 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 of 2009 the DOE sent a letter to WCH staff stating that they intend to maintain the 183-F clearwell and flume long term, and in order to allow the colony to thrive, they instructed WCH to install passive human-access restrictions to the facility including signs and fencing (Figure 27). The fencing and signage were constructed in April of 2009.

**Figure 27. Fencing and Signage at the 183-F Flume Entrance.**



Mitigation monitoring was performed at the 183-F clearwell and flume during August of 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 8 Yuma myotis and 1 small-footed myotis were captured in the mist nets. There were 5 nulliparous female Yuma myotis and 3 parous female Yuma myotis; all individuals were adults. The small-footed myotis was a non-reproductive adult male (Figure 28). When released, the 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 this is not an indication that a second species is using the facility as a maternity roost.

Video monitoring was performed for one hour at the clearwell hatch and one hour at the flume entrance beginning at the start of the emergence. A total of 2367 bats were counted over 62 minutes of emergence at the 183-F clearwell hatch. The emergence was observed to continue for

**Figure 28. 183-F Clearwell Bat Work.**

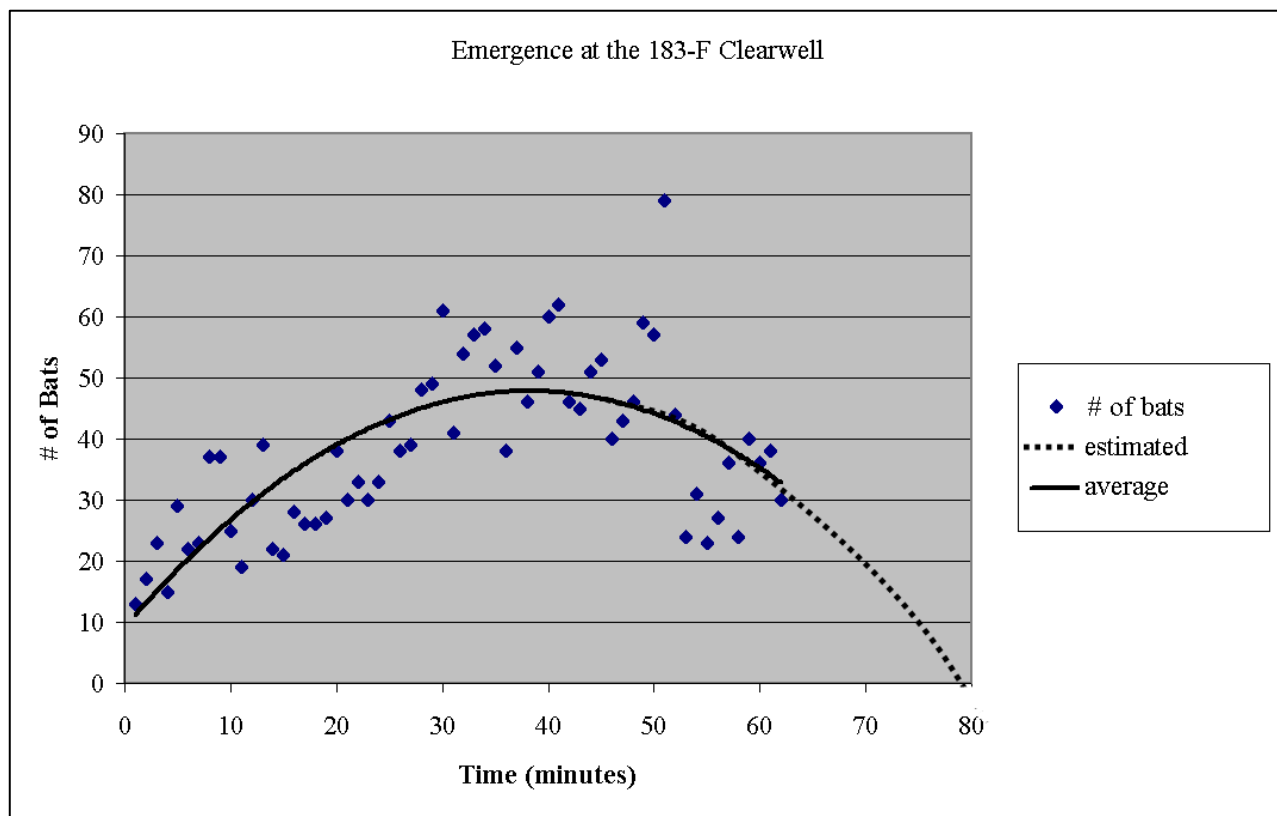


Small-footed myotis captured at the 183-F clearwell, showing lanyard attached for controlled release to allow for recording of echolocation call.

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 (Figure 29). Approximately 120 bats were observed exiting the flume entrance.

The 2009 monitoring information shows that the roost continues to support a large maternity colony. The bats appeared to be in good condition, and no sign of white nose syndrome (WNS) was observed. The importance of monitoring colonies is heightened with the emergence of WNS in the eastern United States. 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 monitoring of this colony, as well as the other colonies that have been identified, will continue to be reported on in this document in coming years. This information can be used for comparison from year to year, to determine if there are any changes in the condition of the bats or the status of the colonies.

**Figure 29. Graph Showing Clearwell Emergence Counts.**





## 8.0 REFERENCES

61 FR 51019, "Notice of Deletion of the Hanford 1100 – Area (USDOE) from National Priorities List," *Federal Register*, Vol. 61, No. 190, p. 51019, September 30, 1996.

*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*,  
42 U.S.C. 9601, et seq.

Daubenmire, R., 1970, *Steppe Vegetation of Washington*, Washington Agricultural Experiment Station Technical Bulletin 62, Washington Agricultural Experiment Station, Pullman, Washington.

DOE-RL, 1996, *Superfund Site Final Closeout Report*, Administrative Record Number 0044910, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1998, *Tri-Party Agreement Handbook Management Procedures*, RL-TPA-90-0001, Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS)," U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1999, *Removal Action Workplan for the Hanford Generating Plant Ancillary Facilities*, DOE/RL-99-61, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-EA, 2003, *Environmental Assessment Reactivation and Use of Three Former Borrow Sites in the 100-F, 100-H, and 100-N Areas*, DOE/EA-1454, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2000A, *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, DOE/RL-96-17, Rev. 2, U. S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL, 2000B, *Remedial Design Report/Remedial Action Work Plan for the 100-NR-1 Treatment, Storage, and Disposal Units*, DOE/RL-2000-16 Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington

DOE-RL, 2001, *Hanford Site Biological Resources Management Plan*, DOE/RL-96-32, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2002, *Evaluation of Risk to Ecological Receptors from DDT at the Horseshoe Landfill*, DOE/RL-2002-35, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2005A, *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2005B, *Revised Mitigation Action Plan for the Environmental Restoration Disposal Facility*, DOE/RL-2005-27, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, EPA, and DOE, 1998, *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement), 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

Ecology, EPA, and DOE, 1999, *Action Memorandum 100 N Area Ancillary Facilities*, U.S. Department of Energy Hanford Site, Richland, Washington, Washington State Department of Ecology, Olympia Washington, and U. S. Environmental Protection Agency Region 10, Seattle, Washington.

Ecology, 2000, 100-NR-1 Interim Remedial Action Record of Decision (ROD), Washington State Department of Ecology, Olympia, Washington.

EPA, 1993, *Declaration of the Record of Decision, U.S. Department of Energy, Hanford 1100 Area*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, Ecology, and DOE, 1995, *Interim Action Record of Decision for the U.S. DOE Hanford 100 Area, 100-BC-1, 100-DR-1, 100-HR-1 Operable Units, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Washington State Department of Ecology, and U.S. Department of Energy, Olympia, Washington.

EPA, Ecology, and DOE, 1996, *Record of Decision for the U.S. DOE Hanford 300 Area; 300-FF-1 and 300-FF-5 Operable Units, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Washington State Department of Ecology, and U.S. Department of Energy, Olympia, Washington.

EPA, 1997, *Amendment to the Interim Action Record of Decision for the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units, Hanford Site, Benton County, Washington*, EPA/AMD/R10-97/044, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, Ecology, and DOE, 1999, *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*, U.S. Environmental Protection Agency, Washington State Department of Ecology, and U.S. Department of Energy, Olympia, Washington.

- Gano, K. A., J. G. Lucas, and C. T. Lindsey, 2009, *Identification and Protection of a Bat Colony in the 183-F Clearwell: Mitigation of Bat Habitat on the Hanford Site*, WCH-312, Rev. 0, Washington Closure Hanford, Richland, Washington.
- Gano, K. A. and C. T. Lindsey, 2007, *2007 River Corridor Closure Contractor Revegetation Monitoring Report*, WCH-223, Rev. 0, Washington Closure Hanford, Richland, Washington.
- Hitchcock, C. L., and A. Cronquist, 1973, *Flora of the Pacific Northwest*, University of Washington Press, Seattle, Washington.
- Johnson, A.L. and K. A. Gano, 2006, *2006 River Corridor Closure Contractor Revegetation Monitoring Report*, WCH-133, Rev. 0, Washington Closure Hanford, Richland, Washington.
- Johnson, A.L., 2005, *2005 River Corridor Closure Contractor Revegetation Monitoring Report*, WCH-24, Rev. 0, Washington Closure Hanford, Richland, Washington.
- Johnson, A.L., 2004, *2004 Environmental Restoration Contractor Revegetation Monitoring Report*, BHI-01745, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
- Johnson, A. L., 2003, *2003 Environmental Restoration Contractor Revegetation Monitoring Report*, BHI-01694, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
- Johnson, A. L., 2002, *2002 Environmental Restoration Contractor Revegetation Monitoring Report*, BHI-01659, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
- Johnson, A. L., 2001, *2001 Environmental Restoration Contractor Revegetation Monitoring Report*, BHI-01554, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
- Lindsey, C. T. and K. A. Gano, 2008, *2008 River Corridor Closure Contractor Revegetation Monitoring Report*, WCH-288, Rev. 0, Washington Closure Hanford, Richland, Washington.
- McLendon, T., E. F. Redente, and C. J. Kemp, 1997, *Revegetation Manual for the Environmental Restoration Contractor*, BHI-00971, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
- Sackschewsky, M. R., and J. L. Downs, 2001, *Vascular Plants of the Hanford Site*, PNNL-13688, Pacific Northwest National Laboratory, Richland, Washington.
- WAC 173-340, "Model Toxics Control Act – Cleanup," *Washington Administrative Code*, 1996, 2001.



## **APPENDIX A**

### **2008 REVEGETATION MONITORING RESULTS**



**Table A-28. Percent Canopy Cover and Frequency of Occurrence  
at the 300-FF-1 Process Ponds in 2008.**

Species	% Cover	Freq of Occ %
<i>Bromus tectorum</i> * (cheatgrass)	37.6	94.3
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	26.9	82.9
<i>Poa sandbergii</i> (Sandberg's bluegrass)	18.1	82.9
<i>Agropyron cristatum</i> * (Crested Wheatgrass)	11.4	48.6
<i>Salsola kali</i> * (Russian thistle)	4.0	91.4
<i>Vulpia myuros</i> * (rattail fescue)	2.2	20.0
<i>Erodium cicutarium</i> * (storksbill)	1.9	62.9
<i>Descurainia pinnata</i> (western tansymustard)	1.1	5.7
<i>Centaurea diffusa</i> * (diffuse knapweed)	0.6	11.4
<i>Holosteum umbellatum</i> * (jagged chickweed)	0.3	11.4
<i>Epilobium paniculatum</i> (tall willowherb)	0.3	11.4
<i>Machaeranthera canescens</i> (hoary aster)	0.2	8.6
<i>Sisymbrium altissimum</i> * (tumble mustard)	0.1	5.7
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.1	2.9
<i>Agropyron dasytachyum</i> (thickspike wheatgrass)	0.1	2.9
<i>Hordeum leporinum</i> * (hare barley)	0.1	2.9
<i>Lactuca serriola</i> * (prickly lettuce)	0.1	2.9
<i>Chondrilla juncea</i> * (rush skeletonweed)	0.1	2.9
<i>Melilotus officinalis</i> * (sweetclover)	0.1	2.9
<i>Tragopogon dubius</i> * (yellow salsify)	0.1	2.9
<i>Malva neglecta</i> * (cheeseweed)	0.1	2.9
<i>Petalostemon ornatum</i> (prairie clover)	X	X
<i>Taraxacum officinale</i> * (common dandelion)	X	X
<i>Erigeron filifolius</i> (threadleaf fleabane)	X	X
<i>Lepidium perfoliatum</i> (clasping pepperweed)	X	X
<i>Achillea millefolium</i> (yarrow)	X	X
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	X	X
<i>Sphaeralcea munroana</i> (globemallow)	X	X
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	X
<i>Astragalus caricinus</i> (buckwheat milkvetch)	X	X
<i>Cardaria draba</i> * (whitetop)	X	X
<i>Hymenopappus filifolius</i> (Columbia cutleaf)	X	X
Biotic crust	10.8	60.0
Bare Soil	46.9	97.1
Litter	42.6	100.0
<b>Total canopy cover (litter not included)</b>	<b>105.4</b>	

\* Introduced species.

X = Species present on the site but not counted in a plot frame.

Total Introduced % Cover 2008	58.6
Total Native % Cover 2008	46.7
Change in Native Plant % Cover from 2007 to 2008	+12.3

**Table A-29. Percent Canopy Cover and Frequency of Occurrence  
at 618-2 and 618-3 in 2008.**

Species	% Cover	Freq of Occ %
<i>Agropyron cristatum</i> * (crested wheatgrass)	21.7	100.0
<i>Bromus tectorum</i> * (cheatgrass)	15.3	93.3
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	4.7	86.7
<i>Poa sandbergii</i> (Sandberg's bluegrass)	3.2	93.3
<i>Salsola kali</i> * (Russian thistle)	2.2	86.7
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	0.2	6.7
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	0.2	6.7
<i>Centaurea diffusa</i> * (diffuse knapweed)	0.2	6.7
<i>Sisymbrium altissimum</i> * (tumble mustard)	0.2	6.7
<i>Epilobium paniculatum</i> (tall willowherb)	0.2	6.7
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Ambrosia acanthicarpa</i> (bur ragweed)	X	X
<i>Lactuca serriola</i> * (prickly lettuce)	X	X
<i>Machaeranthera canescens</i> (hoary aster)	X	X
<i>Agropyron dasytachyum</i> (thickspike wheatgrass)	X	X
<i>Eriogonum niveum</i> (snow buckwheat)	X	X
<i>Achillea millefolium</i> (yarrow)	X	X
Biotic crust	0.0	0.0
Bare Soil	46.7	93.3
Litter	46.8	100.0
<b>Total canopy cover (litter not included)</b>	<b>47.8</b>	

\* Invasive species

X=present but not counted in plot frames

Total Invasive % Cover	39.5
Total Native % Cover	8.3
Total Change in Native Cover from 2007	-3.4



**Table A-30. Percent Canopy Cover and Frequency of Occurrence at 300-8 in 2008.**

Species	% Cover	Freq of Occ %
<i>Bromus tectorum</i> * (cheatgrass)	37.6	96.0
<i>Agropyron cristatum</i> * (crested wheatgrass)	16.4	96.0
<i>Salsola kali</i> * (Russian thistle)	3.9	96.0
<i>Holosteum umbellatum</i> * (jagged chickweed)	2.3	52.0
<i>Festuca octoflora</i> (slender sixweeks)	1.9	20.0
<i>Oenothera pallida</i> (evening primrose)	1.5	4.0
<i>Poa sandbergii</i> (Sandberg's bluegrass)	1.4	56.0
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	1.0	20.0
<i>Draba verna</i> * (spring whitlowgrass)	0.9	36.0
<i>Machaeranthera canescens</i> (hoary aster)	0.4	16.0
<i>Erodium cicutarium</i> * (storksbill)	0.3	12.0
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	0.2	8.0
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	0.2	8.0
<i>Poa bulbosa</i> * (bulbous bluegrass)	0.1	4.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Chondrilla juncea</i> * (rush skeletonweed)	X	X
<i>Crepis atrabarba</i> (slender hawkbeard)	X	X
<i>Centaurea diffusa</i> * (diffuse knapweed)	X	X
<i>Sisymbrium altissimum</i> * (tumble mustard)	X	X
<i>Stipa comata</i> (needle-and-thread grass)	X	X
<i>Artemisia tridentata</i> (sagebrush)	X	X
Biotic crust	0.0	0.0
Bare Soil	58.5	96.0
Litter	34.9	100.0
<b>Total canopy cover (litter not included)</b>	<b>68.1</b>	

\* Invasive species

X=present but not counted in plot frames

Total Invasive % Cover	61.5
Total Native % Cover	6.6
Change in Native Cover from 2007	-33.5

**Table A-4. Percent Canopy Cover and Frequency of Occurrence at the Hanford Generating Plant West Cobble and East Topsoil Sites in 2008.**

