LMS/AMC/S08247

Amchitka Mud Pit Sites 2011 Post-Closure Monitoring and Inspection Report Amchitka Island, Alaska

November 2012

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Executive Summary

This *Amchitka Mud Pit Sites 2011 Post-Closure Monitoring and Inspection Report* describes how the U.S. Department of Energy (DOE) Office of Legacy Management performed the inspection and vegetation survey of seven mud pits on Amchitka Island in June 2011. In accordance with the *Long-Term Surveillance and Maintenance Plan for the U.S. Department of Energy Amchitka, Alaska, Site* (DOE 2008a), the mud pits caps will be monitored for subsidence, erosion, and vegetation cover on a 5-year basis. The last time the mud pit caps were inspected was in August 2006.

The Rifle Range, Cannikin South, and Cannikin Ground Zero mud pit caps had no significant change in their condition since the 2006 inspection. Minor conditions at the other four mud pit caps that require monitoring or repair during the next inspection are as follows:

Site E	Monitor a small reddish-brown colored seep just northeast of the mud pit cap.
Site F	Plan to fill a small depression in the southwest part of the mud pit cap. Re-contour Channel F1 at the east end of the mud pit cap to reduce ponding.
Site D	Plan to fill the small holes along the southwest side of the west mud pit cap. Repair any erosion on the southwest side of the west mud pit cap. Repair the breach in the dam for sediment trap D-1 just southwest of the west mud pit cap.
Long Shot	Repair minor rills in the northeast and southwest parts of the mud pit cap. Repair several small depressions in the south and southwest parts of the mud pit cap. Repair several small holes along the east base of the mud pit cap. Re-contour a small area along the base of the southwest corner of the cell to avoid ponding water. Monitor a small reddish (probably iron)-colored seep at the east base of the mudpit cap.

The vegetation survey of each of the seven mud pit caps indicates the species richness and vegetation cover increased on all mud pit caps between the 2006 and 2011 survey periods, and establishment conditions continue to become more favorable due to increases in mosses, lichens, and organic materials. Vegetation is generally reestablishing much more quickly on the mud pit caps than would be expected on bare mineral soils that were not reseeded. Vascular vegetation has become established on all of the mud pit caps, and cover is at least 20 percent, even on mud pit caps with the lowest cover values. Cover is more than 50 percent on four of the seven mud pit caps when nonvascular species are considered. Vegetation cover has increased on all post-closure caps over the past 5 years, there is little risk of invasive species establishment, and the total amount of area disturbed by the caps is a very small percentage of the total area of the island. Therefore, there are few ecological motives to pursue further revegetation efforts at this time.

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1.0 Introduction

In 2001, the U.S. Department of Energy (DOE) National Nuclear Security Administration remediated six areas associated with mud pit release sites located on Amchitka Island, Alaska. Remediation included the construction of seven mud pit caps. To ensure the integrity and effectiveness of remedial action, the mud pit caps are inspected every 5 years as part of DOE's long-term surveillance and monitoring program. The first 5-year inspection occurred in 2006, and the second 5-year inspection occurred in June 2011. The mud pit caps were inspected in accordance with the *Post-Closure Monitoring and Inspection Plan for Amchitka Island Mud Pit Release Sites, Well Abandonment, and Infantry Road Repair Amchitka, Alaska* (DOE 2011). This post-closure monitoring report provides the 2011 mud pit cap inspection results.

In August 2006, as part of the DOE's long-term monitoring and surveillance program, the DOE National Nuclear Security Administration, Nevada Site Office (NNSA/NSO), performed the 5-year inspection of seven closure caps on Amchitka Island, AK. On October 23, 2006, the subsequent *Amchitka Island Mud Pit Sites 2006 Post-Closure Monitoring and Inspection Report, Amchitka Island, Alaska* (DOE/NNSA/NSO 2006) was submitted to the following: Department of Environmental Conservation; Spill Prevention and Response for the State of Alaska; Aleutian Pribilof Islands Association, Inc.; and U.S. Fish and Wildlife Service (USFWS) on October 23, 2006.

An integral part of the inspection was an objective vegetation cover-estimating task using line interception and point interception techniques to determine the amount and type of vegetation on the mud pit caps. The 2006 vegetation survey found that total vegetative cover was inversely proportionate to the elevation of the mud pit caps. The highest total vegetative cover (50 percent) was found on the Longshot mud pit cap, and the lowest vegetative cover was found on mud pit caps at Sites E and F (8.0 and 7.9 percent, respectively).

Amchitka Island is part of the Alaska National Maritime Wildlife Refuge and is administered by USFWS. In a letter dated December 15, 2006, U.S. Fish and Wildlife Service (USFWS) stated that the vegetation coverage at caps D, E, and F was very thin, and additional action would likely be required to prevent significant erosion prior to the next 5-year inspection in 2011. In 2007, DOE and USFWS agreed to perform the revegetation task in 2008.

In late Spring 2008, personnel from the DOE Office of Legacy Management, the Alaska Maritime National Wildlife Refuge for the USFWS and S.M. Stoller, Legacy Management Support Contractor, travelled to Amchitka Island to perform revegetation activities of the three mud pit caps. The revegetation activities are summarized in *Nevada Offsites Project Amchitka Island Revegetation Task*, (DOE 2008b).

1.1 Mobilization/Demobilization

The inspection crew arrived on Amchitka Island midday Monday, June 20, 2011, via Stabbert Maritime's vessel, *Ocean Pioneer*. Upon arrival, the four Jeep Grand Cherokees, one John Deere backhoe, and miscellaneous equipment were unloaded onto the Constantine Harbor pier. The first mud pit cap inspection began mid-afternoon on June 20. Island activities were concluded by midday on Friday, June 24, and equipment and vehicles were loaded onto the *Ocean Pioneer*, and the vessel departed that same day.

1.2 Key Personnel

The inspection crew consisted of the following personnel:

- Mark Kautsky, DOE Office of Legacy Management, Offsites Project Lead
- Jason Nguyen, DOE Office of Legacy Management, Inspection Team Support
- Paul S. Darr, S.M. Stoller Corporation (Stoller), Task Manager
- Craig Goodknight, Stoller, Inspection Team Lead
- Amy Forman, Gonzales-Stoller Surveillance, Vegetation Specialist
- Stephen Pitton, Stoller, Engineer and Inspection Team Support
- Kyle Turley, Stoller, Heavy Equipment Operator
- Merry Maxwell, U.S. Fish and Wildlife Service representative

1.3 Work Activities

Four tasks were scheduled for the on-island work:

- Inspection of seven earthen mud pit caps,
- Vegetation survey of the seven earthen mud pit caps,
- Infantry Road maintenance, and
- Inspection of three wells.

1.3.1 Mud Pit Cap Inspection

A physical inspection of each mud pit site was conducted and consisted of visual observations and photo documentation of the mud pit caps, energy dissipators, and areas adjacent to the mud pit cap. Notable damage to or degradation of the mud pit cap (e.g., subsidence, rills, erosion, small holes), loss of vegetation over significant portions of the mud pit cap, erosion along the base of or adjacent to the mud pit cap, or erosion of drainage ditches or energy dissipators was also documented and reported. All findings from the site inspections are documented on a post-closure monitoring checklist for each site (see Appendix A) for submittal to DOE and for future reference and monitoring. The seven mud pit cap sites are shown in the map of Amchitka Island in Figure 1 along with their location in respect to mile markers along Infantry Road.

1.3.2 Vegetation Survey

The mud pit cap was inspected to document percentage of vegetation on the cover, weeds, disease, pests, and plant die-out. The percentage of vegetation on the mud pit cap was estimated as identified in Section 3.0. Documentation consists of completing a worksheet for percentage of vegetation cover and measuring, photographing, and staking any deficient conditions.

Figure 1. Location on Amchitka Island of Seven Mud Pit Cap Sites and Infantry Road

1.3.3 Infantry Road Maintenance

During the Office of Legacy Management's last trip to Amchitka Island in the summer of 2008, Infantry Road was impassable near mile marker 8 and marginally passable just south of the Long Shot site near mile marker 4. In order for the inspectors to access sites farther north on the island, temporary repair of Infantry Road was necessary.

1.3.4 Well Inspection

Two wells and a hydrologic test hole were scheduled for inspection and, based on the results of a borehole video survey, retained for future use or abandoned. The two wells are groundwater monitoring wells located at the Long Shot site, and the third is a hydrologic test hole located at Drill Site E. The two groundwater monitoring wells at the Long Shot site are GZ-1 and GZ-2 and were part of the U.S. Environmental Protection Agency's Long-Term Hydrologic Monitoring Program (DOE 1982).

1.4 Island Overview

Amchitka Island is located in a maritime tundra ecosystem with low-energy dynamics, including; low primary productivity and decomposition rates, relatively few plant taxa, slow rates of change in the species composition of plant communities, and limited nutrient availability. Climatic conditions of Amchitka are typified by narrow seasonal and diurnal temperature fluctuations, frequent high winds, high relative humidity, and low solar input due to persistent cloud ceilings. Mean annual temperature is about 4.5 °C (40 °F) and precipitation ranges from approximately 76 to 89 centimeters (cm) (30 to 35 inches), falling as both rain and snow (Amundsen 1972). Although freeze/thaw events occur frequently, mean temperatures are not low enough to sustain permafrost. The attributes of undisturbed soils reflect the slow rate of ecosystem processes on the island; they tend to be acidic with abundant organic material, which can form a peat substrate up to 4 meters (m) thick, especially in lower-elevation tundra. Soil drainage generally increases and peat accumulation decreases with increasing elevation, which results in very wet lowland soils and a much drier topoenvironment for higher-elevation tundra (Amundsen 1972).

