WCH-133
Rev. 0

River Corridor
Closure Contract

2006 River Corridor Closure Contractor Revegetation and Mitigation Monitoring Report

September 2006

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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DISCLM-5.CHP (11/99)

DOCUMENT CONTROL 10/03/06 DD

WCH-133
Rev. 0
OU: N/A
TSD: N/A
ERA: N/A

STANDARD APPROVAL PAGE

Title: *2006 River Corridor Closure Contractor Revegetation Monitoring Report*

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9·28·06
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EXECUTIVE SUMMARY

The purpose of this report is to document the status of revegetation projects and natural resources mitigation efforts that have been 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 of the objectives of restoration is the revegetation of remediated waste sites to stabilize the soil and restore the land to native vegetation. In addition, mitigation measures are taken to reduce impacts from the cleanup activities. This report documents the results of revegetation and mitigation monitoring conducted in 2006 and includes 11 revegetation/restoration projects, one revegetation/mitigation project, and 2 bat habitat mitigation projects.

Revegetation / Restoration Projects:

- Fifth year of monitoring following revegetation of the remediated liquid sites in the 100-DR-1 Operable Unit, and fifth year monitoring at the 600-23 and J. A. Jones sites in the 100-IU-6 Operable Unit;
- fourth year monitoring at the120-N revegetation area;
- third year monitoring at the 300-FF-1 Operable Unit revegetated areas;
- second year monitoring of 100- FR-1 Operable Unit waste sites and 116-N-3 Trench in the 100 N Area; and
- first 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.

Mitigation / Restoration Project:

- Fourth year monitoring of the revegetation/mitigation project of the Environmental Restoration Disposal Facility (ERDF) Mitigation plantings on the Fitzner-Eberhardt Arid Land Ecology Reserve (ALE).

Monitoring of these revegetation and mitigation projects are conducted annually to ensure the

objectives of the revegetation efforts 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. The bat mitigation projects were conducted to replace roosting habitat lost as a result of the Interim Safe Storage (Interim Safe Storage) projects of 105-D and -DR Reactors and 105-F Reactor. These projects involved cocooning the reactors which excluded bats from using these historic roosting sites. Alternate roost sites were established as mitigation at the two reactors sites. Monitoring these mitigation projects includes estimating the population of bats present and the conditions of the roosts to ensure they remain viable.

Revegetation/Restoration Projects

The 600-23 and J. A. Jones sites were backfilled in late summer 2001 and revegetated in December 2001. Both areas were broadcast seeded with a mixture of native seed collected from the Hanford site. Triple 16 fertilizer was applied during seeding at 112 kg/ha and irrigated with 0.62 cm/ha of water. The entire seeded area was mulched with grass straw, then crimped into the soil surface with a crimper. The 600-23 site was planted with 140 4-in sagebrush (*Artemisia tridentata*) tublings and 150 4-in bitterbrush (*Purshia tridentata*) tublings. The J.A. Jones site was planted with 100 4-in sagebrush tublings and 130 10-in bitterbrush tublings. Vegetation surveys conducted in 2006 found 35 species on the 600-23, 25 of which were native, and 38 species on the J. A. Jones site, of which 31 were native. Shrub survival measured on the 600-23 site in 2006 found survival rates of the 4-in sagebrush at 32.6% and 4-in bitterbrush at 43.6%. Shrub survival data collected in April 2006 on the J. A. Jones site counted survival of both planted shrub species at 64.1% for 4-in sagebrush and 19.4% for 10-in bitterbrush, a 12.8% reduction in sagebrush survival from last years count.

The 300-FF-1 Process Ponds and Burial Grounds were seeded in February 2004. A 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, the area was broadcast seeded with only grass species. To facilitate successful germination, 16.8 kg/ha Terrabond was applied during seeding. The seeded area was irrigated with 0.62 cm/ha, mulched with grass straw, and crimped with a crimper to minimize wind

erosion. Third year vegetation survey's conducted in April 2006 calculated total cover of seeded species at 22.1%. Sandberg's bluegrass (*Poa sandbergii*) was the dominant seeded species on the site with 9.4% cover followed by bluebunch wheatgrass (*Agropyron spicatum*) with 7.6% cover.

The remediated liquid waste sites in the 100 D/DR Area were revegetated in November and December 2001. The entire backfilled area at 100 D/DR, 27.9 hectares were broadcast seeded with a hydroseeder and irrigated with 0.62 cm/ha of water. The seeded area was mulched with grass straw and crimped into the soil surface. The fifth and final year of vegetation analysis at the 100 D/DR Area identified 41 species across the site, 30 of which were native, including 20 species that were included in the seed mix. The dominant species within the revegetated area was Sandberg's bluegrass and cheatgrass (*Bromus tectorum*) with 12% and 11% covers. Total cover recorded within the seeded area on April 12, 2006, was 33.1% in 2006, down from 47% cover recorded May 24, 2005. Sagebrush survival within the monitoring plot at the 100 D/DR Area remains consistent with the 2004 and 2005 survival counts at 78.2%. The average sagebrush ranged in height from 40 to 61 cm tall, with a few plants as tall as 91 cm and producing seed.

The 120-N-1 and 120-N-2 sites were remediated then backfilled with clean material in December 2002. The remediated area was broadcast seeded with a mix including Sandberg's bluegrass, needle-and-thread grass (*Stipa comata*), Indian ricegrass (*Oryzopsis hymenoides*), thickspike (*Agropyron dasytachyum*), bluebunch wheat grasses and hand collected amounts of yarrow (*Achillea millefolium*), false yarrow (*Chaenactis douglasii*), wall flower (*Erysimum asperum*), sand beardtongue (*Penstemon acuminatus*), sagebrush, and fleabane (*Erigeron* sp.) in mid January 2003. The 1.6-ha area was separated into four treatment areas. A combination of two separate fertilizer treatments and two types of mulch were used. The entire area was broadcast seeded and irrigated with 0.62 cm/ha of water. One half of the remediated area was fertilized with triple 16 fertilizer with the other half was fertilized with Biosol, an organic slow release fertilizer. One half of the triple 16 fertilized area and one half of the Biosol fertilized area was mulched with grass straw then crimped into the soil surface. The remaining area was mulched with industry standard hydromulch fiber. Vegetation surveys conducted in April 2006, found 30 species across the entire seeded area. The Biosol fertilized areas had the greatest total cover with

99.5% on the straw mulch and 70.8% on the hydromulch treatments. Total cover of native species on the Biosol treatments were 35.2% on the straw mulch and 5.4% on the hydromulch treatment compared to triple 16 fertilized areas with 39.7% native cover on the straw mulch treatment and 25.2% native cover on the hydromulch treatment.

Several waste sites in the 100-FR-1 Operable Unit were remediated then backfilled with clean material from a local borrow area in the summer of 2003. The remediated waste sites and areas adjacent to the waste sites that were disturbed during remedial actions were revegetated in January 2005. Approximately 34.4 hectares impacted by cleanup activities were broadcast seeded with a mix of Sandberg's bluegrass, bluebunch wheatgrass, thickspike wheatgrass, Indian ricegrass, prairie junegrass (*Koeleria cristata*), and needle-and-thread grass. The remediated waste sites and an on site borrow area, that was seeded with grasses in December 2003 were planted with 43,500 sagebrush seedlings. In May 2006, a vegetation survey was performed on the planted waste sites. The dominant species within the revegetated area was cheatgrass with 23% cover and 100% frequency followed by Sandberg's bluegrass with 7% cover and 88% frequency, then bluebunch wheatgrass with 6.3% cover and 96% frequency. The sagebrush survival was counted on four plots established across the planted area. The overall survival of sagebrush planted in January 2005 was 67.4%.

The 116-N-3 Trench was constructed within a portion of the depositional features created by cataclysmic floods 20,000 to 10,000 years ago. These features appear as small hills north and east of the 100 N Reactor, and are known as *Mooli Mooli* to local Native American Tribes. The construction of the trench and subsequent remediation resulted in a flat linear structure. Because of the cultural significance of the *Mooli Mooli*, Cultural Resources and Remedial Action staff in coordination with tribal members developed a backfill and recontour design to restore the previously impacted portions of *Mooli Mooli*. Following the completion of backfill, the trench and the on-site borrow area were seeded in January 2005, with native grass species and planted with sagebrush and hopsage seedlings propagated from seed collected on the Hanford site. In early June 2006, vegetation surveys were conducted on the revegetated area and twenty-five species were recorded on the site. Russian thistle (*Salsola kali*) remains the dominant species on the site with 14.5% cover, down from 25.5% cover recorded in May 2005. The dominant seeded

species were bluebunch wheatgrass and Sandberg's bluegrass with 7.8 and 5.8% covers respectively. Sagebrush and hopsage shrub monitoring plots were established to estimate shrub survival. Sagebrush survival was estimated at 46% and hopsage at 30%.

Energy Northwest Inc. worked on demolition and removal of the 185-N Hanford Generating Plant complex from 2001 through 2004. The complex was transferred to the Environmental Restoration Contractor in August 2004 after the site was backfilled with clean material from a nearby borrow pit. The complex was included into the River Corridor Closure Contractor work scope in August 2006. Revegetation of the disturbed area was initiated in early February and continued through mid March 2006. Prior to seeding the area disturbed by demolition activities, 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. An initial vegetation survey was conducted on the revegetated area in late April 2006. 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. The revegetated areas were dominated by Russian thistle and native grasses. The eastern portion of the site had a higher percent cover of Russian thistle while the western portion had a higher percent of native grasses. Sagebrush survival monitoring transects were established in April with initial survival of shrubs on the eastern topsoil portion of the site at 94.9%, and 98.1% on the western cobble portion of the site.

The Horseshoe Landfill is located on the ALE and served as a military landfill for the nearby Nike missile base. The Horseshoe Landfill is a former CERCLA waste site that was part of the 1100-IU-1 Operable Unit. It was remediated as part of the activities outlined in the Record of Decision (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 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). Based on the

results of the post-closure soil sampling that indicated residual DDT/DDE/DDD contamination exceeded the ecological indicator soil concentration, a decision was made to perform additional remediation of the southern portion of the Horseshoe Landfill to remove DDT to meet the more stringent ecological indicator soil concentration for protection of terrestrial plants and animals for total DDT/DDE/DDD of 0.75 mg/kg (WAC 173-340, Table 749-3). Remedial actions on the landfill were initiated mid May 2005 with cleanup activities completed with backfill of the site on December 1, 2005.

The landfill was revegetated the first week of February 2006. Prior to broadcast seeding the Horseshoe landfill and soil staging area located south the landfill, the top 20.3 cm of soil was loosened with a spring tooth drawn implement. The landfill and soil staging area, approx 1.6 ha was seeded with native grass seed and planted with sagebrush plugs. The sites were monitored in May 2006 to document seedling emergence and to establish sagebrush survival monitoring transects. Native grass seedlings were counted in 100% of the plot frames and had an estimated 20% and 25% cover on the soil staging area and landfill. The sagebrush survival within the monitoring transects on the landfill and soil staging area was 93.8%.

The 100-B-1, 128-C-1, and 600-232 Remaining Sites were remediated as part of the Interim Action ROD 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 (EPA et al. 1999). The areas disturbed by the remedial action activities including the waste site footprint, soil staging areas, and access roads were broadcast with a mix of native grass seed, triple 16 fertilizer, and polyacrylamide (water retaining crystals). The seeded areas were mulched with grass straw and crimped into the soil surface. The reseeded areas were planted with 16,000 10-in sagebrush plugs and the 100-B-1 site was planted with an additional 600 10-in spiny hopsage plugs.

Initial vegetation surveys were conducted on the revegetated areas in mid May 2006. The 100-B-1 waste site was evaluated separately from the 128-C-1 site, as the fine grained topsoil salvaged from the soil staging area adjacent to the 100-B-1 site was redistributed across the backfilled waste site and soil staging area upon completion of cleanup activities. The 128-C-1

waste site was backfilled with rocky cobble from borrow pit 24 located west of the 100 B/C Area. The dominant species on both sites were native seeded grasses followed by Russian thistle. Sagebrush monitoring transects were established on both sites with initial sagebrush survival estimated at 82.3% on the 100-B-1 site and 74.2% on the 128-C-1 site.

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 remediated to meet the cleanup standards specified in the 1997 Amendment to the Interim Action Record of Decision for the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units (EPA et al 1997). Remedial actions were initiated in December 2002 on the 116-KW-3 site and continued through February 2006 with the completion of backfill operations on the 116-K-2 Trench. Revegetation of the backfilled sites was initiated in February and continued through 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 planted area was monitored for seed germination and shrub survival in mid May 2006. The dominant species counted across the planted area was Russian thistle at 9.4% cover followed by native grass seedlings at 5.7% cover and 90% frequency. Sagebrush monitoring transects were established along the 116-K-2 Mile Long Trench and the 116-K-1 Crib. Initial shrub survival was estimated at 91%. Survival estimates collected after an entire growing season will provide a more accurate depiction of first year survival.

Revegetation/Mitigation

In December 2002 the DOE Richland Operations Office and the U.S. Fish and Wildlife Service cooperatively worked on a compensatory mitigation planting project on the ALE Reserve for the original construction of the ERDF Cells 1 and 2, where approximately 68.8 ha of mature sagebrush habitat was lost. The mitigation project included three separate planting elements to be completed in the winter of 2002 and 2003. In the winter of 2002 a native grass seed planting and shrub seedling planting was completed. Approximately 64.7 ha were broadcast seeded with 20.55 kg/ha native grass seed in mid December then harrowed with a tractor drawn implement. Approximately 139,000 shrub seedlings were planted across 125.5 ha in early December 2002. The shrubs planted included 10,300 10-in, 28, 100 4-in, and 93,000 bareroot sagebrush, as well as 6,000 gray rabbitbrush (*Chrysothamnus nauseosus*), and 6,000 green rabbitbrush

(*Chrysothamnus viscidiflorus*). The shrubs were planted in three separate areas and monitored for survival. In December 2003 bitterbrush and additional rabbitbrush seedlings and grass plugs were planted in two separate areas on the ALE. Fourth year sagebrush shrub survival data was collected in May 2006, with results estimated per seedling type: 22.1% bareroot sagebrush, 14.3% 10-in sagebrush, and 26.7% 4-in sagebrush. Third year survival was 6.1% for bitterbrush, 30.3% for rabbitbrush, and 5.7% for grass plugs.

Bat Habitat Mitigation

Bat mitigation projects have been conducted at the 105-D, 105-DR, and 105-F Reactors to mitigate for roosting habitat lost as a result of the Interim Safe Storage projects at these reactors. Ecological reviews identified the presence of multiple bat species utilizing the reactors as maternity roosts where they rear their young. At least 2 species of little brown bats (*Myotis ciliolabrum* and *M. yumanensis*) have been found at both areas and pallid bats (*Antrozous pallidus*) at the 105-F Reactor. These bats are listed as Washington State priority species at communal roosts and breeding areas and require mitigation according to the Hanford Biological Resources Management Plan 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.

The mitigation project at 100-D Area was initiated in 1998 by providing alternate access to their maternity roosts in the process water tunnels by installing bat gates that exclude humans and wildlife but allow the bats to fly in and out. Monitoring of bat roosting began in July 1999. There were approximately 19 bats observed in the 190-D tunnel and 36 in the 190-DR tunnels before the ISS project isolated the tunnels from the reactor. No inspection of the tunnels was made during the year 2000 (the first year after the tunnels were isolated from the reactor), however a small number of bats were observed emerging from the gates in August 2000, which verified that they had found the bat gate entrance and were continuing to use the tunnels. No observations were made during 2001. Inspections of the 190-DR tunnels have been conducted from 2002 to 2005 and the number of bats roosting in the hatches were 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. Often the majority of the

population roosts in the same location within the tunnel with several small clusters of bats ranging from 5 to 50 individuals. These clusters are maternity colonies consisting of mothers with their young. Most bats appear to be Yuma myotis (*M. yumanensis*) along with some small-footed myotis (*M. ciliolabrum*) and western pipistrel (*Pipistrellus hesperus*). The increase in the population observed during the second inspection of 2005 indicates the bats utilize other roosts sites such as the 190-D tunnel or buildings still standing in the 100-D Area and that they move between the roosts.

A maternity colony of pallid bats was observed in 105-F Reactor in 2003 during ISS and mitigation efforts were initiated to remove the bats from the building unharmed and provide alternate roosting habitat. The bats were successfully evicted from the building and follow-up surveys confirmed that the pallid bats were utilizing the houses mounted on the exterior of the building. It was estimated that the colony contained approximately 30 individuals in September 2003. The following spring, the pallid bats returned from winter hibernation to use the boxes on the reactor. They primarily used box #1 was on the east side of the building, but by the end of the summer, they had used all 5 bat boxes on the building. In 2005, the colony size appeared to remain about the same size or larger. The use of other boxes became more frequent and often pallid bats were observed in multiple boxes at the same time. The colony left for the winter in early October 2005 and in 2006, began returning to the roost site in April. On August 3, 2006, the population was estimated to be approximately 80 to 90 individuals. This is a substantial increase since the mitigation project began in 2003 when the population was estimated to be approximately 30.