Species	% Cover		Freq of Occ %	
	E. Topsoil	W. Cobble	E. Topsoil	W. Cobble
<i>Poa sandbergii</i> (Sandberg's bluegrass)	47.3	47.0	88.0	100.0
<i>Bromus tectorum</i> * (cheatgrass)	45.2	15.8	100.0	80.0
<i>Holosteum umbellatum</i> * (jagged chickweed)	43.2	8.6	92.0	40.0
<i>Chorispora tenella</i> * (blue mustard)	6.1	--	56.0	--
<i>Agropyron Spp.</i>	--	4.7	--	36.0
<i>Ranunculus testiculatus</i> * (bur buttercup)	3.4	--	40.0	--
<i>Sisymbrium altissimum</i> * (tumble mustard)	1.1	0.7	44.0	28.0
<i>Centaurea diffusa</i> * (diffuse knapweed)	0.9	0.5	16.0	20.0
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	0.2	3.4	8.0	40.0
<i>Salsola kali</i> * (Russian thistle)	0.4	1.6	16.0	64.0
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	0.1	1.6	4.0	8.0
<i>Draba verna</i> * (spring whitlow)	X	1.5	X	20.0
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	0.8	--	12.0	--
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.5	--	20.0	--
<i>Erodium cicutarium</i> * (storksbill)	--	0.4	--	16.0
<i>Festuca octoflora</i> (six-weeks fescue)	--	0.4	--	16.0
<i>Microsteris gracilis</i> (annual phlox)	--	0.4	--	16.0
<i>Artemesia tridentata</i> (sagebrush)	0.2	0.3	8.0	12.0
<i>Descurainia pinnata</i> (western tansymustard)	--	0.2	--	8.0
<i>Achillea millefolium</i> (yarrow)	0.1	0.2	4.0	8.0
<i>Chorispora tenella</i> * (blue mustard)	--	0.1	--	4.0
<i>Poa bulbosa</i> * (bulbous bluegrass)	--	0.1	--	4.0
<i>Machaeranthera canescens</i> (hoary aster)	--	X	--	X
<i>Agropyron dasytachyum</i> (thickspike wheatgrass)	--	X	--	X
<i>Verbascum thapsus</i> * (common mullein)	--	X	--	X
Biotic Crust	0.0	0.0	0.0	0.0
Bare Soil	19.2	45.9	84.0	96.0
Litter	84.5	53.6	100.0	100.0
<b>Total canopy cover (litter not included)</b>	<b>149.5</b>	<b>87.5</b>		

\* Invasive species

X=present but not counted in plot frames

Total Invasive % Cover	100.3	29.3
Total Native % Cover	49.2	58.2
Change in Native Cover % from 2007 to 2008	-36.6	+20.2

**Table A-5. Percent Canopy Cover and Frequency of Occurrence at 116-N-1 in 2008.**

Species	% Cover	Freq of Occ %
<i>Poa sandbergii</i> (Sandberg's bluegrass)	40.5	96
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	6.5	68
<i>Salsola kali</i> * (Russian thistle)	5	84
<i>Sisymbrium altissimum</i> * (tumble mustard)	1.9	76
<i>Bromus tectorum</i> * (cheatgrass)	1.9	76
<i>Artemesia tridentata</i> (sagebrush)	1.2	28
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	0.3	12
<i>Descurainia pinnata</i> (western tansymustard)	0.3	12
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	0.1	4
<i>Epilobium paniculatum</i> (tall willowherb)	0.1	4
<i>Achillea millefolium</i> (yarrow)	0.1	4
<i>Lactuca seriola</i> * (prickly lettuce)	0.1	4
<i>Centaurea diffusa</i> * (diffuse knapweed)	X	X
<i>Tragopogon dubius</i> * (yellow salsify)	X	X
Biotic crust	0	0
Bare Soil	38.5	92
Litter	64.1	100
<b>Total canopy cover (litter not included)</b>	<b>58.0</b>	

\* Invasive species

X=present but not counted in plot frames

Total Invasive % Cover	8.9
Total Native % Cover	49.1
Change in Native Cover % from 2007	+16.43

**Table A-6. Percent Canopy Cover and Frequency of Occurrence at 116-N-3 in 2008.**

<b>Species</b>	<b>% Cover</b>	<b>Freq of Occ %</b>
<i>Poa sandbergii</i> (Sandberg's bluegrass)	33.0	88.0
<i>Bromus tectorum</i> * (cheatgrass)	20.3	84.0
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	9.9	52.0
<i>Salsola kali</i> * (Russian thistle)	4.2	92.0
<i>Holosteum umbellatum</i> * (jagged chickweed)	1.5	20.0
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	1.5	4.0
<i>Sisymbrium altissimum</i> * (tumblemustard)	1.0	40.0
<i>Lactuca serriola</i> * (prickly lettuce)	0.4	16.0
<i>Centaurea diffusa</i> * (diffuse knapweed)	0.3	12.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.2	8.0
<i>Draba verna</i> * (spring whitlowgrass)	0.1	4.0
<i>Epilobium paniculatum</i> (tall willowherb)	0.1	4.0
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	X	X
<i>Melilotus alba</i> * (sweetclover)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	X	X
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	X
<i>Machaeranthera canescens</i> (hoary aster)	X	X
<i>Biotic crust</i>	0.0	0.0
<i>Bare soil</i>	53.3	100.0
<i>Litter</i>	31.9	92.0
<b>Total canopy cover (litter not included)</b>	<b>72.5</b>	
* Invasive species		
X=present but not counted in plot frames		
Total Invasive % Cover	27.8	
Total Native % Cover	44.7	
Change in Native Cover from 2007	+6.7	

**Table A-7. Percent Canopy Cover and Frequency of Occurrence at 100-F Area Sites in 2008.**

Species	% Cover	Freq of Occ %
<i>Bromus tectorum</i> * (cheatgrass)	53.9	100.0
<i>Poa sandbergii</i> (Sandberg's bluegrass)	28.9	94.3
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	11.8	71.4
<i>Salsola kali</i> * (Russian thistle)	2.4	82.9
<i>Achillea millefolium</i> (yarrow)	2.3	8.6
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	1.4	17.1
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	1.1	5.7
<i>Holosteum umbellatum</i> * (jagged chickweed)	0.7	14.3
<i>Artemesia tridentata</i> (sagebrush)	0.5	5.7
<i>Agropyron dasytachyum</i> (thickspike wheatgrass)	0.4	2.9
<i>Erodium cicutarium</i> * (storksbill)	0.3	11.4
<i>Draba verna</i> * (spring whitlow)	0.3	11.4
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	0.1	2.9
<i>Sisymbrium altissimum</i> * (tumble mustard)	0.1	2.9
<i>Lepidium perfoliatum</i> * (clasping pepperweed)	0.1	2.9
<i>Centaurea diffusa</i> * (diffuse knapweed)	X	X
<i>Chrysothamnus viscidiflorus</i> (green rabbitbrush)	X	X
<i>Agoseris heterophylla</i> (mountain dandelion)	X	X
<i>Amsinckia lycopoides</i> (tarweed fiddleneck)	X	X
<i>Sporobolus cryptandrus</i> (sanddrop seed)	X	X
<i>Machaeranthera canescens</i> (hoary aster)	X	X
<i>Astragalus sclerocarpus</i> (stalk-pod milkvetch)	X	X
<i>Astragalus caricinus</i> (buckwheat milkvetch)	X	X
<i>Astragalus succumbens</i> (crouching milkvetch)	X	X
<i>Lactuca seriola</i> * (prickly lettuce)	X	X
<i>Vicia cracca</i> * (bird vetch)	X	X
<i>Koeleria cristata</i> (prairie junegrass)	X	X
<i>Tragopogon dubius</i> * (yellow salsify)	X	X
<i>Poa bulbosa</i> * (bulbous bluegrass)	X	X
<i>Ambrosia acanthicarpa</i> (bur ragweed)	X	X
Biotic crust	1.4	28.6
Bare Soil	28.5	94.3
Litter	64.4	100.0
<b>Total canopy cover (litter not included)</b>	<b>104.3</b>	

\* Introduced species.

X = Species present on the site but not counted in a plot frame.

Total Introduced % Cover 2008	57.43
Total Native % Cover 2008	46.57
Change in Native Plant % Cover from 2007 to 2008	+8.9

**Table A-8. Percent Canopy Cover and Frequency of Occurrence at the 118-F-1 Burial Ground in 2008.**

Species	% Cover	Freq of Occ %
Native Grasses <sup>b</sup>	3.5	100.0
<i>Salsola kali</i> * (Russian thistle)	2.8	56.0
<i>Artemisia tridentata</i> (sagebrush)	0.2	8.0
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	X
<i>Erodium cicutarium</i> * (storksbill)	X	X
<i>Bromus tectorum</i> * (cheatgrass)	X	X
<i>Lactuca serriola</i> * (prickly lettuce)	X	X
<i>Grayia spinosa</i> (hopsage)	X	X
<i>Sisymbrium altissimum</i> * (tumble mustard)	X	X
<i>Poa bulbosa</i> * (bulbous bluegrass)	X	X
Biotic crust	0	0.0
Bare soil	40.8	100.0
Litter	57	100.0
<b>Total canopy cover (litter not included)</b>	<b>6.5</b>	

\* Invasive species

X=present but not counted in plot frames

<sup>b</sup>Includes Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, needle-and-thread grass, and prairie junegrass seedlings.

Total Invasive % Cover	2.8
Total Native % Cover	3.7

**Table A-9. Percent Canopy Cover and Frequency of Occurrence at 118-F-2 in 2008.**

Species	% Cover	Freq of Occ %
Native Grasses <sup>b</sup>	18.7	96.0
<i>Salsola kali</i> * (Russian thistle)	9.5	88.0
<i>Nama densum</i> (purplemat)	0.1	4.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.1	4.0
<i>Sisymbrium altissimum</i> * (tumble mustard)	2.6	28.0
<i>Lactuca serriola</i> * (prickly lettuce)	0.1	4.0
<i>Bromus tectorum</i> * (cheatgrass)	4.2	16.0
<i>Poa bulbosa</i> * (bulbous bluegrass)	0.2	8.0
<i>Artemisia tridentata</i> (sagebrush)	0.1	4.0
<i>Descurainia pinnata</i> (western tansymustard)	0.1	4.0
<i>Grayia spinosa</i> (Spiny hopsage)	0.1	4.0
<i>Draba verna</i> * (spring whitlow)	0.1	4.0
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	X
<i>Holosteum umbellatum</i> * (jagged chickweed)	X	X
<i>Cardaria draba</i> * (whitetop)	X	X
<i>Vicia cracca</i> * (bird vetch)	X	X
<i>Lepidium perfoliatum</i> (clasping pepperweed)	X	X
Biotic Crust	0	0.0
Bare Soil	52.9	100.0
Litter	41.9	100.0
<b>Total canopy cover (litter not included)</b>	<b>35.9</b>	

\* Invasive species

X=present but not counted in plot frames

<sup>b</sup>Includes Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, needle-and-thread grass, and prairie junegrass seedlings.

Total Invasive % Cover	16.7
Total Native % Cover	19.2

**Table A-10. Percent Canopy Cover and Frequency of Occurrence at 182-F North and South in 2008.**

Species	% Cover North	% Cover South	Freq of Occ % North	Freq of Occ % South
Native Grasses <sup>b</sup>	47.2	35.2	100.0	100.0
<i>Bromus tectorum</i> * (cheatgrass)	17.7	33.8	73.3	96.0
<i>Salsola kali</i> * (Russian thistle)	1.2	29.4	46.7	92.0
<i>Sisymbrium altissimum</i> * (tumble mustard)	0.3	2.4	13.3	56.0
<i>Poa bulbosa</i> * (Bulbous bluegrass)	1.3	1.2	20.0	28.0
<i>Draba verna</i> * (spring whitlowgrass)	0.2	0.4	6.7	16.0
<i>Artemisia tridentata</i> (sagebrush)	0.2	0.1	6.7	4.0
<i>Erodium cicutarium</i> * (storksbill)	--	0.9	--	16.0
<i>Sporobolus cryptandrus</i> (sanddrop seed)	X	0.6	X	4.0
<i>Verbena bracteata</i> (big-bract verbena)	--	0.1	--	4.0
<i>Vicia cracca</i> * (bird vetch)	--	0.1	--	4.0
<i>Achillea millefolium</i> (yarrow)	--	X	--	X
<i>Triticum aestivum</i> * (wheat)	--	X	--	X
<i>Artemisia ludoviciana</i> (white sagebrush)	X	X	X	X
<i>Centaurea diffusa</i> * (diffuse knapweed)	X	X	X	X
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	X	X	X
<i>Sphaeralcea munroana</i> (globemallow)	--	X	--	X
<i>Astragalus succumbens</i> (Columbia milk-vetch)	--	X	--	X
<i>Lactuca seriola</i> * (prickly lettuce)	--	X	--	X
<i>Machaeranthera canescens</i> (hoary aster)	X	X	X	X
<i>Astragalus spp.</i>	X	X	X	X
<i>Melilotus alba</i> * (sweetclover)	X	--	X	--
Biotic crust	0.0	0.0	0.0	0.0
Bare soil	20.5	16.8	80.0	80.0
Litter	75.8	75.9	100.0	100.0
<b>Total canopy cover (litter not included)</b>	<b>68.0</b>	<b>104.2</b>		

\* Invasive species

X=present but not counted in plot frames

-- species not recorded

<sup>b</sup>Includes Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, needle-and-thread grass, and prairie junegrass seedlings.

Total Invasive % Cover	20.7	68.2
Total Native % Cover	47.3	36.0



**Table A-11. Percent Canopy Cover and Frequency of Occurrence at the 183-F East Clearwell in 2008.**

Species	% Cover	Freq of Occ %
Native grasses <sup>b</sup>	52.3	100.0
<i>Bromus tectorum</i> * (cheatgrass)	1.3	20.0
<i>Salsola kali</i> * (Russian thistle)	6.7	100.0
<i>Ranunculus testiculatus</i> * (bur buttercup)	1.5	26.7
<i>Grayia spinosa</i> (hopsage)	0.2	6.7
<i>Festuca octoflora</i> (slender sixweeks)	0.2	6.7
<i>Astragalus succumbens</i> (Columbia milk-vetch)	0.2	6.7
<i>Erodium cicutarium</i> * (storksbill)	0.2	6.7
<i>Poa bulbosa</i> * (bulbous bluegrass)	0.2	6.7
<i>Nama densum</i> (purplemat)	0.2	6.7
<i>Cryptantha circumscissa</i> (matted cryptantha)	0.2	6.7
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	0.2	6.7
<i>Sisymbrium altissimum</i> * (tumble mustard)	0.3	13.3
<i>Artemisia tridentata</i> (big sagebrush)	0.2	6.7
<i>Lactuca serriola</i> * (prickly lettuce)	0.2	6.7
<i>Chorispora tenella</i> * (blue mustard)	X	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
Biotic crust	0.0	0.0
Bare soil	45.2	100.0
Litter	46.0	100.0
<b>Total canopy cover (litter not included)</b>	<b>63.8</b>	

\* Invasive species  
X=present but not counted in plot frames

<sup>b</sup>Includes Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, needle-and-thread grass, and prairie junegrass seedlings.

Total Invasive % Cover 10.3  
Total Native % Cover 53.5

**Table A-12. Percent Canopy Cover and Frequency of Occurrence at 100-F-26 in 2008.**

Species	% Cover	Freq of Occ %
Native grasses <sup>b</sup>	22.7	86.7
<i>Bromus tectorum</i> * (cheatgrass)	16.2	73.3
<i>Salsola kali</i> * (Russian thistle)	16.3	100.0
<i>Festuca octoflora</i> (slender sixweeks)	0.2	6.7
<i>Sisymbrium altissimum</i> * (tumble mustard)	0.7	26.7
<i>Chenopodium album</i> (lambsquarters)	0.3	13.3
<i>Artemisia tridentata</i> (big sagebrush)	0.2	6.7
<i>Erodium cicutarium</i> * (storksbill)	0.2	6.7
<i>Chorispora tenella</i> * (blue mustard)	0.2	6.7
<i>Lepidium perfoliatum</i> (clasping pepperweed)	X	X
<i>Amsinckia lycopoides</i> (tarweed fiddleneck)	X	X
<i>Poa bulbosa</i> * (bulbous bluegrass)	X	X
<i>Ranunculus testiculatus</i> * (bur buttercup)	X	X
<i>Achillea millefolium</i> (yarrow)	X	X
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	X
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Grayia spinosa</i> (hopsage)	X	X
<i>Centaurea diffusa</i> * (diffuse knapweed)	X	X
Biotic crust	0.0	0.0
Bare soil	41.3	100.0
Litter	53.0	100.0
<b>Total canopy cover (litter not included)</b>	<b>56.8</b>	

\* Invasive species

X=present but not counted in plot frames

<sup>b</sup>Includes Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, needle-and-thread grass, and prairie junegrass seedlings.