By 1972, about 5 percent of the total area of Amchitka Island had been disturbed by anthropogenic activities, primarily related to military occupation (Amundsen 1972). Additional disturbance occurred during the late 1960s and early 1970s to support underground nuclear testing by the U.S. Department of Defense and the U.S. Atomic Energy Commission. In 2001, six sites containing drilling mud from drilling associated with underground testing were remediated, resulting in seven mud pit caps. The two lowest-elevation mud pit caps, Rifle Range and Long Shot, are in relatively well-drained, lowland tundra topoenvironments and are situated within crowberry meadow communities, as described by Amundsen (1977). The remaining five mud pit caps are in upland tundra topoenvironments. Both mud pit caps at the Cannikin site are surrounded by crowberry meadow communities, and Drill Sites D, F, and E are within crowberry stripe communities, where the amount of area occupied by stripes increases with increasing elevation. Remediation at all sites included stabilizing the drilling mud, installing a geosynthetic cap over the stabilized mud, revegetating the mud pit cap, and installing drainage ditches and energy dissipaters around the mud pit cap (NNSA/NSO 2003). The mud pit caps were revegetated by emplacing a seed mat containing red fescue (*Festuca rubra*) and Bering's tufted hairgrass (*Deschampsia beringensis*) seed over each mud pit cap surface.

Monitoring and inspection of the mud pit caps are required once every 5 years (NNSA/NSO 2004 and DOE 2008a). The first survey to assess vegetation recovery on the mud pit caps was conducted as part of the mud pit cap inspection effort in 2006. Results from the 2006 survey indicated that vegetation cover on the mud pit caps ranged from about 8 percent to nearly 50 percent, and cover generally decreased with increasing elevation (NNSA/NSO 2006). The authors suggested that lower vegetation cover on the upper-elevation mud pit caps may have been caused by those mud pit caps having been planted later in the growing season than the lower-elevation mud pit caps. Based on results from the 2006 survey, three of the highest-elevation mud pit caps were reseeded again during the 2008 growing season. All three mud pit caps were broadcast seeded with red fescue and Bering's tufted hairgrass. The 2011 vegetation survey is described herein.

The dock (pier) on Constantine Harbor is in good condition. The island's roads, with the exception of Infantry Road near mile marker 4 and mile marker 8, were passable. Infantry Road was partially washed out near mile marker 4, just south of the Long Shot site and completely washed out near mile marker 8, just north of the intersection of the RX site road.

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2.0 Mud Pit Cap Inspection

2.1 Introduction

This section summarizes the methods used to document the mud pit cap inspections, the differences in the 2011 inspection from the 2006 inspection, and the recommendations from the inspection results. Mud pit cap inspections proceeded from southeast to northwest by site and followed the protocol shown for each mud pit cap in Table 3, Proposed Cap Inspection Specifications, in the Post-Closure Monitoring and Inspection Plan (DOE 2011). The transects, visual inspection routes, and photopoints for each mud pit cap established during the 2006 inspection were reported for the 2011 inspection. Documentation for each mud pit cap inspection included a drawing of the constructed mud pit generated from the 2001 as-built drawings, a monitoring checklist, and photographs. The drawings, checklists, and photographs are provided in Appendix A, "Inspection Reports."

2.2 Mud Pit Drawings

An inset in the mud pit drawing for each site (Figures A-1 through A-7) shows the access route to Infantry Road. The drawings were generated using the as-built drawings from the 2001 closure survey. Each drawing includes the transect lines, inspection path and end points (photopoints), findings of the inspection, and additional photo locations. Findings include areas of subsidence, small holes, seeps, and effects of erosion. The two mud pit caps in Site D were designated as West Cap and East Cap. At Site F, a new transect line, F-1, was established along the center axis of the mud pit cap. This adjustment was made because the GPS locations of the end points of the F-1 transect for the 2006 inspection placed the transect well down the south flank of the mud pit cap.

2.3 Monitoring Checklists

The Field Conclusions section of each monitoring checklist contains a discussion of all findings from the inspection. The findings are shown on the mud pit drawing for each site and include items that require monitoring during future inspections. Some of the findings identify deficiencies, and the discussion includes recommendations for possible future repairs.

2.4 Photographs

Photographs taken during the inspection are listed and described in the Photograph Log. Photopoints, generally of the USFWS monument and at the ends of the transects, are designated. Additional photographs included in the log document conditions or findings such as small holes, seeps, erosion, subsidence, and ponded water. Additional photographs were also included to show the mud pit cap from a distance, if possible, otherwise photographs of parts of the cap were provided. Photographs are shown in Appendix A following the Photograph Log for each site.

Comparison photographs showing the increase in vegetation cover from 2006 to 2011 are shown for Sites D (four locations), E (one location), and F (one location). These comparison photos are from the same end-of-transect location. One other comparison photograph is included in Site F where a small area of minor subsidence shown in 2006 is compared to the 2011 condition.

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3.0 Vegetation Survey

3.1 Introduction

The vegetation of Amchitka Island comprises several plant communities that are characteristic of maritime tundra. Specifically, Amundsen (1972) described 10 community types that tend to occur along an elevation gradient coincident with soil drainage and organic deposition patterns. A few of the more abundant species on the island dominate or co-dominate most of the plant communities, and communities often differ from one another only with respect to the relative abundance of the dominant or co-dominant species. The communities have been grouped into three topoenvironmental units: beach vegetation, lowland tundra, and upland tundra. Two communities associated with beach vegetation occur just above the high-tide mark. One is dominated by grasses and the other is dominated by diffuse succulents. The lowland tundra vegetation types include ephemeral pools, dominated by semiaquatic graminoids; waterlogged fens, which have an abundance of lichens, rushes, and sedges; and slightly better drained bogs, which support black crowberry (*Empetrum nigrum*) and several upland grass species. Upland tundra community types range from meadows co-dominated by black crowberry, grasses, and sedges and to wind-desiccated "stripe" zones where linear patches of black crowberry and grasses are interspersed with patches of bare mineral soils (Amundsen 1977). The "stripes" are thought to be a consequence of downslope soil movement, which results from solifluction and from frost heaving (Amundsen 1972). Soliflucation is the downslope movement of waterlogged surface substrates over impermeable material that is often related to soil saturation subsequent to ice and snow melt during freeze/thaw cycles. In all plant community types except the stripe communities, the substrate is nearly 100 percent covered by some combination of nonvascular and vascular plant species. In the stripe communities, a substantial portion of the community is characterized by exposed mineral soils without vegetation cover. Non-indigenous plant species are uncommon, and invasive weeds have not been documented on the island.

Community dynamics of native Amchitka vegetation types are reflective of their low-energy environment, and change occurs slowly. Although annual productivity and relative species abundance can be quite variable, long-term "successional" patterns are not directional or linear. Instead, the distribution of plant communities appears to be mediated by hydrological processes that lead to complex mosaics of communities across the landscape. The spatial distribution and composition of community types appear to fluctuate slowly through time as communities become either more hydrophytic or mesophytic based on constantly changing hydrologic patterns. Hydrophytic communities are dominated by plant species which are adapted to living in water or very wet environments. Mesophytic communities are dominated by plant species which require moderate soil moisture conditions, where soils are generally not saturated during the entire growing season. Re-colonization of communities disturbed by natural processes, primarily solifluction, or by anthropogenic activities (e.g., road construction) is a very slow process. Bare mineral soils, like those present in the stripe communities, appear to persist for long periods of time, and some disturbed soils associated with World War II activities have remained barren for several decades. Vegetation recovery on soils with abundant organic material has been documented to be somewhat more vigorous (Amundsen 1976). Unlike ecosystems elsewhere, there are very few ephemeral, annual species present in the Amchitka maritime tundra to initiate colonization of disturbed soils. Amundsen (1972) did note, however, that Nootka lupine (*Lupinus nootkatensis*), a perennial forb, is abundant on disturbed sites and likely helps provide favorable microsites for the germination and establishment of additional vascular species.

All seven mud pit caps were sampled for vegetation cover using the same methodology employed for the 2006 surveys according to the 2011 sampling plan (DOE 2011). The findings from the 2006 survey indicated the mud pit caps on Drill Sites D, E and F had minimal vegetative cover. These three sites were reseeded in 2008.

3.2 Methods

Inspectors estimated cover using point interception, which is often recommend for monitoring vegetation status on mud pit caps (ITRC 2003) because the technique is precise and efficient. Specifically, inspectors used a point interception frame to establish a grid at each sample location. The frame is described in detail by Floyd and Anderson (1987) and consists of using double sets of crosshairs, placed on 10 cm centers within a 0.5 m by 1.0 m mount, to visualize a total of 36 points. A species or other nonvegetation entity is counted when it intercepts a point. Point interception frames of this design have been used effectively in mud pit capping research for more than 20 years (Forman and Anderson 2005).

