3.2 Ecological Monitoring

3.2.1 Introduction

The Ecology Group conducts ecological monitoring of the Site's ecological resources to ensure regulatory compliance and to preserve, protect, and manage those resources. Ecological monitoring is an integral aspect of determining whether the management objectives and goals for the natural resources at the Site are being achieved. This report summarizes the results of the ecological monitoring that was conducted at the Site during 2009. It does not include monitoring conducted for Preble's meadow jumping mouse mitigation and wetland mitigation activities. Those data are summarized in separate regulatory reports provided to the appropriate agencies.

At an elevation of approximately 6,000 feet, the Site contains a unique ecotonal mixture of mountain and prairie plant species resulting from the topography of the area and its proximity to the mountain front. The POU, the area surrounding the COU (the general area where the former IA was once located), is one of the largest remaining undeveloped tracts of its kind along the Colorado Piedmont. A number of plant communities present in the COU and POU have been identified as increasingly rare and unique by the Colorado Natural Heritage Program (CNHP 1994, 1995). These communities include the xeric tallgrass prairie, tall upland shrubland, wetlands, and Great Plains riparian woodland communities. Small inclusions of a number of other increasingly rare plant communities are also found on the Site. Many of these communities support populations of increasingly rare animals as well, including the federally protected Preble's meadow jumping mouse (*Zapus hudsonius preblei*), and other uncommon species such as the grasshopper sparrow (*Ammodramus savannarum*), loggerhead shrike (*Lanius ludovicianus*), Merriam's shrew (*Sorex merriami*), black crowned night heron (*Nycticorax nycticorax*), hops blue butterfly (*Celastrina sp*.), and Arogos skipper (*Atrytone arogos*).

During 2007, transfer of the POU was made to USFWS to create the Rocky Flats National Wildlife Refuge. As a result, the total acreage managed by LM is now approximately 1,308 acres in the COU. A summary of the highlights from the 2009 field season is provided in the following sections. Full, detailed summaries, methodology, and analyses for each field monitoring effort are presented as stand-alone reports on the accompanying Ecology DVD.

3.2.2 Vegetation Monitoring

Vegetation monitoring reported here is conducted at the Site to provide information necessary for management of the natural resources. Objectives of the vegetation monitoring in 2009 were to:

- Identify any new plant species records for the Site;
- Identify and document infestations of selected noxious weeds at the Site to assist with planning of noxious weed control applications;
- Document and track the locations where herbicide applications were conducted in 2009;
- Document where revegetation activities were conducted in 2009;
- Evaluate the success of revegetation activities at the Site; and
- Conduct photomonitoring for visual documentation of changes in vegetation establishment at the Site.

3.2.2.1 Site Flora

The complete list of plant species known to be at the Site as of the end of 2009 can be found on the Ecology DVD. The Site species list includes the complete flora of both the COU and the POU. The vascular flora of the Site consists of 630 species in 84 families and 340 genera. The taxonomic classes of the flora include 5 pteridophytes, 5 gymnosperms, and 620 angiosperms. Seventy-six percent of the flora is composed of native species. The growth habits of the flora include 145 graminoids, 421 forbs, 32 shrubs, 24 trees, 6 cacti, and 2 vines. The plant families that contribute the greatest number of species to the flora are the Asteraceae (108 species), Poaceae (101 species), Fabaceae (34 species), Cyperaceae (31 species), Rosaceae (28 species), Brassicaceae (28 species), and Scrophulariaceae (24 species). The flora of the Rocky Flats area was evaluated in 2009. A scientific journal article, to be published in the August 2010 issue of *Phytologia* (a botanical journal), summarizes this information.

Three new records of vascular plant species for the Site flora are reported. Oakleaf goosefoot (*Chenopodium glaucum*) was found at the dam breach revegetation areas at the A-ponds (North Walnut Creek) and B-ponds (South Walnut Creek). It is a native goosefoot commonly found around pond margins on mudflats. It was found growing where some of the pond sediments had been spread in the upland revegetation areas from the dam breach project. The saltmarsh bulrush (*Scirpus maritimus* var. *paludosus)* was found in the FC4 wetland area (western South Walnut Creek). It is a native bulrush found in wetlands. Eaton's penstemon (*Penstemon eatonii*) was found in a revegetation area east of the FC2 wetland (near where the former B771 was located). It is not native to the eastern slope but is a native of the desert southwest and probably came in as a seed mix contaminant. None of these species are considered noxious weeds. The following taxonomic names will be used at the Site for the new plant species records[29]:

Family	Scientific Name	Speccode	Common Name
Chenopodiaceae	*Chenopodium glaucum* L.	CHGL1	Oakleaf Goosefoot
Cyperaceae	*Scirpus maritimus* L. var. *paludosus* (A. Nels.) Kukenth.	SCMA1	Saltmarsh Bulrush
Scrophulariaceae	*Penstemon eatonii A. Gray var. eatonii*	PEEA1	Eaton's Penstemon

Voucher specimens of the species will be deposited at the University of Colorado Herbarium in Boulder, Colorado.

3.2.2.2 Weed Mapping and Weed Control

Resource management is an important concern at the Site with a goal to protect and sustain the native ecological resources that make the Site so unique along the Front Range. One of the challenges at the Site is to manage the ecological resources with a limited set of management tools. Currently, most efforts focus on the control or eradication of the weed species themselves with little emphasis on trying to improve conditions for the desired native species. Two of the key tools for grassland management, fire and grazing, are not currently allowed at the Site. As a result, management of the ecological resources in the COU is largely limited to controlling the noxious weeds themselves. The Comprehensive Conservation Plan (USFWS 2005), developed

[29] Nomenclature follows GPFA (1986), Weber (1976), Weber (1990), and Weber and Wittmann (2001), in that order of determination. Species were verified at the University of Colorado Herbarium in Boulder, Colorado.

by USFWS for management of the Rocky Flats National Wildlife Refuge, has identified the full range of Integrated Pest Management tools for use at the Refuge for controlling weeds. This includes administrative, cultural, biological (including grazing), mechanical (including prescribed fire), and chemical as viable tools for controlling noxious weeds and ecosystem management. Thus, there may be a greater opportunity for some of these other resource management tools to be used in the future.

The methods used for weed mapping are provided in the full report on the Ecology DVD at the end of this report.

Figure 3–211 and Figure 3–212 show the 2009 weed distribution maps for diffuse knapweed (*Centaurea diffusa*) and Dalmatian toadflax (*Linaria dalmatica*), respectively. Table 3–88 shows the estimated total acreage and acreage-by-density categories for each species, based on the mapping data from 2007 through 2009. The total area of the COU is approximately 1,308 acres. In 2009, diffuse knapweed was observed on approximately 425 acres at various levels of infestation. Dalmatian toadflax was mapped on approximately 462 acres at the Site in 2009. Both species showed an increase in acreage compared to the 2008 mapping data. Much of this is likely due to the above-normal precipitation in spring and early summer of 2009.

Table 3–88. COU Noxious Weed Acreage Summary (2007−2009)

Species	Density (acres)				Total
	High	Medium	Low	Scattered	
Diffuse knapweed					
2007	2.2	41.2	248.8	167.7	459.9
2008	1.8	20.6	110.0	147.5	279.9
2009	1.6	44.6	231.2	147.5	424.9
Dalmatian toadflax					
2007	77.1	51.0	0.0	109.0	237.1
2008	0	0	54.3	151.8	206.1
2009	2.1	16.8	56.5	386.7	462.1

Additional species that were mapped based on fortuitous observations in 2009 included Scotch thistle (*Onopordum acanthium*), dame's rocket (*Hesperis matronalis*), leafy spurge (*Euphorbia uralensis*), tall mustard (*Cardaria chalepensis*), whitetop (*Cardaria draba*), wild carrot (*Daucus carota*), and tamarisk (*Tamarix ramosissima*). No acreages are provided for these species since the polygons simply show the general location of the infestations. Figure 3–213 shows the locations of these species as mapped in 2009.

During 2009, approximately 355 acres were treated with herbicides at the Site via ground application (Figure 3–214). Table 3–89 lists the target species, herbicides used, application rates, and the approximate timing of the application during the year. (**Note:** Multiple herbicides are listed at some locations. This does not mean that each herbicide was used across that entire location. Rather, depending on site-specific characteristics such as target weed species, the locations of water bodies, soil types, and the professional judgment of the licensed herbicide applicator, different herbicides were used within that location to provide the control needed.)

In 2007, a small patch of leafy spurge, a State-listed noxious weed, was documented for the first time at the Site. This patch was sprayed in 2007 to control its spread. In 2008, two additional small patches of leafy spurge were found in the northern COU. Because these new patches of leafy spurge had already started going to seed when they were discovered, the seedheads were cut off, bagged, and sent to the landfill for burial. These three locations plus an additional location that was discovered were sprayed with Plateau herbicide in 2009 to control the infestations. Hand-control and weed-whacking were also used to control some small patches of Scotch thistle, tall mustard, and whitetop in 2009.

Biocontrol insects continue to be used at the Site. At a location in the eastern COU, stem-mining beetles (*Mecinus janthinus*), were released several years ago to help control Dalmatian toadflax. The beetles have established and continue to help control the species at this location. In 2009, approximately 35 individual beetles were collected and transplanted to a location west of the OLF in the hopes of establishing another population there. Collections and transplants from other established populations of various biocontrols at the Site may continue to be made to further establish populations elsewhere across the Site. Additional biocontrol insects for different weed species may be released as they become available. The integrated weed management approach at the Site continues to address noxious weed issues through mapping and the use of various control methods.