Total Invasive % Cover 33.5

Total Native % Cover 23.3

**Table A-13. Percent Canopy Cover and Frequency of Occurrence at 118-F-5 Soil Staging Area and Burial Ground in 2008.**

Species	% Cover SSA	% Cover BG	Freq of Occ % SSA	Freq of Occ % BG
<i>Bromus tectorum</i> * (cheatgrass)	49.2	13.5	100.0	93.3
Native Grasses <sup>b</sup>	16.0	4.2	100.0	100.0
<i>Salsola kali</i> * (Russian thistle)	3.5	3.8	73.3	86.7
<i>Ambrosia acanthicarpa</i> (bur ragweed)	1.2	--	13.3	--
<i>Sisymbrium altissimum</i> * (tumble mustard)	0.5	0.2	20.0	6.7
<i>Chenopodium leptophyllum</i> (slimeleaf goosefoot)	0.3	--	13.3	--
<i>Triticum aestivum</i> * (common wheat)	0.3	--	13.3	--
<i>Plantago patagonica</i> (Indian wheat)	0.3	--	13.3	--
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.2	0.2	6.7	6.7
<i>Holosteum umbellatum</i> * (jagged chickweed)	0.2	--	6.7	--
<i>Draba verna</i> * (spring whitlow)	0.2	--	6.7	--
<i>Astragalus</i> spp.	0.2	--	6.7	--
<i>Microsteris gracilis</i> (annual phlox)	0.2	--	6.7	--
<i>Achillea millefolium</i> (yarrow)	0.2	X	6.7	X
<i>Grayia spinosa</i> (hopsage)	X	X	X	X
<i>Machaeranthera canescens</i> (hoary aster)	X	--	X	--
<i>Hackelia diffusa</i> (sagebrush stickseed)	X	--	X	--
<i>Chondrilla juncea</i> * (rush skeletonweed)	X	--	X	--
<i>Artemisia tridentata</i> (sagebrush)	X	0.3	X	13.3
<i>Chenopodium album</i> (lambsquarters)	X	--	X	--
<i>Lactuca seriola</i> * (prickly lettuce)	X	X	X	X
<i>Hordeum leporinum</i> * (hare barley)	X	--	X	--
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	--	0.3	--	13.3
<i>Poa bulbosa</i> * (bulbous bluegrass)	--	X	--	X
<i>Agoseris heterophylla</i> (mountain-dandelion)	--	X	--	X
<i>Machaeranthera canescens</i> (hoary aster)	--	X	--	X
<i>Triticum aestivum</i> * (common wheat)	--	X	--	X
Biotic crust	0.0	0.0	0.0	0.0
Bare Soil	46.3	37.2	100.0	100.0
Litter	45.2	50.7	100.0	100.0
<b>Total Canopy Cover</b> (litter not included)	<b>72.3</b>	<b>22.5</b>		

\* Introduced species.

X = Species present but not counted in a plot frame

-- species not observed on site

<sup>b</sup>Includes Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, needle-and-thread grass, and prairie junegrass seedlings.

Total Introduced % Cover 2008	53.8	17.5
Total Native % Cover 2008	18.5	5.0

**Table A-14. Percent Canopy Cover and Frequency of Occurrence at 100-B-1 and 128-C-1 in 2008.**

Species	% Cover 100-B-1	% Cover 128-C-1	Freq of Occ %	Freq of Occ %
<i>Poa sandbergii</i> (Sandberg's bluegrass)	43.9	15.3	100.0	100.0
<i>Bromus tectorum</i> * (cheatgrass)	23.6	24.8	100.0	100.0
<i>Salsola kali</i> * (Russian thistle)	5.9	5.2	100.0	80.0
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	2.5	2.7	40.0	40.0
<i>Sisymbrium altissimum</i> * (tumble mustard)	1.7	0.7	28.0	26.7
<i>Artemesia tridentata</i> (sagebrush)	0.1	5.7	4.0	6.7
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	0.6	1.2	4.0	13.3
<i>Sitanion hystrix</i>	--	14.7	--	73.3
<i>Microsteris gracilis</i> (annual phlox)	0.1	--	4.0	--
<i>Lomatium macrocarpum</i> (bigseed desertparsley)	0.1	--	4.0	--
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	X	--	X	--
<i>Grayia spinosa</i> (hopsage)	X	--	X	--
<i>Tragopogon dubius</i> (yellow salsify)	X	--	X	--
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	--	X	--
<i>Koeleria cristata</i> (prairie junegrass)	X	--	X	--
<i>Hordeum leporinum</i> * (hare barley)	X	--	X	--
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	--	X	--
<i>Descurainia pinnata</i> (western tansymustard)	X	--	X	--
<i>Astragalus purshii</i> (woolly-pod milkvetch)	X	--	X	--
<i>Machaeranthera canescens</i> (hoary aster)	X	--	X	--
<i>Lactuca seriola</i> * (prickly lettuce)	--	0.5	--	20.0
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	--	0.2	--	6.7
<i>Draba verna</i> * (spring whitlowgrass)	--	1.3	--	20.0
<i>Erodium cicutarium</i> * (storksbill)	--	X	--	X
<i>Tragopogon dubius</i> * (yellow salsify)	--	X	--	X
Biotic crust	29.2	0.0	96.0	0.0
Bare Soil	49.5	37.5	100.0	100.0
Litter	43.2	57.8	100.0	100.0
<b>Total canopy cover (litter not included)</b>	<b>34.6</b>	<b>56.8</b>		

\* Invasive species

X=present but not counted in plot frames

-- species not present on site

Total Invasive % Cover	31.2	32.5
Total Native % Cover	47.3	39.7
Total Change in Native Cover from 2007	+1.9	+14.7

**Table A-15. Percent Canopy Cover at 100-C-9 in 2008.**

<b>Species</b>	<b>T1</b>	<b>T2</b>	<b>T3</b>
<i>Poa sandbergii</i> (Sandberg's bluegrass)	12.0	5.0	17.0
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	9.5	1.3	9.2
<i>Bromus tectorum</i> * (cheatgrass)	4.8	11.3	33.0
<i>Salsola kali</i> * (Russian thistle)	2.5	2.3	4.2
<i>Draba verna</i> * (spring whitlowgrass)	0.3	0.2	0.5
<i>Festuca octoflora</i> (slender sixweeks)	0.3	1.0	--
<i>Sisymbrium altissimum</i> * (tumble mustard)	0.5	1.8	11.5
<i>Descurainia pinnata</i> (western tansymustard)	0.3	0.7	0.5
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	1.5	--	0.2
<i>Artemesia tridentata</i> (sagebrush)	0.2	X	0.2
<i>Lactuca seriola</i> * (prickly lettuce)	0.2		0.2
<i>Holosteum umbellatum</i> * (jagged chickweed)	X	0.2	2.8
<i>Poa bulbosa</i> * (bulbous bluegrass)	X	0.3	--
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	--	--
<i>Machaeranthera canescens</i> (hoary aster)	X	--	--
<i>Erodium cicutarium</i> * (storksbill)	--	0.2	0.2
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	--	--	0.2
<i>Centaurea diffusa</i> * (diffuse knapweed)	--	X	0.5
<i>Verbena bracteata</i> * (big-bract verbena)	--		X
<i>Erigeron vimineum</i> (broom buckwheat)	--	0.7	--
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	--	0.2	--
<i>Sphaeralcea munroana</i> (Munro's globemallow)	--	X	--
<i>Chaenactis douglasii</i> (hoary falseyarrow)	--	X	--
<i>Chorispora tenella</i> <sup>a</sup> (blue mustard)	--	X	--
Biotic crust	0.0	0.0	0.0
Bare Soil	54.8	42.0	34.2
Litter	43.5	57.8	64.2
<b>Total canopy cover (litter not included)</b>	<b>32.2</b>	<b>25.2</b>	<b>80.0</b>
* = Invasive species			
X = present but not counted in plot frames			
-- = not present in plot			
Total Invasive % Cover	8.3	16.3	52.8
Total Native % Cover	23.8	8.8	27.2
Change in Native Cover % from 2007	-30.8	-9.7	-15.5

**Table A-16. Frequency of Occurance at 100-C-9 in 2008.**

<b>Species</b>	<b>T1</b>	<b>T2</b>	<b>T3</b>
<i>Salsola kali</i> * (Russian thistle)	100.0	93.3	100.0
<i>Poa sandbergii</i> (Sandberg's bluegrass)	100.0	100.0	100.0
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	60.0	53.3	73.3
<i>Bromus tectorum</i> * (cheatgrass)	66.7	100.0	86.7
<i>Sisymbrium altissimum</i> * (tumble mustard)	20.0	73.3	100.0
<i>Descurainia pinnata</i> (western tansymustard)	13.3	26.7	20.0
<i>Draba verna</i> * (spring whitlowgrass)	13.3	6.7	20.0
<i>Festuca octoflora</i> (slender sixweeks)	13.3	40.0	--
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	26.7	--	6.7
<i>Artemesia tridentata</i> (sagebrush)	6.7	X	6.7
<i>Lactuca seriola</i> * (prickly lettuce)	6.7	--	6.7
<i>Holosteum umbellatum</i> * (jagged chickweed)	X	6.7	20.0
<i>Poa bulbosa</i> * (bulbous bluegrass)	X	13.3	--
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	--	--
<i>Machaeranthera canescens</i> (hoary aster)	X	--	--
<i>Erodium cicutarium</i> * (storksbill)	--	6.7	6.7
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	--	--	6.7
<i>Centaurea diffusa</i> * (diffuse knapweed)	--	X	20.0
<i>Verbena bracteata</i> (big-bract verbena)	--		X
<i>Erigonum vimineum</i> (broom buckwheat)	--	26.7	--
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	--	6.7	--
<i>Sphaeralcea munroana</i> (Munro's globemallow)	--	X	--
<i>Chaenactis douglasii</i> (hoary falseyarrow)	--	X	--
<i>Chorispora tenella</i> <sup>a</sup> (blue mustard)	--	X	--
Biotic crust	0.0	0.0	0.0
Bare Soil	100.0	100.0	100.0
Litter	100.0	100.0	100.0

\*= Invasive species

X=present but not counted in plot frames

--=not present in plot

**Table A-17. Percent Canopy Cover and Frequency of Occurrence at 100-B-14 South in 2008.**

Species	% Cover	Freq. of Occ.
<i>Salsola kali</i> * (Russian thistle)	31.4	100
<i>Sisymbrium altissimum</i> * (tumble mustard)	7.3	76
Native Grasses <sup>b</sup>	6.7	76
<i>Artemesia tridentata</i> (sagebrush)	0.1	4
<i>Bromus tectorum</i> * (cheatgrass)	1.1	24
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	0.9	16
<i>Melilotus alba</i> * (sweetclover)	0.6	4
<i>Chorispora tenella</i> * (blue mustard)	0.1	4
<i>Festuca octoflora</i> (slender sixweeks)	0.1	4
<i>Poa bulbosa</i> * (Bulbous bluegrass)	X	X
<i>Epilobium paniculatum</i> (tall willowherb)	X	X
<i>Lactuca serriola</i> * (prickly lettuce)	X	X
<i>Centaurea diffusa</i> * (diffuse knapweed)	X	X
<i>Ranunculus testiculatus</i> * (bur buttercup)	X	X
Biotic Crust	0	0
Bare Soil	50.8	96
Litter	46.8	88
<b>Total canopy cover (litter not included)</b>	<b>48.3</b>	

\* Invasive species

X=present but not counted in plot frames

<sup>b</sup>Includes Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, needle-and-thread grass, and prairie junegrass seedlings.

Total Invasive % Cover	40.5
Total Native % Cover	7.8

**Table A-18. Percent Canopy Cover and Frequency of Occurrence at the 118-B-1 Burial Ground and Soil Staging Area 2008.**

Species	% Cover SSA	% Cover BG	Freq of Occ % SSA	Freq of Occ % BG
Native Grasses <sup>b</sup>	11.0	13.6	76.0	84.0
<i>Salsola kali</i> * (Russian thistle)	4.5	3.8	64.0	72.0
<i>Bromus tectorum</i> * (cheatgrass)	1.2	2.0	28.0	24.0
<i>Lactuca serriola</i> * (prickly lettuce)	0.1	--	4.0	--
<i>Sisymbrium altissimum</i> * (tumble mustard)	0.3	0.6	12.0	24.0
<i>Poa bulbosa</i> * (Bulbous bluegrass)	0.2	X	8.0	X
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	0.1	0.4	4.0	16.0
<i>Festuca octoflora</i> (slender sixweeks)	0.1	0.6	4.0	4.0
<i>Ambrosia acanthicarpa</i> (bur ragweed)	0.1	--	4.0	--
<i>Melilotus alba</i> * (sweetclover)	0.1	X	4.0	X
<i>Microsteris gracilis</i> (pink microsteris)	X	--	X	--
<i>Chenopodium leptophyllum</i> (slimleaf goosefoot)	X	X	X	X
<i>Erodium cicutarium</i> * (storksbill)	X	0.2	X	8.0
<i>Lactuca serriola</i> * (prickly lettuce)	X	0.1	X	4.0
<i>Artemisia tridentata</i> (sagebrush)	X	0.3	X	12.0
<i>Amsinckia lycopsoides</i> (fiddleneck)	X	X	X	X
<i>Achillea millefolium</i> (yarrow)	X	--	X	--
<i>Centaurea diffusa</i> * (diffuse knapweed)	--	0.2	--	8.0
<i>Descurainia pinnata</i> (western tansymustard)	--	X	--	X
<i>Chorispora tenella</i> * (blue mustard)	--	X	--	X
<i>Hordeum leporinum</i> * (hare barley)	--	X	--	X
Biotic crust	0.0	0.0	0.0	0.0
Bare soil	48.8	38.7	92.0	92.0
Litter	50.0	58.6	100.0	100.0
<b>Total canopy cover (litter not included)</b>	<b>17.7</b>	<b>21.8</b>		

\* Invasive species

X=present but not counted in plot frames

--=species not observed in area

<sup>b</sup>Includes Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, needle-and-thread grass, and prairie junegrass seedlings.

Total Invasive % Cover

6.4      6.9

Total Native % Cover

11.3      14.9



**Table A-19. Percent Canopy Cover and Frequency of Occurrence at 118-C-1 in 2008.**

Species	% Cover	Freq of Occ %
<i>Salsola kali</i> * (Russian thistle)	21.2	100
NATIVE GRASSES <sup>b</sup>	9.7	100
<i>Sisymbrium altissimum</i> * (tumble mustard)	1.6	44
<i>Bromus tectorum</i> * (cheatgrass)	0.6	24
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	0.2	8
<i>Lactuca seriola</i> * (prickly lettuce)	0.2	8
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Kochia scopari</i> * (kochia)	X	X
<i>Melilotus alba</i> * (sweetclover)	X	X
<i>Sisymbrium altissimum</i> * (tumble mustard)	X	X
Biotic crust	0	0
Bare soil	33.2	92
Litter	62.6	100
<b>Total canopy cover (litter not included)</b>	<b>33.5</b>	

\* Invasive species

X=present but not counted in plot frames

<sup>b</sup>Includes Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, needle-and-thread grass, and prairie junegrass seedlings.

Total Invasive % Cover	23.6
Total Native % Cover	9.9

**Table A-20. Percent Canopy Cover at the 116-K-2 (MLT) in 2008.**

<b>Species</b>	<b>T1</b>	<b>T2</b>	<b>T3</b>	<b>T4</b>
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	27.2	22.0	16.3	6.5
<i>Poa sandbergii</i> (Sandberg's bluegrass)	7.8	14.7	30.0	13.5
<i>Bromus tectorum</i> * (cheatgrass)	12.0	15.2	15.8	25.8
<i>Salsola kali</i> * (Russian thistle)	2.3	3.7	3.0	14.3
<i>Artemesia tridentata</i> (sagebrush)	4.0	2.7	3.2	X
<i>Draba verna</i> * (spring whitlowgrass)	0.2	1.5	1.7	0.3
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.2	1.0	0.2	0.2
<i>Centaurea diffusa</i> * (diffuse knapweed)	0.7	0.2	6.0	0.2
<i>Sisymbrium altissimum</i> * (tumble mustard)	0.5	0.5	0.2	0.2
<i>Descurainia pinnata</i> (western tansymustard)	X	--	0.2	--
<i>Lactuca seriola</i> * (prickly lettuce)	0.7	0.3	0.3	0.2
<i>Tragopogon dubius</i> (yellow salsify)	--	0.3	0.2	--
<i>Holosteum umbellatum</i> * (jagged chickweed)	--	0.5	X	0.2
<i>Achillea millefolium</i> (yarrow)	--	X	X	X
<i>Festuca octoflora</i> (slender sixweeks)	--	--	--	0.2
<i>Agoseris heterophylla</i> (mountain-dandelion)	--	--	--	0.2
<i>Gilia leptomeria</i> (Great Basin gilia)	--	--	--	X
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	--	--	--	X
<i>Microsteris gracilis</i> (annual phlox)	--	0.5	--	--
<i>Epilobium paniculatum</i> (tall willowherb)	--	0.2	--	--
<i>Verbascum thapsus</i> * (common mullein)	X			
Biotic crust	0.0	0.0	1.8	0.0
Bare Soil	21.8	25.8	31.7	23.3
Litter	74.3	65.7	64.2	63.2
<b>Total canopy cover (litter not included)</b>	<b>55.5</b>	<b>63.2</b>	<b>77.0</b>	<b>61.5</b>
* Invasive species				
X=present but not counted in plot frames				
-- species not recorded				
Total Invasive % Cover	16.3	22.2	27.2	41.2
Total Native % Cover	39.2	41	49.8	20.5
Change in Native Cover from 2007	-11.6	+1	+5.1	+8.1