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FIGURES

TABLES

METRIC CONVERSION CHART

Into Metric Units

If You Know	*Multiply By*	*To Get*
Length		
inches	25.4	Millimeters
inches	2.54	Centimeters
feet	0.305	Meters
yards	0.914	Meters
miles	1.609	Kilometers
Area		
sq. inches	6.452	sq. centimeters
sq. feet	0.093	sq. meters
sq. yards	0.0836	sq. meters
sq. miles	2.6	sq. kilometers
acres	0.405	hectares
Mass (weight)		
ounces	28.35	grams
pounds	0.454	kilograms
ton	0.907	metric ton
Volume		
teaspoons	5	milliliters
tablespoons	15	milliliters
fluid ounces	30	milliliters
cups	0.24	liters
pints	0.47	liters
quarts	0.95	liters
gallons	3.8	liters
cubic feet	0.028	cubic meters
cubic yards	0.765	cubic meters
Temperature		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius

Out of Metric Units

If You Know	*Multiply By*	*To Get*
Length		
Millimeters	0.039	Inches
Centimeters	0.394	Inches
Meters	3.281	feet
Meters	1.094	yards
Kilometers	0.621	miles
Area		
sq. centimeters	0.155	sq. inches
sq. meters	10.76	sq. feet
sq. meters	1.196	sq. yards
sq. kilometers	0.4	sq. miles
Hectares	2.47	acres
Mass (weight)		
Grams	0.035	ounces
Kilograms	2.205	pounds
metric ton	1.102	ton
Volume		
Milliliters	0.033	fluid ounces
Liters	2.1	pints
Liters	1.057	quarts
Liters	0.264	gallons
cubic meters	35.315	cubic feet
cubic meters	1.308	cubic yards
Temperature		
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 2006 from the River Corridor Closure Contractor's (RCCC) revegetation and mitigation areas on the Hanford Site. It also contains monitoring results of bat habitat mitigation projects. The vegetation monitoring sites included in this report are the 600-23 site, J.A. Jones, 300-FF-1 revegetation area, 618-4 sagebrush monitoring, the revegetated area at 100 D/DR, 120-N sites, 100-FR-1 Operable Unit revegetation area, 116-N-3 Trench, Hanford Generating Plant, Horseshoe landfill, 100 B/C sites, 100-KR-1 Operable Unit sites, and Environmental Restoration Disposal Facility (ERDF) Cells 1 and 2 Mitigation planting on the Arid Lands Ecology Reserve (ALE). 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 2006 monitoring efforts and data collection activities.

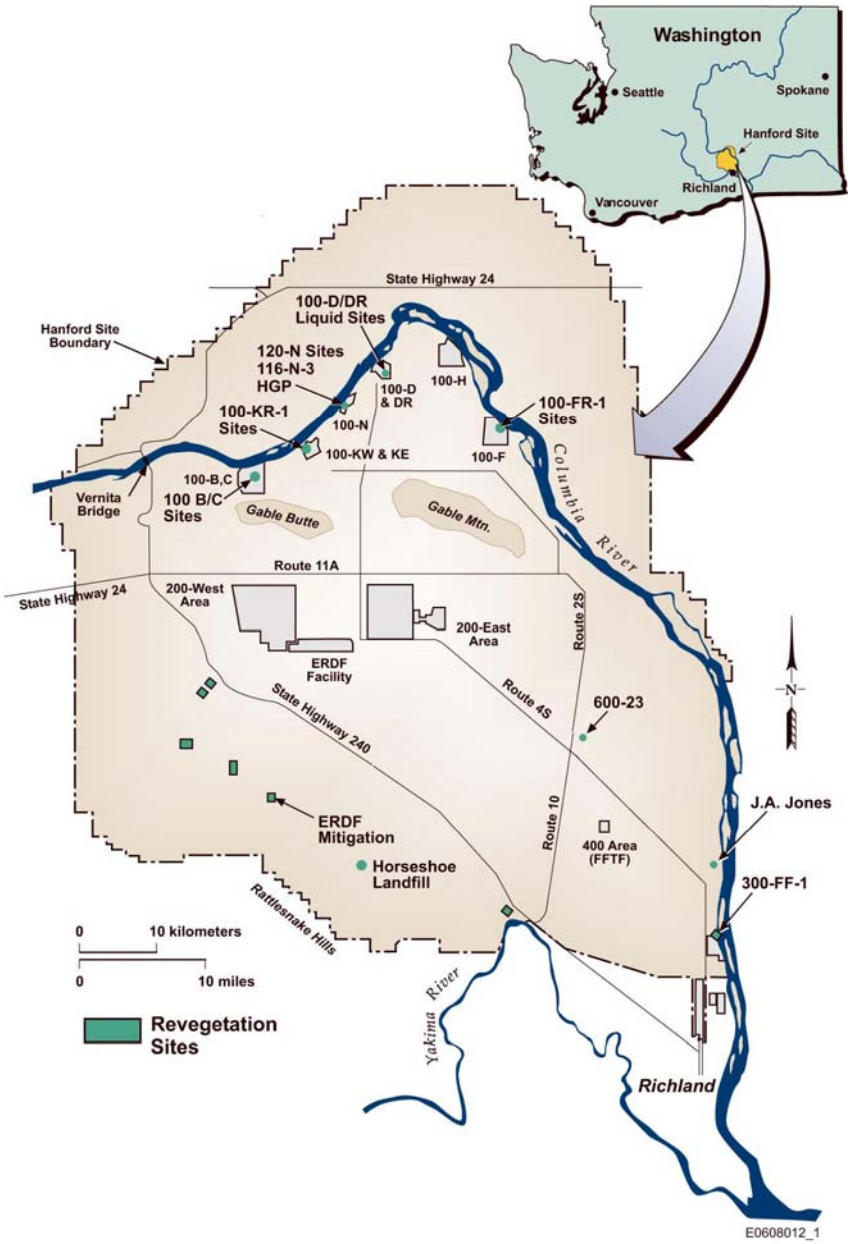
This report provides fifth-year monitoring results for the 100-D/DR liquid waste sites, the 600-23, and the J. A. Jones sites, fourth year data is included for the 120-N sites and ERDF Cells 1 and 2 Mitigation plantings, third year data was collected on the 300-FF-1 Process Ponds and Burial Grounds, second year surveys were completed on the 100-FR-1 operable unit sites and 116-N-3 Trench. First year survey results of the revegetated areas at 100-KR-1, Hanford Generating Plant at the 100 N Area, 618-4 Burial Ground sagebrush planting, Horseshoe landfill on the ALE, and 100 B/C Area. Results from previous years' monitoring are provided in reports for each respective year (Johnson 2005, Johnson 2004, Johnson 2003, Johnson 2002 and Johnson 2001). 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 x 100 = 40%.

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, the survival rate 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 rate.

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. The objective of revegetating the 120-N-1 and 120-N-2 sites was to stabilize the soils and initiate the establishment of native species. The restoration effort included the combined use of two fertilizer and two mulch types. The sites will be evaluated to document the effect of the material type on plant establishment and success over a five year period.

In the long-range planning, 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 sagebrush, forbs, and grasses. Areas identified for future industrial use will be stabilized with wheatgrass (*Agropyron*) varieties because of the potential for future land disturbance.

2.0 600 AREA REVEGETATION

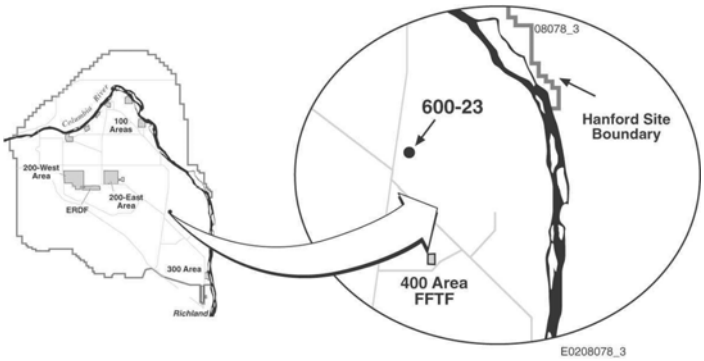
2.1 600-23 AND J. A. JONES SITES

The 600-23 and J. A. Jones sites were remediated as part of 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* (EPA et al. 1999). The 600-23 site is located north of the Hanford Site's Wye Barricade, along Route 2 south, and is within the borrow Pit 11 boundary (Figure 2). The J.A. Jones site is located north of the 300 Area (Figure 3). Both sites were used for the disposal of construction waste and miscellaneous debris. Prior to remediation, the 600-23 site was dominated by cheatgrass (*Bromus tectorum*) and Russian thistle (*Salsola kali*), with occurrences of snow buckwheat (*Eriogonum niveum*) and bitterbrush. The J. A. Jones site was dominated by cheatgrass and gray rabbitbrush (*Chrysothamnus nauseosus*) with some Sandberg's bluegrass (*Poa sandbergii*) and bitterbrush. The area surrounding the J. A. Jones site is mature sagebrush and is identified as a Level III resource in the BRMaP (DOE-RL 2001). The goal of each revegetation effort was to stabilize the soils and initiate vegetative recovery.

The areas disturbed by remedial action activities include 0.78 ha area at the 600-23 site and 0.4 ha area at the J. A. Jones site. Both sites were revegetated under the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1998) Milestone M-16-41C in mid-December 2001. Both areas were backfilled and contoured to the surrounding terrain just prior to being planted. The areas were broadcast seeded with a mix of native seeds collected from the Hanford Site. The entire revegetated area had 112 kg/ha of Triple -16 fertilizer applied during seeding and irrigated with 0.62 cm/ha of water. The seeded areas were mulched with straw at a rate of 4.5 metric tons / ha then crimped into the soil surface. The 600-23 site was planted with 140, 4-in sagebrush plugs and 150, 4-in bitterbrush plugs. The J. A. Jones site was planted with 100, 4-in sagebrush plugs and 130, 10-in bitterbrush plugs. All bitterbrush plants were protected with biodegradable mesh tubes placed around the plants and anchored with bamboo stakes to prevent browsing by deer.

The fifth year vegetation survey was conducted on the 600-23 site on May 15, 2006. Thirty-five species were identified on the site, 25 of those were native species. The total measured vegetative cover on site was 56.4% with native species contributing 46.3 % (Table 1). Sandberg's bluegrass was the dominant species on the site with 28.1% cover and 100 % occurrence within the plot frames. Bluebunch wheatgrass (*Agropyron spicatum*) was the second most dominant species on the site with 13.5% cover and 85 % frequency. Cheatgrass and Russian thistle covers; 7% and 0.5% did not significantly change from 2005 data collections. While the snow buckwheat cover did not change from 2005 data collections, there were numerous volunteer seedlings observed on the site. Other perennial forbs that were included in the seed mix and observed blooming on the site include prairie clover (*Petalostemon ornatum*), globemallow (*Sphaeralcea munroana*), Cusick's sunflower (*Helianthus cusickii*), sand beardtongue (*Penstemon acuminatus*), and milkvetch (*Astragalus*) species. Sagebrush recruitment was also observed for the first time this year. A number of the bitterbrush plants were browsed but blooming and producing seed (Figure 2).

Figure 2. 600-23 Site

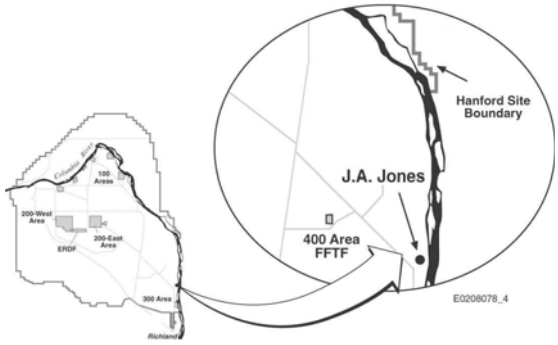


Sagebrush Recruitment Seedlings, May 2006.

Five Year Old Bitterbrush, May 2006.

Revegetated 600-23 Site, May 2006.

Figure 3. J. A. Jones Site.



J.A. Jones Site, April 2006.

Snow Buckwheat Recruitment, April 2006.

Balsamroot, Sandberg's Bluegrass, Yarrow, and Rabbitbrush, April 2006.

Table 1. Percent Canopy Cover and Frequency of Occurrence at the 600-23 Site in 2006.

Species	% Cover	% Frequency
Vulpia myuros [a] (Rattail fescue)	2.3	40
Poa sandbergii (Sandberg's bluegrass)	28.1	100
Bromus tectorum [a] (cheatgrass)	7.0	85
Salsola kali [a] (Russian thistle)	0.5	20
Achillea millefolium (yarrow)	0.8	30
Melilotus alba [a] (sweetclover)	0.1	5
Eriogonum niveum (snow buckwheat)	0.1	5
Stipa comata (needle-and-thread grass)	X	X
Agropyron spicatum (bluebunch wheatgrass)	13.5	85
Artemisia tridentata (sagebrush)	X	X
Festuca octoflora (slender sixweeks)	2.1	60
Sisymbrium altissimum [a] (tumble mustard)	X	X
Holosteum umbellatum [a] (jagged chickweed)	X	X
Lactuca serriola [a] (prickly lettuce)	0.1	5
Poa bulbosa [a] (bulbous bluegrass)	X	X
Purshia tridentata (bitterbrush)	X	X
Mentzelia laevicaulis (blazing star)	X	X
Machaeranthera canescens (hoary aster)	0.3	10
Draba verna (spring whitlow)	1.3	50
Epilobium paniculatum (tall willowherb)	0.1	5
Astragalus sclerocarpus (stalk-pod milkvetch)	X	X
Phacelia linearis (threadleaf scorpionweed)	X	X
Penstemon acuminatus (sand beardtongue)	X	X
Helianthus cusickii (Cusick's sunflower)	X	X
Erodium cicutarium [a] (storksbill)	0.1	5
Sitanion hystrix (bottlebrush squirreltail)	X	X
Chrysothamnus nauseosus (gray rabbitbrush)	X	X
Tragopogon dubius [a] (yellow salsify)	X	X
Astragalus caricinus (buckwheat milkvetch)	X	X
Astragalus purshii (woolly-pod milkvetch)	X	X
Astragalus succumbens (crouching milkvetch)	X	X
Petalostemon ornatum (prairie clover)	X	X
Oryzopsis hymenoides (Indian ricegrass)	X	X
Sphaeralcea munroana (globemallow)	X	X
Chrysothamnus viscidiflorus (green rabbitbrush)	X	X
Biotic crust	3.5	100
Bare Soil	35.5	100
Litter	30.4	100
Total cover (does not include litter)	**56.4**	

[a] Introduced Species.

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

Sagebrush survival within the monitoring plot is down slightly from last years count (dropped by 1.9%) to 32.6% while bitterbrush survival remains the same with 43.6% of the plants within the monitoring plot still alive (Table 2).

Fifth year vegetation analysis was conducted on the J. A. Jones site in April 2006. The survey identified 38 species across the site, of those 31 were native species contributing 55.6% to the 70.6% total cover of the site. Sandberg's bluegrass was the dominant species with 38.1% cover followed by cheatgrass with 8.4% cover (Table 3). The total cover of Russian thistle across the site was only 1.8% indicating that it is no longer a contributing species within the vegetative community. Sagebrush survival within the monitoring plot is down this year with 64.1% of the plants still alive. The bitterbrush survival within the monitoring plot remains at 19.4%. Sagebrush and bitterbrush recruitment seedlings were noted on the site this year, and both shrub species will produce seed again.

Comparison of the bitterbrush survival between the seedlings grown in 10-in versus 4-in tubes planted on the J.A. Jones and 600-23 site should also note the soil type differences of each site. The J.A. Jones site has sandy soils with very few cobbles while the 600-23 site has an assortment of rocky cobble with coarse sand. Soil type impacts the establishment and growth of seeded species and subsequent completion to the planted shrubs. The first spring following seeding at the J.A. Jones site, the total measured cover was 73.4 % compared to the 600-23 site which had a total cover of 11.5%. The larger 10-in bitterbrush tublings planted on the J.A. Jones site had a survival of 39% compared to the smaller 4-in bitterbrush tublings planted on the 600-23 site which had first year survival of 78.2%. Despite the size of the bitterbrush seedling planted, the shrubs have been blooming and producing seeds since 2004. The revegetation efforts on both of the waste site should be considered successful, as the initial goal of stabilizing the soils with a vegetative community dominated by native species has been achieved.

Table 2. Percent Survival Rate of Transplanted Shrubs.