3.2.2.3 Revegetation Activities in 2009

During the winter and early spring of 2009, interseeding was conducted on approximately 48 acres at the Site where vegetation cover was still sparse (Figure 3–215). At most of these locations, the seed was broadcast using an all-terrain-vehicle broadcast seeder, and the ground was harrowed to cover the seed. The above-average precipitation during the spring and early summer caused abundant germination of the seed at most of these locations, and the plants were starting to become establish by the end of 2009. At several other locations, extra soil left over from other projects on Site was spread over approximately 1.5 acres that had very poor soil conditions (rock, roadbase, old parking areas, or roads) to increase the chances of revegetation success. Revegetation activities were also conducted where an Xcel Energy pipeline project disturbed the land on Site (approximately 0.3 acre). During fall 2009, fertilizer was spread on and disced into these areas, and then seed was broadcast there, and the ground was harrowed (Figure 3–215). Erosion controls were installed where appropriate. After the dam breach project in the winter of 2008 and 2009, approximately 6.5 acres of disturbed areas around the dams (both inside and outside the Preble's meadow jumping mouse protection areas) were seeded and erosion controls were installed (Figure 3–215). A total of approximately 56 acres were revegetated during 2009.

3.2.2.4 Revegetation Monitoring

As part of the cleanup and closure of the Site, the buildings, roads, and other infrastructure in the IA were removed. Approximately 650 acres were disturbed during cleanup activities, which were completed in fall 2005. Revegetation of the disturbed areas was conducted to prevent erosion and sedimentation of the Site streams and to meet water quality standards. Reestablishment of native plant species is also desirable to benefit wildlife and provide desirable vegetation and ground cover adjacent to the Rocky Flats National Wildlife Refuge. As part of the revegetation process,

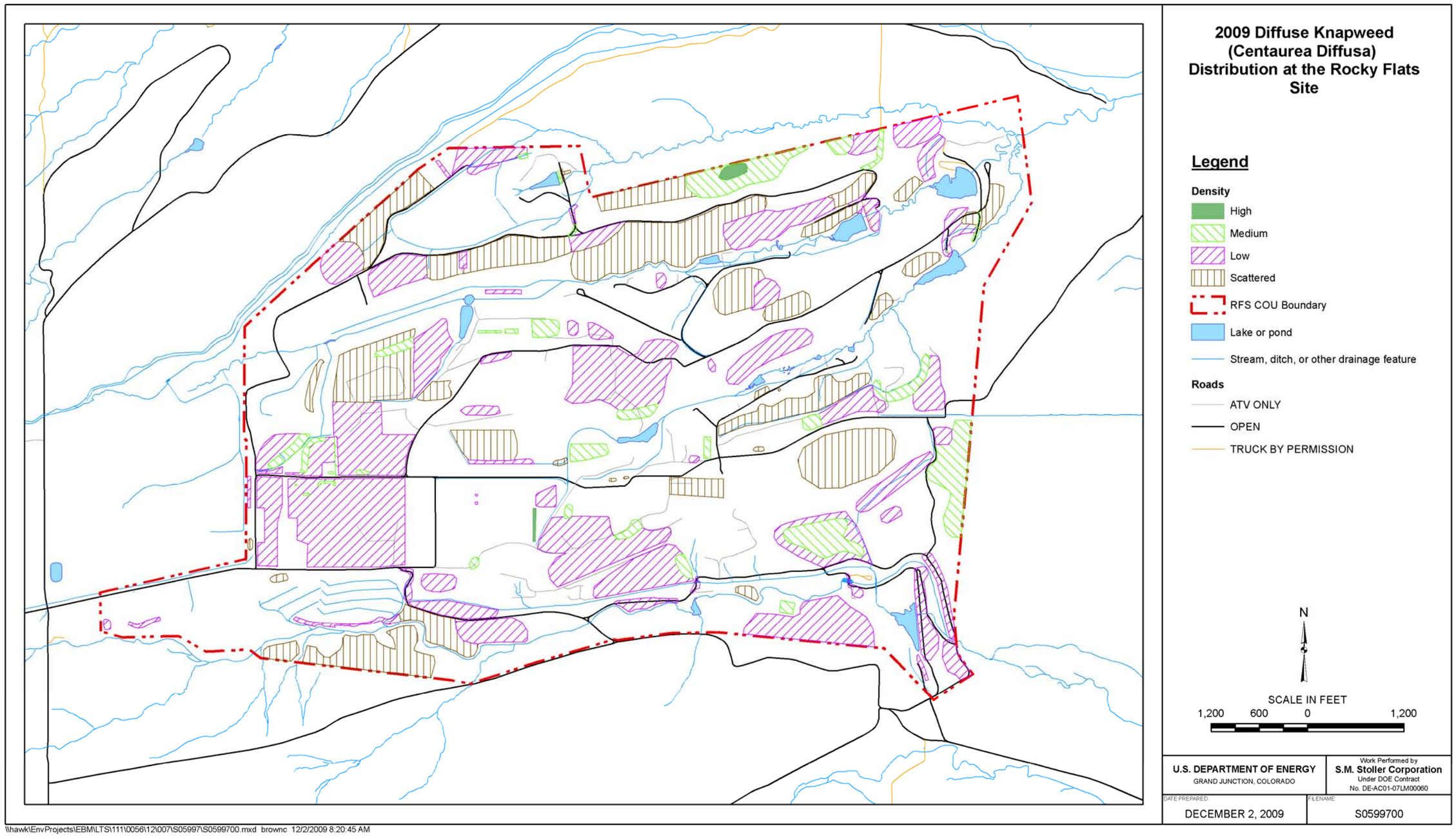

Figure 3–211. 2009 Diffuse Knapweed (Centaurea diffusa) Distribution at Rocky Flats

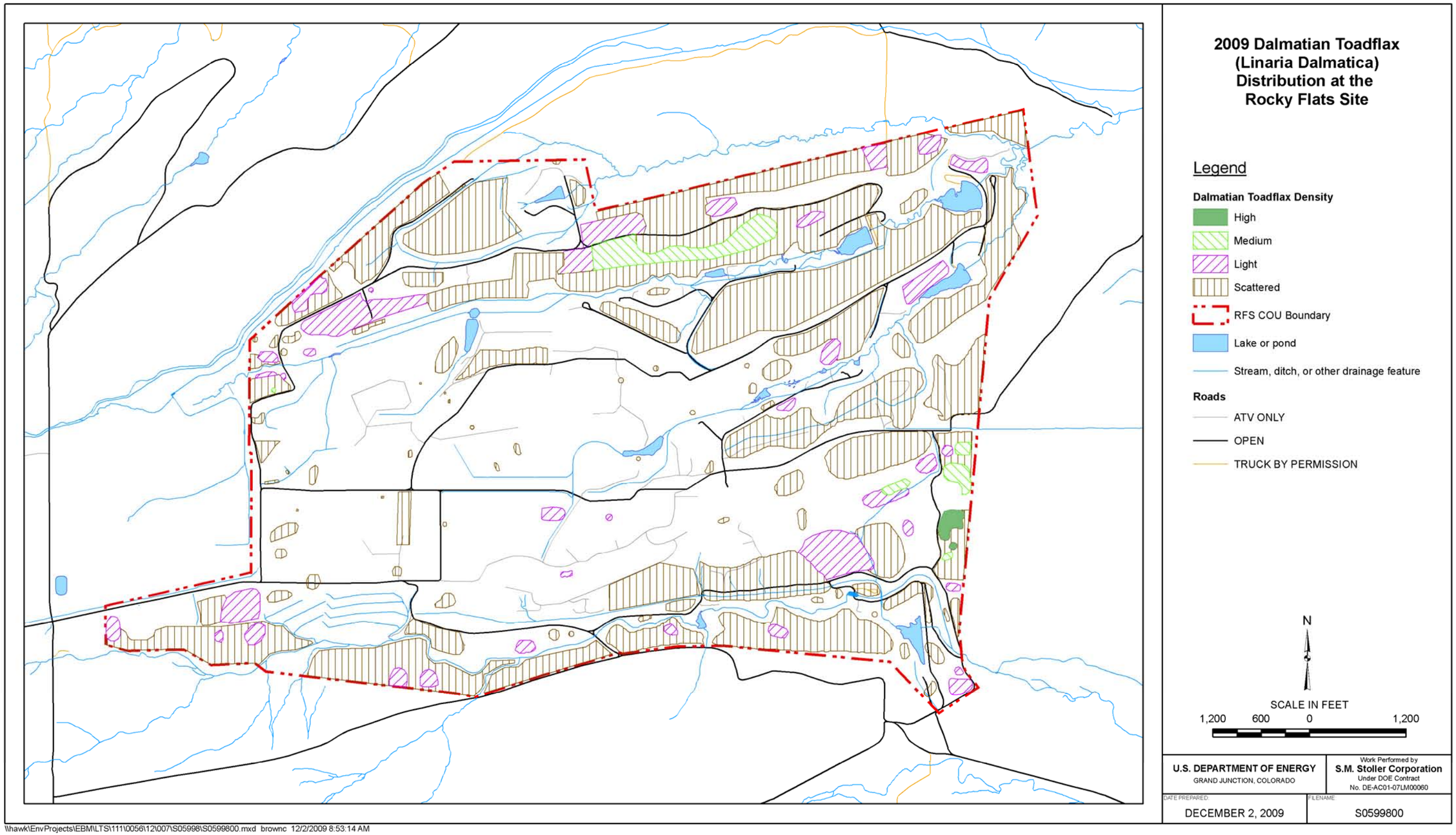

Figure 3–212. 2009 Dalmation Toadflax (Linaria dalmatica) Distribution at Rocky Flats