**Table A-21. Frequency of Occurrence at 116-K-2 (MLT) in 2008.**

<b>Species</b>	<b>T1</b>	<b>T2</b>	<b>T3</b>	<b>T4</b>
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	93.3	80.0	80.0	40.0
<i>Poa sandbergii</i> (Sandberg's bluegrass)	86.7	100.0	93.3	86.7
<i>Bromus tectorum</i> * (cheatgrass)	93.3	93.3	86.7	80.0
<i>Salsola kali</i> * (Russian thistle)	60.0	80.0	86.7	100.0
<i>Artemesia tridentata</i> (sagebrush)	33.3	40.0	26.7	X
<i>Draba verna</i> * (spring whitlowgrass)	6.7	60.0	33.3	13.3
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	6.7	40.0	6.7	6.7
<i>Centaurea diffusa</i> * (diffuse knapweed)	26.7	6.7	46.7	6.7
<i>Sisymbrium altissimum</i> * (tumble mustard)	20.0	20.0	6.7	6.7
<i>Lactuca seriola</i> * (prickly lettuce)	26.7	13.3	13.3	6.7
<i>Descurainia pinnata</i> (western tansymustard)	X	--	6.7	--
<i>Tragopogon dubius</i> (yellow salsify)	--	13.3	6.7	--
<i>Holosteum umbellatum</i> (jagged chickweed)	--	20.0	X	6.7
<i>Achillea millefolium</i> (yarrow)	--	X	X	X
<i>Festuca octoflora</i> (slender sixweeks)	--	--	--	6.7
<i>Agoseris heterophylla</i> (mountain-dandelion)	--	--	--	6.7
<i>Gilia leptomeria</i> (Great Basin gilia)	--	--	--	X
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	--	--	--	X
<i>Microsteris gracilis</i> (annual phlox)	--	20.0	--	--
<i>Epilobium paniculatum</i> (tall willowherb)	--	6.7	--	--
<i>Verbascum thapsus</i> * (common mullein)	X	--	--	--
Biotic crust	0.0	0.0	40.0	0.0
Bare Soil	80.0	86.7	93.3	80.0
Litter	100.0	100.0	100.0	100.0

\* Invasive species

X=present but not counted in plot frames

-- species not recorded

**Table A-22. Percent Canopy Cover at the Horseshoe Landfill and Soil Staging Area in 2008.**

<u>Species</u>	<u>HSLF</u>	<u>SSA</u>
<i>Poa sandbergii</i> (Sandberg's bluegrass)	60.0	46.0
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	7.2	3.7
<i>Bromus tectorum</i> * (cheatgrass)	2.5	13.5
<i>Salsola kali</i> * (Russian thistle)	0.8	17.0
<i>Artemesia tridentata</i> (sagebrush)	2.2	4.8
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	3.7	1.3
<i>Lupinus leucophyllus</i> (velvet lupine)	1.0	0.7
<i>Epilobium paniculatum</i> (tall willowherb)	0.8	0.2
<i>Agropyron cristatum</i> * (crested wheatgrass)	0.2	0.2
<i>Lactuca seriola</i> * (prickly lettuce)	0.3	0.2
<i>Crepis atrabarba</i> (slender hawkbeard)	--	3.7
<i>Sisymbrium altissimum</i> * (tumble mustard)	X	2.3
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	1.7	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	--	1.5
<i>Festuca octoflora</i> (slender sixweeks)	--	0.3
<i>Kochia scoparia</i> * (kochia)	--	0.3
<i>Machaeranthera canescens</i> (hoary aster)	0.3	X
<i>Draba verna</i> * (spring whitlowgrass)	--	0.2
<i>Descurainia pinnata</i> (western tansymustard)	--	0.2
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	0.2	--
<i>Lomatium macrocarpum</i> (bigseed desertparsley)	--	X
<i>Phlox longifolia</i> (longleaf phlox)	--	X
<i>Erodium cicutarium</i> * (storksbill)	--	X
<i>Achillea millefolium</i> (yarrow)	--	X
<i>Tragopogon dubius</i> * (yellow salsify)	--	X
Biotic crust	43.3	42.0
Bare Soil	52.2	42.0
Litter	45.2	45.3
<b>Total Canopy Cover (excludes litter)</b>	<b>80.8</b>	<b>96.0</b>

\* Invasive species

X=present but not counted in plot frames

-- species not recorded

Total Invasive % Cover	3.8	33.7
Total Native % Cover	77.0	62.3
Change in Native Cover from 2007	^41.7	^27.0

**Table A-23. Frequency of Occurance at the Horseshoe Landfill and Soil Staging Area in 2008.**

<b>Species</b>	<b>HSLF</b>	<b>SSA</b>
<i>Sisymbrium altissimum</i> * (tumble mustard)	X	93.3
<i>Bromus tectorum</i> * (cheatgrass)	100.0	93.3
<i>Poa sandbergii</i> (Sandberg's bluegrass)	100.0	100.0
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	60.0	20.0
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	46.7	20.0
<i>Salsola kali</i> * (Russian thistle)	33.3	80.0
<i>Lupinus leucophyllus</i> (velvet lupine)	--	26.7
<i>Festuca octoflora</i> (slender sixweeks)		13.3
<i>Kochia scoparia</i> * (kochia)	--	13.3
<i>Artemesia tridentata</i> (sagebrush)	20.0	33.3
<i>Lactuca seriola</i> * (prickly lettuce)	13.3	6.7
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	--	26.7
<i>Draba verna</i> * (spring whitlowgrass)	--	6.7
<i>Crepis atrabarba</i> (slender hawkbeard)	--	20.0
<i>Descurainia pinnata</i> (western tansymustard)	--	6.7
<i>Epilobium paniculatum</i> (tall willowherb)	33.3	6.7
<i>Agropyron cristatum</i> * (crested wheatgrass)	6.7	6.7
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	33.3	X
<i>Lomatium macrocarpum</i> (bigseed desertparsley)	--	X
<i>Phlox longifolia</i> (longleaf phlox)	--	X
<i>Erodium cicutarium</i> * (storksbill)	--	X
<i>Machaeranthera canescens</i> (hoary aster)	13.3	X
<i>Achillea millefolium</i> (yarrow)	--	X
<i>Tragopogon dubius</i> * (yellow salsify)	--	X
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	6.7	--
Biotic crust	100.0	100.0
Bare Soil	100.0	100.0
Litter	100.0	100.0

\* Invasive species

X=present but not counted in plot frames

-- species not recorded



## **APPENDIX B**

### **2007 REVEGETATION MONITORING RESULTS**





**Table B-1. Percent Canopy Cover and Frequency of Occurrence at the 300-FF-1 Process Ponds and Burial Grounds 2007.**

Species	% Cover	% Frequency
<i>Poa sandbergii</i> (Sandberg's bluegrass)	7.9	57
<i>Bromus tectorum</i> * (cheatgrass)	32.0	97
<i>Salsola kali</i> * (Russian thistle)	3.4	80
<i>Ag. Spp.</i> (Wheatgrasses)	20.4	74
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	0.1	3
<i>Vulpia myuros</i> * (rattail fescue)	3.7	51
<i>Lactuca serriola</i> * (prickly lettuce)	0.9	37
<i>Centaurea diffusa</i> * (diffuse knapweed)	0.8	17
<i>Festuca octoflora</i> (six-weeks fescue)	0.4	17
<i>Erodium cicutarium</i> * (storksbill)	5.3	51
<i>Sisymbrium altissimum</i> * (tumble mustard)	0.8	31
<i>Epilobium paniculatum</i> (tall willowherb)	0.2	9
<i>Agropyron cristatum</i> * (Crested Wheatgrass)	3.1	40
<i>Senecio vulgaris</i> (common groundsel)	0.1	6
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.3	11
<i>Lepidium perfoliatum</i> (clasping pepperweed)	4.7	11
<i>Descurainia pinnata</i> (western tansymustard)	0.1	6
<i>Tragopogon dubius</i> * (yellow salsify)	0.1	3
<i>Hordeum leporinum</i> (hare barley)	0.1	3
<i>Holosteum umbellatum</i> (jagged chickweed)	0.0	0
<i>Petalostemon ornatum</i> (prairie clover)	X	X
<i>Melilotus alba</i> * (sweetclover)	X	X
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	X
<i>Artemisia tridentata</i> (sagebrush)	X	X
<i>Tragopogon dubius</i> (yellow salsify)	X	X
<i>Achillea millefolium</i> (yarrow)	X	X
<i>Cardaria draba</i> * (whitetop)	X	X
<i>Machaeranthera canescens</i> (hoary aster)	X	X
<i>Descurainia pinnata</i> (western tansymustard)	X	X
<i>Agoseris heterophylla</i> (mountain dandelion)	X	X
<i>Malva neglecta</i> * (cheeseweed)	X	X
<i>Centaurea repens</i> * (Russian knapweed)	X	X
Biotic crust	7.2	31
Bare Soil	34.5	100
Litter	62.0	100
<b>Total canopy cover</b> (Biotic crust and litter not included)	<b>84.4</b>	

\*Introduced species.

X = Species present on the site but not counted in a plot frame.

Total Introduced species % Cover 2007	50.0
Total Native % Cover 2007	34.4
Change in Native Plant % Cover from 2006 to 2007	+15.7

**Table B-2. Percent Canopy Cover and Frequency of Occurrence at 618-2 & 618-3 in 2007.**

Species	% Cover	% Freq
<i>Salsola kali</i> * (Russian thistle)	11.8	100
<i>Sisymbrium altissimum</i> * (tumble mustard)	7.6	88
<i>Bromus tectorum</i> * (cheatgrass)	4.6	84
<i>Agropyron spp.</i> (wheatgrasses)	11.2	100
<i>Ambrosia acanthicarpa</i> (bur ragweed)	0.3	12
<i>Amsinckia lycopoides</i> (tarweed fiddleneck)	0.1	4
<i>Epilobium paniculatum</i> (tall willowherb)	0.1	4
<i>Erodium cicutarium</i> * (storksbill)	0.1	4
Bare Soil	58.9	100
Litter	35.5	96
<b>Total canopy cover (Litter not included)</b>	<b>35.8</b>	

\* Introduced Species

X= present but not counted in plot frames

Total Introduced Species % Cover 2007 24.1

Total Native % Cover 2007 11.7

**Table B-3. Percent Canopy Cover and Frequency of Occurrence at 300-8 in 2007.**

Species	% Cover	% Freq
<i>Salsola kali</i> * (Russian thistle)	12.6	100
<i>Sisymbrium altissimum</i> * (tumble mustard)	12.6	96
<i>Bromus tectorum</i> * (cheatgrass)	16.2	88
<i>Ambrosia acanthicarpa</i> (bur ragweed)	0.3	12
<i>Agropyron spp.</i> (wheatgrasses)	36.2	100
<i>Holosteum umbellatum</i> * (jagged chickweed)	0.2	8
<i>Machaeranthera canescens</i> (hoary aster)	0.3	12
<i>Plantago patagonica</i> (indian wheat)	0.1	4
<i>Vulpia myuros</i> (rattail fescue)	1.2	8
<i>Draba verna</i> * (spring whitlowgrass)	0.4	16
<i>Artemisia tridentata</i> (sagebrush)	0.3	12
<i>Oenothera pallida</i> (primerose)	1.5	4
<i>Erodium cicutarium</i> * (storksbill)	0.1	4
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	X
<i>Lactuca serriola</i> * (prickly lettuce)	X	X
<i>Conyza canadensis</i> * (horseweed)	X	X
<i>Amsinckia lycopoides</i> (tarweed fiddleneck)	X	X
<i>Centaurea diffusa</i> * (diffuse knapweed)	X	X
Bare Soil	54.2	100
Litter	45.9	100
<b>Total canopy cover (Litter not included)</b>	<b>82.0</b>	

\* Introduced Species

X= present but not counted in plot frames

Total Introduced Species % Cover 2007 41.9

Total Native % Cover 2007 40.1

**Table B-4. Percent Canopy Cover on the 120-N-1 and 120-N-2 Sites in 2007.**

Species	Biosol and Straw Mulch	Biosol and Hydromulch	Triple-16 and Straw Mulch	Triple-16 and Hydromulch
<i>Bromus tectorum</i> * (cheatgrass)	83.7	71.3	34.3	16.2
<i>Poa sandbergii</i> (Sandberg's bluegrass)	11.7	1.2	29.3	23.2
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	5.2	2.7	33.7	3.3
<i>Agropyron dasytachyum</i> (thickspike wheatgrass)	--	--	0.2	--
<i>Centaurea diffusa</i> * (diffuse knapweed)	0.2	0.3	0.8	1.5
<i>Poa bulbosa</i> * (bulbous bluegrass)	--	1.0	0.3	--
<i>Artemisia tridentata</i> (sagebrush)	--	0.0	0.2	--
<i>Salsola kali</i> * (Russian thistle)	1.5	1.3	0.2	3.0
<i>Achillea millefolium</i> (yarrow)	0.2	--	0.3	6.2
<i>Holosteum umbellatum</i> * (jagged chickweed)	--	0.2	0.2	0.7
<i>Erysimum asperum</i> (wallflower)	--	0.0	--	0.0
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	--	0.2	--	4.5
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	--	2.0	--	2.0
<i>Sisymbrium altissimum</i> * (tumble mustard)	0.2	1.0	X	0.2
<i>Tragopogon dubius</i> * (yellow salsify)	--	--	--	0.2
<i>Erigeron poliospermus</i> (cushion fleabane)	--	--	X	1.0
<i>Draba verna</i> * (spring whitlow)	--	0.2	--	--
<i>Lactuca serriola</i> * (prickly lettuce)	--	--	X	0.2
<i>Penstemon acuminatus</i> (sand beardtongue)	--	--	--	X
<i>Chaenactis douglasii</i> (hoary falseyarrow)	--	--	--	X
<i>Erysimum asperum</i> (rough wallflower)	--	--	X	--
<i>Hordeum leporinum</i> * (hare barley)	--	--	X	--
Biotic crust	--	--	3.00	2.33
Bare soil	23.83	39.17	24.00	78.83
Litter	76.50	54.17	59.50	11.33
<b>Total canopy cover</b> (Biotic crust or Litter not included)	<b>102.5</b>	<b>81.3</b>	<b>99.5</b>	<b>62.0</b>

\* Introduced species.

X = Species observed but not counted in a plot frame.

-- = Not present on site.

% Cover Introduced Species	85.5	75.3	35.8	21.8
% Cover Native	17.0	6.0	63.7	40.2
Change in Native Plant % Cover from 2006 to 2007	-18.3	+0.7	+38.5	+15.0

**Table B-5. Percent Frequency on the 120-N-1 and 120-N-2 Sites in 2007.**

Species	Biosol and Straw Mulch	Biosol and Hydromulch	Triple-16 and Straw Mulch	Triple-16 and Hydromulch
<i>Bromus tectorum</i> * (cheatgrass)	100	100	100	100
<i>Poa sandbergii</i> (Sandberg's bluegrass)	87	100	80	47
<i>Salsola kali</i> * (Russian thistle)	7	87	60	53
<i>Achillea millefolium</i> (yarrow)	13	80	7	--
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	87	67	47	13
<i>Centaurea diffusa</i> * (diffuse knapweed)	33	27	7	13
<i>Holosteum umbellatum</i> * (jagged chickweed)	7	27	--	7
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	20	--	7
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	--	13	--	13
<i>Erigeron poliospermus</i> (cushion fleabane)	X	7	--	--
<i>Lactuca serriola</i> * (prickly lettuce)	X	7	--	--
<i>Sisymbrium altissimum</i> * (tumble mustard)	X	7	7	40
<i>Tragopogon dubius</i> * (yellow salsify)	--	7	--	--
<i>Agropyron dasytachyum</i> (thickspike wheatgrass)	7	--	--	--
<i>Artemisia tridentata</i> (sagebrush)	7	--	--	--
<i>Draba verna</i> * (spring whitlow)	--	--	--	7
<i>Erysimum asperum</i> (wallflower)	--	--	--	--
<i>Poa bulbosa</i> * (bulbous bluegrass)	13	--	--	7
<i>Penstemon acuminatus</i> (sand beardtongue)	--	X	--	--
<i>Chaenactis douglasii</i> (hoary falseyarrow)	--	X	--	--
<i>Erysimum asperum</i> (rough wallflower)	X	--	--	--
<i>Hordeum leporinum</i> * (hare barley)	X	--	--	--
Biotic crust	53	60	--	--
Bare soil	80	100	100	100
Litter	100	100	100	100

\* Introduced species.

X = present but not counted in a plot frame.

-- = Not present on site.