Site	2002	2003	2004	2005	2006
600-23					
Sagebrush	83.6	83.6	34.5	34.5	34.5
Bitterbrush 4-in	78.2	78.2	43.6	43.6	43.6
J. A. Jones					
Sagebrush	89.2	81.1	87.2	76.9	64.1
Bitterbrush 10-in	39	19.5	21.1	19.4	19.4
100 D/DR					
Sagebrush	93.8	87.8	78.2	78.2	78.2
ERDF Mitigation					
10-in Sagebrush		65.6	24.6	20.6	14.3
4-in Sagebrush		76.7	51.7	50	26.7
Bareroot Sagebrush		57.9	36.8	27.5	22
Bitterbrush (mesh tubes)			38.6	19	3.3
Bitterbrush (animal repellant)			25.7	14.7	12
Rabbitbrush			77.1	67.6	30.3
Bunchgrass			53.7	27.4	5.7
Thickspike wheatgrass			72.5	62.5	57.3
100 F					
Sagebrush				100	67.4
116-N-3					
Sagebrush				100	46.4
Hopsage				100	30
100-KR-1					
Transect 1					98.5
Transect 2					95.1
Transect 3					91.6
Transect 4					65.8
Hanford Generating Plant					
Cobble Area					98.1
Topsoil Area					94.9
300-FF-1					
Sagebrush					85.8
100B/C					
100-B-1					82.3
128-C-1					74.2
Horseshoe Landfill					
Landfill					93
Soil Staging Area					94.5

Table 3. Percent Canopy Cover and Frequency of Occurrence on the J. A. Jones Site in 2006.

Species	% Cover	% Frequency
Agropyron spicatum (bluebunch wheatgrass)	3.9	55
Bromus tectorum [a] (cheatgrass)	8.4	100
Salsola kali [a] (Russian thistle)	1.8	70
Poa sandbergii (Sandberg's bluegrass)	38.1	100
Stipa comata (needle-and-thread grass)	X	X
Gilia leptomeria (great basin gilia)	X	X
Achillea millefolium (yarrow)	2.5	75
Amsinckia lycopsoides (tarweed fiddleneck)	2.0	80
Artemisia tridentata (big sagebrush)	0.1	5
Purshia tridentata (bitterbrush)	0.1	5
Chrysothamnus nauseosus (gray rabbitbrush)	2.3	15
Descurainia pinnata (western tansymustard)	0.9	35
Epilobium paniculatum (tall willowherb)	0.1	5
Eriogonum niveum (snow buckwheat)	0.3	10
Erodium cicutarium [a] (storksbill)	4.5	80
Lactuca serriola [a] (prickly lettuce)	X	X
Festuca octoflora (slender sixweeks)	1.3	50
Sisymbrium altissimum [a] (tumblemustard)	0.4	15
Machaeranthera canescens (hoary aster)	X	X
Chaenactis douglasii (hoary falseyarrow)	X	X
Astragalus purshii (woolly pod milkvetch)	X	X
Penstemon acuminatus (sand beardtongue)	X	X
Balsamorhiza careyana (Carey's balsamroot)	0.1	5
Phlox longifolia (longleaf phlox)	0.1	5
Cymopterus terebithinus (turpentine springparsley)	X	X
Oenothera pallida (pale evening primrose)	X	X
Ambrosia acanthicarpa (bur ragweed)	2.1	85
Erigeron poliospermus (cushion fleabane)	X	X
Draba verna (spring whitlowgrass)	X	X
Holosteum umbellatum (jagged chickweed)	1.8	70
Erysimum asperum (rough wallflower)	X	X
Astragalus sclerocarpus (stalk pod milkvetch)	X	X
Astragalus caricinus (buckwheat milkvetch)	X	X
Astragalus succumbens (crouching milkvetch)	X	X
Centaurea diffusa [a] (diffuse knapweed)	X	X
Helianthus cusickii (Cusick's sunflower)	X	X
Oryzopsis hymenoides (Indian ricegrass)	X	X
Polygonum convolvulus [a] (bindweed)	X	X
biotic crust	29.0	95
Bare soil	35.9	95
Litter	19.9	100
Total Cover (does not include biotic crust or litter)	**70.6**	

[a] Introduced Species.

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

3.0 300 AREA

3.1 300-FF-1 PROCESS PONDS AND BURIAL GROUNDS

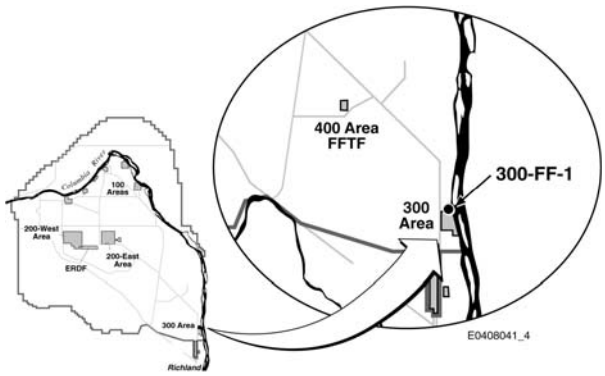
The process pond system received cooling water and low level liquid process wastes from the fuel fabrication facilities and early laboratories. The two solid waste burial grounds, 618-4 and 618-5 received dry waste from the 300 Area operations. Remediation on the 300-FF-1 Operable Unit waste sites were initiated in 1997 and completed in 2004 with the completion of backfill and revegetation in February 2004.

In long range planning a majority of theses sites are within the 300 Area that has been designated as future industrial use (EPA et al. 1996). Guidance provided in BRMaP prescribe industrial areas to be stabilized with crested wheatgrass. To promote a more diverse vegetative community, the 28.3 ha area was broadcast seeded with 11.2 kg/ha crested wheatgrass as well as 11.2 kg/ha Sandberg's bluegrass, 5.6 kg/ha Regreen (*Agropyron* hybrid), 5.6 kg/ha Indian Ricegrass (*Oryzopsis hymenoides*), 5.6 kg/ha Thickspike wheatgrass (*Agropyron dasytachyum*), 5.6 kg/ha Bluebunch wheatgrass, and 2.45 kg/ha needle-and-thread grass (*Stipa comata*). Since this planting effort was initiated in mid February, to help promote successful germination, 16.8 kg/ha Terra Bond (water retaining crystals) applied during seeding to help with seed germination. Straw mulch was distributed across the seeded areas and crimped into the soil surface to prevent wind erosion (Figure 4).

Third year data was collected in mid April 2006. The total cover across the site was measured at 50.2%, of that 22.1% was contributed by the seeded grass species. Sandberg's bluegrass is the most dominant seeded species on the site with 9.4% canopy cover followed by bluebunch wheatgrass with 7.6% cover (Table 4). In addition to the planted species, several other native species were observed on the sites including scorpionweed (*Phacelia hastata*), primerose (*Oenothera pallida*), scurf pea (*Psoralea lanceolata*), prairie clover, globemallow and rabbitbrush. These species are primarily along the northern perimeter of the revegetated sites that are adjacent to undisturbed areas.

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 4,000, sagebrush tublings the first week of February 2006. Shrub survival monitoring transects were established in late April 2006 to capture baseline survival counts. Initial shrub survival on the burial ground recorded 85.8% of the February planted seedlings were still alive. Survival counts captured after an entire growing season will provide a more accurate depiction of first year survival.

Figure 4. 300-FF-1 Process Ponds and Burial Grounds.



February 2004 Revegetated Process Ponds, April 2006.

Sagebrush Monitoring Transect on the 618-4 Burial Ground, April 2006.

Table 4. Percent Canopy Cover and Frequency of Occurrence at the 300-FF-1 Process Ponds and Burial Grounds 2006.

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

[a] Introduced species.

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

4.0 100 AREA

4.1 100-D/DR AREA REVEGETATION

100 D/DR Liquid Waste sites were remediated under the direction of the *Interim Action Record of Decision for the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units* (EPA 1995). Remediation and backfill was completed at the 100 D/DR Area in the fall of 2001. The remediated sites were revegetated in November and December 2001 in accordance with the TPA Milestone M-16-26B. Twenty-four sites and areas adjacent to waste sites that were disturbed during remedial actions were planted. The primary objective of this revegetation effort was to stabilize the soils while promoting the establishment of a vegetative community dominated by native species. Seeds from several native species were collected on the Hanford site and added to the seed mix to provide the area with a seed source. The establishment of these species were observed and included in the annual vegetation monitoring report.

The material used as backfill in the 100 D/DR Area was obtained from a nearby borrow pit. As with most borrow areas, the material is excavated from several feet below grade and was nutrient deficient. The help establish vegetation on these soils, Triple 16 fertilizer was applied at a rate of 112 kg/ha during seeding. A native seed mix was broadcast across the sites with a hydroseeder. The seed mix included 22.4 kg/ha Sandberg's bluegrass, 2.24 kg/ha needle-and-thread grass, and small amounts of yarrow (*Achillea millefolium*), prairie clover, sagebrush, rabbitbrush, indian ricegrass, Carey's balsamroot (*Balsamorhiza careyana*) , snow buckwheat, milkvetch (*Astragalus caricinus, A. sclerocarpus,* and *A. purshii*), mariposa lily (*Calochortus macrocarpus*), grayball sage (*Salvia dorrii*), false yarrow (*Chaenactis douglasii*), slender hawksbeard (*Crepis atrabarba*), sanddrop seed (*Sporobolus cryptandrus*), fleabane (*Erigeron*), wallflower (*Erysimum occidentale*), blazingstar (*Mentzelia laevicaulis*), spring parsely (*Cympopterus terebinthinus*), sand beardtongue, and long leaf phlox (*Phlox longifolia*). The seeded area was irrigated with 0.62 cm/ha of water. One half of the irrigation was applied during initial seeding, the remaining irrigation was applied immediately after seeding. Grass straw was used as mulch and distributed across the seeded area at a rate of 4.5 metric tons per hectare and crimped. Following the mulch application 4-in sagebrush seedlings were planted across the site.

Fifth year vegetation surveys on the 100 D/DR Area sites were conducted in April 2006. Fortyone species were observed on the site this year, 30 of those were native species contributing 35.5% of the 47.5% total cover (Figure 5). The dominant species across the planted area was Sandberg's bluegrass with 20.8% cover and 88% frequency followed by cheatgrass with 10.7% cover and 96% and bluebunch wheatgrass and squirreltail grass with 4.9% and 3.2% covers (Table 5). Russian thistle cover remains at less than 1% and is no longer impacting the vegetative community. All three milkvetch species, yarrow, false yarrow, prairie clover, sand beardtongue, Carey's balsamroot, Cusick's sunflower, and fleabane that were included in the seed mix are persisting on the site and have been blooming for the last three years, providing the recovering sites with a seed source. Five species that were included

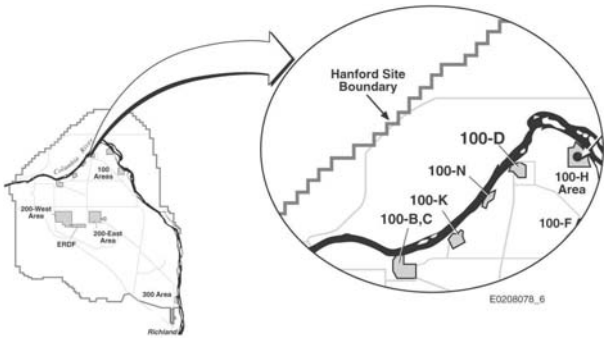
in the seed mix but never recorded on the site include mariposa lily, grayball sage, slender hawksbeard, blazing star, and spring parsley.

Biotic crust is an important component of the native shrub steppe community. It is made up of a mixture if lichens, mosses, and algae that bind to the soil surface, helping to reduce erosion and facilitate percolation of water. A well developed biotic crust is indicative of a mature native community, particularly in areas with fine soils. Most of the borrow pits in the 100 Areas that are used to backfill excavated waste sites have a course assortment of sand and cobble. Biotic crust is very slow to establish on these soil types. Borrow pit 21 has a higher sand content compared to other 100 Area borrow pits, facilitating the establishment of biotic crust cover. Biotic crust cover was measured at 24.4% and occurred in 100% of the plot frames at the 100 D/DR Area.

Sagebrush survival of transplanted shrubs were counted on a representative plot that was established the first summer following the December 2001 planting. Sagebrush survival within the monitoring plot has remained consistent for the last three years with 78.2% of the plants still alive (Table 2). The average height of the five year old sagebrush across the site ranged between 40 and 61 cm with the largest shrubs measuring up to 91 cm. Sagebrush plants across the site have been producing seed for the last three years.

The objective of this restoration effort has been accomplished. The revegetated area has been stabilized to prevent wind erosion and is recovering with native shrubs, forbs, and grasses.

Figure 5. 100 D/DR Area



December 2001 Planted Sagebrush, April 2006.

Looking North over December 2001 Revegetated Area, April 2006

Looking South over the 2001 Planted Area, April 2006.

Table 5. Percent Canopy Cover and Frequency of Occurrence at the 100 D/DR Sites in 2006.

Species	% Cover	% Frequency
Vulpia myuros [a] (rattail fescue)	X	X
Poa sandbergii (Sandberg's bluegrass)	20.8	88
Eriogonum niveum (snow buckwheat)	X	X
Salsola kali [a] (Russian thistle)	0.3	12
Achillea millefolium (yarrow)	0.3	12
Sisymbrium altissimum [a](tumblemustard)	0.4	16
Amsinckia lycopsoides (tarweed fiddleneck)	X	X
Centaurea diffusa [a] (diffuse knapweed)	X	X
Artemisia tridentata (big sagebrush)	X	X
Chrysothamnus nauseosus (gray rabbitbrush)	2.5	24
Chrysothamnus viscidiflorus (green rabbitbrush)	X	X
Erodium cicutarium [a] (storksbill)	0.2	8
Bromus tectorum [a] (cheatgrass)	10.7	96
Phacelia hastata (threadleaf scorpionweed)	X	X
Melilotus officinalis [a] (sweetclover)	0.1	4
Lactuca serriola [a] (prickly lettuce)	X	X
Machaeranthera canescens (hoary aster)	X	X
Epilobium paniculatum (tall willowherb)	0.1	4
Microsteris gracilis (annual phlox)	0.1	4
Poa bulbosa [a] (bulbous bluegrass)	0.7	8
Draba verna (spring whitlow)	0.4	16
Agropyron spicatum (bluebunch wheatgrass)	4.9	24
Stipa comata (needle-and-thread grass)	0.8	12
Erigeron poliospermus (cushion fleabane)	X	X
Lepidium perfoliatum [a] (clasping pepperweed)	X	X
Holosteum umbellatum (jagged chickweed)	1.2	28
Sphaeralcea munroana (globemallow)	0.2	8
Chaenactis douglasii (hoary falseyarrow)	X	X
Sitanion hystrix (squirreltail)	3.2	32
Festuca octoflora (slender sixweeks)	X	X
Petalostemon ornatum (prairie clover)	X	X
Erysimum asperum (wall flower)	X	X
Sporobolus cryptandrus (sand dropseed)	X	X
Oryzopsis hymenoides (Indian ricegrass)	0.6	4
Penstemon acuminatus (sand beardtongue)	X	X
Astragalus caricinus (buckwheat milkvetch)	X	X
Astragalus sclerocarpus (stalked pod milkvetch)	X	X
Balsamorhiza careyana (Carey's balsamroot)	X	X
Helianthus cusickii (Cusick's sunflower)	X	X
Astragalus purshii (woolly pod milkvetch)	X	X
Ranunculus testiculatus [a] (bur buttercup)	0.3	12
Biotic crust	24.4	100
Bare soil	14.8	96
Litter	24.3	96
Total Cover (does not include biotic crust or litter)	**47.5**	

[a] Introduced species.
X = Species observed on the site but not counted in a plot frame.

4.2 120-N-1 AND 120-N-2 SITES

The 120-N-1 and 120-N-2 ponds were operated from 1977 - 1986 and 1986 - 1988 respectively, receiving process effluent from the 163-N De-mineralization Plant. The two sites were remediated as part of the *100-NR-1 Interim Remedial Action Record of Decision* (Ecology 2000). Following remediation in the fall of 2002, the sites were backfilled to grade using material from a nearby borrow pit. Just prior to seeding, the top 12.7 cm of the entire area was ripped with a spring tooth implement. In mid January 2003 the 1.6 hectare area was broadcast seeded with 11.2 kg/ha Sandberg's bluegrass, 2.8 kg/ha Indian ricegrass, 2.8 kg/ha Thickspike wheatgrass, 2.8 kg/ha Bluebunch wheatgrass, 1.12 kg/ha Needle-and-thread grass, .56 kg/ha sagebrush seed, 0.14 kg/ha yarrow, and small amounts of cushion fleabane (*Erigeron poliospermus*), false yarrow, phlox, wallflower, and rabbitbrush seeds. One half of the 1.6 hectare area had 112 kg/ha triple 16 fertilizer applied during seeding, while the remaining area was treated with Biosol, an organic, slow release fertilizer at a rate of approximately 1,120 kg/ha. Upon completion of seeding and fertilizer application, the entire area was irrigated with 0.62 cm of water per hectare. One half of the triple 16 fertilizer area and one half of the Biosol treated area was hydromulched with industry standard mulch fiber. The remaining triple 16 fertilizer area and Biosol treated area was mulched with grass straw at approximately 4.5 metric tons per hectare then crimped into the soil surface (Figure 6).