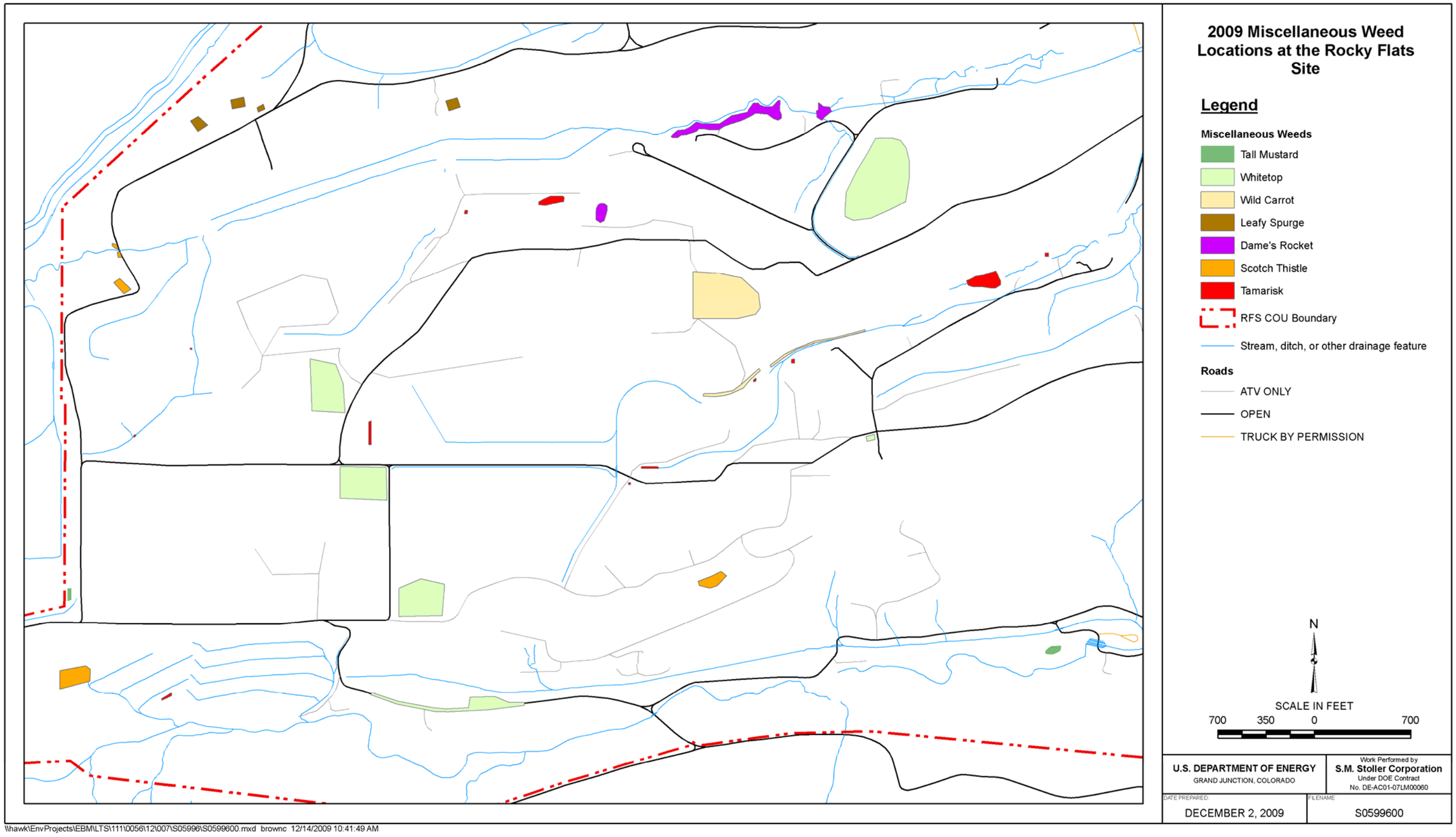

Figure 3–213. 2009 Miscellaneous Noxious Weed Locations at Rocky Flats

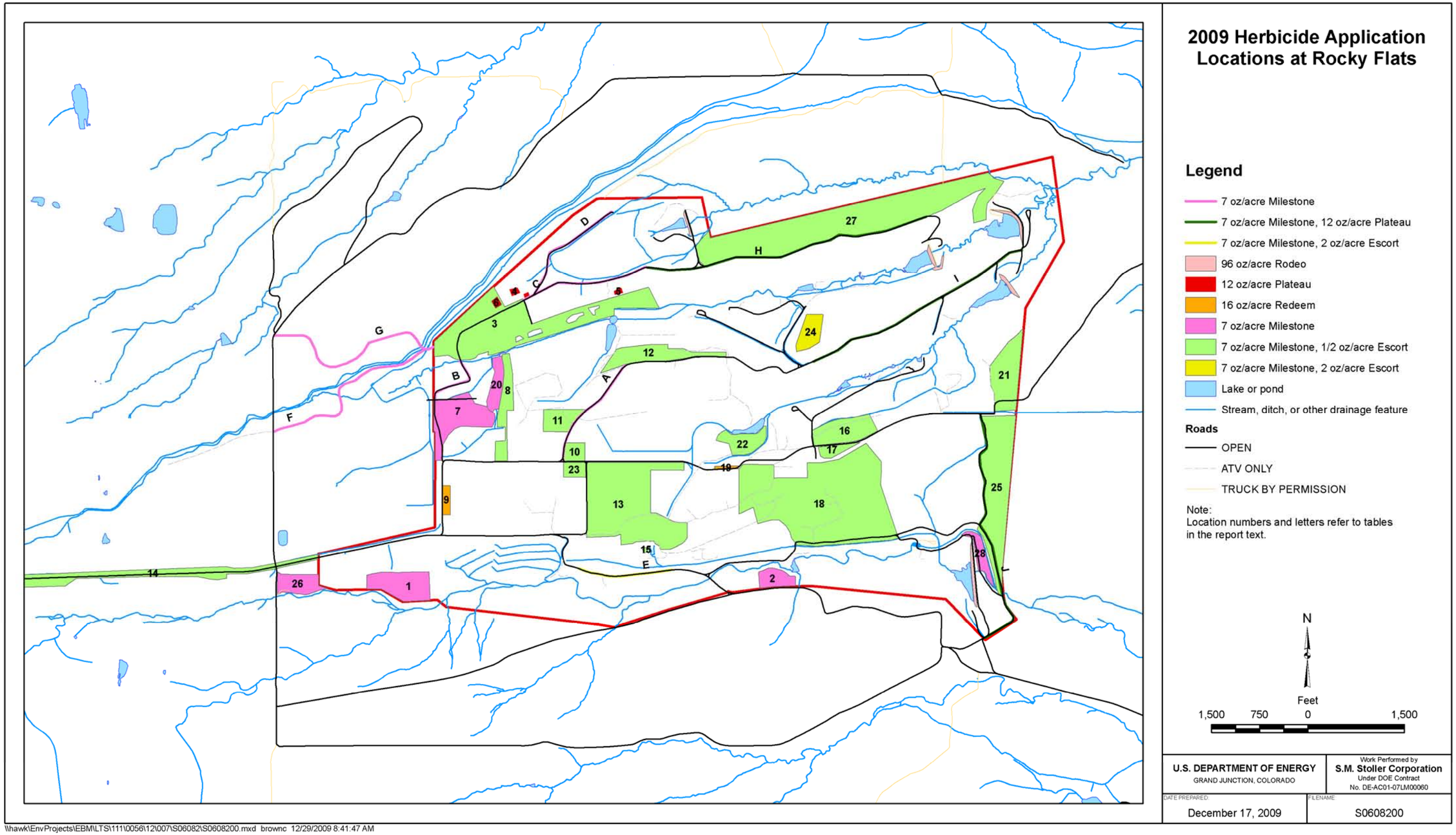

Figure 3–214. 2009 Herbicide Application Locations at the Rocky Flats Site

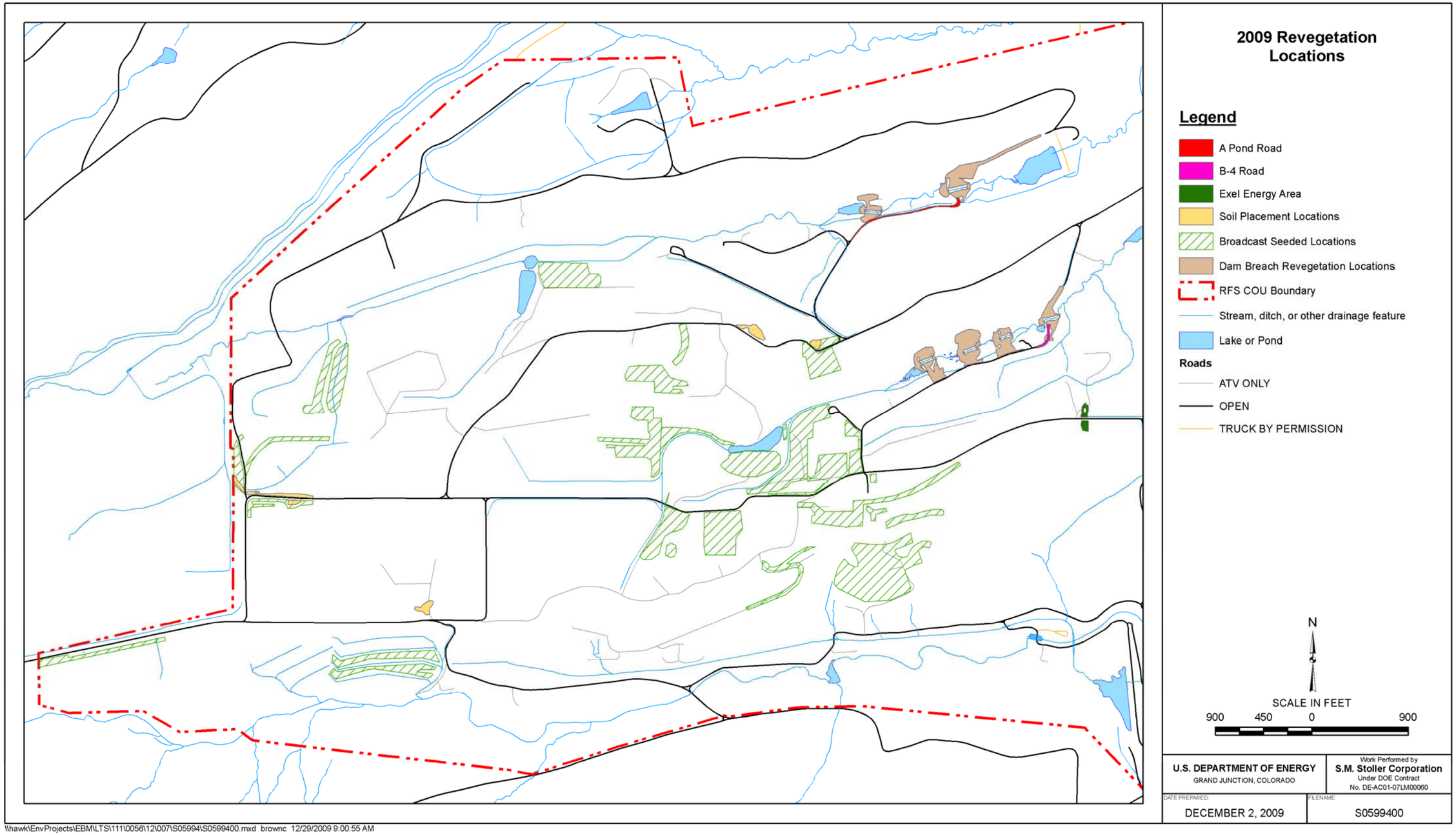

Figure 3–215. 2009 Revegetation Locations

This page intentionally left blank

Table 3–89. FY 2009 Herbicide Application Summary

Location	Type of Area	Target Species[a]	Treatment[b]	Actual Acreage Treated[c]	Time of Year Treated
1	Polygon	CEDI1	7 oz/acre Milestone	9.0	Spring 09
2	Polygon	CEDI1	7 oz/acre Milestone	3.0	Spring 09
3	Polygon	CEDI1, CIAR1	7 oz/acre Milestone, 1/2 oz/acre Escort	44.0	Spring 09
4	Polygon	EUUR1	12 oz/acre Plateau	0.2	Spring 09
5	Polygon	EUUR1	12 oz/acre Plateau	0.2	Spring 09
6	Polygon	EUUR1	12 oz/acre Plateau	0.2	Spring 09
7	Polygon	CEDI1, MEOF1	7 oz/acre Milestone	11.5	Spring 09
8	Polygon	CEDI1	7 oz/acre Milestone, 1/2 oz/acre Escort	6.5	Spring 09
9	Polygon	CEDI1	16 oz/acre Redeem	1.3	Spring 09
10	Polygon	CEDI1	7 oz/acre Milestone, 1/2 oz/acre Escort	2.0	Spring 09
11	Polygon	CEDI1, CADR1	7 oz/acre Milestone, 1/2 oz/acre Escort	5.0	Spring 09
12	Polygon	CEDI1	7 oz/acre Milestone, 1/2 oz/acre Escort	9.0	Spring 09
13	Polygon	CEDI1, CIAR1	7 oz/acre Milestone, 1/2 oz/acre Escort	38.0	Spring 09
14	Polygon	CEDI1	7 oz/acre Milestone, 1/2 oz/acre Escort	14.0	Spring 09
15	Polygon	CIAR1	7 oz/acre Milestone, 1/2 oz/acre Escort	0.2	Spring 09
16	Polygon	CEDI1	7 oz/acre Milestone, 1/2 oz/acre Escort	7.5	Spring 09
17	Polygon	CEDI1	7 oz/acre Milestone, 1/2 oz/acre Escort	1.8	Spring 09
18	Polygon	CEDI1	7 oz/acre Milestone, 1/2 oz/acre Escort	62.0	Spring 09
19	Polygon	CEDI1	16 oz/acre Redeem	0.5	Spring 09
20	Polygon	CEDI1, MEOF1	7 oz/acre Milestone	2.5	Spring 09
21	Polygon	CEDI1, ONAC1	7 oz/acre Milestone, 1/2 oz/acre Escort	10.0	Spring 09
22	Polygon	CEDI, MEOF1	7 oz/acre Milestone, 1/2 oz/acre Escort	4.5	Spring 09
23	Polygon	CADR1	7 oz/acre Milestone, 1/2 oz/acre Escort	2.0	Spring 09
24	Polygon	CADR1	7 oz/acre Milestone, 2 oz/acre Escort	3.8	Spring 09
25	Polygon	CEDI1, CIAR1	7 oz/acre Milestone, 1/2 oz/acre Escort	23.0	Fall 09
26	Polygon	CEDI1, CIAR1	7 oz/acre Milestone	5.0	Fall 09
27	Polygon	CEDI1, CIAR1	7 oz/acre Milestone, 1/2 oz/acre Escort	53.0	Fall 09
28	Polygon	CEDI1, CIAR1	7 oz/acre Milestone	2.8	Fall 09

Table 3−89 (continued). FY 2009 Herbicide Application Summary

Location	Type of Area	Target Species[a]	Treatment[b]	Actual Acreage Treated[c]	Time of Year Treated