**TableB-6. Percent Canopy Cover at the Hanford Generating Plant in 2007.**

Species	Topsoil	Cobble
<i>Poa sandbergii</i> (Sandberg's bluegrass)	21.1	26
<i>Native Grasses</i> <sup>b</sup>	2.6	9
<i>Bromus tectorum</i> * (cheatgrass)	73.5	15
<i>Sisymbrium altissimum</i> * (tumble mustard)	3.1	3
<i>Salsola kali</i> * (Russian thistle)	1.1	27
<i>Erodium cicutarium</i> * (storksbill)	0.3	0
<i>Lactuca serriola</i> * (prickly lettuce)	0.3	1
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	0
<i>Draba verna</i> * (spring whitlow)	0.3	1
<i>Holosteum umbellatum</i> * (jagged chickweed)	22.1	1
<i>Vulpia myuros</i> * (rattail fescue)	0.1	1
<i>Artemisia tridentata</i> (sagebrush)	0.3	0
<i>Centaurea diffusa</i> * (diffuse knapweed)	X	0
<i>Achillea millefolium</i> (yarrow)	--	0
<i>Chorispora tenella</i> * (blue mustard)	5.4	0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.3	0
<i>Descurainia pinnata</i> (western tansymustard)	--	0
<i>Ranunculus testiculatus</i> * (bur buttercup)	1.3	X
<i>Poa bulbosa</i> * (Bulbous bluegrass)	X	X
<i>Hordeum leporinum</i> * (hare barley)	X	--
<i>Machaeranthera canescens</i> (hoary aster)	--	X
<i>Sphaeralcea munroana</i> (Munro's globemallow)	--	X
Bare Soil	3.6	38
Litter	85.9	56
<b>Total canopy cover</b> (Biotic crust or Litter not included)	<b>131.6</b>	<b>85</b>

\*Introduced species.

<sup>b</sup>Includes Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, needle-and-thread grass, and prairie junegrass seedlings.

X = Species present on the site but not counted in a plot frame

-- = Not observed on the site.

Total Introduced % Cover 2007	3.63	56
Total Native % Cover 2007	85.88	38
Change in Native Plant % Cover from 2006 to 2007	+64.68	+2.7

**Table B-7. Frequency of Occurrence at the Hanford Generating Plant in 2007.**

Species	Topsoil	Cobble
<i>Poa sandbergii</i> (Sandberg's bluegrass)	65	92
<i>Native Grasses</i> <sup>b</sup>	35	72
<i>Bromus tectorum</i> * (cheatgrass)	100	96
<i>Sisymbrium altissimum</i> * (tumble mustard)	75	80
<i>Salsola kali</i> * (Russian thistle)	45	92
<i>Erodium cicutarium</i> * (storksbill)	10	12
<i>Lactuca serriola</i> * (prickly lettuce)	10	28
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	4
<i>Draba verna</i> * (spring whitlow)	10	20
<i>Holosteum umbellatum</i> * (jagged chickweed)	80	28
<i>Vulpia myuros</i> * (rattail fescue)	5	28
<i>Artemisia tridentata</i> (sagebrush)	10	4
<i>Centaurea diffusa</i> * (diffuse knapweed)	X	12
<i>Achillea millefolium</i> (yarrow)	X	8
<i>Chorispora tenella</i> * (blue mustard)	50	4
<i>Amsinckia lycopoides</i> (tarweed fiddleneck)	10	4
<i>Descurainia pinnata</i> (western tansymustard)	X	4
<i>Ranunculus testiculatus</i> * (bur buttercup)	25	X
<i>Poa bulbosa</i> * (Bulbous bluegrass)	X	X
<i>Hordeum leporinum</i> * (hare barley)	X	--
<i>Machaeranthera canescens</i> (hoary aster)	--	X
<i>Sphaeralcea munroana</i> (Munro's globemallow)	--	X
Bare Soil	70	92
Litter	100	100

\* Introduced species.

<sup>b</sup>Includes Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, needle-and-thread grass, and prairie junegrass seedlings.

X = Species present but not counted in a plot frame

-- = Not present on site.

**Table B-8. Percent Canopy Cover and Frequency of Occurrence at 116-N-3 in 2007.**

Species	% Cover	% Freq
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	5.1	43
<i>Bromus tectorum</i> * (cheatgrass)	16.8	97
<i>Salsola kali</i> * (Russian thistle)	14.8	100
<i>Lactuca serriola</i> * (prickly lettuce)	1.8	23
<i>Sisymbrium altissimum</i> * (tumble mustard)	1.5	60
<i>Poa sandbergii</i> (Sandberg's bluegrass)	30.8	90
<i>Holosteum umbellatum</i> * (jagged chickweed)	0.8	30
<i>Draba verna</i> * (spring whitflow)	0.3	10
<i>Agoseris heterophylla</i> (mountain-dandelion)	0.3	13
<i>Erodium cicutarium</i> * (storksbill)	0.5	3
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.2	7
<i>Vulpia myuros</i> * (Rattail fescue)	0.1	3
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	0.1	3
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	1.5	13
<i>Centaurea diffusa</i> * (diffuse knapweed)	0.5	3
<i>Koeleria cristata</i> (prairie Junegrass)	X	X
<i>Machaeranthera canescens</i> (hoary aster)	X	X
Bare Soil	53.9	93
Litter	35.8	100
<b>Total canopy cover</b> (Litter not included)	<b>74.9</b>	

\* Introduced species.

X = Species observed not counted in a plot frame.

Total Introduced % Cover 2007	36.17
Total Native % Cover 2007	38.00
Change in Native Plant % Cover from 2006 to 2007	+21.1

**Table B-9. Percent Canopy Cover and Frequency of Occurrence at 116-N-1 in 2007.**

<b>Species</b>	<b>% Cover</b>	<b>Freq. of Occ.</b>
Native Grasses <sup>b</sup>	31.8	100
<i>Sisymbrium altissimum</i> * (tumble mustard)	17.7	87
<i>Lactuca serriola</i> * (prickly lettuce)	0.8	30
<i>Bromus tectorum</i> * (cheatgrass)	0.9	37
<i>Salsola kali</i> * (Russian thistle)	4.4	93
<i>Artemisia tridentata</i> (sagebrush)	0.8	30
<i>Poa sandbergii</i> (Sandberg's bluegrass)	0.1	3
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	0.1	3
<i>Kochia scopari</i> * (kochia)	0.2	7
<i>Descurainia pinnata</i> (western tansymustard)	X	X
<i>Conyza canadensis</i> * (horseweed)	X	X
<i>Epilobium paniculatum</i> (tall willowherb)	X	X
<i>Achillea millefolium</i> (yarrow)	X	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	X	X
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	X	X
<i>Poa sandbergii</i> (Sandberg's bluegrass)	X	X
Bare Soil	31.3	97
Litter	63.7	100
<b>Total canopy cover</b> (Litter not included)	<b>56.6</b>	

\* Introduced species

X=present but not counted in plot frames

<sup>b</sup>Includes Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, needle-and-thread grass, and prairie junegrass seedlings.

Total Introduced % Cover	23.92
Total Native % Cover	32.67



**Table B-10. Percent Canopy Cover and Frequency of Occurrence at 100-F Area Sites in 2007.**

Species	% Cover	% Freq
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	11.6	69
<i>Bromus tectorum</i> * (cheatgrass)	45.6	97
<i>Salsola kali</i> * (Russian thistle)	4.4	94
<i>Sisymbrium altissimum</i> * (tumble mustard)	0.3	11
<i>Artemisia tridentata</i> (sagebrush)	0.1	3
<i>Poa sandbergii</i> (Sandberg's bluegrass)	18.7	94
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	0.1	3
<i>Achillea millefolium</i> (yarrow)	0.1	6
<i>Holosteum umbellatum</i> * (jagged chickweed)	5.4	26
<i>Draba verna</i> * (spring whitflow)	0.3	11
<i>Poa bulbosa</i> * (bulbous bluegrass)	0.4	14
<i>Sporobolus cryptandrus</i> (sanddrop seed)	0.1	3
<i>Erodium cicutarium</i> * (storksbill)	0.3	11
<i>Vicia cracca</i> * (bird vetch)	1.1	3
<i>Festuca octoflora</i> (slender sixweeks)	0.1	3
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	0.4	3
<i>Astragalus sclerocarpus</i> (stalk-pod milkvetch)	0.4	3
<i>Lepidium perfoliatum</i> (clasping pepperweed)	0.1	3
<i>Astragalus succumbens</i> (crouching milkvetch)	X	X
<i>Phacelia linearis</i> (threadleaf scorpionweed)	X	X
<i>Koeleria cristata</i> (prairie junegrass)	X	X
<i>Centaurea diffusa</i> * (diffuse knapweed)	X	X
<i>Agoseris heterophylla</i> (mountain dandelion)	X	X
<i>Machaeranthera canescens</i> (hoary aster)	X	X
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	X
<i>Tragopogon dubius</i> * (yellow salsify)	X	X
<i>Astragalus caricinus</i> (buckwheat milkvetch)	X	X
<i>Chrysothamnus viscidiflorus</i> (green rabbitbrush)	X	X
Bare Soil	28.3	80
Litter	69.0	100
<b>Total canopy cover</b> (Litter not included)	<b>89.4</b>	

\* Introduced species.

X = Species present on the site but not counted in a plot frame.

-- = Not present on site.

Total Introduced % Cover 2007	57.71
Total Native % Cover 2007	31.71
Change in Native Plant % Cover from 2006 to 2007	+15.4

**Table B-11. Percent Canopy Cover and Frequency on the 100-B-1 and 128-C-1 Sites in 2007.**

Species	% Cover on 100-B-1	% Cover on 128-C-1	% Frequency on 100-B-1	% Frequency on 100-C-1
<i>Sisymbrium altissimum</i> * (tumble mustard)	6.1	1.2	84	47
<i>Salsola kali</i> * (Russian thistle)	17.8	19.2	100	100
<i>Poa sandbergii</i> (Sandberg's bluegrass)	41.6	8.8	100	67
<i>Agropyron spp.</i> (Wheatgrasses)	2.7	1.5	68	60
<i>Bromus tectorum</i> * (cheatgrass)	18.5	17.7	84	100
<i>Poa bulbosa</i> (Bulbous bluegrass)	0.1	--	4	--
<i>Hordeum leporinum</i> * (hare barley)	0.2	--	8	--
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.7	--	8	--
<i>Agoseris heterophylla</i> (mountain dandelion)	0.1	0.2	4	7
<i>Vulpia myuros</i> * (rattail fescue)	0.1	--	4	--
<i>Artemisia tridentata</i> (sagebrush)	0.1	1.0	4	7
<i>Grayia spinosa</i> (hopsage)	X	--	X	--
<i>Descurainia pinnata</i> (western tansymustard)	X	--	X	--
<i>Hordeum leporinum</i> * (hare barley)	X	--	X	--
<i>Kochia scoparia</i> * (kochia)	X	--	X	--
<i>Amsinckia lycopsoides</i> (fiddleneck)	X	--	X	--
<i>Lactuca serriola</i> * (prickly lettuce)	--	0.7	--	27
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	--	12.2	--	73
<i>Draba verna</i> (spring whitlowgrass)	--	0.5	--	20
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	--	1.3	--	20
Bare Soil	30.5	34.2	96	100
Litter	57.2	55.2	100	100
<b>Total Canopy Cover</b> (litter not included)	<b>88.0</b>	<b>64.2</b>		

\* Introduced species.

X = Observed on the site but not counted in a plot frame.

-- = Not present on site.

Total Introduced % Cover 2007	42.6	39.2
Total Native % Cover 2007	45.4	25.0
Difference in % Cover of Native Plants from 2006 to 2007	+31.2	+20.8

**Table B-12. Percent Canopy Cover at 100-C-9 Transects 1, 2, 3, & 4 in 2007.**

Species	T-1 % Cover	T-2 % Cover	T-3 % Cover	T-4 % Cover
<i>Salsola kali</i> * (Russian thistle)	12.3	24.7	25.7	39.8
<i>Bromus tectorum</i> * (cheatgrass)	0.2	5.7	10.0	3.0
Native Grasses <sup>b</sup>	61.7	47.0	18.0	42.2
<i>Sisymbrium altissimum</i> * (tumble mustard)	1.3	1.5	13.2	25.5
<i>Artemisia tridentata</i> (sagebrush)	0.2	0.5	0.2	0.2
<i>Lactuca serriola</i> * (prickly lettuce)	0.5	0.2	1.0	0.3
<i>Holosteum umbellatum</i> * (jagged chickweed)	--	1.0	--	--
<i>Poa bulbosa</i> * (bulbous bluegrass)	X	X	0.2	--
<i>Draba verna</i> (spring whitlowgrass)	--	--	0.5	0.2
<i>Epilobium paniculatum</i> (tall willowherb)	--	--	0.2	--
<i>Eriogonum niveum</i> (snow buckwheat)	--	--	0.3	--
<i>Centaurea diffusa</i> * (diffuse knapweed)	--	--	X	0.7
<i>Festuca octoflora</i> (slender sixweeks)	X	--	--	0.2
<i>Agropyron</i> spp. (wheatgrasses)	--	--	--	0.2
<i>Erodium cicutarium</i> * (storksbill)	--	--	X	0.2
<i>Tragopogon dubius</i> * (yellow salsify)	--	X	--	--
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	--	X	--	--
<i>Agastache occidentalis</i> (western horsemint)	--	--	--	X
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	--	X	X	--
<i>Chaenactis douglasii</i> (hoary falseyarrow)	--	--	X	--
<i>Machaeranthera canescens</i> (hoary aster)	--	--	X	--
<i>Gnaphalium chilense</i> (cottonbating cudweed)	--	--	--	X
<i>Melilotus officinalis</i> * (sweetclover)	--	--	--	--
Bare Soil	48.5	32.2	40.5	37.2
Litter	52.8	70.5	60.8	60.8
<b>Total canopy cover</b> (Litter not included)	<b>76.2</b>	<b>80.5</b>	<b>69.2</b>	<b>112.3</b>
* Introduced species				
<sup>b</sup> Includes Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, needle-and-thread grass, and prairie junegrass seedlings.				
X=present but not counted in plot frames				
-- = Not present on site.				
Total Introduced % Cover 2007	14.33	33	50.5	69.7
Total Native % Cover 2007	61.83	47.5	18.7	42.7

**Table B-13. Percent Frequency of Occurrence at 100-C-9 Transects 1, 2, 3, & 4 in 2007.**

Species	T-1 Freq. of Occ.	T-2 Freq. of Occ.	T-3 Freq. of Occ.	T-4 Freq. of Occ.
<i>Salsola kali</i> * (Russian thistle)	100	100	100	100
<i>Bromus tectorum</i> * (cheatgrass)	7	7	80	53
Native Grasses <sup>b</sup>	100	100	100	100
<i>Sisymbrium altissimum</i> * (tumble mustard)	53	27	100	93
<i>Artemisia tridentata</i> (sagebrush)	7	20	7	7
<i>Lactuca serriola</i> * (prickly lettuce)	20	7	40	13
<i>Holosteum umbellatum</i> * (jagged chickweed)	--	7	--	--
<i>Poa bulbosa</i> * (bulbous bluegrass)	X	X	7	--
<i>Draba verna</i> (spring whitlowgrass)	--	--	20	7
<i>Epilobium paniculatum</i> (tall willowherb)	--	--	7	--
<i>Eriogonum niveum</i> (snow buckwheat)	--	--	13	--
<i>Centaurea diffusa</i> * (diffuse knapweed)	--	--	X	27
<i>Festuca octoflora</i> (slender sixweeks)	X	--	--	7
Ag spp. (wheatgrasses)	--	--	--	7
<i>Erodium cicutarium</i> * (storksbill)	--	--	X	7
<i>Tragopogon dubius</i> * (yellow salsify)	--	X	--	--
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	--	X	--	--
<i>Agastache occidentalis</i> (western horsemint)	--	--	--	X
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	--	X	X	--
<i>Chaenactis douglasii</i> (hoary falseyarrow)	--	--	X	--
<i>Machaeranthera canescens</i> (hoary aster)	--	--	X	--
<i>Gnaphalium chilense</i> (cottonbatting cudweed)	--	--	--	X
<i>Melilotus officinalis</i> * (sweetclover)	--	--	--	--
Bare Soil	100	93	100	100
Litter	93	100	100	100

\* Introduced species

<sup>b</sup>Includes Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, needle-and-thread grass, and prairie junegrass seedlings.

X=present but not counted in plot frames

-- = Not present on site.