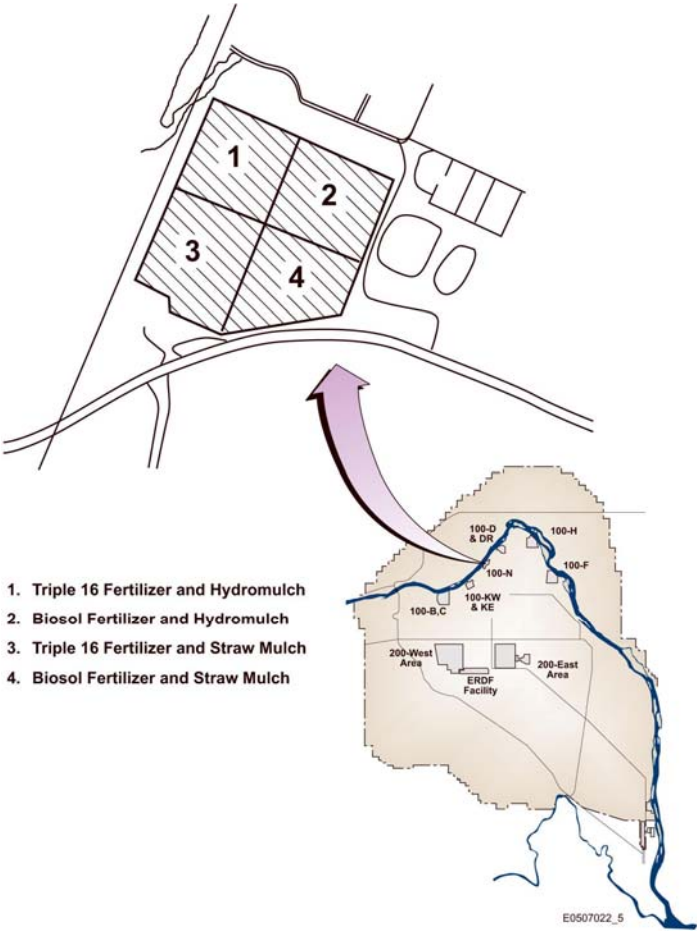
Vegetation surveys were conducted on the four treatments on April 26, 2006. The survey identified 30 species across the site and of those species, 20 were native. The triple 16 fertilizer and straw mulch treatment had the greatest species diversity with 25 species observed, of which 15 were native contributing 39.7% of the 66.2% total cover (Table 6). Sixteen of the 22 species observed on the triple 16 fertilizer and hydromulch treatment were native contributing 25.2% of the total cover. The Biosol fertilizer treatments with straw and hydromulch had 99.5% and 70.8% measured covers, respectively. Cheatgrass was the dominant species on both Biosol fertilized treatments with 60.8% and 62.1% covers and 100% occurrence (Table 7). The Biosol and straw mulch treatment had 24.7% Sandberg’s bluegrass and 8.8% bluebunch wheatgrass covers. The Biosol and hydromulch treatment had 3.1% Sandberg’s bluegrass cover, while bluebunch wheatgrass was present but not measured in a plot frame.

Figure 6. 120-N Sites

Triple 16 and Hydromulch, April 2006

Biosol and Hydromulch, April 2006

Triple 16 and Straw Mulch, April 2006



Biosol and Straw Mulch, April 2006

Table 6. 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
Agropyron dasytachyum (thickspike wheatgrass)	X	0.3	X	--
Agropyron spicatum (bluebunch wheatgrass)	15.8	2.0	8.8	X
Poa sandbergii (Sandberg's bluegrass)	20.7	17.7	24.7	3.1
Stipa comata (needle-and-thread grass)	X	X	X	--
Bromus tectorum [a] (cheatgrass)	23.2	2.5	60.8	62.1
Salsola kali [a] (Russian thistle)	1.2	1.7	0.5	1.0
Achillea millefolium (yarrow)	2.2	3.7	0.2	X
Vulpia myuros [a] (rattail fescue)	0.2	--	1.3	--
Artemisia tridentata (big sagebrush)	0.5	X	X	X
Centaurea diffusa [a] (diffuse knapweed)	0.7	0.7	0.2	0.2
Chrysothamnus nauseosus (gray rabbitbrush)	0.2	0.3	0.2	0.2
Eriogonum niveum (snow buckwheat)	--	X	--	--
Erodium cicutarium [a] (storksbill)	X	--	--	0.2
Lactuca serriola [a] (prickly lettuce)	0.3	X	0.2	--
Festuca octoflora (slender sixweeks)	0.2	--	1.0	0.6
Sisymbrium altissimum [a] (tumblemustard)	0.5	0.7	1.2	1.9
Tragopogon dubius [a] (yellow salsify)	X	--	--	--
Machaeranthera canescens (hoary aster)	X	X	--	X
Chaenactis douglasii (hoary falseyarrow)	X	X	--	X
Microsteris gracilis (pink microsteris)	--	--	0.2	--
Penstemon acuminatus (sand beardtongue)	--	X	--	--
Erigeron poliospermus (cushion fleabane)	X	X	--	X
Oryzopsis hymenoides (Indian ricegrass)	--	0.3	X	0.4
Draba verna (spring whitlowgrass)	0.2	0.2	0.2	0.6
Holosteum umbellatum (jagged chickweed)	X	0.7	--	0.4
Erysimum asperum (rough wallflower)	--	X	X	X
Erigeron pumilis (shaggy fleabane)	X	--	--	--
Erigeron filifolius (threadleaf fleabane)	X	--	--	--
Poa bulbosa [a] (bulbous bluegrass)	0.3	X	X	X
Ranunculus testiculatus [a] (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
Total Cover (does not include biotic crust or litter)	**66.2**	**30.7**	**99.5**	**70.8**

[a] Introduced species.
X = Species observed on the treatment but not counted in a plot frame.
-- = Species not observed on the treatment.

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

[a] Introduced species.
X = Species observed on the treatment but not counted in a plot frame.
-- = Species not observed on the treatment.

4.3 HANFORD GENERATING PLANT

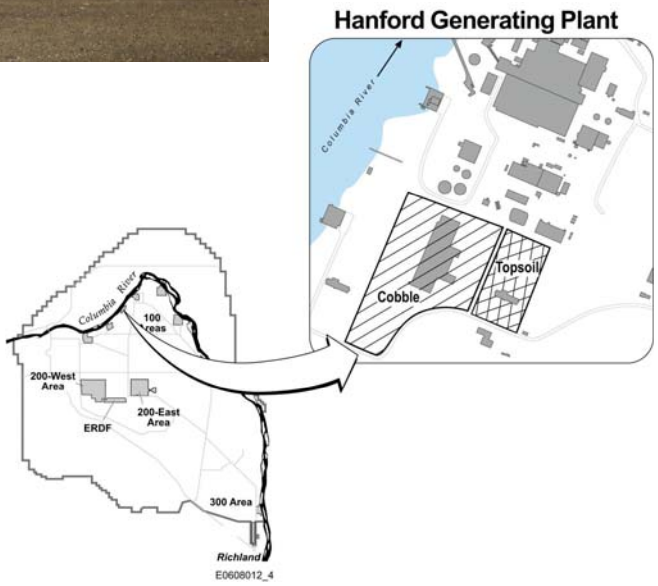
Energy Northwest Inc. worked on demolition of the 185-N Hanford Generating Plant complex from 2001 through 2004. The remedial action objectives and goals were attained for the sites in accordance with the 100 N Area Ancillary Facilities Action Memorandum (Ecology 1999) and in accordance with the Interim 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 7).

An initial vegetation survey was conducted on the revegetated area in late April 2006. The planted area was separated into two analysis sections; the eastern half of the area has native fine grained soils that was not removed during the demolition activities while the western area has rocky cobble backfill material from a nearby borrow pit. The total measured cover on the eastern portion of the site was 66.1% and 69.2% on the western area. Both of the monitoring areas were dominated by Russian thistle and the native seeded grasses. The eastern portion of the site had a greater Russian thistle cover with 26.1% cover compared to 19.9% on the western area (Table 8). The total measured cover of native species was greater on the western half of the site with 35.7% compared to the eastern area which had 21.1%. Of the total measured covers 34.8% and 20.4% was contributed by the seeded native grasses. Furthermore, native grasses were recorded in 100% of the plot frames within both monitoring areas (Table 9). The eastern portion of the site had 15% cheatgrass cover while the western portion had only 2.1%. However, the western area had 9.1% tumble mustard cover compared to the eastern area which had only 1.0%. The initial vegetation survey indicates germination of the seeded greases was successful, however analysis conducted after an entire growing season will provide a more accurate representation of plant establishment. Sagebrush survival monitoring transects were established within each of the monitoring areas. Total sagebrush survival was estimated at 96%, with the western area yielding 98.1% survival and 94.9% on the eastern half of the site.

Figure7. Hanford Generating Plant.

Seeding the former Hanford Generating Plant, February 2006.



February 2006 Planted Sagebrush Eastern Area, April 2006.

Grasses on the Cobble Backfill Area, April 2006.

Table 8. Percent Canopy Cover at the Hanford Generating Plant in 2006.

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

[a] Introduced species.
[b] 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 9. Frequency of Occurrence at the Hanford Generating Plant in 2006.

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

[a] Introduced species.

[b] 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

4.4 116-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 remain important to their religion, traditions, and cultural heritage. The 116-N-3 trench was constructed within a portion of *Mooli Mooli* (Figure 8). 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 Conctactor'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 on site 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, then mulched with 4.5 metric tons/ha grass straw, and crimped into the soil surface to help hold it in place.

Sagebrush and spiny hopsage 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. Shrub survival monitoring plots were established in the spring of 2005 within the planted area to mark sagebrush and spiny hopsage plants for future plant survival counts.

In early May 2006, vegetation surveys were conducted on the 116-N-3 trench. Twenty-five species were observed within the revegetated area; 15 of those were native. Russian thistle remains the dominant species on the trench, however it had a measured canopy cover of 14.5%, down 11% from the 2005 survey (Table 10). Sandberg's bluegrass cover and

frequency increased this year to 5.8% cover and 73.3% frequency. Bottlebrush squirrel grass cover was down 6.4% from 2005 measurements while bluebunch wheatgrass cover remained consistent with 2005 observations with 7.8% and 86.7% frequency. Shrub survival counts within the monitoring plots found 46% of the sagebrush and 30% of the spiny hopsage seedlings alive.

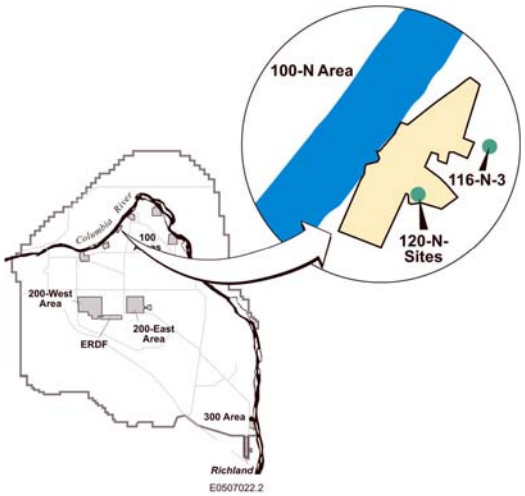
Table 10. Percent Canopy Cover and Frequency of Occurrence at the 116-N-3 Site in 2006.

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

[a] Introduced species.

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

Figure 8. 116-N-3 Trench



February 2005 Planted Sagebrush, May, 2006.

Southwest Portion of the 116-N-3 Trench, May 2006.

Grasses on the 116-N-3 Trench, May 2006.

2.2 100 F AREA

Remedial action of several waste sites within the 100-FR-1 Operable Unit in the 100-F Area were 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 course 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.

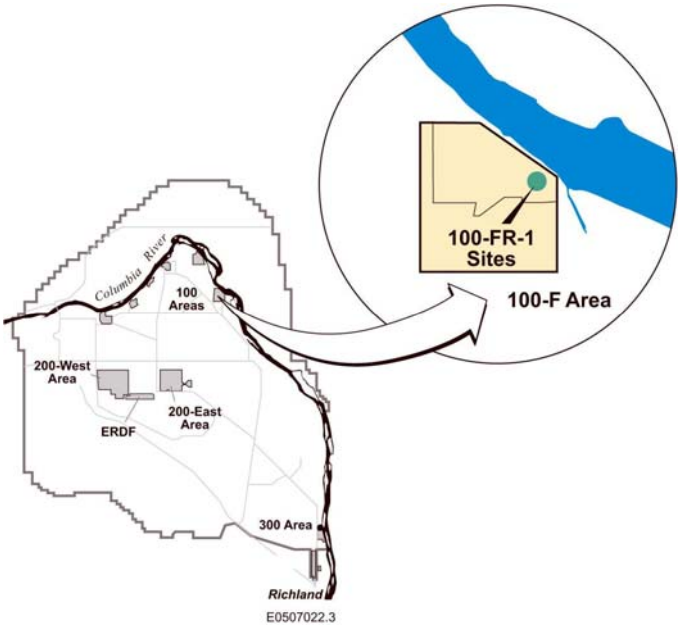
The backfilled and recontoured waste sites were revegetated in January 2005. The objective of revegetating the area was to establish a plant community dominated by native species with a limited number of introduced species within the community after establishment.

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. Fifty-five thousand sagebrush plants were planted across the remediated waste sites and borrow area. In spring of 2005, shrub survival monitoring plots were marked within the planted area. Sagebrush survival counted across the remediated waste sites and borrow area this spring recorded a survival of 67.4%. The sagebrush plants within the monitoring plots established in the rocky cobble of the backfilled waste sites had an average survival of 72.2%. Some of the plants had doubled in size since they were planted. The sagebrush planted in the fine grained soils of the borrow area had an average survival of 50% (Figure 9).

In May 2006, vegetation measurements were collected from the planted areas at the 100 F Area. Thirty-four species were observed within the revegetated area, of those 24 were native. There was an increase of cheatgrass cover from 0.7 % in 2005 to 23.0 %, and frequency of occurrence from 28% in 2005 to 100% within the plot frames (Table 11). There was a significant decrease in Russian thistle cover from 25% in 2005 to 1.9% cover this year. The dominant planted grass species was Sandberg's bluegrass with 7% cover and 88% frequency, followed by bluebunch wheatgrass with 6.3% cover and 96% frequency. The total cover of native grass species including bluebunch wheatgrass, Indian ricegrass, needle-and-thread grass, Sandberg's bluegrass, and squirreltail grass was 14.9%; an increase from 6.7% in 2005.

Figure 7. 100 F Area



January 2005 Planted Sagebrush, May 2006.

January 2005 Seeded Area, May 2006.

Table 11. Percent Canopy Cover and Frequency of Occurrence at the 100 F Area Sites in 2006.

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

[a] Introduced species.

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

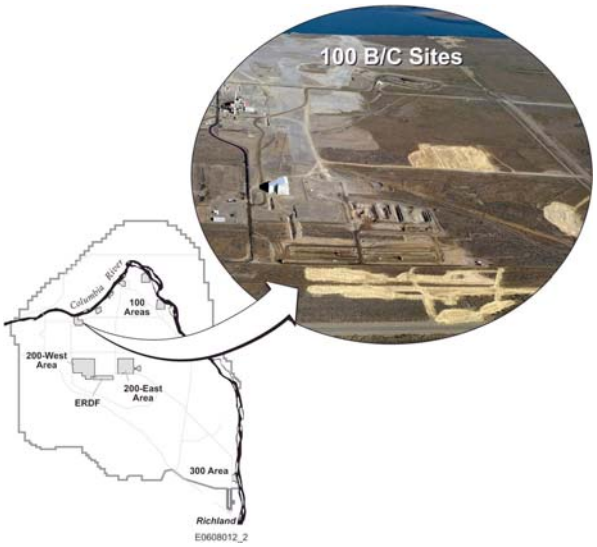
4.6 100 B/C

Three waste sites; 100-B-1, 128-C-1, and 600-232 in the 100 B/C Area were cleaned up 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 2005) 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 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. Upon completion of seeding, the sites were planted with 16,000 sagebrush and 600 spiny hopsage seedlings (Figure 10).

In May 2006, vegetation surveys on the 100-B-1 and 128-C-1 sites were conducted to document the plant establishment on the 100-B-1 topsoil covered site compared to the 128-C-1 cobble backfilled site. In addition to the six grass species planted on the sites, 10 additional species were observed on the 100-B-1 site and 7 additional species on the 128-C-1 site. Because the grass seedlings were small at the time of monitoring, the percent cover and frequency was recorded for native grasses rather then for each grass species. The initial survey recorded 13.9% cover of native grasses on the 100-B-1 site and 4.2% on the 128-C-1 site, however both sites had 100% occurrence of native grasses within the plot frames (Table 12). Russian thistle cover was 3.3% on the backfill cobble 128-C-1 site and 9.6% on the 100-B-1 site (Table 13). Shrub survival monitoring transects were established within the planted area. Shrub survival recorded during establishment of the monitoring transects found 82.3% of the plants alive on the 100-B-1 site and 74.2% on the 128-C-1 site (Table 2).