No ID	Polygon	EUUR1	12 oz/acre Plateau	0.2	Fall 09
A	Road	CEDI1	7 oz/acre Milestone	1.5	Spring 09
B	Road	CEDI1	7 oz/acre Milestone	1	Spring 09
C	Road	CEDI1	7 oz/acre Milestone	1.9	Spring 09
D	Road	CEDI1	7 oz/acre Milestone	1.6	Spring 09
E	Road	CADR1	7 oz/acre Milestone, 2 oz/acre Escort	1	Spring 09
F	Road	CEDI1, CIAR1	7 oz/acre Milestone	4.1	Fall 09
G	Road	CEDI1, CIAR1	7 oz/acre Milestone	5.4	Fall 09
H	Road	AECY1, CEDI1	7 oz/acre Milestone, 12 oz/acre Plateau	6	Fall 09
I	Road	AECY1, CEDI1	7 oz/acre Milestone, 12 oz/acre Plateau	4.25	Fall 09
J	Road	AECY1, CEDI1	7 oz/acre Milestone, 12 oz/acre Plateau	3.25	Fall 09
	Riprap Dam Faces	Total Kill	96 oz/acre Rodeo	2.9	Spring 09
			Total Area Treated in 2009	355.4	

[a]Species Codes: AECY1 = jointed goatgrass, CEDI1 = diffuse knapweed, CIAR1 = Canada thistle, CADR1 = whitetop, ONAC1 = Scotch thistle, MEOF1 = yellow sweetclover, EUUR1 = leafy spurge

[b]Each herbicide listed was not sprayed across the entire area. The first herbicide listed was the primary herbicide used across the entire area. The additional herbicides were used at selected locations within each area to target specific species.

[c]Acreages based on billing statements, not original GPS locations provided to subcontractor.

monitoring is conducted to determine whether success criteria, as stated in the *Rocky Flats, Colorado, Site Revegetation Plan* (Revegetation Plan; DOE 2009b) are being met as well as to determine whether management of these revegetation areas is needed.

The success criteria from the Revegetation Plan are:

- The revegetation site will have a minimum of 30 percent relative foliar cover of live desired species (seeded or nonseeded native species). Relative cover is defined as the percentage of cover of a given species divided by the total amount of vegetation cover present. Example: Species A has 20 percent absolute cover, and total vegetation cover (all individual species cover values summed) is 80 percent. Relative cover = (20/80) × 100 = 25%.
- The revegetation site will have a minimum of 70 percent total ground cover that comprises litter cover, current year live vegetation basal cover, and rock cover.
- A minimum of 50 percent of the seeded native species will be present at the revegetation site.
- No single species will contribute more than 45 percent of the relative foliar cover (except in areas where dominance by a single species is appropriate for long-term wildlife and habitat management objectives).