Inspectors located sample frames on each mud pit cap using a stratified random sampling design. Permanent transects were established systematically across all mud pit caps in 2006, and frames were placed randomly along each transect such that about one out of every four meters was sampled (NNSA/NSO 2006). The same sample transects and random frame locations were used again for the 2011 survey. Table 1 summarizes the number of transects and frames sampled on each mud pit cap.

Table 1. Sample Design for Vegetation Surveys Conducted on Seven Mud Pit Caps on Amchitka Island, Alaska, during the 2006 and 2011 Growing Seasons

	Number of Transects	Number of Frames
Rifle Range	4	80
Long Shot	5	123
Cannikin South	2	30
Cannikin Ground Zero	5	62
Drill Site D	11	134
Drill Site F	3	35
Drill Site E	2	30
Total	**32**	**494**

Hultén (1968) was used as the taxonomic standard for species identification, and nomenclature was updated using the PLANTS National Database (USDA 2011). Data for vascular plants were recorded at the species level, and cryptogams were identified as either mosses or lichens. Both groups are abundant and well-represented across Amchitka Island. Moss species belonging to the genus *Sphagnum* and lichens in the *Cladonia* genus are among the most abundant cryptogams (Shacklette 1969).

Mean cover was summarized by species for vascular taxa, or by group for cryptogams, for each of the seven mud pit caps. Absolute cover for each species or functional group is calculated as the percentage of points intercepted by that species or functional group out of the total number of points sampled. Mean absolute cover for each species or functional group within each cap represents absolute cover from each frame averaged across all frames sampled within the cap. Mean total vegetation cover values were compared between the 2006 and 2011 surveys and

among mud pit caps using two-way analysis of variance (ANOVA) (Zar 1999) analyses. Because vegetation cover data are generally non-normal and fail to meet assumptions of equal variance, conditions that are also true of this data set, a two-way ANOVA was performed on ranks. General cover trends are discussed in the following section, and mud pit cap-specific cover summaries are presented in Appendix B.

3.3 Results and Discussion

Twenty-eight species consisting of one subshrub, eight graminoids, and 19 forbs were identified across the seven mud pit caps during the 2011 survey (Table 2). Vascular species richness ranged from 9 species on the Cannikin South mud pit cap to 22 species on the Long Shot mud pit cap (Appendix B; B-1 through B-7). Species richness generally increased between the 2006 and 2011 survey periods, as species richness ranged from only 4 to 14 species in 2006. Species richness was generally higher on lower-elevation mud pit caps than on higher-elevation mud pit caps during both survey periods. The overall increase in species richness between the two survey periods indicates that species from the undisturbed communities surrounding the mud pit caps continue to colonize and establish on the disturbed sites. The species richness data also suggest that conditions are more favorable for colonizing species on the lower-elevation mud pit caps.

More-diverse native, undisturbed plant communities surrounding the mud pit caps at lower-elevation sites, which provide a more-diverse natural seed source, may also be a factor influencing increased species richness on the mud pit caps at lower elevations.

Mean absolute vegetation cover ranged from approximately 23 percent on the Cannikin Ground Zero mud pit cap to nearly 58 percent on the Drill Site F mud pit cap (Table 3). On some sites, such as the Rifle Range mud pit cap and both Cannikin mud pit caps, nearly all of the vegetation cover is from vascular species. On others, such as the Long Shot mud pit cap and the mud pit caps at Drill Sites D and E, a substantial amount of vegetation cover is from cryptogams, primarily mosses (Table 3). Although cryptogams, non-vascular species of plants such as moss, are a conspicuous component of the Amchitka Island plant communities, they are rarely the dominant species and do not provide enough subsurface root structure to stabilize disturbed soils. For vegetation recovery purposes, however, cryptograms are preferable to exposed mineral soils because they can improve microsites for subsequent establishment of vascular species. Increasing nutrient availability, adding organic materials, and improving water-holding capacity are a few mechanisms by which cryptogams can improve soils for vascular species.

Black crowberry was the only subshrub encountered on the mud pit caps during the 2011 survey, and it occurred on the two lowest-elevation mud pit caps (Rifle Range and Long Shot) with less than 1 percent absolute cover at each site. This species dominates undisturbed plant communities across much of the island but is slow to establish on disturbed areas. It tends to produce few large seeds and appears to increase primarily through vegetation spread (Amundsen 1977); both are life history characteristics which would indicate that extended periods of time are required for reestablishment. Graminoids provided the greatest proportion of vascular cover on all seven mud pit caps, with cover values between 16 percent and 38 percent (Table 3).

Table 2. Vascular Species Identified During the 2011 Vegetation Surveys for Seven Mud Pit Caps on Amchitka Island

Scientific Name[a]	Common Name	Family	Duration
Subshrubs			
Empetrum nigrum	black crowberry	Empetraceae	Perennial
Graminoids			
Agrostis mertensii	northern bentgrass	Poaceae	Perennial
Bromus sitchensis	Alaska brome	Poaceae	Perennial
Carex macrochaeta	longawn sedge	Cyperaceae	Perennial
Deschampsia beringensis	Bering's tufted hairgrass	Poaceae	Perennial
Elymus macrourus	tufted wheatgrass	Poaceae	Perennial
Festuca rubra	red fescue	Poaceae	Perennial
Phleum alpinum	alpine timothy	Poaceae	Perennial
Poa stenantha	northern bluegrass	Poaceae	Perennial
Forbs			
Achillea millefolium	common yarrow	Asteraceae	Perennial
Anaphalis margaritacea	western pearly everlasting	Asteraceae	Perennial
Angelica lucida	seacoast angelica	Apiaceae	Perennial
Arnica unalaschcensis	Alaska arnica	Asteraceae	Perennial
Chamerion latifolium	dwarf fireweed	Onagraceae	Perennial
Conioselinum chinense	Chinese hemlockparsley	Apiaceae	Perennial
Draba stenopetala	Anadyr draba	Brassicaceae	Perennial
Equisetum arvense	field horsetail	Equisetaceae	Perennial
Koenigia islandica	island purslane	Polygonaceae	Annual
Lupinus nootkatensis	Nootka lupine	Fabaceae	Perennial
Pinguicula vulgaris	common butterwort	Lentibulariaceae	Perennial
Platanthera dilatata	scentbottle	Orchidaceae	Perennial
Potentilla villosa	villous cinquefoil	Rosaceae	Perennial
Primula cuneifolia	wedgeleaf primrose	Primulaceae	Perennial
Saxifraga sp.	saxifrage	Saxifragaceae	Perennial
Senecio pseudoarnica	seaside ragwort	Asteraceae	Perennial
Taraxacum officinale	common dandelion	Asteraceae	Perennial
Veronica americana	American speedwell	Scrophulariaceae	Perennial
Veronica serpyllifolia	thymeleaf speedwell	Scrophulariaceae	Perennial

[a] Nomenclature follows the PLANTS National Database (USDA 2011), and all species are considered to be native to Alaska by the same source.

Red fescue was consistently the most abundant grass, followed by Bering's tufted hairgrass; both species were seeded. Seeded grass species, which are proportionally much more abundant on the mud pit caps than in the surrounding undisturbed community, were providing the bulk of the vegetation cover on the mud pit caps during the 2011 survey. Longawn sedge (*Carex macrochaeta*) was the most abundant naturally colonizing graminoid with cover ranging between 0.5 percent and 3.2 percent (Appendix B). Forb cover varied greatly with a low cover value of less than 2 percent on the Drill Site D mud pit cap to a high value of about 18 percent on the Rifle Range mud pit cap. Nootka lupine was generally the most abundant forb species, which would be expected as it has been described as filling the niche of a "pioneer species." The abundance of lupine should have a positive impact on vegetation recovery on the mud pit caps because it functions as a nitrogen-fixer to improve soil nutrients, and it captures seed and provides suitable microhabitats for the establishment of other species (Amundsen 1972).

Table 3. Mean Absolute Cover for Vegetation and Nonvegetation Entities Across Seven Mud Pit Caps on Amchitka Island, 2011 Growing Season

	Rifle Range (%)	Long Shot (%)	Cannikin South (%)	Cannikin Ground Zero (%)	Drill Site D (%)	Drill Site F (%)	Drill Site E (%)
Vascular Growth Form							
Subshrub Cover	0.42	0.84	0.00	0.00	0.00	0.00	0.00
Graminoid Cover	23.72	22.81	31.30	15.95	19.82	37.94	26.39
Forb Cover	18.02	7.00	2.78	5.15	1.72	3.65	3.89
Total Vascular Cover	**42.15**	**30.65**	**34.07**	**21.10**	**21.54**	**41.59**	**30.28**
Nonvascular Growth Forms							
Moss Cover	2.33	25.93	4.26	1.25	25.08	15.40	26.02
Lichen Cover	0.00	0.52	0.09	0.31	4.33	0.79	0.00
Total Nonvascular Cover	**2.33**	**26.45**	**4.35**	**1.57**	**29.42**	**16.19**	**26.02**
Total Vegetation Cover	**44.48**	**57.09**	**38.43**	**22.67**	**50.95**	**57.78**	**56.30**
Nonvegetation Entities							
Bare Ground	30.59	34.15	38.80	57.75	7.21	4.37	2.22
Litter Cover	25.52	8.83	22.87	19.58	41.83	37.86	41.48
Total Nonvegetation Cover	**56.11**	**42.98**	**61.67**	**77.33**	**49.05**	**42.22**	**43.70**

Compared with values from the 2006 survey, mean total vegetation cover was higher in 2011 (Figure 2), and the increases were significant ($p < 0.05$) for all mud pit caps (Table 4 and Table 5). The magnitude of the cover increase between the two sample periods was greatest for the higher-elevation mud pit caps (Figure 2). Lower-elevation mud pit caps had significantly higher vegetation cover than higher-elevation mud pit caps in 2006 (Table 4), a trend that was described in the 2006 monitoring and inspection report using regression analyses (NNSA/NSO 2006). In 2011, cover values among mud pit caps were also significantly different, but some of both the higher- and lower-elevation mud pit caps had significantly higher cover values than some of the mid-elevation mud pit caps. The disproportionate trend in increasing vegetation cover on the upper-elevation mud pit caps indicates that the 2008 seeding effort was successful in overcoming some of the disparities in vegetation establishment among the lower- and higher-elevation mud pit caps. Figure 3 and Figure 4 show the change in vegetation as a result of the 2008 seeding effort on Site D.