The initial monitoring of the planted sites indicate successful germination, however vegetation analysis conducted after an entire growing season will provide a more accurate depiction of seeding success.

Figure 10. 100 B/C Sites



Mulching and Crimping 100-B-1 Site, February 2006.

Planting Sagebrush 100-B-1 Site, February 2006.

Grasses on the 100-B-1 Site, May 2006.

Table 12.Percent Frequency of Occurrence at the 100 B/C Sites in 2006.

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

[a] Introduced species

[b] 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 13. Percent Canopy Cover on the 100 B/C Sites in 2006.

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

[a] Introduced species.
[b] 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.

4.7 100 K AREA

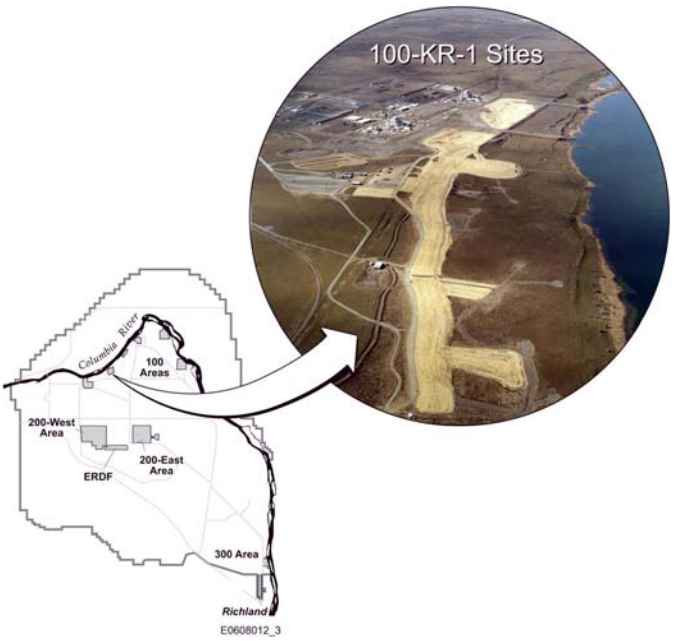
Remedial action of the large liquid waste sites; 116-KE-3, 116-KW-4, 116-K-1, 100-K-55, 100-K-56, and 116-K-2 in the 100-KR-1 Operable Unit was initiated in October 2002 and continued through October 2005. Remediation of the sites was in accordance with the *Amendment to the Interim Action Record of 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 2005). 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.

Initial vegetation surveys were conducted on the planted sites in mid May 2006. The percent cover and frequency of occurrence of grasses were recorded as total native grasses rather then individual species due to the small size of the seedlings. The initial survey recorded 5.7% cover of native grasses with 90% of the monitoring frames having native grass seedlings present (Table 14). Total measured vegetative cover on the sites was 19.2%, with Russian thistle contributing 9.4%. Other species recorded on the site include tumble mustard, (Si*symbrium altissimum*), cheatgrass, diffuse knapweed (*Centaurea diffusa*), and fiddleneck (*Amsinckia lycopsoides*). Sagebrush monitoring transects were established in May 2006. Of the sagebrush counted in the monitoring transects, 91% were alive (Figure 11). Vegetation surveys and shrub survival measurements collected after an entire growing season will provide a more accurate depiction of future success.

Figure 11. 100-KR-1 Sites



Sagebrush Monitoring Transect, May 2006.

Grass seedlings, May 2006.

Mulching, Crimping, and Irrigating 100-KR-1, February 2006.

Table 14. Percent Canopy Cover and Frequency of Occurrence on the 100-KR-1 in 2006.

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

[a] Introduced Species.
[b] 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.

5.0 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 12 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^3 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 and clean soil staging area was 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.

An initial vegetation survey was conducted on the Horseshoe Landfill and Soil Staging Area in May 2006. The landfill and 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. Plant succession and shrub survival will be collected and recorded for each soil type. The landfill had a total measured cover of 28.2% and the soil staging area had a total cover of 34.3%. Both areas were dominated by native grass species. The landfill had 25.7% native grass cover and the soil staging area had 20.2% with 100% frequency of occurrence within the plot frames on both areas (Tables 15 and 16). The frequency of native grasses indicates successful germination; however, measurements recorded after an entire year will provide a more accurate indication of species establishment. The most significant difference between the two areas is the presence of tumble mustard on the soil staging area, with 8% cover and 93.3% frequency, compared to the landfill where tumble mustard was observed on the site but not recorded within a monitoring frame.

Sagebrush monitoring transects were established in early May to capture shrub survival before the stresses of summer conditions to provide a baseline for future counts. Sagebrush survival on the landfill will be evaluated against the survival of the shrubs planted on the adjacent soil staging area to compare the affects of soil type. During the monitoring transect establishment,

sagebrush survival on the landfill was 93% and the soil staging area was 94.5%. Shrub survival measurements collected after an entire growing season will provide a more accurate depiction of future success.

Table 15. Percent Canopy Cover on the Horseshoe Landfill and Soil Staging Area 2006.

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

[a] Introduced species

[b] 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 16. Frequency of Occurrence on the Horseshoe Landfill and Soil Staging Area 2006.

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

[a] Introduced species
[b] 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.

Figure 12. Horseshoe Landfill

Ripping the Soil Staging Area Prior to Seeding, February 2006.

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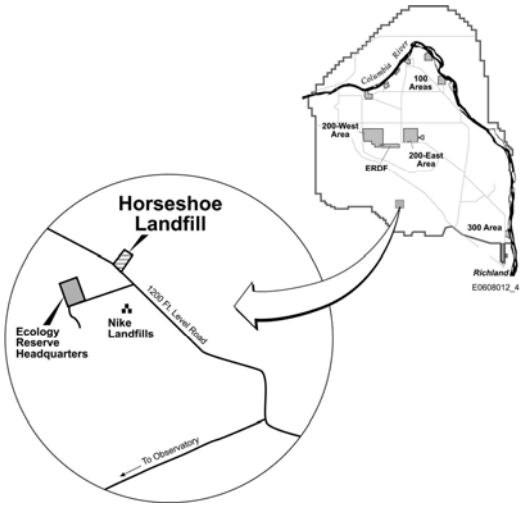


Grasses on the Horseshoe landfill, May 2006.

Soil Staging Area Adjacent to the Horseshoe Landfill, May 2006

6.0 ERDF MITIGATION

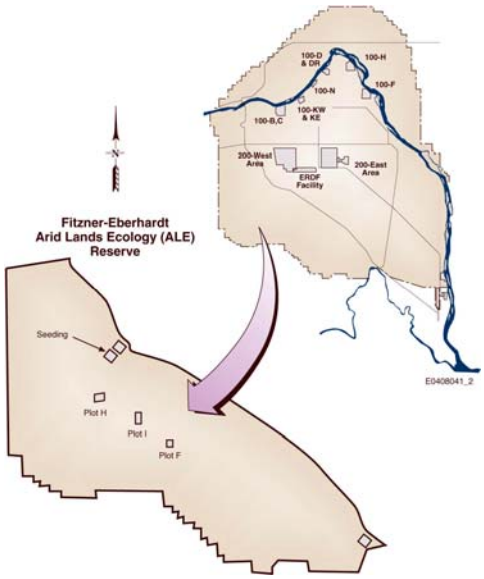
In December 2002 the DOE Richland Operations Office and U.S. Fish and Wildlife Service cooperatively worked on a compensatory mitigation planting project for the original construction of the ERDF Cells 1 and 2 on the Arid Lands Ecology Reserve (ALE). Approximately 68.8 ha of mature sagebrush habitat was lost during the facility construction. The *Hanford Site Biological Resources Management Plan* (DOE-RL 2001) requires that if more than 1 hectare of high quality habitat is destroyed, then compensatory mitigation must take place at a rate of 3:1.

The ERDF Mitigation project included three separate planting elements that were completed in winter of 2002 and 2003. The native grass seeding was completed in December 2002 and portions of the native shrub seedling planting was completed in the winter of 2002 and 2003. The native grass plug and additional shrub plantings were also completed in the winter of 2003 (Figure 13). The native grass seed used in the seeding project was purchased from a local seed producer and derived from local sources. Prior to seeding approximately 64.8 ha with native grasses, an application of Roundup^{TM} was aerial applied to the project site in mid November 2002. In mid December 2002, following the herbicide application, 22.4 kg/ha of native grass seed mix consisting of Sandberg's bluegrass, thickspike wheatgrass, bottlebrush squirreltail, Indian ricegrass, and needle-and-thread grass was aerial broadcast then harrowed with a tractor drawn implement. An additional Roundup^{TM} application was applied in mid February 2003 to reduce cheatgrass competition to the seeded species.

Approximately 139,000 shrubs were planted across 125.5 ha in early December 2002. The shrubs planted included 10,300 10-in sagebrush, 28,100 4-in sagebrush, 93,000 bare root sagebrush, 6,000 green rabbitbrush, and 6,000 gray rabbitbrush. The bare root plants were dipped in mycorrhizal root gel prior to planting to provide the plants nutrients required for plant establishment. The shrubs were planted in three separate areas and were monitored for survival. The remaining shrub and grass plug plantings were completed in the winter of 2003. Two areas were planted. One included planting native grass and shrub plugs adjacent to, and north of the 2002 broadcast seeded area. A mixture of bitterbrush, green and gray rabbitbrush, indian ricegrass, and needle-and-thread grass were planted over a 14.1 ha area. Approximately 10,000 thickspike wheatgrass plugs were planted separately, as this species tends to form a monculture. The other area planted in the winter of 2003 is located southeast of gate 109. This area was planted with bitterbrush plugs. Since bitterbrush are susceptible to browsing, the plants were either protected with biodegradable mesh tubes that were anchored with bamboo stakes or treated with a foliar solution of animal repellant to evaluate alternative browse protection. Each protection method is monitored to evaluate protectiveness.

All the ERDF mitigation plantings are monitored annually to document the planting success, plant establishment, and shrub survival with data collections included in the annual revegetation monitoring report.

Figure 13. ERDF Mitigation



December 2003 Planted Green Rabbitbrush, May 2006.

Bitterbrush Planted in December 2003, May 2006.

December 2002 Planted Bareroot Sagebrush, May 2006.

Monitoring transects were installed within the sagebrush plots in the spring of 2003. Four plots were established within the sagebrush planting areas; two plots within Area F and H, which were planted with bareroot seedlings, and the remaining two plots were installed on Area I. All plants within the monitoring transect were staked with a 46 cm length of 1/2 inch white PVC pipe in early April before the stress of summer heat to capture baseline plant survival. One plot within Area I was established to monitor survival of 10-in sagebrush plugs and the other plot to measure survival of the 4-in sagebrush plugs. Additional monitoring plots were installed in spring of 2004 within the bitterbrush, rabbitbrush, and grass plug areas that were planted in the winter of 2003.

Shrub survival was counted within the monitoring plots of each planted area in May 2006. All marked plants were examined for survival and the results recorded for each seedling type. The bareroot sagebrush had 22% survival, the 10-in sagebrush plugs had 14.3%, and the 4-in sagebrush plugs had 26.7% survival. The bitterbrush treated with animal repellant had 12% survival, the bitterbrush protected with biodegradable mesh tubes 3.3%, rabbitbrush 30.3%, bunchgrass (indian ricegrass and needle-and-thread grass mix) 5.5%, and thickspike wheatgrass 57.3% (Table 2).

Sagebrush survival fell in all three seedling types, with the lowest survival recorded in the 10-in plug size (14.3%) and the highest survival observed on the 4-in plug size (26.7% survival). A few of the bareroot plants within the monitoring plots had noticeable branching and top growth, with some of the plants blooming for the third consecutive year. The bitterbrush plants treated with animal repellant had an estimated survival of 12%, compared to 2.6% for the bitterbrush planted in the same area with biodegradable mesh tubes. The monitoring plot for the animal repellant treated bitterbrush was on top of a small hill that has very sandy soils with open space between plants and subsequently less competition. The bitterbrush protected with biodegradable mesh tubes were within dense stands of Sandberg's bluegrass and needle-and-thread grass with cheatgrass and tumble mustard (Figure 13).

Survival of the rabbitbrush has decreased from 67.6% in 2005 to 30.3% this spring. The plants had significantly fewer leaves this year compared to the same time last year.

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 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. There are at least 2 species of little brown bats (*Myotis ciliolabrum* and *M. yumanensis*) that have been found at both areas and pallid bats (*Antrozous pallidus*) at the 105-F Reactor. 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

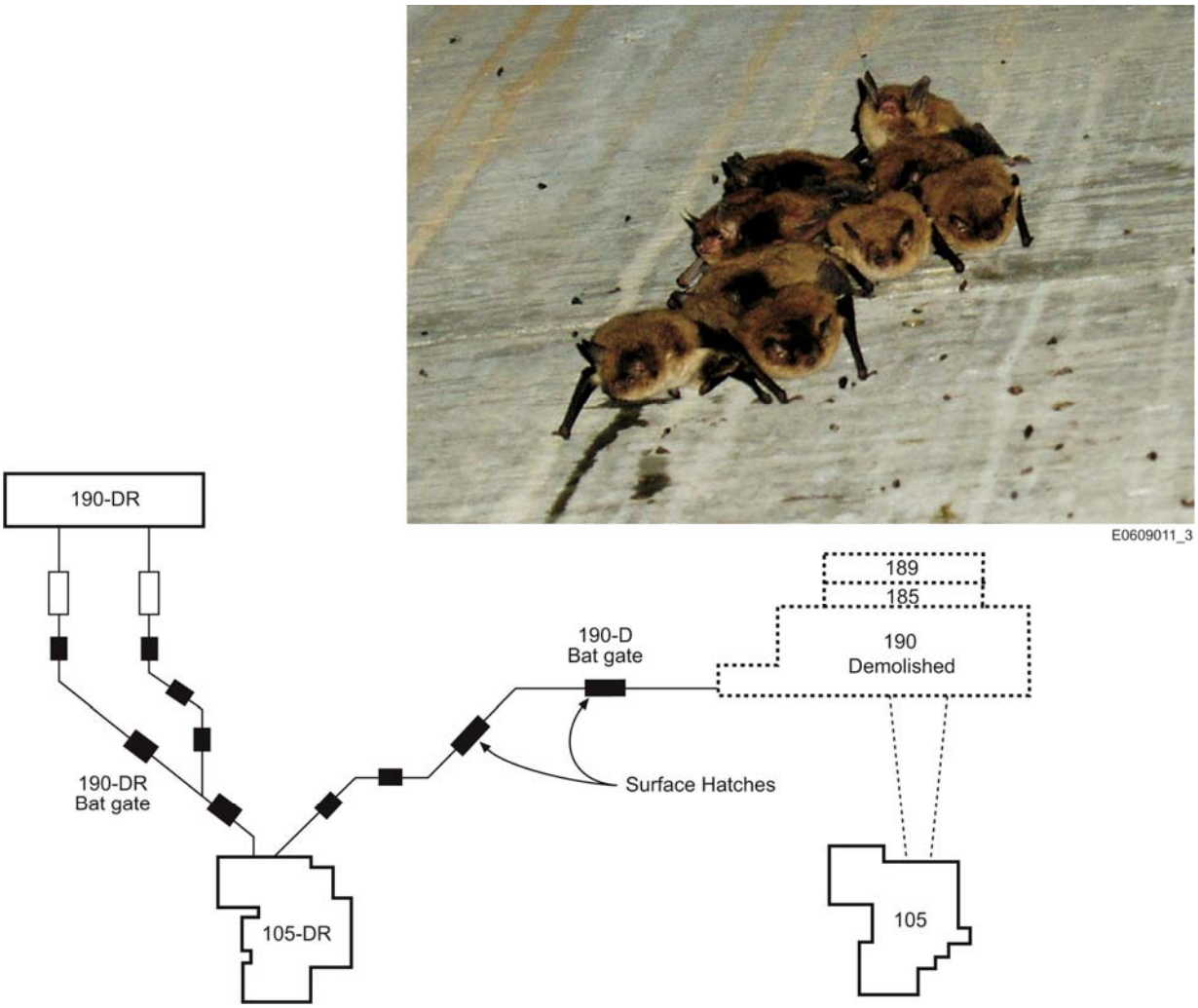
mitigation projects conducted at the reactor sites included establishing the process water tunnels at D Area as alternative roost sites and installing artificial roost boxes at 105-F Reactor.