This report section summarizes the revegetation monitoring results for data collected during 2009. The objective of the revegetation monitoring in 2009 was to assess the success of the revegetation efforts. The methods and the large data summary tables are not presented here but may be found in the full report on the Ecology DVD at the end of this report. Figure 3–216 shows the locations at the Site where revegetation monitoring was conducted in 2009.

Species richness in 2009 ranged from a low of 8 species in unit L42 to a high of 43 species in unit L37. The wide range in the number of species present is attributable to a number of factors, including how long ago the area was revegetated, the size of the location, the number of quadrats sampled in the location, the degree of disturbance in the area prior to revegetation, and the management actions (e.g., weed control) that have been conducted in the area. Thirteen different seeded graminoid species had become established and were growing at some locations in 2009. These included western wheatgrass (*Agropyron smithii*), slender wheatgrass (*Agropyron caninum = Agropyron trachycaulum*), thickspike wheatgrass (*Agropyron dasystachyum*), Griffith's wheatgrass (*Agropyron griffithsii = A. lanceolatus*), junegrass (*Koleria pyramidata*), green needle grass (*Stipa viridula*), big bluestem (*Andropogon gerardii*), little bluestem (*Andropogon scoparius*), side-oats grama (*Bouteloua curtipendula*), blue grama (*Bouteloua gracilis*), buffalo grass (*Buchloe dactyloides*), Indian grass (*Sorghastrum nutans*), and sand dropseed (*Sporobolus cryptandrus*). No species was established at all 49 locations; however, western wheatgrass and slender wheatgrass were each growing at all but one location. As would be expected in a revegetation project, several other early successional species were growing at many of the areas. Kochia (*Kochia scoparia*), yellow sweet clover (*Melilotus officinalis*), alyssum (*Alyssum minus*), wild lettuce (*Lactuca serriola*), and knotweed (*Polygonum ramosissimum*) were among the more abundant species. These will largely disappear on their own over the next couple of years as the seeded species begin to fill in more. Several noxious weeds were also found in the revegetation areas. The most common of these were downy brome (*Bromus tectorum*), filaree (*Erodium cicutarium*), diffuse knapweed, and bindweed (*Convolvulus arvensis*). Weeds will continue to be managed as needed to keep noxious weed populations down

in the revegetation areas and enable the desired seeded species to become established more quickly and compete with the weeds.

Slightly different seed mixes were used at the revegetation locations depending on the year they were seeded and the slope position. According to a success criterion in the Revegetation Plan, at least 50 percent of the seeded species must be present in an area for it to be considered successful. Thirty-one locations (63 percent) had 50 percent or more seeded species present in 2009 and have thus met this success criterion (Table 3–90). Many of the locations that did not have at least 50 percent of the seeded species present recently had the revegetation replanted with soil amendments added. These locations are, therefore, quite new, and more time is needed for the various seeded species to become established. For the other locations that did not meet this criterion in 2009, factors that may explain why many of the seeded species have not become established include inadequate or uneven initial seeding, poor soil conditions, competition from the more aggressive graminoid species in the seed mix, or drought. The monitoring method may also contribute to the lack of seeded species present, because the measure is based solely on the species list generated from the quadrat sampling. Given the small size of the total area measured on the ground through the quadrat method, it is possible that more of the seeded species are present at the revegetation locations but are simply outside the "footprint" of the randomly located quadrats in 2009. In 2010, additional observations beyond the footprint of the quadrats may be made.

Ground cover protection from rock, litter, and current-year live vegetation varied from 37 percent to over 100 percent at the revegetation locations in 2009. The Revegetation Plan states that a minimum of 70 percent total ground cover comprising litter cover, current-year live vegetation basal cover, and rock cover is to be present to help prevent erosion. Thirty-nine of the 49 locations (80 percent) met this criterion in 2009 (Table 3–90). Where overall cover is less than 70 percent, additional erosion control measures such as wattles and hay bales are in place to protect the areas and prevent erosion—or, bands of established vegetation are present between the revegetation areas and water resources.

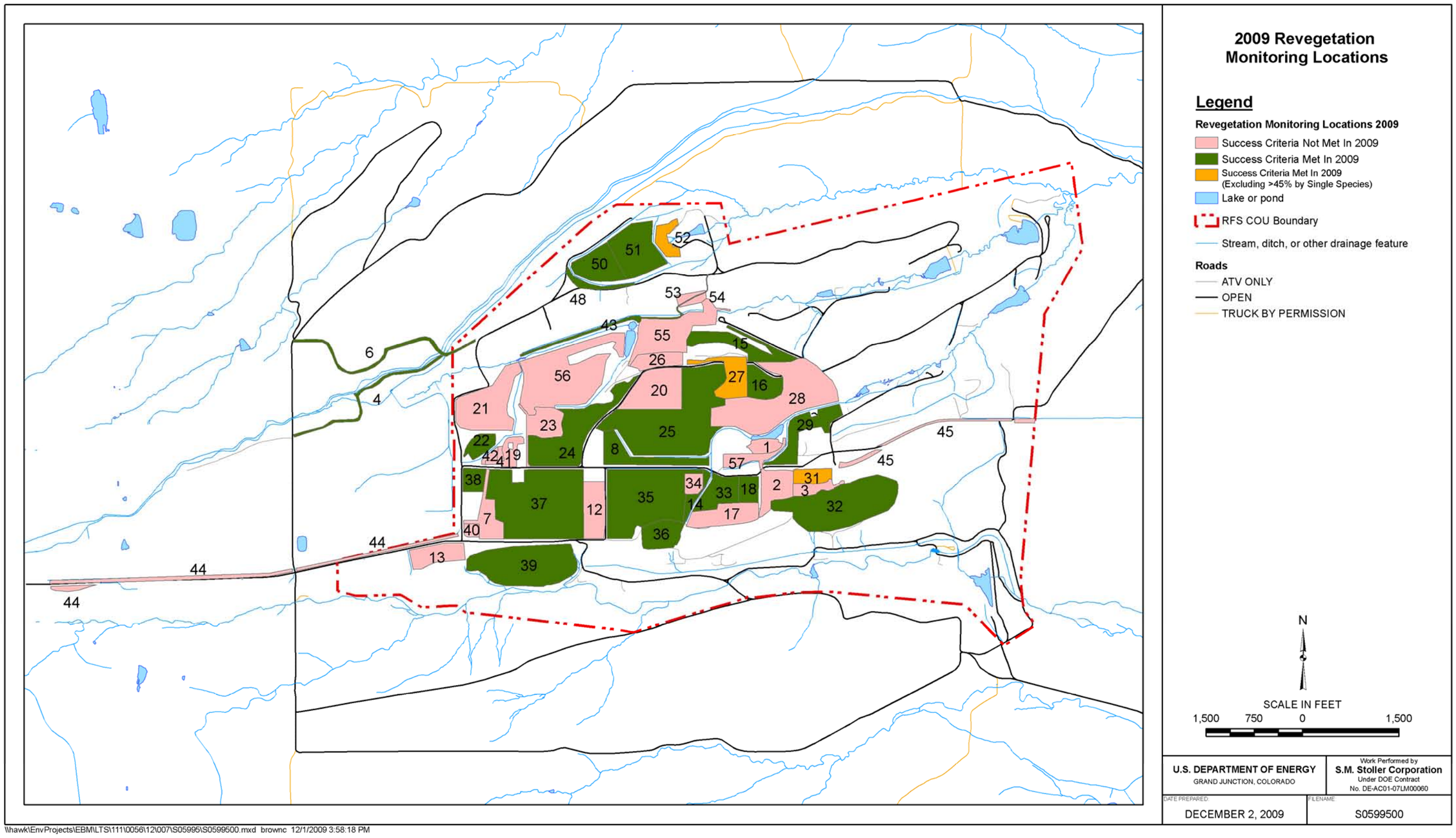

Figure 3–216. 2009 Revegetation Monitoring Locations

This page intentionally left blank

Table 3–90. Success Criteria Evaluation Summary 2009

Location	>30% Relative Cover of Desired Species	>70% Total Ground Cover (Litter, Rock, and Basal Veg Cover)	50% or More of Seeded Species Present	No Single Species With >45% Relative Foliar Cover	PASS/FAIL
L1	PASS	FAIL	PASS	PASS	FAIL
L2	PASS	FAIL	FAIL	PASS	FAIL
L3	PASS	FAIL	FAIL	PASS	FAIL
L4	PASS	PASS	PASS	PASS	PASS
L6	PASS	PASS	PASS	PASS	PASS
L7	PASS	PASS	FAIL	PASS	FAIL
L8	PASS	PASS	PASS	PASS	PASS
L12	PASS	PASS	FAIL	PASS	FAIL
L13	PASS	PASS	FAIL	PASS	FAIL
L14	PASS	PASS	PASS	PASS	PASS
L15	PASS	PASS	PASS	PASS	PASS
L16	PASS	PASS	PASS	PASS	PASS
L17	PASS	PASS	FAIL	PASS	FAIL
L18	PASS	PASS	PASS	PASS	PASS
L19	PASS	PASS	FAIL	PASS	FAIL
L20	PASS	PASS	FAIL	PASS	FAIL
L21	PASS	FAIL	PASS	PASS	FAIL
L22	PASS	PASS	PASS	PASS	PASS
L23	PASS	FAIL	FAIL	PASS	FAIL
L24	PASS	PASS	PASS	PASS	PASS
L25	PASS	PASS	PASS	PASS	PASS
L26	PASS	PASS	FAIL	FAIL	FAIL
L27	PASS	PASS	PASS	FAIL	PASS
L28	PASS	FAIL	PASS	PASS	FAIL
L29	PASS	PASS	PASS	PASS	PASS
L31	PASS	PASS	PASS	FAIL	PASS
L32	PASS	PASS	PASS	PASS	PASS
L33	PASS	PASS	PASS	PASS	PASS
L34	PASS	PASS	FAIL	FAIL	FAIL
L35	PASS	PASS	PASS	PASS	PASS