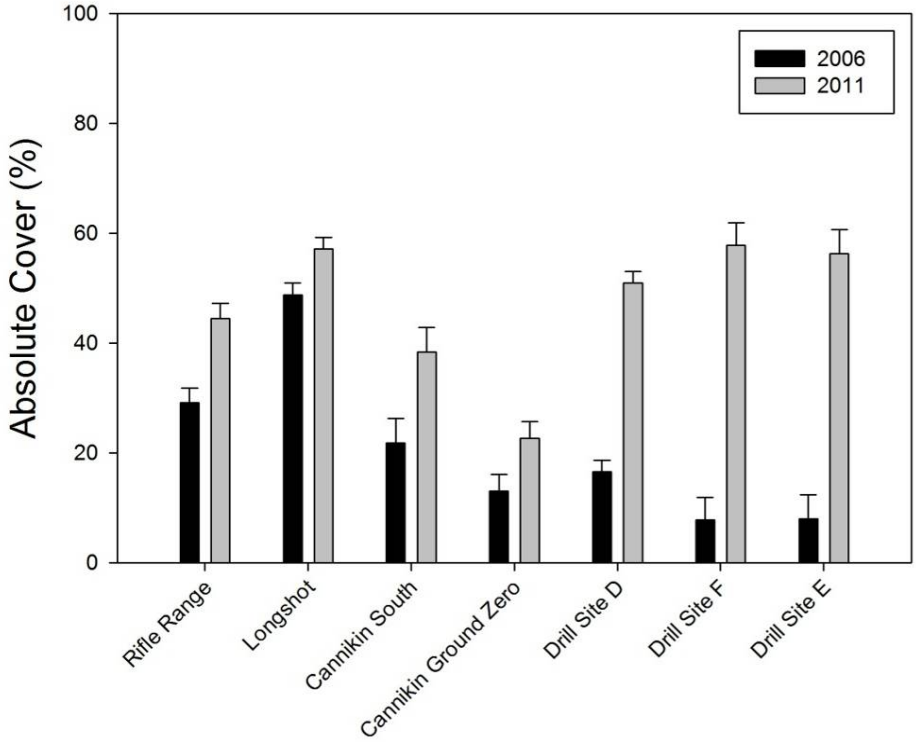

Figure 2. Mean Absolute Total Vegetation Cover from Seven Mud Pit Caps on Amchitka Island Surveys were conducted during the 2006 and 2011 growing seasons. Error bars represent ±1 standard error.

Figure 3. Site D Vegetative Cover in 2006

Figure 4. Site D Vegetative Cover in 2011

Table 4. Mean Vegetation Cover from Seven Mud Pit Caps on Amchitka Island, 2006 and 2011 Growing Seasons

Location	2006 (%)	2011 (%)	Significant
Rifle Range	29.13	44.48	Yes
Long Shot	48.74	57.09	Yes
Cannikin South	21.85	38.43	Yes
Cannikin Ground Zero	13.04	22.67	Yes
Drill Site D	16.56	50.95	Yes
Drill Site F	7.86	57.78	Yes
Drill Site E	7.96	56.30	Yes
Minimum Significant Difference[a]	**13.89**	**18.66**	

[a] Minimum significant difference indicates the value at which the difference of means between multiple pairwise comparisons among mud pit caps within each growing season becomes significant. The significance column indicates whether the mean cover difference between growing seasons was significant for a given mud pit cap.

Table 5. Results for Two-Way ANOVA on Ranks Comparing Mean Vegetation Cover Among Mud Pit Caps and Between Growing Seasons for Seven Mud Pit Caps on Amchitka Island

Two-Way ANOVA on Ranks Results					
Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Year	1	14091520.25	14091520.25	281.28	<0.001
Mud Pit Cap	6	10095770.91	1682628.49	33.59	<0.001
Year x Mud Pit Cap	6	6409668.81	1068278.14	21.32	<0.001
Residual	974	48794975.53	50097.51		
Total	987	80239258.50	81296.11		

DF = Degrees of Freedom
SS = Sum of Squares
MS = Mean Squares
F = F Statistic
P = P Value

Although vascular vegetation cover was substantially higher on the upper-elevation mud pit caps in 2011 than it was in 2006, due primarily to seeded species, nearly half of the total vegetation cover on those mud pit caps during the 2011 survey was from nonvascular mosses and lichens (Table 3), which also increased between the two survey periods. Drill Site D, for example, had more than 50 percent total vegetation cover but only around 20 percent vascular species cover. While 20 percent vascular cover on Drill Site D mud pit cap in 2011 is a marked increase over the approximately 6 percent vascular cover on the same mud pit cap reported in 2006 (NNSA/NSO 2006), it is not entirely comparable to the more that 40 percent vascular cover on the Rifle Range mud pit cap. Nonetheless, the upper-elevation mud pit caps had considerably higher cover values in 2011 than would have been expected without the 2008 supplemental seeding. Furthermore, cover by nonvascular species is preferable to bare ground, as discussed previously.

The three upper-elevation mud pit caps—Drill Sites D, F, and E—also had demonstrable increases in litter (i.e., standing dead biomass) between the two survey periods and had higher litter cover in 2011 than the lower-elevation mud pit caps during the same survey period. The increase in litter between the two sample periods, like the increase vascular species, is likely an effect of the 2008 seeding. Based on observations made during the 2011 surveys, it appears as though the species seeded in 2008 germinated and established vigorously during the first growing season. In fact, so much biomass was produced during the first growing season that it formed a thick thatch that suppressed growth of vascular vegetation, particularly the seeded grasses, during subsequent growing seasons. Though the high cover of litter on the upper-elevation mud pit caps has probably reduced the amount of vascular vegetation in the short-term, especially when compared to establishment during the first growing season subsequent to seeding, it will improve conditions for vascular re-establishment in the long-term. As the dead plant litter decomposes, it will add valuable organic material to the soil, which will further facilitate colonization of the disturbed sites and reduce the amount of time required for vegetation recovery. Lack of organic material was cited as one of the primary factors limiting recovery during the 2006 survey (NNSA/NSO 2006).

During the 2006 survey, mud pit cap inspections were conducted from August 2 through August 6, and many vascular plants were either flowering or in seed. The time period during which vegetation data were collected was probably very close to peak biomass conditions, and species were easily identified using reproductive structures. The 2011 vegetation survey was

conducted from June 20 to June 24; very few species were flowering, and several species were likely just emerging from dormancy. Consequently, species identifications were more challenging, and the vegetation cover was probably underestimated when compare to the 2006 data. This is especially notable for the upper-elevation mud pit caps where grass tillers were small and most graminoids lacked reproductive structures entirely.

Overall, species richness and vegetation cover increased on all mud pit caps between the 2006 and 2011 survey periods, and establishment conditions continue to become more favorable due to increases in mosses, lichens, and organic materials. Vegetation is generally reestablishing much more quickly on the mud pit caps than would be expected on bare mineral soils that were not reseeded. Amundsen (1977) reported that although vegetation on organic substrates could recover to levels comparable to the surrounding vegetation within about 20 years without intervention, natural vegetation recovery on mineral substrates could take centuries. Given observations made about vegetation recovery on Amchitka Island prior to this effort, it should be expected that mud pit caps at lower elevations and with more gentle slopes would recover more quickly, as both elevation and slope affect soil moisture availability (Amundsen 1972, 1976, and 1977).

3.4 Summary

Vascular vegetation has become established on all of the mud pit caps, and cover is at least 20 percent, even on mud pit caps with the lowest cover values. Cover is more than 50 percent on four of the seven mud pit caps when nonvascular species are considered. Because vegetation cover has been increasing on all mud pit caps over the past 5 years, there is little risk of invasive species establishment, and the total amount of area disturbed by the mud pit caps is a very small percentage of the total area of the island, there are few ecological motives to pursue further revegetation efforts. Monitoring efforts, however, should continue to ensure that vegetation recovery of the mud pit caps continues to progress and that any conditions that hinder continued establishment are addressed. If further revegetation efforts are required to address structural issues (e.g., erosion control), they should recognize the fragile nature of the vascular and nonvascular vegetation that already exists on the mud pit caps and minimize any disturbance to that vegetation. Because there are no known invasive plant species on Amchitka Island, any future revegetation efforts should also consider the potential risk of inadvertent introductions. If additional revegetation activities are required for purposes of erosion control, the availability of additional plant materials should be explored, as a more diverse seed mix is more likely to contain species adapted to the array of microsites available across each mud pit cap. The use of live materials, such as container-stock seedlings or wilding transplants may also be advantageous if additional revegetation efforts are required.