Bat Mitigation at 100-D Area

The mitigation project at 100-D Area was initiated when a 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 14). 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 15). 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 14. 190 DR Bate Gate

Figure 15. 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 were 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 appear to use all the hatches except the ones where the bat gates are located. Often the majority of the population will be roosting in the same hatch where there will be several small clusters ranging from 5 to 50. These clusters are maternity colonies consisting of mothers with their young. No bats were captured so it is difficult to verify species. Most bats appear to be Yuma myotis (*M. yumanensis*) along with some small-footed myotis (*M. ciliolabrum*) and western pipistrel (*Pipistrellus hesperus*). The increase in the population observed during the second inspection of 2005 indicates the bats utilize other roosts sites such as the 190-D tunnel or buildings still standing in the 100-D Area and that they move between the roosts.

In 2006, it was not possible to enter the 190-DR tunnels because a radiation survey conducted in October 2005 had detected pure alpha contamination which resulted in posting the tunnel as a contamination area. Upon further sampling and verification surveys in July 2006, the tunnel was found to be not contaminated with radioactive material and down-posted. The source of the elevated radiation readings was assumed to be radon-222 (a naturally occurring radionuclide) which is known to accumulate in confined concrete structures.

Prior to being down-posted, a census of bats emerging from the 190-DR tunnel was attempted, however, it was discovered that someone had placed chicken wire over the entrance to the tunnel which would preclude the bats from flying through the gate. Myotis can get through the openings of chicken wire so it is not likely any were trapped in the tunnel. However, it is not known whether the screening will have any long term detrimental effects on the roost. The chicken wire was removed and bats were observed in the tunnel during the down-posting but not at the previous numbers.

The 190-D bat gate 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.

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 was observed in the upper areas of the reactor building (Figure 16). 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, an 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 17). 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 2005, no attempts were made to quantify the population of pallid bats, however, observations were made throughout the season to determine which boxes were being used. The colony size appeared to remain about the same size or larger. The use of other boxes became more frequent and often pallid bats were observed in multiple boxes at the same time. Box number 8 was used for the first time in August 2005. An attempt was made to determine when the bats left for the winter. By September 20, 2005, approximately 20 to 30 bats remained in the boxes. The population declined to 11 by October 6, and by October 20, only 2 pallid bats remained (in box 7) at the reactor building.

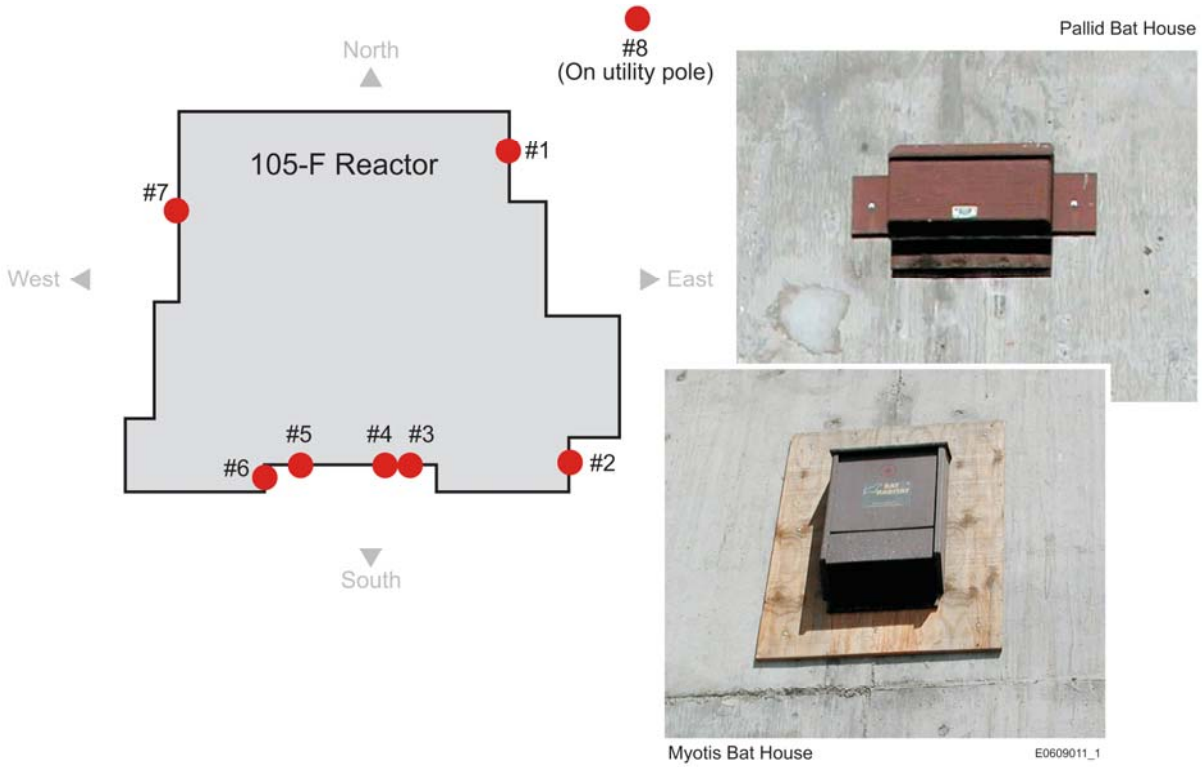
In 2006, the pallid bats began returning to the roost site at 105-F Reactor in April. Fresh pallid bat fecal pellets were observed under the boxes on April 11, 2006. During the spring months (April & May) the bats appeared to prefer the roosts on the south side of the building, probably because these 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.

The *Myotis* bats have never been observed in large numbers in the bat boxes on the reactor building. In April 2006, approximately 20 individuals were observed in box 5, but subsequent

observations indicate that they do not rely on the boxes for primary or maternity roosts sites. The likely reason for this is because a very large roost site exists in the 183-F Clearwell, a non-radioactive facility located approximately 400 m north of the reactor building. The clearwell was a storage facility for filtered cooling water for the reactor and consists of a concrete basin approximately 18 feet deep, covered with a concrete lid that measures 375 feet long by 134 feet wide. The concrete lid provides ideal conditions for a maternity roost because of the solar heating and un-obstructed access through an open hatch. Approximately 2,000 bats were observed emerging from this facility on May 25, 2006.

Figure 16. Pallid Bats at 105-F Reactor

Figure 17. 105-F Bat Houses



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APPENDIX A

2005 REVEGETATION MONITORING RESULTS

Table A1. Percent Canopy Cover and Frequency of Occurrence on 600-23 Site in 2005.

Species	% Cover	% Frequency
Vulpia myuros [a] (rattail fescue)	1.1	24
Poa sandbergii (Sandberg's bluegrass)	12	96
Bromus tectorum [a] (cheatgrass)	5.7	92
Salsola kali [a] (Russian thistle)	2.5	60
Achillea millefolium (yarrow)	0.8	12
Melilotus alba [a] (sweetclover)	X	X
Eriogonum niveum (snow buckwheat)	0.1	4
Stipa comata (needle-and-thread grass)	X	X
Agropyron spicatum (bluebunch wheatgrass)	13.2	88
Artemisia tridentata (sagebrush)	X	X
Festuca octoflora (slender sixweeks)	1.8	32
Sisymbrium altissimum [a] (tumble mustard)	X	X
Holosteum umbellatum [a] (jagged chickweed)	0.2	8
Lactuca serriola [a] (prickly lettuce)	X	X
Phacelia hastata (whiteleaf scorpionweed)	X	X
Ambrosia acanthicarpa (bur ragweed)	X	X
Poa bulbosa [a] (bulbous bluegrass)	0.1	4
Chaenactis douglasii (hoary falseyarrow)	X	X
Purshia tridentata (bitterbrush)	X	X
Mentzelia laevicaulis (blazing star)	X	X
Machaeranthera canescens (hoary aster)	0.2	8
Draba verna (spring whitlow)	0.9	36
Epilobium paniculatum (tall willowherb)	1	40
Astragalus sclerocarpus (stalk-pod milkvetch)	X	X
Penstemon acuminatus (sand beardtongue)	X	X
Helianthus cusickii (Cusick's sunflower)	X	X
Erodium cicutarium [a] (storksbill)	0.2	8
Chrysothamnus nauseosus (gray rabbitbrush)	X	X
Oenothera pallida (evening primrose)	X	X
Tragopogon dubius [a] (yellow salsify)	X	X
Astragalus caricinus (buckwheat milkvetch)	X	X
Astragalus purshii (woolly-pod milkvetch)	X	X
Petalostemon ornatum (prairie clover)	X	X
Oryzopsis hymenoides (Indian ricegrass)	0.2	8
Sphaeralcea munroana (globemallow)	X	X
Chrysothamnus viscidiflorus (green rabbitbrush)	X	X
Erysimum asperum (wall flower)	X	X
Cryptantha circumscissa (matted cryptantha)	X	X
Biotic crust	1.5	60
Bare Soil	42.4	100
Litter	22.5	4
Total cover (does not include crust or litter)	**40**	

[a] Introduced Species.

X= Present but not counted in plot frames.

Table A2. Percent Canopy Cover and Frequency of Occurrence on the J. A. Jones Site in 2005.

Species	% Cover	% Frequency
Agropyron spicatum (bluebunch wheatgrass)	7.8	48
Bromus tectorum [a] (cheatgrass)	4.9	96
Salsola kali [a] (Russian thistle)	2.2	48
Poa sandbergii (Sandberg's bluegrass)	31.1	100
Stipa comata (needle-and-thread grass)	X	X
Achillea millefolium (yarrow)	2.3	32
Amsinckia lycopsoides (tarweed fiddleneck)	2.9	76
Artemisia tridentata (big sagebrush)	X	X
Purshia tridentata (bitterbrush)	X	X
Chrysothamnus nauseosus (gray rabbitbrush)	0.3	12
Epilobium paniculatum (tall willowherb)	0.2	8
Eriogonum niveum (snow buckwheat)	0.2	8
Erodium cicutarium [a] (storksbill)	2	60
Festuca octoflora (slender sixweeks)	2.1	44
Sisymbrium altissimum [a] (tumblemustard)	0.4	16
Machaeranthera canescens (hoary aster)	X	X
Chaenactis douglasii (hoary falseyarrow)	0.6	4
Astragalus purshii (woolly pod milkvetch)	X	X
Microsteris gracilis (pink microsteris)	0.1	4
Penstemon acuminatus (sand beardtongue)	X	X
Balsamorhiza careyana (Carey's balsamroot)	X	X
Phlox longifolia (longleaf phlox)	0.3	12
Oenothera pallida (evening primrose)	X	X
Ambrosia acanthicarpa (bur ragweed)	0.5	20
Erigeron poliospermus (cushion fleabane)	0.1	4
Draba verna (spring whitlowgrass)	0.7	28
Holosteum umbellatum [a] (jagged chickweed)	1.1	44
Erysimum occidentale (wallflower)	X	X
Erigeron filifolius (threadleaf fleabane)	X	X
Astragalus sclerocarpus (stalk-pod milkvetch)	X	X
Centaurea diffusa [a] (diffuse knapweed)	0.1	4
Helianthus cusickii (Cusick's sunflower)	X	X
Biotic crust	0.7	28
Bare soil	36.3	100
Litter	30.8	100
Total cover (does not include crust or litter)	**59.9**	

[a] Introduced Species.

X= Present but not counted in plot frames.

Table A3. 300-FF-1 Process Ponds and Burial Grounds

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

[a] Introduced Species.
X= Present but not counted in plot frames.

Table A4. Percent Canopy Cover and Frequency of Occurrence at the 100 D/DR Area in 2006.

% Cover	% Frequency	% Frequency
Vulpia myuros [a] (rattail fescue)	4.9	60
Poa sandbergii (Sandberg's bluegrass)	13.3	72
Eriogonum niveum (snow buckwheat)	X	X
Salsola kali [a] (Russian thistle)	0.7	28
Achillea millefolium (yarrow)	0.3	12
Sisymbrium altissimum [a] (tumblemustard)	0.3	12
Descurainia pinnata (western tansymustard)	X	X
Amsinckia lycopsoides (tarweed fiddleneck)	1.3	8
Centaurea diffusa [a] (diffuse knapweed)	X	X
Artemisia tridentata (big sagebrush)	0.2	8
Chrysothamnus nauseosus (gray rabbitbrush)	0.4	16
Chrysothamnus viscidiflorus (green rabbitbrush)	X	X
Erodium cicutarium (storksbill)	0.7	8
Bromus tectorum [a] (cheatgrass)	12.7	84
Phacelia hastata (threadleaf scorpionweed)	X	X
Melilotus officinalis [a] (sweetclover)	X	X
Lactuca serriola [a] (prickly lettuce)	X	X
Machaeranthera canescens (hoary aster)	1.0	20
Epilobium paniculatum (tall willowherb)	X	X
Poa bulbosa [a] (bulbous bluegrass)	X	X
Agropyron dasytachyum (thickspike wheatgrass)	X	X
Stipa comata (needle-and-thread grass)	0.1	4
Tragopogon dubius (yellow salsify)	0.1	4
Erigeron poliospermus (cushion fleabane)	0.1	4
Holosteum umbellatum (jagged chickweed)	0.2	8
Sphaeralcea munroana (globemallow)	X	X
Chaenactis douglasii (hoary falseyarrow)	X	X
Ambrosia acanthicarpa (bur ragweed)	0.1	4
Sitanion hystrix (bottlebrush squirreltail)	3.9	24
Petalostemon ornatum (prairie clover)	X	X
Erysimum asperum (wall flower)	X	X
Sporobolus cryptandrus (sand dropseed)	X	X
Oryzopsis hymenoides (Indian ricegrass)	2.1	8
Agropyron spicatum (bluebunch wheatgrass)	4.7	36
Penstemon acuminatus (sand beardtongue)	X	X
Astragalus caricinus (buckwheat milkvetch)	X	X
Astragalus sclerocarpus (stalked pod milkvetch)	X	X
Balsamorhiza careyana (Carey's balsamroot)	X	X
Oenothera pallida (evening primrose)	X	X
Lupinus pusillus (low lupine)	X	X
Erigeron filifolius (threadleaf fleabane)	X	X
Helianthus cusickii (Cusick's sunflower)	X	X
Astragalus purshii (woolly pod milkvetch)	X	X
Biotic crust	0.7	28
Bare soil	36.1	100
Litter	37.7	100
Total cover (does not include crust or litter)	**47**	

[a] Introduced Species.
X= Present but not counted in plot frames.

Table A5. 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
Agropyron dasytachyum (thickspike wheatgrass)	X	--	X	--
Agropyron spicatum (bluebunch wheatgrass)	26.3	1.8	4.7	1.7
Poa sandbergii (Sandberg's bluegrass)	10.3	3.7	3.3	2.3
Stipa comata (needle-and-thread grass)	X	0.2	0.2	0.2
Bromus tectorum [a] (cheatgrass)	2.2	6.0	8.0	23.3
Salsola kali [a] (Russian thistle)	0.3	2.8	0.5	1.3
Achillea millefolium (yarrow)	2.3	1.5	0.2	X
Vulpia myuros [a] (rattail fescue)	2.7	--	5.2	0.3
Artemisia tridentata (big sagebrush)	0.3	X	X	X
Centaurea diffusa [a] (diffuse knapweed)	0.2	0.3	X	0.3
Chrysothamnus nauseosus (gray rabbitbrush)	X	X	X	X
Descurainia pinnata (western tansymustard)	--	0.3	0.3	0.2
Epilobium paniculatum (tall willowherb)	--	0.2	--	--
Eriogonum niveum (snow buckwheat)	--	0.2	--	--
Erodium cicutarium [a] (storksbill)	X	--	--	--
Lactuca serriola [a] (prickly lettuce)	X	--	--	X
Festuca octoflora (slender sixweeks)	0.2	--	0.5	--
Sisymbrium altissimum [a] (tumblemustard)	0.5	1.0	0.7	1.0
Tragopogon dubius [a] (yellow salsify)	X	--	--	--
Machaeranthera canescens (hoary aster)	X	X	--	--
Chaenactis douglasii (hoary falseyarrow)	X	1.5	X	3.8
Penstemon acuminatus (sand beardtongue)	--	X	--	--
Erigeron poliospermus (cushion fleabane)	X	X	--	--
Oryzopsis hymenoides (Indian ricegrass)	0.3	0.5	X	X
Draba verna (spring whitlowgrass)	--	0.2	--	--
Erysimum asperum (wall flower)	0.3	0.8	X	0.2
Amsinckia lycopsoides (tarweed fiddleneck)	0.3	--	0.3	0.2
Erigeron pumilis (shaggy fleabane)	X	X	--	--
Erigeron filifolius (threadleaf fleabane)	X	X	--	--
Poa bulbosa [a] (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
Total cover (does not include crust or litter)	**46.5**	**21.3**	**23.8**	**34.8**

[a] Introduced Species.

X= Present but not counted in plot frames.