**Table B-14. Percent Canopy Cover and Frequency of Occurrence at 118-B 2 & 118-B- 3 in 2007.**

<b>Species</b>	<b>% Cover</b>	<b>% Freq</b>
Native Grasses	26.5	100
<i>Salsola kali</i> * (Russian thistle)	61.7	100
<i>Sisymbrium altissimum</i> * (tumble mustard)	0.5	20
<i>Bromus tectorum</i> * (cheatgrass)	0.2	7
<i>Artemisia tridentata</i> (sagebrush)	0.2	7
<i>Lactuca serriola</i> * (prickly lettuce)	X	X
<i>Chondrilla juncea</i> * (rush skeletonweed)	X	X
Bare Soil	39.8	100
Litter	55.2	100
<b>Total canopy cover</b> (Litter not included)	<b>89.0</b>	

\* Introduced species

X=present but not counted in plot frames

Total Introduced % Cover 2007 62.3  
Total Native % Cover 2007 26.7

**Table B-15. Percent Canopy Cover on 116-K-2 in 2007.**

Species	116-K2-T1	116-K2-T2	116-K2-T3	116-K2-T4
Native Grasses <sup>b</sup>	49.2	37.5	42.7	12.0
<i>Bromus tectorum</i> * (cheatgrass)	8.7	7.8	4.5	6.1
<i>Artemisia tridentata</i> (sagebrush)	0.3	1.2	1.0	--
<i>Salsola kali</i> * (Russian thistle)	13.7	39.0	47.3	63.0
<i>Sisymbrium altissimum</i> * (tumble mustard)	1.7	1.5	1.0	0.8
<i>Epilobium paniculatum</i> (tall willowherb)	0.2	--	--	--
<i>Agoseris heterophylla</i> (mountain-dandelion)	0.5	0.8	0.5	0.2
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.3	0.3	0.2	--
<i>Holosteum umbellatum</i> (jagged chickweed)	0.3	--	0.3	--
<i>Draba verna</i> * (spring whitlow)	0.7	0.7	--	--
<i>Lactuca serriola</i> * (prickly lettuce)	0.2	0.7	0.2	0.9
<i>Centaurea diffusa</i> * (diffuse knapweed)	0.2	1.0	0.2	--
<i>Tragopogon dubius</i> (yellow salsify)	--	0.2	--	--
<i>Microsteris gracilis</i> (annual phlox)	--	0.2	--	--
<i>Gnaphalium chilense</i> (Cudweed)	--	--	--	0.2
<i>Layia glandulosa</i> (white daisy tidytips)	X	--	--	--
<i>Chaenactis douglasii</i> (hoary falseyarrow)	X	--	--	--
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	X	--	--	--
<i>Verbascum thapsus</i> * (common mullein)	X	--	--	--
<i>Poa sandbergii</i> (Sandberg's bluegrass)	--	X	--	--
<i>Astragalus sclerocarpus</i> (stalked pod milkvetch)	--	--	X	--
<i>Oenothera pallida</i> (evening primrose)	--	--	X	--
<i>Achillea millefolium</i> (yarrow)	--	--	X	--
<i>Epilobium paniculatum</i> (tall willowherb)	--	--	--	X
Bare Soil	21.3	17.7	27.7	13.0
Litter	70.2	75.3	67.3	77.2
<b>Total canopy cover</b> (Litter not included)	<b>75.8</b>	<b>90.8</b>	<b>97.8</b>	<b>83.1</b>

\*Introduced Species.

<sup>b</sup>Includes Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, needle-and-thread grass, and prairie junegrass seedlings.

X= Present but not counted in plot frames.

-- = Not present on site.

Total Introduced % Cover 2007	25.0	50.2	53.2	70.8
Total Native % Cover 2007	50.8	90.2	44.7	12.3

**Table B-16. Frequency of Occurance on 116-K-2 in 2007.**

Species	116-K2-T1	116-K2-T2	116-K2-T3	116-K2-T4
Native Grasses <sup>b</sup>	100	100	93	100
<i>Bromus tectorum</i> * (cheatgrass)	87	87	80	63
<i>Artemisia tridentata</i> (sagebrush)	13	13	7	--
<i>Salsola kali</i> * (Russian thistle)	100	100	100	100
<i>Sisymbrium altissimum</i> * (tumble mustard)	67	60	40	31
<i>Epilobium paniculatum</i> (tall willowherb)	7	--	--	--
<i>Agoseris heterophylla</i> (mountain-dandelion)	20	33	20	6
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	13	13	7	--
<i>Holosteum umbellatum</i> (jagged chickweed)	13	--	13	--
<i>Draba verna</i> * (spring whitlow)	27	27	--	--
<i>Lactuca serriola</i> * (prickly lettuce)	7	27	7	38
<i>Centaurea diffusa</i> * (diffuse knapweed)	7	7	7	--
<i>Tragopogon dubius</i> (yellow salsify)	--	7	--	--
<i>Microsteris gracilis</i> (annual phlox)	--	7	--	--
<i>Gnaphalium chilense</i> (Cudweed)	--	--	--	6
<i>Layia glandulosa</i> (white daisy tidytips)	X	--	--	--
<i>Chaenactis douglasii</i> (hoary falseyarrow)	X	--	--	--
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	X	--	--	--
<i>Verbascum thapsus</i> * (common mullein)	X	--	--	--
<i>Poa sandbergii</i> (Sandberg's bluegrass)	--	X	--	--
<i>Astragalus sclerocarpus</i> (stalked pod milkvetch)	--	--	X	--
<i>Oenothera pallida</i> (evening primrose)	--	--	X	--
<i>Achillea millefolium</i> (yarrow)	--	--	X	--
<i>Epilobium paniculatum</i> (tall willowherb)	--	--	--	X
Bare Soil	93	73	93	81
Litter	100	100	100	100

\*Introduced Species.

<sup>b</sup>Includes Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, needle-and-thread grass, and prairie junegrass seedlings.

X= Present but not counted in plot frames.

-- = Not present on site.

**Table B-17. Percent Canopy Cover on the Horseshoe Landfill and Soil Staging Area 2007.**

Species	Horseshoe Landfill	Soil Staging Area
<i>Salsola kali</i> * (Russian thistle)	5.8	30.0
<i>Bromus tectorum</i> * (cheatgrass)	15.5	20.0
<i>Artemisia tridentata</i> (sagebrush)	0.2	2.3
<i>Sisymbrium altissimum</i> * (tumble mustard)	2.0	12.8
<i>Poa sandbergii</i> (Sandberg's bluegrass)	18.0	20.8
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	5.7	--
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	6.3	4.3
<i>Lactuca serriola</i> * (prickly lettuce)	1.7	1.3
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	3.8	--
<i>Agropyron cristatum</i> * (crested wheatgrass)	0.2	--
<i>Epilobium paniculatum</i> (tall willowherb)	0.5	0.2
<i>Vulpia myuros</i> * (rattail fescue)	0.3	--
<i>Lupinus leucophyllus</i> (velvet lupine)	0.2	0.5
<i>Kochia scopari</i> * (kochia)	0.5	0.2
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	--	0.7
<i>Amaranthus albus</i> * (white pigweed)	--	0.8
<i>Agropyron spp.</i> (wheatgrasses)	--	5.8
<i>Draba verna</i> * (spring whitlowgrass)	--	0.2
<i>Holosteum umbellatum</i> * (jagged chickweed)	--	0.2
<i>Agoseris heterophylla</i> (mountain dandelion)	--	0.2
<i>Descurainia pinnata</i> (western tansymustard)	--	0.3
<i>Crepis atrabarba</i> (slender hawksbeard)	--	0.2
<i>Linum perenne</i> (wild blueflax)	--	X
<i>Achillea millefolium</i> (yarrow)	--	X
<i>Melilotus alba</i> * (sweetclover)	X	--
Bare Soil	50.0	39.7
Litter	39.0	55.2
<b>Total canopy cover</b> (Litter not included)	<b>60.7</b>	<b>100.8</b>
* Introduced species		
X = Species present on the site but not counted in a plot frame.		
-- = Not present on site.		
Total Introduced % Cover 2007	26.00	65.50
Total Native % Cover 2007	34.67	35.33
Change in Native Plant % Cover from 2006 to 2007	+8.7	+13.2



**Table B-18. Frequency of Occurrence on the Horseshoe Landfill and Soil Staging Area 2007.**

Species	Horseshoe Landfill	Soil Staging Area
<i>Salsola kali</i> * (Russian thistle)	100	93
<i>Bromus tectorum</i> * (cheatgrass)	100	100
<i>Artemisia tridentata</i> (sagebrush)	7	27
<i>Sisymbrium altissimum</i> * (tumble mustard)	47	100
<i>Poa sandbergii</i> (Sandberg's bluegrass)	100	100
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	93	--
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	60	47
<i>Lactuca serriola</i> * (prickly lettuce)	33	53
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	53	--
<i>Agropyron cristatum</i> * (crested wheatgrass)	7	--
<i>Epilobium paniculatum</i> (tall willowherb)	20	7
<i>Vulpia myuros</i> * (rattail fescue)	13	--
<i>Lupinus leucophyllus</i> (velvet lupine)	7	20
<i>Kochia scopari</i> * (kochia)	20	7
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	--	27
<i>Amaranthus albus</i> * (white pigweed)	--	33
<i>Agropyron spp.</i> (wheatgrasses)	--	100
<i>Draba verna</i> (spring whitlowgrass)	--	7
<i>Holosteum umbellatum</i> * (jagged chickweed)	--	7
<i>Agoseris heterophylla</i> (mountain dandelion)	--	7
<i>Descurainia pinnata</i> (western tansymustard)	--	13
<i>Crepis atrabarba</i> (slender hawksbeard)	--	7
<i>Linum perenne</i> (wild blueflax)	--	X
<i>Achillea millefolium</i> (yarrow)	--	X
<i>Melilotus alba</i> * (sweetclover)	X	--
Bare Soil	100	100
Litter	100	100

\* Introduced species

X = Species present on the site but not counted in a plot frame.

-- = Not present on site.



**APPENDIX C**  
**2006 REVEGETATION MONITORING RESULTS**



**Table C-1. Percent Canopy Cover and Frequency of Occurrence at the 300-FF-1 Process Ponds and Burial Grounds 2006.**

Species	% Cover	% Frequency
<i>Agropyron dasytachyum</i> (thickspike wheatgrass)	X	X
<i>Agropyron spicatum</i> (bluebunch Wheatgrass)	7.6	68.6
<i>Agropyron cristatum</i> <sup>a</sup> (crested Wheatgrass)	4.9	42.9
<i>Stipa comata</i> (needle-and-thread grass)	X	X
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	0.2	8.6
<i>Vulpia myuros</i> <sup>a</sup> (rattail)	3.0	51.4
<i>Melilotus officinalis</i> <sup>a</sup> (sweetclover)	0.0	0.0
<i>Eriogonum niveum</i> (snow buckwheat)	X	X
<i>Poa sandbergii</i> (Sandberg's bluegrass)	9.4	77.1
<i>Centaurea diffusa</i> <sup>a</sup> (diffuse knapweed)	0.1	2.9
<i>Sisymbrium altissimum</i> <sup>a</sup> (tumble mustard)	3.0	77.1
<i>Bromus tectorum</i> <sup>a</sup> (cheatgrass)	16.9	94.3
<i>Lactuca serriola</i> <sup>a</sup> (prickly lettuce)	0.3	11.4
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.6	25.7
<i>Phacelia hastata</i> (whiteleaf scorpionweed)	0.1	2.9
<i>Ambrosia acanthicarpa</i> (bur ragweed)	0.1	5.7
<i>Erodium cicutarium</i> <sup>a</sup> (storksbill)	1.1	42.9
<i>Senecio vulgaris</i> (common groundsel)	0.1	2.9
<i>Salsola kali</i> <sup>a</sup> (Russian thistle)	2.1	68.6
<i>Lepidium perfoliatum</i> (clasping pepperweed)	X	X
<i>Oenothera pallida</i> (pale evening primrose)	X	X
<i>Psoralea lanceolata</i> (dune scurfpea)	X	X
<i>Cryptantha circumscissa</i> (matted cryptantha)	X	X
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	X
<i>Poa bulbosa</i> <sup>a</sup> (bulbous bluegrass)	0.2	8.6
<i>Hymenopappus filifolius</i> (Columbia cutleaf)	X	X
<i>Petalostemon ornatum</i> (prairie clover)	X	X
<i>Sphaeralcea munroana</i> (globemallow)	X	X
<i>Achillea millefolium</i> (yarrow)	X	X
<i>Epilobium paniculatum</i> (tall willowherb)	0.2	8.6
<i>Descurainia pinnata</i> (western tansymustard)	0.2	8.6
<i>Artemisia tridentata</i> (sagebrush)	X	X
<i>Draba verna</i> (spring whitlowgrass)	0.1	2.9
<i>Tragopogon dubius</i> (yellow salsify)	0.1	2.9
<i>Gilia leptomeria</i> (Great Basin gilia)	X	X
<i>Verbascum thapsus</i> <sup>a</sup> (common mullein)	X	X
Biotic crust	0.8	31.4
Bare Soil	33.9	94.3
Litter	51.2	100.0
<b>Total cover</b> (does not include biotic crust or litter)	<b>50.2</b>	

<sup>a</sup> Introduced species.

X = Species present on the site but not counted in a plot frame.

**Table C-2. Percent Canopy Cover on the 120-N-1 and 120-N-2 Sites in 2006.**

Species	Triple 16 and Straw Mulch	Triple 16 and Hydromulch	Biosol and Straw Mulch	Biosol and Hydromulch
<i>Agropyron dasytachyum</i> (thickspike wheatgrass)	X	0.3	X	--
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	15.8	2.0	8.8	X
<i>Poa sandbergii</i> (Sandberg's bluegrass)	20.7	17.7	24.7	3.1
<i>Stipa comata</i> (needle-and-thread grass)	X	X	X	--
<i>Bromus tectorum</i> <sup>a</sup> (cheatgrass)	23.2	2.5	60.8	62.1
<i>Salsola kali</i> <sup>a</sup> (Russian thistle)	1.2	1.7	0.5	1.0
<i>Achillea millefolium</i> (yarrow)	2.2	3.7	0.2	X
<i>Vulpia myuros</i> <sup>a</sup> (rattail fescue)	0.2	--	1.3	--
<i>Artemisia tridentata</i> (big sagebrush)	0.5	X	X	X
<i>Centaurea diffusa</i> <sup>a</sup> (diffuse knapweed)	0.7	0.7	0.2	0.2
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	0.2	0.3	0.2	0.2
<i>Eriogonum niveum</i> (snow buckwheat)	--	X	--	--
<i>Erodium cicutarium</i> <sup>a</sup> (storksbill)	X	--	--	0.2
<i>Lactuca serriola</i> <sup>a</sup> (prickly lettuce)	0.3	X	0.2	--
<i>Festuca octoflora</i> (slender sixweeks)	0.2	--	1.0	0.6
<i>Sisymbrium altissimum</i> <sup>a</sup> (tumblemustard)	0.5	0.7	1.2	1.9
<i>Tragopogon dubius</i> <sup>a</sup> (yellow salsify)	X	--	--	--
<i>Machaeranthera canescens</i> (hoary aster)	X	X	--	X
<i>Chaenactis douglasii</i> (hoary falseyarrow)	X	X	--	X
<i>Microsteris gracilis</i> (pink microsteris)	--	--	0.2	--
<i>Penstemon acuminatus</i> (sand beardtongue)	--	X	--	--
<i>Erigeron poliospermus</i> (cushion fleabane)	X	X	--	X
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	--	0.3	X	0.4
<i>Draba verna</i> (spring whitlowgrass)	0.2	0.2	0.2	0.6
<i>Holosteum umbellatum</i> (jagged chickweed)	X	0.7	--	0.4
<i>Erysimum asperum</i> (rough wallflower)	--	X	X	X
<i>Erigeron pumilis</i> (shaggy fleabane)	X	--	--	--
<i>Erigeron filifolius</i> (threadleaf fleabane)	X	--	--	--
<i>Poa bulbosa</i> <sup>a</sup> (bulbous bluegrass)	0.3	X	X	X
<i>Ranunculus testiculatus</i> <sup>a</sup> (bur buttercup)	0.2	--	0.2	--
Biotic crust	0.7	0.2	--	--
Bare soil	27.8	82.0	20.0	47.9
Litter	58.5	5.8	77.7	44.0
<b>Total Cover</b> (does not include biotic crust or litter)	<b>66.2</b>	<b>30.7</b>	<b>99.5</b>	<b>70.8</b>

<sup>a</sup> Introduced species.

X = Species observed on the treatment but not counted in a plot frame.

-- = Species not observed on the treatment.

**Table C-3. Percent Frequency of Occurrence on the 120-N-1 and 120-N-2 Sites in 2006.**

Species	Triple 16 and Straw Mulch	Triple 16 and Hydromulch	Biosol and Straw Mulch	Biosol and Hydromulch
<i>Agropyron dasytachyum</i> (thickspike wheatgrass)	X	13	X	--
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	93	47	66.7	X
<i>Poa sandbergii</i> (Sandberg's bluegrass)	100	100	100	83.3
<i>Stipa comata</i> (needle-and-thread grass)	X	X	X	--
<i>Bromus tectorum</i> <sup>a</sup> (cheatgrass)	100	100	100	100
<i>Salsola kali</i> <sup>a</sup> (Russian thistle)	47	67	20	41.7
<i>Achillea millefolium</i> (yarrow)	53	80	6.7	X
<i>Vulpia myuros</i> <sup>a</sup> (rattail fescue)	7	--	20	--
<i>Artemisia tridentata</i> (big sagebrush)	20	X	X	X
<i>Centaurea diffusa</i> <sup>a</sup> (diffuse knapweed)	27	27	6.7	8.3
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	7	13	6.7	8.3
<i>Eriogonum niveum</i> (snow buckwheat)	--	X	--	--
<i>Erodium cicutarium</i> <sup>a</sup> (storksbill)	X	--	--	8.3
<i>Lactuca serriola</i> <sup>a</sup> (prickly lettuce)	13	X	6.7	--
<i>Festuca octoflora</i> (slender sixweeks)	7	--	40	25
<i>Sisymbrium altissimum</i> <sup>a</sup> (tumblemustard)	20	27	46.7	75
<i>Tragopogon dubius</i> <sup>a</sup> (yellow salsify)	X	--	--	--
<i>Machaeranthera canescens</i> (hoary aster)	X	X	--	X
<i>Chaenactis douglasii</i> (hoary falseyarrow)	X	X	--	X
<i>Microsteris gracilis</i> (pink microsteris)	--	--	6.7	--
<i>Penstemon acuminatus</i> (sand beardtongue)	--	X	--	--
<i>Erigeron poliospermus</i> (cushion fleabane)	X	X	--	X
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	--	13	X	16.7
<i>Draba verna</i> (spring whitlowgrass)	7	7	6.7	25
<i>Holosteum umbellatum</i> (jagged chickweed)	X	27	--	16.7
<i>Erysimum asperum</i> (rough wallflower)	--	X	X	X
<i>Erigeron pumilis</i> (shaggy fleabane)	X	--	--	--
<i>Erigeron filifolius</i> (threadleaf fleabane)	X	--	--	--
<i>Poa bulbosa</i> <sup>a</sup> (bulbous bluegrass)	13	X	X	X
<i>Ranunculus testiculatus</i> <sup>a</sup> (bur buttercup)	--	--	6.7	--
Biotic crust	27	7	--	--
Bare soil	100	100	100	100
Litter	100	100	100	100

<sup>a</sup> Introduced species.