Finally, the criteria for assessing revegetation success should recognize the variability of the topoenvironments and plant communities in which the mud pit caps occur. For example, the Rifle Range mud pit cap, which is located in a Lowland Tundra wet crowberry meadow, would be expected to recover more quickly and ultimately have more vascular cover than the Drill Site E mud pit cap, which is located in a wind-desiccated upland tundra crowberry stripe community. In fact, it may not be reasonable to expect the three mud pit caps located in the crowberry stripe community type to approach 100 percent vegetation cover, because the mechanisms that perpetuate the barren stripes in those communities also affect the mineral soils remaining from the remediation activities.

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4.0 Infantry Road Maintenance

Road work was needed on Infantry Road to allow vehicle access to the inspection sites. A John Deere 310J backhoe was procured from Hertz Equipment rental to be hauled out and used on-island.

The first partial washout was near mile marker 4 (Figure 5) and required minor reconstruction (Figures 6 and 7). The available gravel was scraped off the surface and stockpiled for later use. The remaining material was spread out above the culvert until the road was approximately 12 feet (ft) wide. The material was compacted with the backhoe tires as it was progressively built up. The stockpiled gravel was spread out over the top of the road, then compacted with the backhoe tires and smoothed to provide the vehicles with a solid base and traction. The finished feature was a small dip.

The second washout was located near mile marker 8 (Figure 8) and required temporary reconstruction. After an on-site discussion, it was decided that the most efficient way to cross was to create a bypass to the north that was sufficient for the SUVs to pass (Figure 9). The bypass was constructed by first scraping and stockpiling the surface gravel for later use, then placing larger rock on the ground to provide a stable foundation. From here, road base was placed on top of the rock to allow the backhoe to cross the drainage. Inspectors borrowed two lengths of 14-inch well casing from the stockpile of well construction materials to use as culverts (Figure 10). The culverts were placed at the bottom of the channel and were armored at the upstream and downstream sides to prevent undercutting. Road base was then placed on the culvert and compacted by the backhoe tires. Once final grade was determined, stockpiled gravel was placed, compacted, and smoothed. The ground around this crossing was saturated, and vehicle traffic resulted in extensive ruts and potholes (Figure 11). This crossing will require additional maintenance during the next site visit.

Figure 5. Washout in Infantry Road near Mile Marker 4

Figure 6. Road repair near Mile Marker 4 in Progress

Figure 7. Completed Road Repair near Mile Marker 4

Figure 8. Infantry Road Washout near Mile Marker 8

Figure 9. Construction of Roadway at Mile Marker 8 Washout

Figure 10. Culverts Installed at Mile Marker 8 Washout

Figure 11. Mile Marker 8 Crossing after a Few Days of Use

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5.0 Miscellaneous Maintenance

The on-island work included various maintenance tasks. All of the issues noted in the Post-Closure Monitoring and Inspection Plan (DOE 2011) were completed. Other maintenance items were addressed as they arose and as time permitted. The road to the RX site was impassable due to a ditch that had been dug through the road to restrict access and make it impassable. At the request of Merry Maxwell of the U.S. Fish and Wildlife Service, the ditch was filled in to allow them access to their inspection sites.

5.1 Monitoring Well Abandonment

On June 21, 2011, former monitoring wells GZ-1 and GZ-2 at the Long Shot site were examined with a borehole video camera (Figure 12). Well GZ-1 had good structural integrity and minimal precipitate in the water but was blocked above the screened interval. Well GZ-2 was in similar condition but had more turbidity and a blockage in the well screen at 96.5 ft. Both wells were abandoned according to state standards—the casings were filled with a polymer-coated, three-eighths-inch bentonite pellets to within 3 ft of the ground surface (Figures 13 and 14). Once the bentonite had hydrated, the remaining void space was filled with concrete. The casings remain in place above ground to use as a future point of reference.

A former borehole at Site E (UAE-7c/h) was an 8-inch-diameter conduit surrounded by a 16-inch-diameter flange that was open at ground level (Figure 15). This hole was abandoned by bolting a three-sixteenths-inch-thick steel plate to the flange, minimizing its potential as a safety hazard.

Figure 12. Scoping Well GZ-1 with a Borehole Video Camera

Figure 13. Placement of Three-Eighths-Inch Bentonite Pellets into Well GZ-1

Figure 14. Well GZ-1 Filled with Bentonite Pellets

Figure 15. 16-Inch Square Plate Attached to Flange a top Hole UAE-7c/h at Site E

5.2 Perimeter Sign Installation

On June 22, 2011, signs warning of diesel-range organics and drilling muds were placed around the perimeter of all seven mud pit caps. Each sign was fastened by two U-bolts bolted onto a 5-foot-tall T-post that was driven 2 to 3 ft into the ground. Signs were spaced close enough to be visible from any direction of approach to each site (Figures 16 and 17).

Figure 16. Perimeter Signs Installed Around a Mud Pit Cap

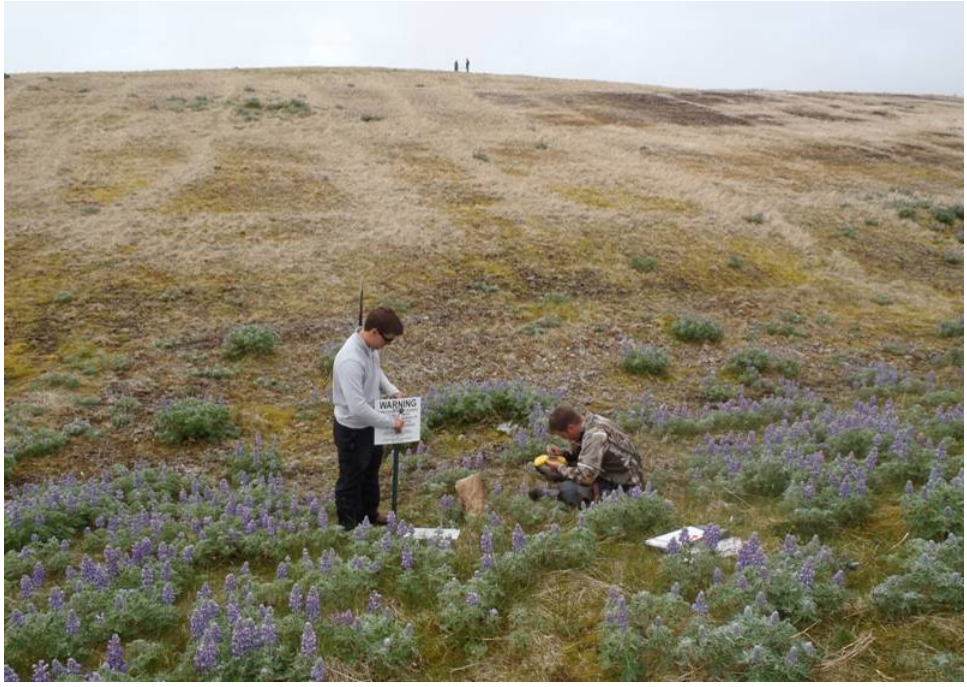

Figure 17. Installation of Signs Around Mud Pit Cap at Site D

5.3 Milrow Surface Ground Zero Plaque Repair

The replacement of the plaque at Milrow Surface Ground Zero was partially completed during the 2008 inspection and sampling event. During the 2011 inspection trip, the task was completed on June 21. The plaque was removed from the underlying concrete structure, and the 2-inch by 6-inch form was inspected to determine if replacement or repairs were needed. It was determined that with minor repairs the wood frame would hold concrete (Figures 18 and 19). Approximately five bags of Quickrete concrete were mixed in the rear bucket of the backhoe with water from a nearby lake. Once the concrete was at the right consistency, the 34-inch by 22-inch internal dimension form was filled to the top with concrete, and the plaque was pressed into place.

All remaining concrete from this repair was utilized to top off monitoring wells GZ-1 and GZ-2 casings at the Long Shot site. Since the bentonite had sufficient time to hydrate, concrete was used for the top 3 ft to form a more durable plug.

Figure 18. Mixing Concrete in the Backhoe Bucket

Figure 19. Finished Plaque at Milrow Surface Ground Zero

5.4 Tsunami Warning Center Telemetry Station

Multiple small telemetry stations are set up on the perimeter of Amchitka Island and are linked wirelessly to a major station at the southeast part of the island overlooking the old runways (Figure 20). This system collects earthquake, volcanic, tidal, and video information and is operated jointly by the Alaska-Pacific Tsunami Warning Center and the Alaska Volcanic Observatory Center. Cyrus Read, a technician with the U.S. Geological Survey's Alaska Volcano Observatory, was unable to make the second flight out to Adak and requested, if time permitted, that someone troubleshoot issues the station had been having.

On June 23, 2011, field personnel attempted to troubleshoot the connection issues at this station. The field crew contacted Cyrus Read via a satellite phone, and the system modem was reset. Other efforts were made to inspect equipment for problems, but with the limited resources available, repairs were unsuccessful, and communication was not re-established.