Table A6. 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
Agropyron dasytachyum (thickspike wheatgrass)	X	--	X	--
Agropyron spicatum (bluebunch wheatgrass)	100	73	87	67
Poa sandbergii (Sandberg's bluegrass)	100	80	100	60
Stipa comata (needle-and-thread grass)	X	7	7	7
Bromus tectorum [a] (cheatgrass)	87	80	93	100
Salsola kali [a] (Russian thistle)	13	47	20	53
Achillea millefolium (yarrow)	60	60	7	X
Vulpia myuros [a] (rattail fescue)	40	--	73	13
Artemisia tridentata (big sagebrush)	13	X	X	X
Centaurea diffusa [a] (diffuse knapweed)	7	13	X	13
Chrysothamnus nauseosus (gray rabbitbrush)	X	27	X	X
Descurainia pinnata (western tansymustard)	--	13	13	7
Epilobium paniculatum (tall willowherb)	--	7	--	--
Eriogonum niveum (snow buckwheat)	--	7	--	--
Erodium cicutarium [a] (storksbill)	X	--	--	--
Lactuca serriola [a] (prickly lettuce)	X	--	--	X
Festuca octoflora (slender sixweeks)	7	--	20	--
Sisymbrium altissimum [a] (tumblemustard)	20	40	27	40
Tragopogon dubius [a] (yellow salsify)	X	--	--	--
Machaeranthera canescens (hoary aster)	X	X	--	--
Chaenactis douglasii (hoary falseyarrow)	X	27	X	27
Penstemon acuminatus (sand beardtongue)	--	X	--	--
Erigeron poliospermus (cushion fleabane)	X	20	--	--
Oryzopsis hymenoides (Indian ricegrass)	13	20	X	X
Draba verna (spring whitlowgrass)	--	7	--	--
Erysimum asperum (wall flower)	13	33	X	7
Amsinckia lycopsoides (tarweed fiddleneck)	13	--	13	7
Erigeron pumilus (shaggy fleabane)	X	X	--	--
Erigeron filifolius (threadleaf fleabane)	X	X	--	--
Poa bulbosa [a] (bulbous bluegrass)	7	13	--	--
Biotic crust	13	20	20	13
Bare soil	93	93	100	100
Litter	100	93	100	100

[a] Introduced Species.

X= Present but not counted in plot frames.

Table A7. Percent Canopy Cover and Frequency of Occurrence on the 100 F Liquid Sites in 2005.

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

[a] Introduced Species.
X= Present but not counted in plot frames.

Table A8. Percent Canopy Cover and Frequency of Occurrence on the 116-N-3 Site in 2005.

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

[a] Introduced Species.
X= Present but not counted in plot frames.

APPENDIX B

2004 REVEGETATION MONITORING RESULTS

Table B-1. Percent Canopy Cover and Frequency of Occurrence on the 600-23 Site in 2004.

Species	% Cover	% Frequency
Vulpia myuros [a] (rattail fescue)	5.7	56
Poa sandbergii (Sandberg's bluegrass)	14.2	100
Bromus tectorum [a] (cheatgrass)	5.6	68
Salsola kali [a] (Russian thistle)	2.3	72
Achillea millefolium (yarrow)	0.8	12
Melilotus alba (sweetclover)	0.3	12
Eriogonum niveum (snow buckwheat)	0.1	4
Stipa comata (needle-and-thread grass)	X	X
Agropyron sp. (wheatgrass)	10.3	88
Artemisia tridentata (big sagebrush)	X	X
Festuca octoflora (slender sixweeks)	0.1	4
Sisymbrium altissimum [a] (tumble mustard)	0.1	4
Holosteum umbellatum [a] (jagged chickweed)	0.1	4
Lactuca serriola [a] (prickly lettuce)	0.2	8
Amsinckia lycopsoides (tarweed fiddleneck)	X	X
Phacelia hastata (whiteleaf scorpionweed)	X	X
Ambrosia acanthicarpa (bur ragweed)	0.1	4
Poa bulbosa [a] (bulbous bluegrass)	0.6	24
Chaenactis douglasii (hoary falseyarrow)	X	X
Purshia tridentata (bitterbrush)	X	X
Mentzelia laevicaulis (blazing star)	X	X
Machaeranthera canescens (hoary aster)	0.1	4
Draba verna (spring whitlow)	0.5	20
Epilobium paniculatum (tall willowherb)	1	40
Astragalus sclerocarpus (stalk-pod milkvetch)	X	X
Phacelia linearis (threadleaf scorpionweed)	X	X
Penstemon acuminatus (sand beardtongue)	X	X
Helianthus cusickii (Cusick's sunflower)	X	X
Erodium cicutarium [a] (storksbill)	0.1	4
Chrysothamnus nauseosus (gray rabbitbrush)	0.2	8
Oenothera pallida (evening primrose)	0.1	4
Tragopogon dubius [a] (yellow salsify)	0.1	4
Astragalus caricinus (buckwheat milkvetch)	X	X
Medicago sativa [a] (alfalfa)	X	X
Oryzopsis hymenoides (Indian ricegrass)	X	X
Sphaeralcea munroana (globemallow)	X	X
Chrysothamnus viscidiflorus (green rabbitbrush)	X	X
Erysimum asperum (wallflower)	X	X
Erigeron poliospermus (cushion fleabane)	X	X
Petalostemon ornatum (prairie clover)	X	X
Bare soil	35.9	100
Litter	38.7	100
Total cover (does not include bare soil or litter)	**42.6**	

[a] Introduced species.
X= Present but not counted in plot frames

Table B-2. Percent Canopy Cover and Frequency of Occurrence on the J.A. Jones Site in 2004.

Species	% Cover	% Frequency
Agropyron dasytachyum (thickspike wheatgrass)	5.7	36
Bromus tectorum [a] (cheatgrass)	4	80
Salsola kali [a] (Russian thistle)	2.1	64
Poa sandbergii (Sandberg's bluegrass)	16.7	96
Stipa comata (needle-and-thread grass)	X	X
Gilia leptomeria (Great Basin gilia)	X	X
Achillea millefolium (yarrow)	0.7	28
Amsinckia lycopsoides (tarweed fiddleneck)	1.2	48
Artemisia tridentata (big sagebrush)	0.1	4
Purshia tridentata (bitterbrush)	X	X
Chrysothamnus nauseosus (gray rabbitbrush)	0.1	4
Epilobium paniculatum (tall willowherb)	0.1	4
Eriogonum niveum (snow buckwheat)	X	X
Erodium cicutarium [a] (storksbill)	0.1	4
Lactuca serriola [a] (prickly lettuce)	X	X
Festuca octoflora (slender sixweeks)	0.1	4
Sisymbrium altissimum [a] (tumblemustard)	X	X
Machaeranthera canescens (hoary aster)	0.1	4
Chaenactis douglasii (hoary falseyarrow)	X	X
Astragalus succumbens (crouching milkvetch)	0.1	4
Microsteris gracilis (pink microsteris)	0.1	4
Penstemon acuminatus (sand beardtongue)	X	X
Balsamorhiza careyana (Carey's balsamroot)	X	X
Phlox longifolia (longleaf phlox)	0.1	4
Ambrosia acanthicarpa (bur ragweed)	0.6	24
Erigeron poliospermus (cushion fleabane)	X	X
Draba verna (spring whitlowgrass)	0.2	8
Holosteum umbellatum [a] (jagged chickweed)	1.7	68
Erysimum occidentale (wallflower)	0.1	4
Erigeron filifolius (threadleaf fleabane)	X	X
Astragalus sclerocarpus (stalked-pod milkvetch)	X	X
Centaurea diffusa [a] (diffuse knapweed)	X	X
Biotic crust	1	40
Bare soil	29.8	92
Litter	27.7	100
Total cover (does not include biotic crust or litter)	**34.9**	

[a] Introduced species.
X = Present but not counted in plot frames

Table B-3. Percent Canopy Cover and Frequency of Occurrence at the 300-FF-1 Process Ponds and Burial Grounds.

Species	% Cover	% Frequency
Agropyron dasytachyum (thickspike wheatgrass)	19	91.4
Agropyron spicatum (bluebunch wheatgrass)	2.9	60
Agropyron hybrid (Regreen)	1.9	62.9
Agropyron cristatum [a] (crested wheatgrass)	6.6	80
Stipa comata (needle-and-thread grass)	0.9	37.1
Oryzopsis hymenoides (Indian ricegrass)	1.3	51.4
Vulpia myuros [a] (rattail)	0.6	25.7
Melilotus alba [a] (sweetclover)	X	X
Eriogonum niveum (snow buckwheat)	X	X
Poa sandbergii (Sandberg's bluegrass)	1.4	57.1
Chaenactis douglasii (hoary falseyarrow)	X	X
Centaurea diffusa [a] (diffuse knapweed)	X	X
Sisymbrium altissimum [a] (tumble mustard)	1.0	40
Bromus tectorum [a] (cheatgrass)	2.6	62.9
Lactuca serriola [a] (prickly lettuce)	X	X
Amsinckia lycopsoides (tarweed fiddleneck)	0.3	11.4
Phacelia hastata (whiteleaf scorpionweed)	0.1	2.9
Ambrosia acanthicarpa (bur ragweed)	0.1	2.9
Erodium cicutarium [a] (storksbill)	0.1	5.7
Senecio vulgaris [a] (common groundsel)	0.4	14.3
Amaranthus alba [a] (pigweed)	0.1	2.9
Kochia scoparia [a] (Kochia)	X	X
Salsola kali [a] (Russian thistle)	1.1	28.6
Lepidium perfoliatum (clasping pepperweed)	X	X
Hordeum leporinum [a] (hare barley)	0.1	2.9
Oenothera pallida (primrose)	X	X
Psoralea lanceolata (dune scurfpea)	X	X
Cryptantha circumscissa (matted cryptantha)	X	X
Plantago patagonica (Indian wheat)	X	X
Cardaria draba [a] (whitetop)	X	X
Polypogon monspeliensis [a] (rabbitfoot grass)	0.3	11.4
Poa annua [a] (annual bluegrass)	0.1	2.9
Chrysothamnus nauseosus (gray rabbitbrush)	X	X
Bare Soil	25.9	100
Litter	52.7	100
Total cover (does not include biotic crust or litter)	**41**	

[a] Introduced species.
X = Present but not counted in plot frames

Table B-4. Percent Canopy Cover and Frequency of Occurrence on the 100-D/DR Liquid Sites in 2004.

Species	% Cover	% Frequency
Vulpia myuros [a] (rattail fescue)	2.9	56
Poa sandbergii (Sandberg's bluegrass)	12	76
Eriogonum niveum (snow buckwheat)	X	X
Salsola kali [a] (Russian thistle)	2.3	72
Achillea millefolium (yarrow)	0.3	12
Sisymbrium altissimum [a] (tumblemustard)	0.4	16
Descurainia pinnata (western tansymustard)	0.1	4
Amsinckia lycopsoides (tarweed fiddleneck)	0.1	4
Centaurea diffusa [a] (diffuse knapweed)	X	X
Artemisia tridentata (big sagebrush)	0.1	4
Chrysothamnus nauseosus (gray rabbitbrush)	0.3	12
Chrysothamnus viscidiflorus (green rabbitbrush)	X	X
Erodium cicutarium [a] (storksbill)	0.1	4
Bromus tectorum [a] (cheatgrass)	7.8	100
Phacelia hastata (threadleaf scorpionweed)	X	X
Melilotus officinalis [a] (sweetclover)	X	X
Lactuca serriola [a] (prickly lettuce)	X	X
Machaeranthera canescens (hoary aster)	0.6	4
Epilobium paniculatum (tall willowherb)	0.3	12
Poa bulbosa [a] (bulbous bluegrass)	X	X
Draba verna (spring whitlow)	X	X
Agropyron dasytachyum (thickspike wheatgrass)	X	X
Stipa comata (needle-and-thread grass)	0.2	8
Tragopogon dubius [a] (yellow salsify)	X	X
Erigeron poliospermus (cushion fleabane)	X	X
Holosteum umbellatum [a] (jagged chickweed)	0.1	4
Sphaeralcea munroana (globemallow)	0.1	4
Chaenactis douglasii (hoary falseyarrow)	0.1	4
Ambrosia acanthicarpa (bur ragweed)	0.3	12
Sitanion hystrix (bottlebrush squirreltail)	3.2	16
Petalostemon ornatum (prairie clover)	X	X
Erysimum asperum (wall flower)	X	X
Sporobolus cryptandrus (sand dropseed)	X	X
Oryzopsis hymenoides (Indian ricegrass)	1.5	4
Agropyron spicatum (bluebunch wheatgrass)	5.2	52
Penstemon acuminatus (sand beardtongue)	X	X
Astragalus caricinus (buckwheat milkvetch)	X	X
Astragalus sclerocarpus (stalked pod milkvetch)	X	X
Balsamorhiza careyana (Carey's balsamroot)	X	X
Oenothera pallida (evening primrose)	X	X
Lupinus pusillus (low lupine)	X	X
Erigeron filifolius (threadleaf fleabane)	X	X
Helianthus cusickii (Cusick's sunflower)	X	X
Astragalus purshii (woolly pod milkvetch)	X	X
Ranunculus testiculatus (bur buttercup)	X	X
Biotic crust	1.7	12
Bare soil	21	64
Litter	54.3	100
Total Cover (does not include biotic crust or litter)	**38**	

[a] Introduced species.
X = Present but not counted in plot frames
-- = Not observed on the site

Table B-5. Percent Canopy Cover on the 120-N-1 and 120-N-2 Sites in 2004.

Species	Triple 16 and Straw Mulch	Triple 16 and Hydromulch	Biosol and Straw Mulch	Biosol and Hydromulch
Agropyron dasytachyum (thickspike wheatgrass)	4.3	4.4	5.0	0.5
Agropyron spicatum (bluebunch wheatgrass)	3.8	0.8	0.5	0.4
Poa sandbergii (Sandberg's bluegrass)	17.9	10.1	6.4	2.9
Stipa comata (needle-and-thread grass)	0.4	0.6	1.1	0.5
Bromus tectorum [a] (cheatgrass)	4.3	2.4	6.0	7.4
Salsola kali [a] (Russian thistle)	1.9	1.8	2.8	2.0
Achillea millefolium (yarrow)	1.4	3.0	1.9	1.6
Vulpia myuros [a] (rattail fescue)	0.4	--	--	--
Artemisia tridentata (big sagebrush)	0.4	0.1	X	X
Centaurea diffusa [a] (diffuse knapweed)	1.4	--	--	0.4
Chrysothamnus nauseosus (gray rabbitbrush)	--	0.5	--	0.3
Descurainia pinnata (western tansymustard)	--	0.3	0.1	--
Epilobium paniculatum (tall willowherb)	1.1	1.8	1.8	1.4
Lactuca serriola [a] (prickly lettuce)	0.3	0.1	0.8	0.4
Sisymbrium altissimum [a] (tumblemustard)	0.5	0.6	1.3	2.1
Tragopogon dubius [a] (yellow salsify)	--	--	--	0.3
Machaeranthera canescens (hoary aster)	--	--	0.3	0.1
Chaenactis douglasii (hoary falseyarrow)	0.1	1.0	0.1	1.5
Penstemon acuminatus (sand beardtongue)	--	--	0.4	0.3
Erigeron poliospermus (cushion fleabane)	0.1	0.1	0.1	--
Oryzopsis hymenoides (Indian ricegrass)	0.4	0.3	1.0	0.3
Draba verna (spring whitlowgrass)	2.0	0.5	0.5	0.4
Holosteum umbellatum [a] (jagged chickweed)	0.1	--	--	--
Erysimum asperum (wall flower)	0.1	0.6	0.5	1.5
Amsinckia lycopsoides (tarweed fiddleneck)	0.1	--	0.1	X
Poa bulbosa [a] (bulbous bluegrass)	0.1	0.3	--	--
Ranunculus testiculatus (bur buttercup)	0.3	0.3	0.4	--
Erigeron pumilus (shaggy fleabane)	X	--	X	--
Melilotus alba [a] (sweetclover)	X	--	--	X
Bare soil	28.9	47.5	27.1	57.3
Litter	36.9	3.1	48.6	3.1
Total Cover (does not include bare soil or litter)	**41.1**	**29.4**	**30.9**	**24.0**

[a] Introduced species.
X = Present but not counted in plot frames
-- = Not observed on the site

Table 1-6. Percent Frequency of Occurrence on the 120-N-1 and 120-N-2 Sites in 2004.