Table 3−90 (continued). Success Criteria Evaluation Summary 2009

Location	>30% Relative Cover of Desired Species	>70% Total Ground Cover (Litter, Rock, and Basal Veg Cover)	50% or More of Seeded Species Present	No Single Species With >45% Relative Foliar Cover	PASS/FAIL
L36	PASS	PASS	PASS	PASS	PASS
L37	PASS	PASS	PASS	PASS	PASS
L38	PASS	PASS	PASS	PASS	PASS
L39	PASS	PASS	PASS	PASS	PASS
L40	PASS	PASS	FAIL	PASS	FAIL
L41	PASS	PASS	FAIL	FAIL	FAIL
L42	PASS	PASS	FAIL	FAIL	FAIL
L43	PASS	PASS	PASS	PASS	PASS
L44	PASS	PASS	FAIL	PASS	FAIL
L45	PASS	PASS	FAIL	PASS	FAIL
L48	PASS	PASS	PASS	PASS	PASS
L50	PASS	PASS	PASS	PASS	PASS
L51	PASS	PASS	PASS	PASS	PASS
L52	PASS	PASS	PASS	FAIL	PASS
L53	PASS	FAIL	FAIL	PASS	FAIL
L54	PASS	FAIL	PASS	PASS	FAIL
L55	PASS	FAIL	PASS	PASS	FAIL
L56	PASS	FAIL	PASS	PASS	FAIL
L57	PASS	PASS	FAIL	PASS	FAIL
% Passing	100	80	63	86	51
Yellow shaded cells indicate all success criteria were met in 2009.					
Blue shaded cells indicate all success criteria would be met in 2009 if >45% cover of a single species was removed as criteria.					
For reasons outlined in the text, these areas are considered to have passed as of 2009.					

The third success criterion states that a minimum of 30 percent relative cover of desired species must be present, and the fourth criterion states that no single species should constitute more than 45 percent of the total relative cover. Total relative vegetation cover of desired (native) species was greater than 30 percent at 100 percent (49) of the locations monitored in 2009 (Table 3–90). Seven of the 49 revegetation locations (14 percent) had a single species that constituted greater than 45 percent of the relative cover in 2009 (Table 3–90). Six of these locations were dominated by western wheatgrass, one of the seeded native species. At the other two locations, side-oats grama and sheep's fescue (*Festuca ovina*) provided greater than 45 percent of the relative cover. Three of these locations, L27, L31, and L52, failed to meet all four success criteria solely because they each had a single species that covered greater than 45 percent of the area (Table 3–90). At L27 and L52, the dominant species was western wheatgrass (70 and 57 percent total relative cover, respectively), while at L31, side-oats grama accounted for 54 percent total relative cover. Regarding the use of the success criteria, the Plan states:

> Success criteria and monitoring are an important component of a revegetation project . . . **These success criteria are provided as initial guidance; however, common sense combined with scientific data must be applied to final evaluations to determine whether further management actions are required** [emphasis added].

Additionally, the Revegetation Plan's success criterion regarding dominance by a single species states that "[n]o single species will contribute more than 45 percent of the relative foliar cover (**except in areas where dominance by a single species is appropriate for long-term wildlife and habitat management objectives**)" [emphasis added].

Both western wheatgrass and side-oats grama are desirable native species. In 2008, both L27 and L52 did not meet this criterion because the cover of western wheatgrass was greater than 45 percent. L31 actually met this criterion in 2008. At locations that fail only this last criterion, several questions are worth considering:

- Is the dominance of these three areas by a single species (with greater than 45 percent relative foliar cover) detrimental to long-term wildlife and habitat management?
- Is the dominance by these species likely to change in the future?
- Is there any other reason not to pass these three locations in 2009, just because they failed this last criterion?

One way to answer the first question is to evaluate the dominance of relative foliar cover of native species on the undisturbed native grassland areas of the Site. Do native species account for greater than 45 percent of the cover at some locations on the native grasslands? Monitoring in 2009 at two reference locations in native grassland used for Preble's meadow jumping mouse mitigation monitoring showed that western wheatgrass provided, respectively, 54 and 59 percent relative foliar cover (Table 3–91; OLF and A-Ponds reference areas). At TR06, a xeric grassland monitoring location, data collected over multiple years showed that needle-and-thread grass (*Stipa comata*), a native grassland species, consistently provided greater than 45 percent relative foliar cover (Table 3–91). Because it is not uncommon for some of the native graminoid species to dominate the foliar cover at some locations, it is unlikely that the revegetation areas L27, L31, and L52, will be hindered by an abundance of western wheatgrass or side-oats grama.

Table 3–91. Relative Foliar Cover of Selected Species on Native Grasslands At Rocky Flats

Location	Species	1993	1994	1995	1998	1999	2000	2001	2007	2008	2009
TR02	*Agropyron smithii*	40.5	33.0	31.5		23.5	23.2				
TR02	Total Foliar Cover	68.2	88.0	97.2		77.4	71.6				
TR04	*Agropyron smithii*	28.6	15.7	19.3		13.7	10.0				
TR06	*Stipa comata*	61.5	62.4	49.4	50.8			45.7			
TR11	*Stipa comata*	11.6	8.7	3.2		6.6	12.6				
TR11	*Bromus japonicus*	3.0	25.8	39.1		19.2	4.5				
OLF Reference Area	*Agropyron smithii*								21.8	33.4	59.0
A-Ponds Reference Area	*Agropyron smithii*										54.2

These data are from various other studies that have been conducted at Rocky Flats. The sporadic nature of the timing of some studies is a result of the purpose of the individual studies.
See the text for more information.

Relative foliar cover of different species and overall vegetation cover also fluctuate in response to environmental conditions (such as temperature and the timing and amounts of precipitation). Table 3–91 shows some of this fluctuation for western wheatgrass at TR02 and TR04 (both mesic grassland monitoring locations) and the OLF revegetation area, for needle-and-thread grass at TR06 and TR11 (mesic grassland monitoring locations), for Japanese brome (*Bromus japonicus*) at TR11, and for overall foliar cover at TR02. Annual fluctuations in species cover are common in response to changing environmental conditions. Although locations L27, L31, and L52 were dominated by species with greater than 45 percent cover in 2009, this may change over time as environmental conditions change. Given the evidence that dominance by a single species occurs on the native prairie, and annual fluctuations in foliar cover are common, there appears to be no practical reason these locations cannot be considered to have passed all four criteria in 2009.

Table 3–90 shows which revegetation locations monitored in 2009 passed or failed which criteria. Twenty-five of the 49 locations (51 percent; approximately 245 acres) passed all four criteria in 2009 (including locations L27, L31, and L52, for the reasons outlined above). These areas have established good stands of vegetation that should be sustainable in the future. Those areas that did not meet success criteria in 2009 need more time. A good stand of vegetation often takes 4 to 6 years to become established. Some of the revegetation locations may require additional reseeding and weed control. Proactive management of the revegetation areas is critical to success. Most of the areas that passed in 2009 will not be monitored in 2010, but some locations may be selected for a multiple-year monitoring rotation to document the long-term successional changes on the revegetation areas at the Site. This information would prove useful for making management decisions and can be used to help improve revegetation techniques at the Site.

3.2.2.5 PLF and OLF Monitoring

As part of the cleanup and closure of the Site, two landfills were covered using different types of covers. At the PLF, a RCRA Subtitle C–compliant cover was constructed to protect the underlying waste. At the OLF, a 2-foot-thick soil cover was placed over the waste material. Both areas were seeded with native plant species to provide a vegetation cover on each landfill. As part of the revegetation process, monitoring is conducted to evaluate the status of the vegetation. This section summarizes revegetation monitoring results for data collected at the PLF and OLF during 2009. The methods and large data summary tables for the revegetation monitoring on the PLF and OLF are provided in the full report on the Ecology DVD at the end of this report. Figure 3–216 shows the locations at the Site where revegetation monitoring was conducted on the landfills in 2009. The monitoring units for the PLF in 2009 were units 50, 51, and 52. The OLF monitoring unit was unit 39.

Total species richness in 2009 was 45 species at the PLF (three sampling units combined) and 30 species at the OLF. The difference in the number of species between the PLF and OLF is largely related to the environmental conditions at each location. The OLF is on a south-facing hillside, where soil is typically much drier than soil at the PLF. One of the success criteria in the Revegetation Plan states that at least 50 percent of the seeded species must be present in an area for it to be considered successful. At the PLF and OLF, the percentage of seeded species present was 65 percent (three sampling units averaged together) and 100 percent, respectively, in 2009. Thus, revegetation at both landfills met this criterion in 2009 (Table 3–90).