X = Species observed on the treatment but not counted in a plot frame.

-- = Species not observed on the treatment.

**Table C-4. Percent Canopy Cover at the Hanford Generating Plant in 2006.**

Species	Topsoil	Cobble
Native Grasses <sup>b</sup>	20.4	34.8
<i>Bromus tectorum</i> <sup>a</sup> (cheatgrass)	15.0	2.1
<i>Salsola kali</i> <sup>a</sup> (Russian thistle)	26.1	19.9
<i>Artemisia tridentata</i> (sagebrush)	0.3	0.1
<i>Chorispura tenella</i> <sup>a</sup> (blue mustard)	1.8	1.5
<i>Amsinckia lycopsoides</i> (fiddleneck)	0.1	0.1
<i>Draba verna</i> (spring whitlowgrass)	X	0.1
<i>Ranunculus testiculatus</i> <sup>a</sup> (bur buttercup)	0.3	--
<i>Lactuca serriola</i> <sup>a</sup> (prickly lettuce)	X	0.4
<i>Melilotus alba</i> <sup>a</sup> (sweetclover)	0.1	X
<i>Festuca octoflora</i> (slender sixweeks)	--	0.3
<i>Sisymbrium altissimum</i> <sup>a</sup> (tumble mustard)	1.0	9.1
<i>Poa bulbosa</i> <sup>a</sup> (Bulbous bluegrass)	--	X
<i>Holosteum umbellatum</i> (jagged chickweed)	0.4	0.3
<i>Centaurea diffusa</i> <sup>a</sup> (diffuse knapweed)	0.5	0.4
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Erodium cicutarium</i> <sup>a</sup> (storksbill)	0.1	X
<i>Kochia scoparia</i> <sup>a</sup> (kochia)	0.1	--
<i>Tragopogon dubius</i> (yellow salsify)	--	0.1
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	--	X
<i>Machaeranthera canescens</i> (hoary aster)	--	X
<i>Achillea millefolium</i> (yarrow)	--	X
<i>Epilobium paniculatum</i> (tall willowherb)	--	X
Bare Soil	34.4	31.7
Litter	30.4	64.6
<b>Total Cover</b> (does not include litter)	<b>66.1</b>	<b>69.2</b>

<sup>a</sup> Introduced species.

<sup>b</sup> Includes Sandberg's bluegrass, bluebunch wheatgrass, Indian ricegrass, needle-and-thread grass, and prairie junegrass seedlings.

X = Species present on the site but not counted in a plot frame.

-- = Not observed on the site.



**Table C-5. Frequency of Occurrence at the Hanford Generating Plant in 2006.**

Species	Topsoil	Cobble
Native Grasses <sup>b</sup>	100	100
<i>Bromus tectorum</i> <sup>a</sup> (cheatgrass)	90	64
<i>Salsola kali</i> <sup>a</sup> (Russian thistle)	100	96
<i>Artemisia tridentata</i> (sagebrush)	15	4
<i>Chorispora tenella</i> <sup>a</sup> (blue mustard)	20	4
<i>Amsinckia lycopsoides</i> (fiddleneck)	5	4
<i>Draba verna</i> (spring whitlowgrass)	X	4
<i>Ranunculus testiculatus</i> <sup>a</sup> (bur buttercup)	10	--
<i>Lactuca serriola</i> <sup>a</sup> (prickly lettuce)	X	16
<i>Melilotus alba</i> <sup>a</sup> (sweetclover)	5	X
<i>Festuca octoflora</i> (slender sixweeks)	--	12
<i>Sisymbrium altissimum</i> <sup>a</sup> (tumble mustard)	60	92
<i>Poa bulbosa</i> <sup>a</sup> (Bulbous bluegrass)	--	X
<i>Holosteum umbellatum</i> (jagged chickweed)	40	12
<i>Centaurea diffusa</i> <sup>a</sup> (diffuse knapweed)	20	16
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Erodium cicutarium</i> <sup>a</sup> (storksbill)	5	X
<i>Kochia scoparia</i> <sup>a</sup> (kochia)	5	--
<i>Tragopogon dubius</i> (yellow salsify)	--	4
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	--	X
<i>Machaeranthera canescens</i> (hoary aster)	--	X
<i>Achillea millefolium</i> (yarrow)	--	X
<i>Epilobium paniculatum</i> (tall willowherb)	--	X
Bare Soil	100	88
Litter	100	100

<sup>a</sup> Introduced species.

<sup>b</sup> Includes Sandberg's bluegrass, Bluebunch wheatgrass, Indian ricegrass, Needle-and-thread grass, and Prairie junegrass seedlings.

X = Species present on the site but not counted in a plot frame.

-- = Not observed on the site

**Table C-6. Percent Canopy Cover and Frequency of Occurrence at the  
116-N-3 Site in 2006.**

Species	% Cover	% Frequency
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	7.8	86.7
<i>Salsola kali</i> <sup>a</sup> (Russian thistle)	14.5	86.7
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	1.9	43.3
<i>Koeleria cristata</i> (prairie junegrass)	0.3	10.0
<i>Bromus tectorum</i> <sup>a</sup> (cheatgrass)	3.8	66.7
<i>Stipa comata</i> (needle-and-thread grass)	0.5	20.0
<i>Poa sandbergii</i> (Sandberg's bluegrass)	5.8	73.3
<i>Sisymbrium altissimum</i> <sup>a</sup> (tumblemustard)	0.2	6.7
<i>Artemisia tridentata</i> (big sagebrush)	X	X
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	0.3	13.3
<i>Holosteum umbellatum</i> (jagged chickweed)	0.3	13.3
<i>Agropyron dasytachyum</i> (thickspike wheatgrass)	X	X
<i>Achillea millefolium</i> (yarrow)	X	X
<i>Draba verna</i> (spring whitlowgrass)	0.1	3.3
<i>Lactuca serriola</i> <sup>a</sup> (prickly lettuce)	0.6	23.3
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Machaeranthera canescens</i> (hoary aster)	X	X
<i>Poa bulbosa</i> <sup>a</sup> (bulbous bluegrass)	X	X
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	X
<i>Grayia spinosa</i> (hopsage)	X	X
<i>Vulpia myuros</i> <sup>a</sup> (rattail fescue)	X	X
<i>Senecio vulgaris</i> <sup>a</sup> (common groundsel)	X	X
<i>Melilotus officinalis</i> <sup>a</sup> (sweetclover)	X	X
<i>Erodium cicutarium</i> <sup>a</sup> (storksbill)	X	X
<i>Centaurea diffusa</i> <sup>a</sup> (diffuse knapweed)	X	X
Bare soil	41.0	90.0
Litter	44.4	100.0
<b>Total Cover</b> (does not include biotic crust or litter)	<b>36.0</b>	

<sup>a</sup> Introduced species.

X = Species observed on the site but not counted in a plot frame.

**Table C-7. Percent Canopy Cover and Frequency of Occurrence at the 100 F Area Sites in 2006.**

Species	% Cover	% Frequency
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	6.3	96
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	0.7	28
<i>Stipa comata</i> (needle-and-thread grass)	0.1	4
<i>Poa sandbergii</i> (Sandberg's bluegrass)	7	88
<i>Sitanion hystrix</i> (squirreltail grass)	0.7	8
<i>Salsola kali</i> <sup>a</sup> (Russian thistle)	1.9	56
<i>Achillea millefolium</i> (yarrow)	0.3	12
<i>Sisymbrium altissimum</i> <sup>a</sup> (tumblemustard)	0.5	20
<i>Descurainia pinnata</i> (western tansymustard)	0.1	4
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	X	X
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	X
<i>Chrysothamnus viscidiflorus</i> (green rabbitbrush)	X	X
<i>Erodium cicutarium</i> <sup>a</sup> (storksbill)	X	X
<i>Bromus tectorum</i> <sup>a</sup> (cheatgrass)	23	100
<i>Phacelia hastata</i> (threadleaf scorpionweed)	X	X
<i>Cryptantha leucophaea</i> (gray cryptantha)	X	X
<i>Lactuca serriola</i> <sup>a</sup> (prickly lettuce)	0.1	4
<i>Machaeranthera canescens</i> (hoary aster)	X	X
<i>Epilobium paniculatum</i> (tall willowherb)	X	X
<i>Poa bulbosa</i> <sup>a</sup> (bulbous bluegrass)	0.4	16
<i>Agropyron dasytachyum</i> (thickspike wheatgrass)	0.1	4
<i>Tragopogon dubius</i> <sup>a</sup> (yellow salsify)	0.2	8
<i>Lepidium perfoliatum</i> <sup>a</sup> (clasping pepperweed)	X	X
<i>Holosteum umbellatum</i> (jagged chickweed)	0.8	32
<i>Sphaeralcea munroana</i> (globemallow)	X	X
<i>Centaurea diffusa</i> <sup>a</sup> (diffuse knapweed)	X	X
<i>Ambrosia acanthicarpa</i> (bur ragweed)	X	X
<i>Astragalus sclerocarpus</i> (stalked pod milkvetch)	X	X
<i>Astragalus succumbens</i> (crouching milkvetch)	X	X
<i>Vicia cracca</i> <sup>a</sup> (bird vetch)	X	X
<i>Festuca octoflora</i> (slender sixweeks)	0.2	8
<i>Draba verna</i> (spring whitlowgrass)	0.1	4
<i>Eriogonum niveum</i> (snow buckwheat)	X	X
Bare soil	25.7	64
Litter	68.1	100
<b>Total Cover</b> (does not include litter)	<b>42.5</b>	

<sup>a</sup> Introduced species.

X = Species present on the site but not counted in a plot frame.

**Table C-8. Percent Frequency of Occurrence at the 100 B/C Sites in 2006.**

Species	100-B-1	128-C-1
Native Grasses <sup>b</sup>	100	100
<i>Bromus tectorum</i> <sup>a</sup> (cheatgrass)	56	26.7
<i>Salsola kali</i> <sup>a</sup> (Russian thistle)	96	100
<i>Artemisia tridentata</i> (sagebrush)	4	X
<i>Ambrosia acanthicarpa</i> (bur ragweed)	4	--
<i>Amsinckia lycopsoides</i> (fiddleneck)	4	X
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	X	--
<i>Lactuca serriola</i> <sup>a</sup> (prickly lettuce)	--	X
<i>Grayia spinosa</i> (Spiny hopsage)	X	--
<i>Sisymbrium altissimum</i> <sup>a</sup> (tumble mustard)	72	20
<i>Vulpia myuros</i> <sup>a</sup> (rattail fescue)	--	6.7
<i>Sphaeralcea munroana</i> (globemallow)	X	--
<i>Kochia scoparia</i> <sup>a</sup> (kochia)	4	--
Bare Soil	100	100
Litter	100	100

<sup>a</sup> Introduced species

<sup>b</sup> Includes Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, needle-and-thread grass, and prairie junegrass seedlings.

X = Observed on the site but not counted in a plot frame.

-- = Not observed on the site.

**Table C-9. Percent Canopy Cover on the 100 B/C Sites in 2006.**

Species	100-B-1	128-C-1
Native Grasses <sup>b</sup>	13.9	4.2
<i>Bromus tectorum</i> <sup>a</sup> (cheatgrass)	0.7	1.5
<i>Salsola kali</i> <sup>a</sup> (Russian thistle)	9.6	3.3
<i>Artemisia tridentata</i> (sagebrush)	0.1	X
<i>Ambrosia acanthicarpa</i> (bur ragweed)	0.1	--
<i>Amsinckia lycopoides</i> (fiddleneck)	0.1	X
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	X	--
<i>Lactuca serriola</i> <sup>a</sup> (prickly lettuce)	--	X
<i>Grayia spinosa</i> (Spiny hopsage)	X	--
<i>Sisymbrium altissimum</i> <sup>a</sup> (tumble mustard)	1.6	0.5
<i>Vulpia myuros</i> <sup>a</sup> (rattail fescue)	--	0.2
<i>Sphaeralcea munroana</i> (globemallow)	X	--
<i>Kochia scoparia</i> <sup>a</sup> (kochia)	0.1	--
Bare Soil	38.4	40.5
Litter	18.7	31.9
<b>Total Cover</b> (does not include bare soil or litter)	<b>26.2</b>	<b>9.7</b>

<sup>a</sup> Introduced species.

<sup>b</sup> Includes Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, needle-and-thread grass, and prairie junegrass seedlings.

X = Observed on the site but not counted in a plot frame.

-- = Not observed on the site.

**Table C-10. Percent Canopy Cover and Frequency of Occurrence on the  
100-KR-1 in 2006.**

Species	% Cover	% Frequency
<i>Salsola kali</i> <sup>a</sup> (Russian thistle)	9.4	81.7
Native grasses <sup>b</sup>	5.7	90
<i>Sisymbrium altissimum</i> <sup>a</sup> (tumblemustard)	2.5	51.7
<i>Bromus tectorum</i> <sup>a</sup> (cheatgrass)	0.8	30
<i>Artemisia tridentata</i> (big sagebrush)	0.6	23.3
<i>Centaurea diffusa</i> <sup>a</sup> (diffuse knapweed)	0.04	1.7
<i>Amsinckia lycopsoides</i> (tarweed)	0.3	10
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Machaeranthera canescens</i> (hoary aster)	X	X
<i>Ambrosia acanthicarpa</i> (bur ragweed)	X	X
<i>Lactuca serriola</i> <sup>a</sup> (prickly lettuce)	X	X
Bare soil	15	93.3
Litter	77.5	100
<b>Total Cover (does not include litter)</b>	<b>19.2</b>	

<sup>a</sup> Introduced Species.

<sup>b</sup> Includes Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, needle-and-thread grass, and prairie junegrass seedlings.

X= Present but not counted in plot frames.

**Table C-11. Percent Canopy Cover on the Horseshoe Landfill and Soil Staging Area 2006.**

Species	Horseshoe Landfill	Soil Staging Area
Native Grasses <sup>b</sup>	25.7	20.2
<i>Bromus tectorum</i> <sup>a</sup> (cheatgrass)	2	2.8
<i>Artemisia tridentata</i> (sagebrush)	0.3	0.5
<i>Ambrosia acanthicarpa</i> (bur ragweed)	X	--
<i>Amsinckia lycopsoides</i> (fiddleneck)	X	0.7
<i>Amaranthus albus</i> <sup>a</sup> (white pigweed)	X	1.3
<i>Hordeum leporinum</i> <sup>a</sup> (hare barley)	X	--
<i>Lactuca serriola</i> <sup>a</sup> (prickly lettuce)	X	0.2
<i>Melilotus alba</i> <sup>a</sup> (sweetclover)	X	--
<i>Festuca octoflora</i> (slender sixweeks)	X	--
<i>Sisymbrium altissimum</i> <sup>a</sup> (tumble mustard)	X	8
<i>Descurainia pinnata</i> (western tansymustard)	--	0.3
<i>Lupinus leucophyllus</i> (velvet lupine)	--	0.2
<i>Crepis atrabarba</i> (slender hawksbeard)	--	X
<i>Linum perenne</i> (wild blueflax)	--	0.2
<i>Erodium cicutarium</i> <sup>a</sup> (storksbill)	--	X
<i>Kochia scoparia</i> <sup>a</sup> (kochia)	--	X
Bare Soil	52.8	50.2
Litter	38	38.8
<b>Total cover (does not include litter)</b>	<b>28.2</b>	<b>34.3</b>

<sup>a</sup> Introduced species

<sup>b</sup> Sandberg's bluegrass, Indian ricegrass, Bluebunch wheatgrass, Needle-and-Thread grass, and Squirreltail grass

X = Species present on the site but not counted in a plot frame.

-- Not observed the site.