Figure 20. Main Telemetry Station

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6.0 Recommendations

The following recommendations are based on the inspection of the seven earthen caps and access to the seven sites. Three of the mud pit caps (Rifle Range, Cannikin South, and Cannikin Ground Zero) had no significant change in their condition since the 2006 inspection. Minor conditions at the other four mud pit caps that require monitoring or repair during the next inspection are as follows:

- At Site E, monitor a small reddish-brown colored seep just northeast of the mud pit cap.
- At site F, plan to fill a small depression in the southwest part of the mud pit cap and re-contour Channel F1 at the east end of the mud pit cap to reduce ponding.
- At Site D, plan to fill the small holes along the southwest side of the west mud pit cap, correct any erosion on the southwest side of the west mud pit cap, and repair the breach in the dam for sediment trap D-1 just southwest of the west mud pit cap.
- At the Long Shot Site, repair minor rills in the northeast and southwest parts of the mud pit cap, repair several small depressions in the south and southwest parts of the mud pit cap, plan to fill small holes along the east base of the mud pit cap, re-contour a small area along the base of the southwest corner of the cell to avoid ponding water and monitor a small reddish (probably iron)-colored seep at the east base of the mudpit cap.
- Reseeding and fertilizing will take place on all caps and formerly disturbed areas of the seven sites and the seed mixture will be recommended by Stoney Wright of the Alaska Department of Natural Resources.
- Next site visit should be in late July or August so that vegetation on the mud pit caps has had enough time to grow prior to conducting the vegetation survey.
- Be prepared to do road maintenance during the next site visit.
- Any and all work on the caps that require fill material will utilize native soil material.
- Should plan on providing assistance to the USGS in regards to seismic station maintenance in 2016.

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7.0 References

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Appendix A

Inspection Reports

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Appendix A-1

Rifle Range

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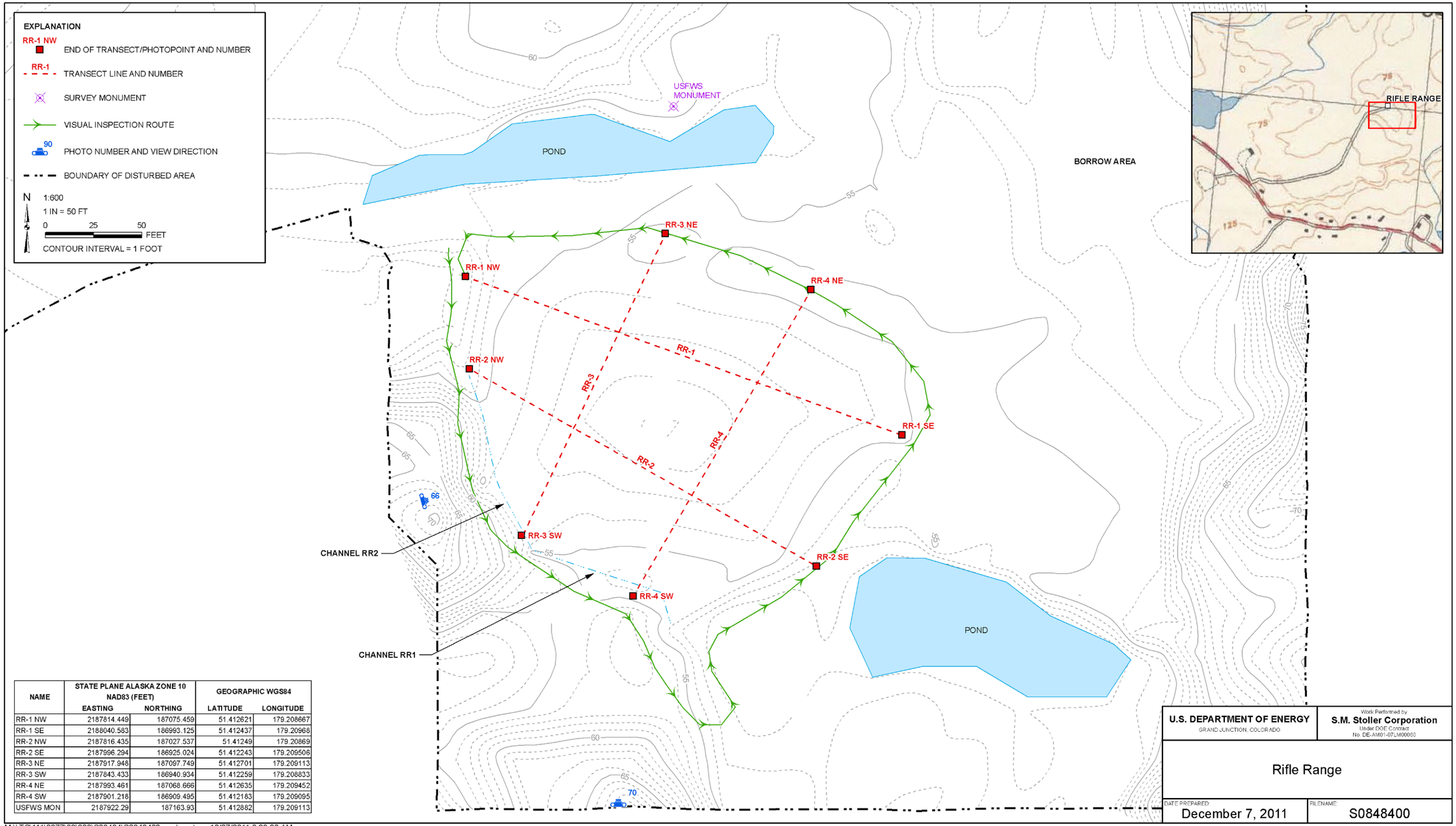

NAME	STATE PLANE ALASKA ZONE 10 NAD83 (FEET)		GEOGRAPHIC WGS84	
	EASTING	NORTHING	LATITUDE	LONGITUDE
RR-1 NW	2187814.449	187075.459	51.412621	179.208667
RR-1 SE	2188040.583	186993.125	51.412437	179.20968
RR-2 NW	2187816.435	187027.537	51.41249	179.20869
RR-2 SE	2187996.294	186925.024	51.412243	179.209506
RR-3 NE	2187917.948	187097.749	51.412701	179.209113
RR-3 SW	2187843.433	186940.934	51.412259	179.208833
RR-4 NE	2187993.461	187068.666	51.412635	179.209452
RR-4 SW	2187901.218	186909.495	51.412183	179.209095
USFWS MON	2187922.29	187163.93	51.412882	179.209113

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Figure A–1. Rifle Range

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AMCHITKA MUD PIT SITES POST-CLOSURE MONITORING CHECKLIST

Mud Pit Site: Rifle Range (RR)	Date of Inspection: June 20 and 21, 2011
Responsible Agency: U.S. Department of Energy – Legacy Management	Project Manager: Mark Kautsky
Inspector (name, title, organization): Craig Goodknight, Inspection Team Lead, S.M. Stoller Corp.	

A. General Instructions

1. All checklist items must be completed and detailed comments made to document the results of the site inspection.
2. The completed checklist is part of the field record of the inspection. Additional pages should be used as necessary to ensure that a complete record is made. Number and attach the additional pages upon completion of the inspection.
3. Any checklist line item marked by an inspector in a SHADED BOX must be fully explained or an appropriate reference to previous reports provided. The explanation should include the inspector's rationale for conclusions and recommendations, if appropriate. Explanations are to be placed on additional attachments and cross-referenced appropriately, and may take the form of sketches, measurements, and/or annotated site maps.
4. The site inspection is a walking inspection of the entire site, including the perimeter and sufficient transects to be able to inspect the entire surface and all features specifically described in this checklist. Attach a drawing indicating the starting and ending points and the direction and pattern of the inspection.
5. A standard set of digital photographs is required. In addition, all anomalous features or new features (such as changes in adjacent area land use) are to be photographed. A photo log entry will be made for each photograph taken.