Ground cover protection from rock, litter, and current-year live vegetation averaged 92.9 percent and 78.9 percent, respectively, at the PLF and OLF. The Revegetation Plan requires a minimum of 70 percent. Therefore in 2009, both landfills met this criterion (Table 3–90). At both locations, most of the ground cover came from litter, of which a portion is represented by the erosion controls. The litter cover will continue to remain the dominant ground cover, but in time, it will come from dead plant material that becomes matted down, rather than from the erosion controls. Both landfills have substantial protection on the soil surface to prevent erosion.

The third success criterion outlined in the Revegetation Plan states that a minimum of 30 percent relative cover of desired species must be present. At each individual sampling unit on the PLF and OLF, the relative cover of desired species was greater than 82 percent, thus meeting this success criterion (Table 3–90). The dominant species on the western half of the cover of the PLF (L50) in 2009 were slender wheatgrass and western wheatgrass, followed by buffalo grass. On the eastern half (L51), the dominant species were western wheatgrass and slender wheatgrass (in that order) followed by big bluestem and buffalo grass. The difference between the western and eastern half is largely related to the different topsoils that were placed at each location during the construction of the cover. The western half received a mixed topsoil that was designed to mimic the native pediment topsoil structure, whereas the eastern half received unmixed Rocky Flats Alluvium. The finer texture on the western half was more conducive to the establishment of the cool-season species that now dominate its surface, and the rocky, cobbly structure on the eastern half favored warm-season, tall grass species, like the big bluestem. Western wheatgrass and slender wheatgrass, along with the native forb white sage (*Artemisia ludoviciana*), dominated the east face of the PLF (L52). At the OLF, the dominant species were western wheatgrass and slender wheatgrass, followed by the forb yellow sweet clover.

The fourth success criterion outlined in the Revegetation Plan states that no single species shall contribute more than 45 percent of the total relative cover. On the PLF cover, locations L50 and L51 met this criterion, while on the east face (L52), western wheatgrass (a native seeded species) had a total cover of 56.5 percent (Table 3–90). Although location L52 had greater than 45 percent cover of a single species it was considered to have passed based on the reasons provided earlier since there is no reason it should not pass from a wildlife or habitat standpoint. The OLF had no single species with a cover value greater than 45 percent (Table 3–90).

Table 3–90 shows which of the PLF's and OLF's revegetation units monitored in 2009 passed or failed which criteria. All three locations sampled on the PLF cover passed all four criteria in 2009. Therefore, these locations will not be monitored annually in the future. Instead, they may be incorporated into a multiple-year monitoring rotation to document the long-term successional changes on the revegetation areas at the Site.

The OLF passed all four success criteria in 2009. However, that does not mean the vegetation has become established to a desirable level. Several areas of the OLF were disturbed during projects in 2008 and 2009 and were subsequently revegetated; these areas are starting over. A good, healthy stand of vegetation is desirable on both landfills to protect the covers and provide good erosion control. The OLF will continue to be monitored in 2010.

3.2.2.6 Photomonitoring Results

Photomonitoring results are presented on the Ecology DVD found at the end of the report.

3.2.3 Wildlife Monitoring

3.2.3.1 Prairie Dog Surveys

Black-tailed prairie dogs (*Cynomys ludovicianus*) are not uncommon at the Site. Prairie dog towns in the upper elevations of the COU and POU are scarce due to the abundance of rocks in the pediment soils. However, they are common in the lower-elevation, deeper-soil areas on the eastern half of the POU and one upper-elevation surface in the northeast corner of the POU where the soils are less rocky. Several prairie dog towns have existed for many years at these locations. From an ecological standpoint, the prairie dogs are an important component of the ecosystem, providing food for raptors and coyotes, and also a source of natural disturbance to the vegetation communities where the prairie dog towns are located. In recent years, conflicts between people and prairie dogs have increased along the Front Range. Prairie dogs are perceived as hindering recreational use and harming the quality of habitat on public lands. Numerous municipalities along the Front Range have instituted prairie dog relocation programs in attempts to limit the outright killing of the prairie dogs. Several of these programs have resulted in prairie dogs being moved just outside the boundaries of the POU on the Site's eastern and northern boundaries. At some off-site locations, the increase in prairie dog populations has denuded the landscape and created bare soil areas that become sources of large dust clouds during high winds.

The primary concern with the prairie dog colonies at the Site is the potential for the prairie dogs to create an erosional surface by removing vegetation cover. Two landfills are present at the Site, the OLF and PLF. The Monitoring and Maintenance Plans for both landfills prohibit the presence of burrowing animals on the landfill covers. Additionally, infrastructure is buried at some locations in the former Industrial Area (within the COU), and the prairie dogs' natural tendency to dig makes them undesirable at these locations. Thus, from a management standpoint, it is important to observe the locations and abundance of prairie dogs at the Site. In 2009, the following monitoring was planned regarding the presence of prairie dogs at the Site:

- The locations of prairie dog towns within the COU and adjacent to the COU fence on POU property.
- The locations of individual prairie dogs observed in the spring when they are roaming in search of potential locations for new prairie dog holes.

Figure 3–217 shows the locations of prairie dog towns in the COU and on the adjacent POU property as of 2009. In early May 2009, fortuitous observations were made at the center prairie dog town along the eastern fence line of the COU. Both adults and the young of the year were observed in the colony. However, in July, when the prairie dog monitoring was scheduled, no prairie dogs were present at either of the two southern locations, and only three or four individuals were observed at the northern location. Investigation of the prairie dogs' disappearance revealed that an outbreak of plague had occurred in the prairie dog colonies east of the POU on the adjacent Westminster Hills Open Space/Dog Park (Jefferson County 2009). Plague is an infectious disease caused by *Yersinia pestis*, a bacterium found in fleas that pass on the bacterium to wild rodents by biting them. Prairie dogs are susceptible to plague, and it is not uncommon for colonies to be wiped out by plague every few years.

At the Site, because the prairie dogs move across Indiana Street between the Westminster property and the POU and COU areas, the prairie dogs in the COU and much of the surrounding POU were infected and killed. Thus, in July 2009, observations showed that no prairie dogs were present in the colonies within the COU (central location on Figure 3–217), none were present in the southern colony in the POU, and only three or four individuals were at the colony north of the COU fence in the POU. No individuals were observed roaming along roads in the COU in 2009. In 2010, monitoring of the prairie dog colonies will continue. Monitoring of these locations will continue throughout the year to determine if and when the prairie dogs return.

3.2.3.2 Mountain Bluebird Nest Box Monitoring

Mountain bluebirds (*Sialia currucoides*) are migratory songbirds that typically visit the Site during their migration in the spring and fall. The species winters south of Colorado in New Mexico, Arizona, west Texas, and northern Mexico but travels as far north as northern Canada and southeastern Alaska to breed in the spring and summer (National Geographic 1999). In Colorado, mountain bluebirds commonly inhabit the foothills and mountains. Their typical habitat is open meadows and rangeland above 5,000 feet, though they also nest in tree cavities, buildings, and birdhouses. Both open prairie and elevations of approximately 6,000 feet on the upper pediment (mesa) tops are present at the Site. In an effort to increase wildlife use of the Site, and as an activity for Bring Your Child to Work Day in 2009, children painted nine bluebird boxes, which were installed at selected locations throughout the COU (Figure 3–218). Mountain bluebird nest box monitoring was conducted at the end of the field season by opening the door of each nest box and inspecting the contents, if any, for evidence of nesting (e.g., nest materials, feathers, eggshells).

On October 27, 2009, the nest boxes were surveyed for nesting activity. Seventy-eight percent of the boxes (seven boxes) had evidence of some type of nesting activity. Evidence of nesting activity included the presence of nest materials and feathers. No eggshells were found in any of the boxes. Several of the boxes had been filled with sticks (usually from the species of tree the box was attached to; Figure 3–219). Observations at one box indicated it was being used by a tree swallow (*Tachycineta bicolor*). It was not determined what species were using the remaining boxes. In 2010, the boxes may be observed throughout the nesting season to identify what species of birds are using them.

The apparent lack of use by mountain bluebirds in 2009 was probably due to the fact that the boxes were installed near the end of the spring migration, so the birds were not aware of the boxes and continued north or into the mountains. In 2010, additional nest boxes will probably be installed, with the help of the children who participate in Take Your Child to Work Day, in the hope that mountain bluebirds will begin to use them.