Species	Triple 16 and Straw Mulch	Triple 16 and Hydromulch	Biosol and Straw Mulch	Biosol and Hydromulch
Agropyron dasytachyum (thickspike wheatgrass)	75	55	30	20
Agropyron spicatum (bluebunch wheatgrass)	55	30	20	15
Poa sandbergii (Sandberg's bluegrass)	90	90	85	90
Stipa comata (needle-and-thread grass)	15	25	45	20
Bromus tectorum [a] (cheatgrass)	95	70	95	100
Salsola kali [a] (Russian thistle)	75	45	85	80
Achillea millefolium (yarrow)	55	95	75	65
Vulpia myuros [a] (rattail fescue)	15	--	--	--
Artemisia tridentata (big sagebrush)	15	5	X	X
Centaurea diffusa [a] (diffuse knapweed)	30	--	--	15
Chrysothamnus nauseosus (gray rabbitbrush)	--	20	--	10
Descurainia pinnata (western tansymustard)	--	10	5	--
Epilobium paniculatum (tall willowherb)	45	70	70	55
Lactuca serriola [a] (prickly lettuce)	10	5	30	15
Sisymbrium altissimum [a] (tumblemustard)	20	25	50	85
Tragopogon dubius [a] (yellow salsify)	--	--	--	10
Machaeranthera canescens (hoary aster)	--	--	10	5
Chaenactis douglasii (hoary falseyarrow)	5	40	5	60
Penstemon acuminatus (sand beardtongue)	--	--	15	10
Erigeron poliospermus (cushion fleabane)	5	5	5	--
Oryzopsis hymenoides (Indian ricegrass)	15	10	40	10
Draba verna (spring whitlowgrass)	55	20	20	15
Holosteum umbellatum [a] (jagged chickweed)	5	--	--	--
Erysimum asperum (wall flower)	5	25	20	60
Amsinckia lycopsoides (tarweed fiddleneck)	5	--	5	X
Poa bulbosa [a] (bulbous bluegrass)	5	10	--	--
Ranunculus testiculatus (bur buttercup)	10	10	15	--
Erigeron pumilus (shaggy fleabane)	X	--	X	
Melilotus alba [a] (sweetclover)	X	--	--	X
Bare soil	100	100	100	100
Litter	100	100	100	100

[a] Introduced species.
X = Present but not counted in plot frames
-- = Not observed on the site

APPENDIX C
2003 REVEGETATION MONITORING RESULTS

Table C-1. Percent Canopy Cover and Frequency of Occurrence on the 600-23 Site in 2003.

Species	% Cover	% Frequency
Vulpia myuros [a] (rattail fescue)	19	92
Poa sandbergii (Sandberg's bluegrass)	2.6	84
Bromus tectorum [a] (cheatgrass)	5.8	80
Salsola kali [a] (Russian thistle)	1.8	52
Achillea millefolium (yarrow)	0.6	24
Melilotus alba [a] (sweetclover)	0.1	4
Eriogonum niveum (snow buckwheat)	0.1	4
Stipa comata (needle-and-thread grass)	0.3	12
Agropyron sp. (wheatgrass)	4.2	52
Artemisia tridentata (sagebrush)	X	X
Festuca octoflora (slender sixweeks)	1.3	32
Gilia leptomeria (Great Basin gilia)	X	X
Sisymbrium altissimum [a] (tumblemustard)	0.9	36
Holosteum umbellatum [a] (jagged chickweed)	0.1	4
Lactuca serriola [a] (prickly lettuce)	X	X
Amsinckia lycopsoides (tarweed fiddleneck)	X	X
Phacelia hastata (whiteleaf scorpionweed)	X	X
Ambrosia acanthicarpa (bur ragweed)	X	X
Poa bulbosa [a] (bulbous bluegrass)	0.8	12
Chaenactis douglasii (hoary falseyarrow)	X	X
Purshia tridentata (bitterbrush)	X	X
Machaeranthera canescens (hoary aster)	0.1	4
Draba verna (spring whitlow)	0.6	24
Epilobium paniculatum (tall willowherb)	0.3	12
Astragalus sclerocarpus (stalk-pod milkvetch)	0.1	4
Phacelia linearis (threadleaf scorpionweed)	0.1	4
Penstemon acuminatus (sand beardtongue)	X	X
Layia glandulosa (white daisy tidytips)	X	X
Helianthus cusickii (Cusick's sunflower)	X	X
Erodium cicutarium [a] (storksbill)	X	X
Chrysothamnus nauseosus (gray rabbitbrush)	X	X
Bare soil	53.2	100
Litter	19.6	100
Total cover (does not include bare soil or litter)	**19.8**	

[a] Introduced species.
X = present but not counted in plot frames

Table C-2. Percent Canopy Cover and Frequency of Occurrence on the J.A. Jones Site in 2003.

Species	% Cover	% Frequency
Agropyron dasytachyum (thickspike wheatgrass)	5.4	44
Bromus tectorum [a] (cheatgrass)	12.9	96
Salsola kali [a] (Russian thistle)	1.4	56
Poa sandbergii (Sandberg's bluegrass)	20.2	100
Achillea millefolium (yarrow)	1.6	44
Amsinckia lycopsoides (tarweed fiddleneck)	8.1	92
Artemisia tridentata (big sagebrush)	X	X
Purshia tridentata (bitterbrush)	X	X
Chrysothamnus nauseosus (gray rabbitbrush)	0.1	4
Eriogonum niveum (snow buckwheat)	0.2	8
Erodium cicutarium [a] (storksbill)	2	60
Lactuca serriola [a] (prickly lettuce)	X	X
Festuca octoflora (slender sixweeks)	1.4	36
Sisymbrium altissimum [a] (tumblemustard)	2.1	64
Machaeranthera canescens (hoary aster)	0.2	8
Chaenactis douglasii (hoary falseyarrow)	0.1	4
Microsteris gracilis (pink microsteris)	0.2	8
Penstemon acuminatus (sand beardtongue)	X	X
Balsamorhiza careyana (Carey's balsamroot)	X	X
Phlox longifolia (longleaf phlox)	0.1	4
Ambrosia acanthicarpa (bur ragweed)	1.2	48
Draba verna (spring whitlowgrass)	1.2	28
Holosteum umbellatum [a] (jagged chickweed)	2.1	84
Cryptantha circumscissa (matted cryptantha)	0.1	4
Erysimum asperum (wallflower)	0.2	8
Stipa comata (needle-and-thread grass)	0.4	16
Hordeum leporinum [a] (Hare barley)	0.6	4
Erigeron poliospermus (cushion fleabane)	0.1	4
Astragalus succumbens (crouching milkvetch)	0.1	4
Gilia leptomeria (Great Basin Gilia)	X	X
Descurainia pinnata (western tansymustard)	0.1	4
Epilobium paniculatum (tall willowherb)	X	X
Tragopogon dubius [a] (yellow salsify)	X	X
Bare soil	44.2	100
Litter	22.6	100
Total cover (does not include bare soil or litter)	62.1	

[a] Introduced species.
X = present but not counted in plot frames

Table C-3. Percent Canopy Cover and Frequency of Occurrence on the 100-D/DR Liquid Sites in 2003.

Species	% Cover	% Frequency
Vulpia myuros [a] (rattail fescue)	23.8	80
Poa sandbergii (Sandberg's bluegrass)	4.7	43.3
Eriogonum niveum (snow buckwheat)	X	X
Salsola kali [a] (Russian thistle)	1	40
Achillea millefolium (yarrow)	0.5	20
Sisymbrium altissimum [a] (tumblemustard)	2.9	53.3
Amsinckia lycopsoides (tarweed fiddleneck)	1.8	6.7
Centaurea diffusa [a] (diffuse knapweed)	0.2	6.7
Artemisia tridentata (big sagebrush)	0.1	3.3
Chrysothamnus nauseosus (gray rabbitbrush)	0.1	3.3
Chrysothamnus viscidiflorus (green rabbitbrush)	X	X
Erodium cicutarium [a] (storksbill)	0.2	6.7
Bromus tectorum [a] (cheatgrass)	29	93.3
Phacelia hastata (threadleaf scorpionweed)	X	X
Melilotus officinalis [a] (sweetclover)	X	X
Lactuca serriola [a] (prickly lettuce)	X	X
Machaeranthera canescens (hoary aster)	X	X
Epilobium paniculatum (tall willowherb)	0.2	6.7
Poa bulbosa [a] (bulbous bluegrass)	0.7	10
Draba verna (spring whitlow)	0.7	10
Stipa comata (needle-and-thread grass)	X	X
Tragopogon dubius [a] (yellow salsify)	X	X
Lepidium perfoliatum [a] (clasping pepperweed)	0.2	6.7
Holosteum umbellatum [a] (jagged chickweed)	0.3	13.3
Chaenactis douglasii (hoary falseyarrow)	X	X
Ambrosia acanthicarpa (bur ragweed)	0.9	20
Sitanion hystrix (bottlebrush squirreltail)	3.7	20
Festuca octoflora (slender sixweeks)	0.1	3.3
Hordeum leporinum [a] (Hare barley)	0.3	10
Taeniatherum asperum [a] (Medusahead)	0.1	3.3
Sphaeralcea munroana (globemallow)	0.1	3.3
Sporobolus cryptandrus (sanddrop seed)	X	X
Oryzopsis hymenoides (Indian ricegrass)	X	X
Agropyron spicatum (bluebunch wheatgrass)	X	X
Penstemon acuminatus (sand beardtounge)	X	X
Astragalus caricinus (buckwheat milkvetch)	X	X
Bare soil	38.5	100
Litter	49.1	100
Total cover (does not include bare soil or litter)	**71.3**	

[a] Introduced species.
X = present but not counted in plot frames

Table C-4. Percent Frequency of Occurrence on the 120-N-1 and 120-N-2 Sites in 2003.

Species	Triple 16 and Straw Mulch	Triple 16 and Hydromulch	Biosol and Straw Mulch	Biosol and Hydromulch
Agropyron dasytachyum (thickspike wheatgrass)	100	95	100	80
Agropyron spicatum (bluebunch wheatgrass)	25	30	15	X
Poa sandbergii (Sandberg's bluegrass)	85	75	60	X
Stipa comata (needle-and-thread grass)	25	--	10	--
Bromus tectorum [a] (cheatgrass)	30	10	15	25
Salsola kali [a] (Russian thistle)	85	90	65	90
Achillea millefolium (yarrow)	75	65	25	5
Vulpia myuros [a] (rattail fescue)	55	--	25	--
Artemisia tridentata (big sagebrush)	20	5	5	X
Centaurea diffusa [a] (diffuse knapweed)	20	10	15	100
Chrysothamnus nauseosus (gray rabbitbrush)	5	--	--	--
Lactuca serriola [a] (prickly lettuce)	X	--	--	--
Festuca octoflora (slender sixweeks)	5	--	--	--
Sisymbrium altissimum [a] (tumblemustard)	X	X	--	X
Machaeranthera canescens (hoary aster)	5	15	--	X
Chaenactis douglasii (hoary falseyarrow)	5	10	X	5
Phlox longifolia (longleaf phlox)	--	X	--	--
Amaranthus albus [a] (pigweed)	5	--	--	X
Erigeron poliospermus (cushion fleabane)	5	10	--	--
Oryzopsis hymenoides (Indian ricegrass)	--	--	5	--
Erysimum asperum (rough wallflower)	--	--	X	--
Bare soil	100	100	95	100
Litter	100	100	100	100

[a] Introduced species.
X = present but not counted in plot frames
-- = not present on site

APPENDIX D

2002 REVEGETATION MONITORING RESULTS

Table D-1. Percent Canopy Cover and Frequency of Occurrence on the 600-23 Site in 2002.

Species	% Cover	% Frequency
Poa sandbergii (Sandberg's bluegrass)	3.7	88
Bromus tectorum [a] (cheatgrass)	0.4	16
Salsola kali [a] (Russian thistle)	2.4	76
Achillea millefolium (yarrow)	1.6	64
Melilotus alba [a] (sweetclover)	0.4	16
Eriogonum niveum (snow buckwheat)	0.2	8
Stipa comata (needle-and-thread grass)	0.2	8
Agropyron dasytachyum (thickspike wheatgrass)	2.1	84
Artemisia tridentata (sagebrush)	0.1	4
Festuca octoflora (slender six-weeks)	0.1	4
Gilia leptomeria (Great Basin gilia)	0.2	8
Sisymbrium altissimum [a] (tumble mustard)	0.1	4
Holosteum umbellatum [a] (jagged chickweed)	X	
Lactuca serriola [a] (prickly lettuce)	X	
Amsinckia lycopsoides (tarweed fiddleneck)	X	
Phacelia hastata (whiteleaf scorpionweed)	X	
Ambrosia acanthicarpa (bur ragweed)	X	
Poa bulbosa [a] (bulbous bluegrass)	X	
Chaenactis douglasii (hoary false yarrow)	X	
Purshia tridentata (bitterbrush)	X	
Mentzelia laevicaulis (blazing star)	X	
Bare soil	52.7	92
Litter (straw mulch)	25.3	96
Total cover (does not include bare soil or litter)	**11.5**	

[a] Introduced species.
X = present but not counted in plot frames

Table D-2. Percent Canopy Cover and Frequency of Occurrence on the J.A. Jones Site in 2002.

Species	% Cover	% Frequency
Agropyron dasytachyum (thickspike wheatgrass)	32.1	100
Bromus tectorum [a] (cheatgrass)	6.2	72
Salsola kali [a] (Russian thistle)	11.7	100
Poa sandbergii (Sandberg's bluegrass)	2.2	88
Achillea millefolium (yarrow)	1.4	56
Amsinckia lycopsoides (tarweed fiddleneck)	1.2	48
Artemisia tridentata (big sagebrush)	X	X
Purshia tridentata (bitterbrush)	X	X
Chrysothamnus nauseosus (gray rabbitbrush)	0.1	4
Eriogonum niveum (snow buckwheat)	X	X
Erodium cicutarium [a] (storksbill)	0.2	8
Lactuca serriola [a] (prickly lettuce)	X	X
Festuca octoflora (slender six-weeks)	0.4	16
Sisymbrium altissimum [a] (tumblemustard)	14	84
Machaeranthera canescens (hoary aster)	X	X
Chaenactis douglasii (hoary false yarrow)	0.3	12
Petalostemon ornatum (western prairieclover)	X	X
Microsteris gracilis (pink microsteris)	X	X
Penstemon acuminatus (sand beardtongue)	X	X
Balsamorhiza careyana (Carey's balsamroot)	0.1	4
Mentzelia laevicaulis (blazing star)	X	X
Plantago patagonica (Indian wheat)	X	X
Phlox longifolia (long-leaf phlox)	X	X
Oenothera pallida (pale evening primrose)	0.4	16
Ambrosia acanthicarpa (bur ragweed)	2.1	64
Draba verna (spring whitlowgrass)	0.3	12
Holosteum umbellatum [a] (jagged chickweed)	0.7	28
Melilotus officinalis [a] (sweetclover)	X	X
Amaranthus albus [a] (pigweed)	X	X
Bare soil	53.8	96
Litter	36.1	100
Total cover (does not include bare soil or litter)	**73.4**	

[a] Introduced species.
X = present but not counted in plot frames

Table D-3. Percent Canopy Cover and Frequency of Occurrence on the 100-D/DR Sites in 2002.

Species	% Cover	% Frequency
Poa sandbergii (Sandberg's bluegrass)	3.2	76
Salsola kali [a] (Russian thistle)	13.1	98
Achillea millefolium (yarrow)	0.4	16
Sisymbrium altissimum [a] (tumblemustard)	1.7	48
Descurainia pinnata (western tansymustard)	0.5	10
Amsinckia lycopsoides (tarweed fiddleneck)	0.3	12
Centaurea diffusa [a] (diffuse knapweed)	X	X
Artemisia tridentata (big sagebrush)	0.1	4
Chrysothamnus nauseosus (gray rabbitbrush)	0.1	2
Chrysothamnus viscidiflorus (green rabbitbrush)	X	X
Erodium cicutarium [a] (storksbill)	X	X
Bromus tectorum [a] (cheatgrass)	2.9	58
Phacelia linearis (threadleaf scorpionweed)	X	X
Melilotus officinalis [a] (sweetclover)	X	X
Lactuca serriola [a] (prickly lettuce)	0.3	12
Machaeranthera canescens (hoary aster)	X	X
Epilobium paniculatum (tall willowherb)	0.1	2
Senecio vulgaris [a] (common groundsel)	X	X
Poa bulbosa [a] (bulbous bluegrass)	0.1	2
Draba verna (spring whitlow)	0.2	8
Agropyron dasytachyum (thickspike wheatgrass)	5.6	64
Stipa comata (needle-and-thread grass)	X	X
Lepidium perfoliatum (clasping pepperweed)	X	X
Holosteum umbellatum (jagged chickweed)	0.5	20
Mentzelia albicaulis (whitestem stickleaf)	X	X
Ranunculus testiculatus (bur buttercup)	0.3	12
Sphaeralcea munroana (globemallow)	0.1	2
Chaenactis douglasii (hoary false yarrow)	X	X
Ambrosia acanthicarpa (bur ragweed)	0.1	2
Bare soil	48.5	90
Litter	31.8	100
Total cover (does not include bare soil or litter)	**29.3**	

[a] Introduced species.
X = present but not counted in plot frames
-- = not present on site

APPENDIX E
NAME CHANGES INCLUDED IN INTEGRATED TAXONOMIC INFORMATION SYSTEM

APPENDIX E
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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