**Table C-12. Frequency of Occurrence on the Horseshoe Landfill and Soil Staging Area 2006.**

Species	Horseshoe Landfill	Soil Staging Area
Native Grasses <sup>b</sup>	100	100
<i>Bromus tectorum</i> <sup>a</sup> (cheatgrass)	80	46.7
<i>Artemisia tridentata</i> (sagebrush)	13.3	20
<i>Ambrosia acanthicarpa</i> (bur ragweed)	X	--
<i>Amsinckia lycopsoides</i> (fiddleneck)	X	26.7
<i>Amaranthus albus</i> <sup>a</sup> (white pigweed)	X	53.3
<i>Hordeum leporinum</i> <sup>a</sup> (hare barley)	X	--
<i>Lactuca serriola</i> <sup>a</sup> (prickly lettuce)	X	6.7
<i>Melilotus alba</i> <sup>a</sup> (sweetclover)	X	--
<i>Festuca octoflora</i> (slender sixweeks)	X	--
<i>Sisymbrium altissimum</i> <sup>a</sup> (tumble mustard)	X	93.3
<i>Descurainia pinnata</i> (western tansymustard)	--	13.3
<i>Lupinus leucophyllus</i> (velvet lupine)	--	6.7
<i>Crepis atrabarba</i> (slender hawksbeard)	--	X
<i>Linum perenne</i> (wild blueflax)	--	6.7
<i>Erodium cicutarium</i> <sup>a</sup> (storksbill)	--	X
<i>Kochia scoparia</i> <sup>a</sup> (kochia)	--	X
Bare Soil	100	100
Litter	100	100

<sup>a</sup> Introduced species

<sup>b</sup> Sandberg's bluegrass, Indian ricegrass, Bluebunch wheatgrass, Needle-and-Thread grass, and Squirrel tail grass

X = Species present on the site but not counted in a plot frame.

-- Not observed the site.



**APPENDIX D**  
**2005 REVEGETATION MONITORING RESULTS**



**Table D-1. 300-FF-1 Process Ponds and Burial Grounds 2005.**

Species	% Cover	% Frequency
<i>Agropyron dasytachyum</i> (thickspike wheatgrass)	0.4	17.1
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	10.0	68.6
<i>Agropyron hybrid</i> (regreen)	0.0	0.0
<i>Agropyron cristatum</i> <sup>a</sup> (crested wheatgrass)	19.3	94.3
<i>Stipa comata</i> (needle-and-thread grass)	0.1	2.9
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	1.1	31.4
<i>Vulpia myuros</i> <sup>a</sup> (rattail fescue)	0.4	14.3
<i>Melilotus officinalis</i> <sup>a</sup> (sweetclover)	0.1	5.7
<i>Eriogonum niveum</i> (snow buckwheat)	X	X
<i>Poa sandbergii</i> (Sandberg's bluegrass)	3.7	65.7
<i>Chaenactis douglasii</i> (hoary falseyarrow)	X	X
<i>Centaurea diffusa</i> <sup>a</sup> (diffuse knapweed)	X	X
<i>Sisymbrium altissimum</i> <sup>a</sup> (tumble mustard)	0.1	2.9
<i>Bromus tectorum</i> <sup>a</sup> (cheatgrass)	4.1	65.7
<i>Lactuca serriola</i> <sup>a</sup> (prickly lettuce)	X	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Phacelia hastata</i> (whiteleaf scorpionweed)	0.1	2.9
<i>Erodium cicutarium</i> <sup>a</sup> (storksbill)	0.1	5.7
<i>Senecio vulgaris</i> (common groundsel)	X	X
<i>Amaranthus albus</i> (white pigweed)	0.0	0.0
<i>Kochia scoparia</i> <sup>a</sup> (kochia)	0.1	2.9
<i>Salsola kali</i> <sup>a</sup> (Russian thistle)	0.6	25.7
<i>Lepidium perfoliatum</i> (clasping pepperweed)	X	X
<i>Hordeum leporinum</i> <sup>a</sup> (hare barley)	0.1	2.9
<i>Oenothera pallida</i> (evening primrose)	X	X
<i>Psoralea lanceolata</i> (dune scurfpea)	X	X
<i>Cryptantha circumscissa</i> (matted cryptantha)	0.0	0.0
<i>Plantago patagonica</i> (Indian wheat)	0.0	0.0
<i>Cardaria draba</i> <sup>a</sup> (whitetop)	X	X
<i>Polypogon monspeliensis</i> <sup>a</sup> (rabbitfoot grass)	0.0	0.0
<i>Poa annua</i> <sup>a</sup> (annual bluegrass)	0.0	0.0
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	X
<i>Poa bulbosa</i> <sup>a</sup> (bulbous bluegrass)	0.1	2.9
<i>Hymenopappus filifolius</i> (Columbia cutleaf)	X	X
<i>Phacelia linearis</i> (threadleaf scorpionweed)	X	X
<i>Petalostemon ornatum</i> (prairie clover)	X	X
<i>Chondrilla juncea</i> <sup>a</sup> (rush skeletonweed)	X	X
<i>Machaeranthera canescens</i> (hoary aster)	X	X
<i>Sphaeralcea munroana</i> (globemallow)	X	X
<i>Achillea millefolium</i> (yarrow)	X	X
<i>Epilobium paniculatum</i> (tall willowherb)	X	X
<i>Descurainia pinnata</i> (western tansymustard)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	X	X
Bare Soil	29.9	94.3
Litter	46.4	100.0
<b>Total cover (does not include litter)</b>	<b>40.4</b>	

<sup>a</sup> Introduced Species.

X= Present but not counted in plot frames.

**Table D-2. Percent Canopy Cover on the 120-N-1 and 120-N-2 Sites in 2005.**

Species	Triple 16 & Straw Mulch	Triple 16 & Hydromulch	Biosol & Straw Mulch	Biosol & Hydromulch
<i>Agropyron dasytachyum</i> (thickspike wheatgrass)	X	--	X	--
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	26.3	1.8	4.7	1.7
<i>Poa sandbergii</i> (Sandberg's bluegrass)	10.3	3.7	3.3	2.3
<i>Stipa comata</i> (needle-and-thread grass)	X	0.2	0.2	0.2
<i>Bromus tectorum</i> <sup>a</sup> (cheatgrass)	2.2	6.0	8.0	23.3
<i>Salsola kali</i> <sup>a</sup> (Russian thistle)	0.3	2.8	0.5	1.3
<i>Achillea millefolium</i> (yarrow)	2.3	1.5	0.2	X
<i>Vulpia myuros</i> <sup>a</sup> (rattail fescue)	2.7	--	5.2	0.3
<i>Artemisia tridentata</i> (big sagebrush)	0.3	X	X	X
<i>Centaurea diffusa</i> <sup>a</sup> (diffuse knapweed)	0.2	0.3	X	0.3
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	X	X	X
<i>Descurainia pinnata</i> (western tansymustard)	--	0.3	0.3	0.2
<i>Epilobium paniculatum</i> (tall willowherb)	--	0.2	--	--
<i>Eriogonum niveum</i> (snow buckwheat)	--	0.2	--	--
<i>Erodium cicutarium</i> <sup>a</sup> (storksbill)	X	--	--	--
<i>Lactuca serriola</i> <sup>a</sup> (prickly lettuce)	X	--	--	X
<i>Festuca octoflora</i> (slender sixweeks)	0.2	--	0.5	--
<i>Sisymbrium altissimum</i> <sup>a</sup> (tumblemustard)	0.5	1.0	0.7	1.0
<i>Tragopogon dubius</i> <sup>a</sup> (yellow salsify)	X	--	--	--
<i>Machaeranthera canescens</i> (hoary aster)	X	X	--	--
<i>Chaenactis douglasii</i> (hoary falseyarrow)	X	1.5	X	3.8
<i>Penstemon acuminatus</i> (sand beardtongue)	--	X	--	--
<i>Erigeron poliospermus</i> (cushion fleabane)	X	X	--	--
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	0.3	0.5	X	X
<i>Draba verna</i> (spring whitlowgrass)	--	0.2	--	--
<i>Erysimum asperum</i> (wall flower)	0.3	0.8	X	0.2
<i>Amsinckia lycopsooides</i> (tarweed fiddleneck)	0.3	--	0.3	0.2
<i>Erigeron pumilis</i> (shaggy fleabane)	X	X	--	--
<i>Erigeron filifolius</i> (threadleaf fleabane)	X	X	--	--
<i>Poa bulbosa</i> <sup>a</sup> (bulbous bluegrass)	0.2	0.3	--	--
Biotic crust	0.3	0.5	0.5	0.3
Bare soil	33.0	46.7	32.8	41.0
Litter	31.3	5.7	29.5	6.7
<b>Total cover</b> (does not include crust or litter)	<b>46.5</b>	<b>21.3</b>	<b>23.8</b>	<b>34.8</b>

<sup>a</sup> Introduced Species.

X= Present but not counted in plot frames.

**Table D-3. Percent Frequency of Occurrence on the 120-N-1 and 120-N-2 Sites in 2005.**

Species	Triple 16 & Straw Mulch	Triple 16 & Hydromulch	Biosol & Straw Mulch	Biosol & Hydromulch
<i>Agropyron dasytachyum</i> (thickspike wheatgrass)	X	--	X	--
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	100	73	87	67
<i>Poa sandbergii</i> (Sandberg's bluegrass)	100	80	100	60
<i>Stipa comata</i> (needle-and-thread grass)	X	7	7	7
<i>Bromus tectorum</i> <sup>a</sup> (cheatgrass)	87	80	93	100
<i>Salsola kali</i> <sup>a</sup> (Russian thistle)	13	47	20	53
<i>Achillea millefolium</i> (yarrow)	60	60	7	X
<i>Vulpia myuros</i> <sup>a</sup> (rattail fescue)	40	--	73	13
<i>Artemisia tridentata</i> (big sagebrush)	13	X	X	X
<i>Centaurea diffusa</i> <sup>a</sup> (diffuse knapweed)	7	13	X	13
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	27	X	X
<i>Descurainia pinnata</i> (western tansymustard)	--	13	13	7
<i>Epilobium paniculatum</i> (tall willowherb)	--	7	--	--
<i>Eriogonum niveum</i> (snow buckwheat)	--	7	--	--
<i>Erodium cicutarium</i> <sup>a</sup> (storksbill)	X	--	--	--
<i>Lactuca serriola</i> <sup>a</sup> (prickly lettuce)	X	--	--	X
<i>Festuca octoflora</i> (slender sixweeks)	7	--	20	--
<i>Sisymbrium altissimum</i> <sup>a</sup> (tumblemustard)	20	40	27	40
<i>Tragopogon dubius</i> <sup>a</sup> (yellow salsify)	X	--	--	--
<i>Machaeranthera canescens</i> (hoary aster)	X	X	--	--
<i>Chaenactis douglasii</i> (hoary falseyarrow)	X	27	X	27
<i>Penstemon acuminatus</i> (sand beardtongue)	--	X	--	--
<i>Erigeron poliospermus</i> (cushion fleabane)	X	20	--	--
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	13	20	X	X
<i>Draba verna</i> (spring whitlowgrass)	--	7	--	--
<i>Erysimum asperum</i> (wall flower)	13	33	X	7
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	13	--	13	7
<i>Erigeron pumilus</i> (shaggy fleabane)	X	X	--	--
<i>Erigeron filifolius</i> (threadleaf fleabane)	X	X	--	--
<i>Poa bulbosa</i> <sup>a</sup> (bulbous bluegrass)	7	13	--	--
Biotic crust	13	20	20	13
Bare soil	93	93	100	100
Litter	100	93	100	100

<sup>a</sup> Introduced Species.

X= Present but not counted in plot frames.

**Table D-4. Percent Canopy Cover and Frequency of Occurrence on the 100 F Liquid Sites in 2005.**

Species	% Cover	% Frequency
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	4.0	80
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	0.8	32
<i>Stipa comata</i> (needle-and-thread grass)	0.4	16
<i>Poa sandbergii</i> (Sandberg's bluegrass)	1.0	40
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	0.5	20
<i>Salsola kali</i> <sup>a</sup> (Russian thistle)	25.0	100
<i>Achillea millefolium</i> (yarrow)	X	X
<i>Sisymbrium altissimum</i> <sup>a</sup> (tumblemustard)	0.5	20
<i>Descurainia pinnata</i> (western tansymustard)	X	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	0.2	8
<i>Chrysothamnus nauseosus</i> (gray rabbitbrush)	X	X
<i>Erodium cicutarium</i> (storksbill)	X	X
<i>Bromus tectorum</i> <sup>a</sup> (cheatgrass)	0.7	28
<i>Phacelia hastata</i> (threadleaf scorpionweed)	X	X
<i>Melilotus officinalis</i> <sup>a</sup> (sweetclover)	X	X
<i>Lactuca serriola</i> <sup>a</sup> (prickly lettuce)	0.4	16
<i>Machaeranthera canescens</i> (hoary aster)	X	X
<i>Epilobium paniculatum</i> (tall willowherb)	0.2	8
<i>Poa bulbosa</i> <sup>a</sup> (bulbous bluegrass)	0.1	4
<i>Agropyron dasytachyum</i> (thickspike wheatgrass)	X	X
<i>Tragopogon dubius</i> (yellow salsify)	X	X
<i>Lepidium perfoliatum</i> <sup>a</sup> (clasping pepperweed)	X	X
<i>Holosteum umbellatum</i> (jagged chickweed)	0.4	16
<i>Sphaeralcea munroana</i> (globemallow)	X	X
<i>Chaenactis douglasii</i> (hoary falseyarrow)	X	X
<i>Centaurea solstitialis</i> <sup>a</sup> (yellow starthistle)	X	X
<i>Triticum aestivum</i> <sup>a</sup> (wheat)	X	X
<i>Astragalus sclerocarpus</i> (stalked pod milkvetch)	X	X
<i>Astragalus succumbens</i> (crouching milkvetch)	X	X
<i>Lupinus pusillus</i> (low lupine)	X	X
<i>Vicia cracca</i> <sup>a</sup> (bird vetch)	X	X
Bare soil	22.9	76
Litter	59.5	100
<b>Total cover (does not include litter)</b>	<b>34.2</b>	

<sup>a</sup> Introduced Species.

X= Present but not counted in plot frames.

**Table D-5. Percent Canopy Cover and Frequency of Occurrence on the 116-N-3 Site in 2005.**

Species	% Cover	% Frequency
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	7.7	76
<i>Salsola kali</i> <sup>a</sup> (Russian thistle)	25.5	100
<i>Sitanion hystrix</i> (bottlebrush squirreltail)	8.3	60
<i>Bromus tectorum</i> <sup>a</sup> (cheatgrass)	0.4	16
<i>Stipa comata</i> (needle-and-thread grass)	0.6	24
<i>Poa sandbergii</i> (Sandberg's bluegrass)	0.9	36
<i>Sisymbrium altissimum</i> <sup>a</sup> (tumblemustard)	0.3	12
<i>Artemisia tridentata</i> (big sagebrush)	0.1	4
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	0.6	24
<i>Amaranthus albus</i> <sup>a</sup> (pigweed)	X	X
<i>Lactuca serriola</i> <sup>a</sup> (prickly lettuce)	X	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Machaeranthera canescens</i> (hoary aster)	X	X
<i>Hordeum leporinum</i> <sup>a</sup> (hare barley)	X	X
<i>Calochortus macrocarpus</i> (mariposa lily)	X	X
<i>Grayia spinosa</i> (hopsage)	X	X
<i>Kochia scoparia</i> <sup>a</sup> (kochia)	X	X
<i>Senecio vulgaris</i> <sup>a</sup> (common groundsel)	X	X
<i>Melilotus officinalis</i> <sup>a</sup> (sweetclover)	X	X
Bare soil	30.9	100
Litter	49	100
<b>Total cover</b> (does not include litter)	<b>44.4</b>	

<sup>a</sup> Introduced Species.

X= Present but not counted in plot frames.





**APPENDIX E**  
**NAME CHANGES INCLUDED IN**  
**INTEGRATED TAXONOMIC INFORMATION SYSTEM**



## NAME CHANGES INCLUDED IN INTEGRATED TAXONOMIC INFORMATION SYSTEM

Name changes included in Integrated Taxonomic Information System (ITIS 1998).

Recent name changes for species mentioned in this report. The first name is that used in Hitchcock and Cronquist (1973) and the second is the more recent version.

*Agropyron cristatum* = *Agropyron desertorum*  
*Agropyron dasytachyum* = *Elymus lanceolatus* var. *lanceolatus*  
*Agropyron spicatum* = *Pseudoroegneria spicata* ssp. *spicata*  
*Chrysothamnus nauseosus* = *Ericameria nauseosa* ssp. *nauseosa* var. *nauseosa*  
*Cymopterus terebinthinus* = *Pteryxia terebinthina* var. *terebinthina*  
*Epilobium paniculatum* = *Epilobium brachycarpum*  
*Erysimum asperum* = *Erysimum capitatum* var. *capitatum*  
*Festuca octoflora* = *Vulpia octoflora* var. *octoflora*  
*Koeleria cristata* = *Koeleria macrantha*  
*Microsteris gracilis* = *Phlox gracilis* ssp. *gracilis*  
*Oryzopsis hymenoides* = *Achnatherum hymenoides*  
*Poa sandbergii* = *Poa secunda*  
*Poa scabrella* = *Poa secunda*  
*Psoralea lanceolata* = *Psoralidium lanceolatum*  
*Ranunculus testiculatus* = *Ceratocephala testiculata*  
*Salsola kali* = *Salsola tragus*  
*Sitanion hystrix* = *Elymus elymoides* ssp. *elymoides*  
*Stipa comata* = *Hesperostipa comata* ssp. *comata*



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