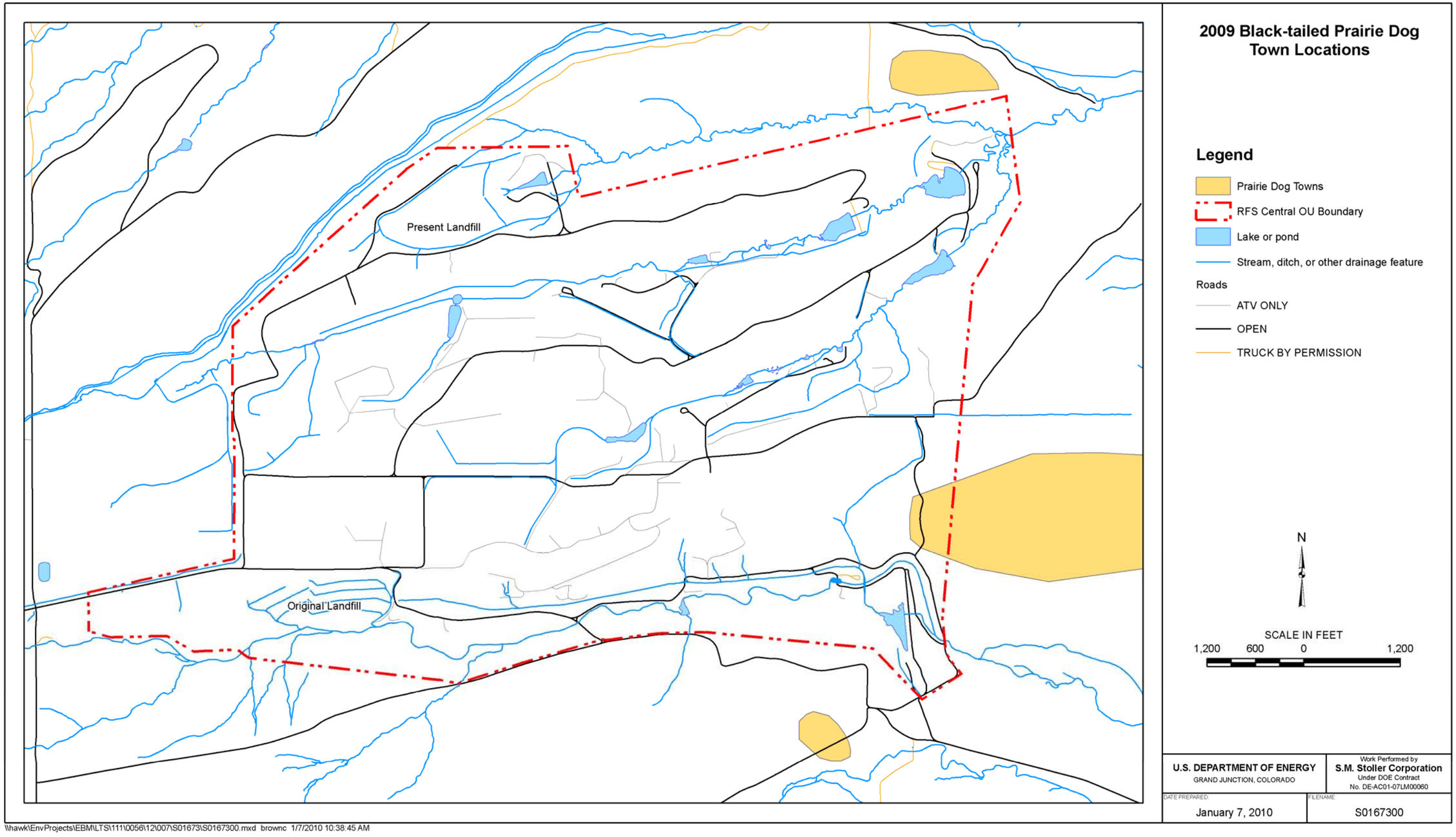

Figure 3–217. 2009 Black-tailed Prairie Dog Locations

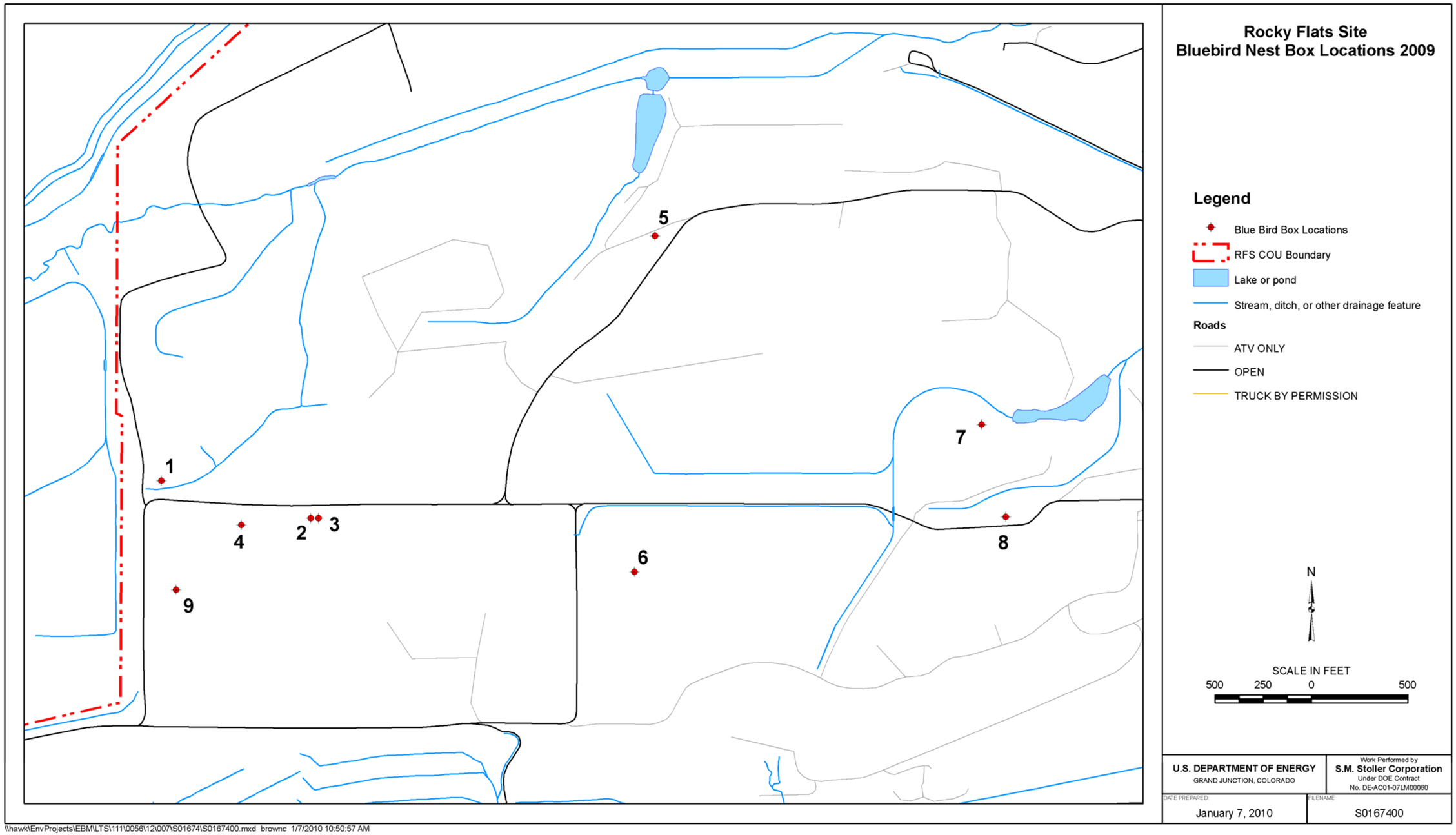

Figure 3–218. Rocky Flats Site Bluebird Nest Box Locations 2009

Figure 3–219. Mountain Bluebird Nest Box Filled With Sticks And Twigs In 2009

3.2.3.3 Additional Wildlife Observations

In September, a dead crow (*Corvus brachyrhynchos*) was observed dangling from the top of a spruce tree at the Site. Closer inspection revealed there was fishing line wrapped around the foot of the bird. Evidently the crow picked up the fishing line on its foot at one of the nearby reservoirs (since fishing is not allowed at the Site). The line was probably dangling from its foot when it landed on the branch. When it attempted to take off the line probably got caught in the tree branch, and the more the bird tried to free itself, the more it wrapped itself around the branch. Finally its foot was so tightly entangled around the branch that the bird could not move and eventually died on the branch. The bird was removed from the tree and disposed of.

In October, the carcass of a dead hawk (unknown species) was found near the bottom of the OLF. The cause of death was unknown. The hawk was turned over to USFWS.

3.2.4 Summary

The Ecology Program at the Site conducts monitoring of the ecological resources to ensure regulatory compliance and to preserve, protect, and manage those resources. Proactive management of the natural resources is critical to the long-term sustainability of the ecosystems at the Site. Noxious weeds continue to be a top priority, as does the revegetation of the COU. Data from 2009 documented the continuing establishment of vegetation at revegetation locations; several met success criteria. Noxious weed control activities and additional revegetation activities were conducted during 2009 to improve and enhance the vegetation at the Site. The monitoring results continue to provide useful information for management activities. Full, detailed reports and analyses for each field monitoring effort are presented as stand-alone reports on the accompanying Ecology DVD.

3.3 Data Management

3.3.1 Water Data

Data from samples submitted to an analytical laboratory are received in both hard copy and electronic data deliverable formats. The electronic data are loaded into an Oracle-based relational database. The environmental monitoring data are accessible using the SEEPro application. The hard-copy analytical reports are archived in the records library in Grand Junction, Colorado, along with the original field data forms and other relevant hard-copy forms or documents containing project data. Well construction and lithology logs are maintained for previously drilled wells and are produced for all new wells drilled. These logs are archived in the records library and can also be accessed electronically via the SEEPro database and the Geospatial Environmental Mapping System.

SEEPro uses Oracle software for data management and Microsoft Access for data retrieval and display. It compiles water quality, air quality, field parameter, sample-tracking, sample location, and water-level data for groundwater, surface water, boreholes, soils, and sediment samples. Field parameter data include such information as sample location, sample date, pH, turbidity, conductivity, and temperature. Chemical information (Chemical Abstracts Service registry numbers, analytical results, and detection limits) is also included. Data managers follow specific procedures for verification of database information received from subcontractors or verification