B. Preparation (to be completed prior to site visit)	YES	NO	EXPLANATION
1. Site as-built plans and site base map reviewed	X		Mud Pit Closure Plans and As-Built
2. Previous inspection reports reviewed	X		2006 Inspection Report
a. Were anomalies or trends detected on previous inspections?		X	
b. Was maintenance performed on areas with anomalies?			Not Applicable
3. Site maintenance and repair records reviewed		X	No previous maintenance activities were done
a. Has site repair resulted in a change from as-built conditions?		X	No detectable changes from as-built condition
b. Are revised as-builts available that reflect repair changes?			Not Applicable. No repairs have been made

C. Site Inspection (to be completed during inspection)	YES	NO	EXPLANATION
1. Adjacent offsite features within mud pit site area			
a. Changes in use of adjacent area?		X	Wildlife refuge
b. Any new roads or trails?		X	Per previous photos and as-built drawings
c. Change in the position of nearby washes?		X	None detected
d. Erosion/deposition of nearby washes?		X	None detected
e. New drainage channels?		X	None detected
f. Change in surrounding vegetation?		X	None detected
2. Security markers; signs			
a. Displacement of site markers, boundary markers, or monuments?		X	USFWS Monument was present/Good condition
b. Signs damaged or removed?		X	Signs were installed around mud pit cap margin
3. Mud Pit Cap			
a. Evidence of subsidence?		X	
b. Evidence of cracking?		X	
c. Evidence of erosion (wind or water)?		X	
d. Evidence of animal burrowing?		X	
e. Are site markers disturbed? By man?_____ By natural processes?_____		X	
f. Do natural processes threaten the integrity of mud pit cap or site marker?		X	

AMCHITKA MUD PIT SITES POST-CLOSURE MONITORING CHECKLIST (continued)

Mud Pit Site: Rifle Range (RR)	Date of Inspection: June 20 and 21, 2011

C. Site inspection (continued)	YES	NO	EXPLANATION
4. Vegetative cover			
a. Is plant cover adequate to prevent erosion?	X		See discussion in Section 3.0
b. Are weedy annual plants present? Do they require removal?		X	See discussion in Section 3.0
c. Evidence of animals on mud pit cap?		X	See discussion in Section 3.0
d. Evidence of excessive plant mortality?		X	See discussion in Section 3.0
e. Has a vegetative cover log been completed?	X		See Vegetative Cover Log
5. Photo Documentation			
a. Has a photo log been prepared?	X		See Photograph Log
b. How many photos were taken?			11 photos as noted in the Photograph Log

D. Field Conclusions			
1. Imminent hazard to integrity of mud pit cap? (If yes, immediate report required. Note the person or agency the report will be made to.)		X	
2. Are more frequent inspections required?		X	
3. Are existing maintenance actions satisfactory?			Not Applicable. No maintenance was done or required.
4. Are existing repair actions satisfactory?			Not Applicable. No repairs were done or required.
5. Is other maintenance/repair necessary?		X	

6. Rationale for field conclusions: Conclusions were based on walkover visual inspections and plant counts.

7. Factors contributing to or impacting inspection: None noted

E. Certification

I certify that I have conducted an inspection of the Rifle Range mud pit cap in accordance with the Post-Closure Monitoring and Inspection Plan for Amchitka Island Mud Pit Release Sites, dated March 2011, as recorded on this checklist, discussion in Section 2.0, field notes, vegetative cover log, photograph log, and photos.

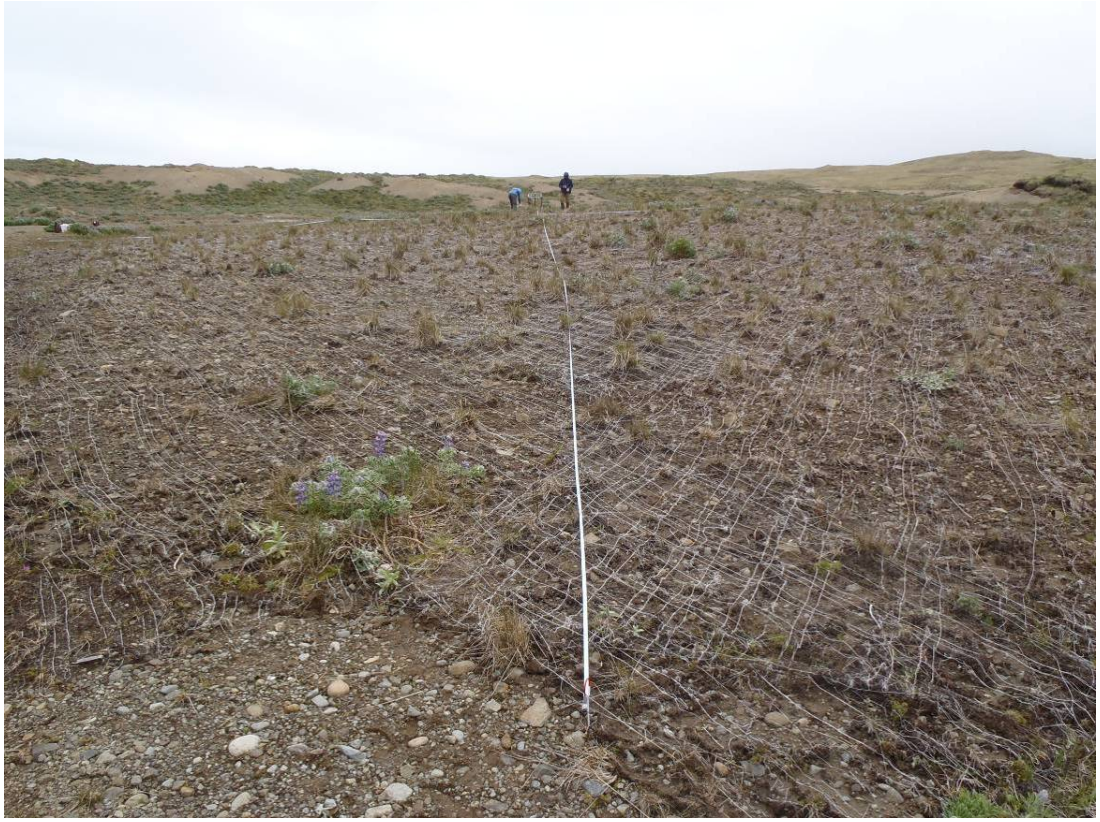
Inspector Printed Name: Craig Goodknight	Inspector Signature:
Title: Inspection Team Lead	Date: 7/15/11

PHOTOGRAPH LOG

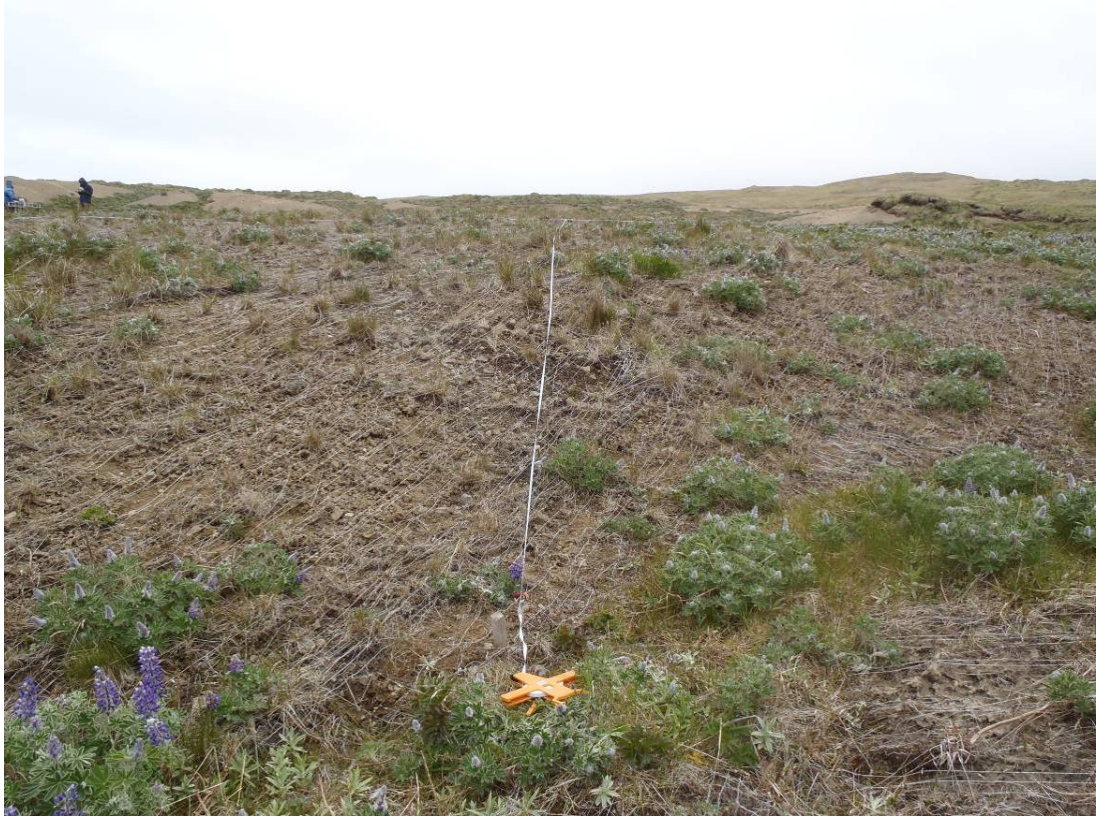
Mud Pit Site: Rifle Range (RR)				
Date	**Photo #**	**GPS Location***	**Direction of Photo**	**DESCRIPTION (Photopoints indicated by an *)**
6/20/11	P6200057	See Figure A-1	Northwest	USFWS Monument*
6/20/11	P6200058	See Figure A-1	Southeast	Transect RR-1 NW*
6/20/11	P6200059	See Figure A-1	Southeast	Transect RR-2 NW*
6/20/11	P6200060	See Figure A-1	Northeast	Transect RR-3 SW*
6/20/11	P6200061	See Figure A-1	Northeast	Transect RR-4 SW*
6/20/11	P6200062	See Figure A-1	Northwest	Transect RR-2 SE*
6/20/11	P6200063	See Figure A-1	Northwest	Transect RR-1 SE*
6/20/11	P6200064	See Figure A-1	Southwest	Transect RR-4 NE*
6/20/11	P6200065	See Figure A-1	Southwest	Transect RR-3 NE*
6/20/11	P6200066	See Figure A-1	East	View across mud pit cap
6/21/11	P6210070	See Figure A-1	North	View across mud pit cap

*GPS location datum AK State Plane NAD 1983

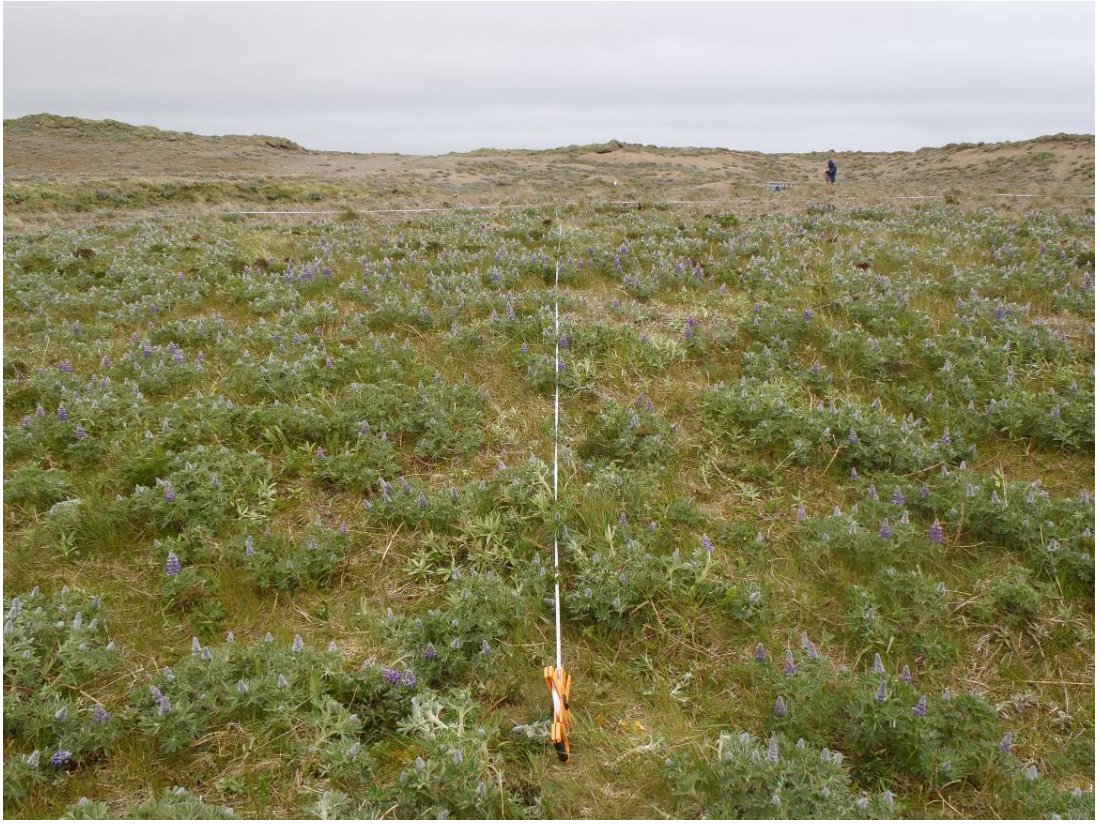
P6200057 – Rifle Range USFWS Monument, view NW



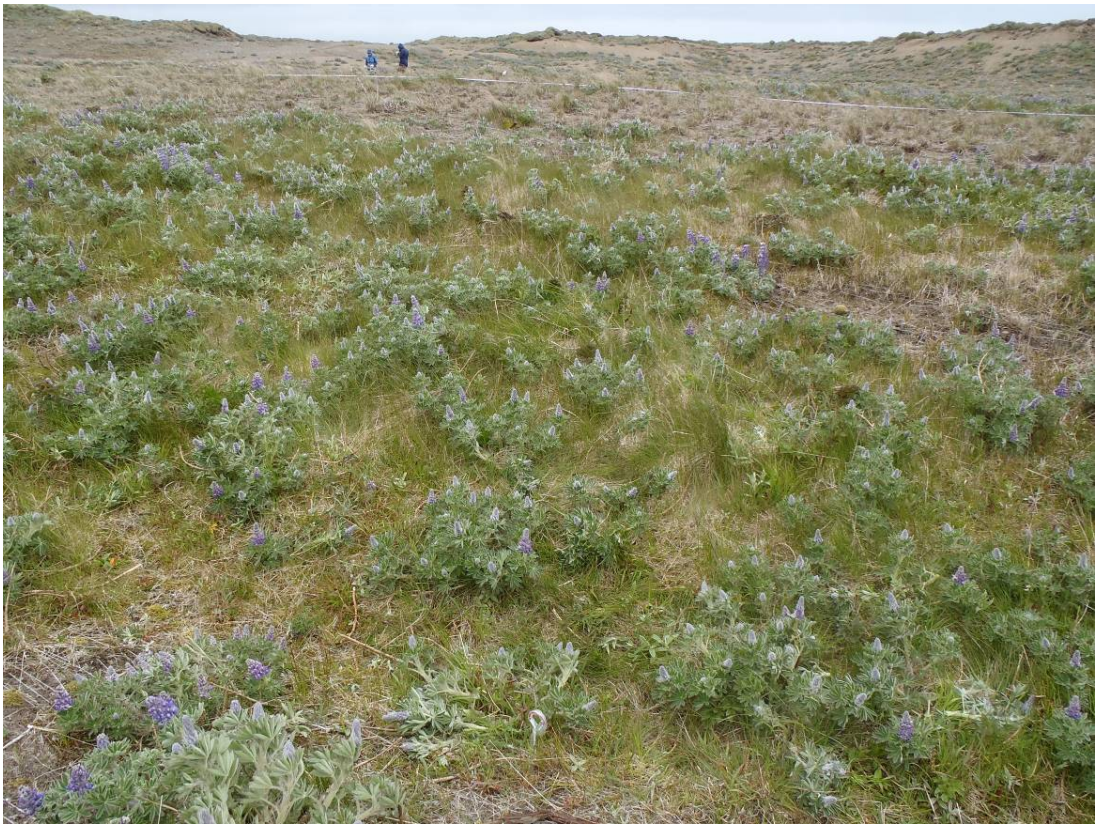
P6200058 – View SE from RR-1 NW



P6200059 – View SE from RR-2 NW



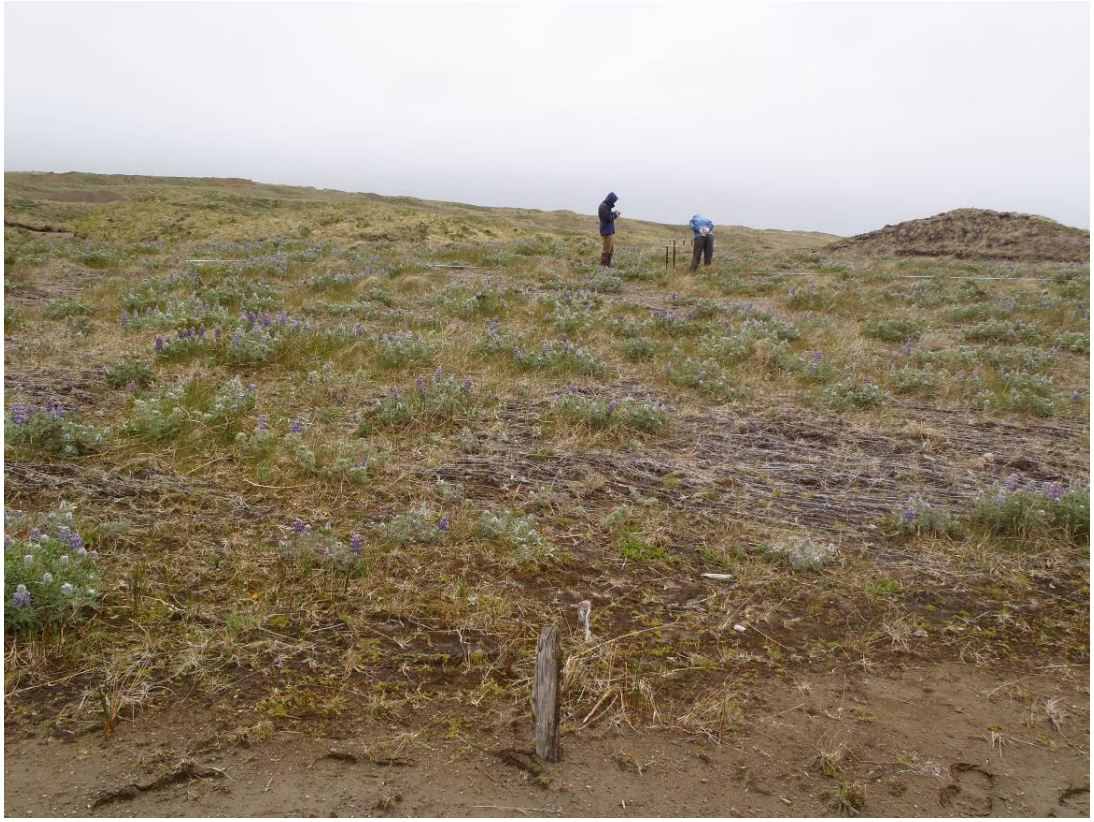
P6200060 – View NE from RR-3 SW



P6200061 – View NE from RR-4 SW

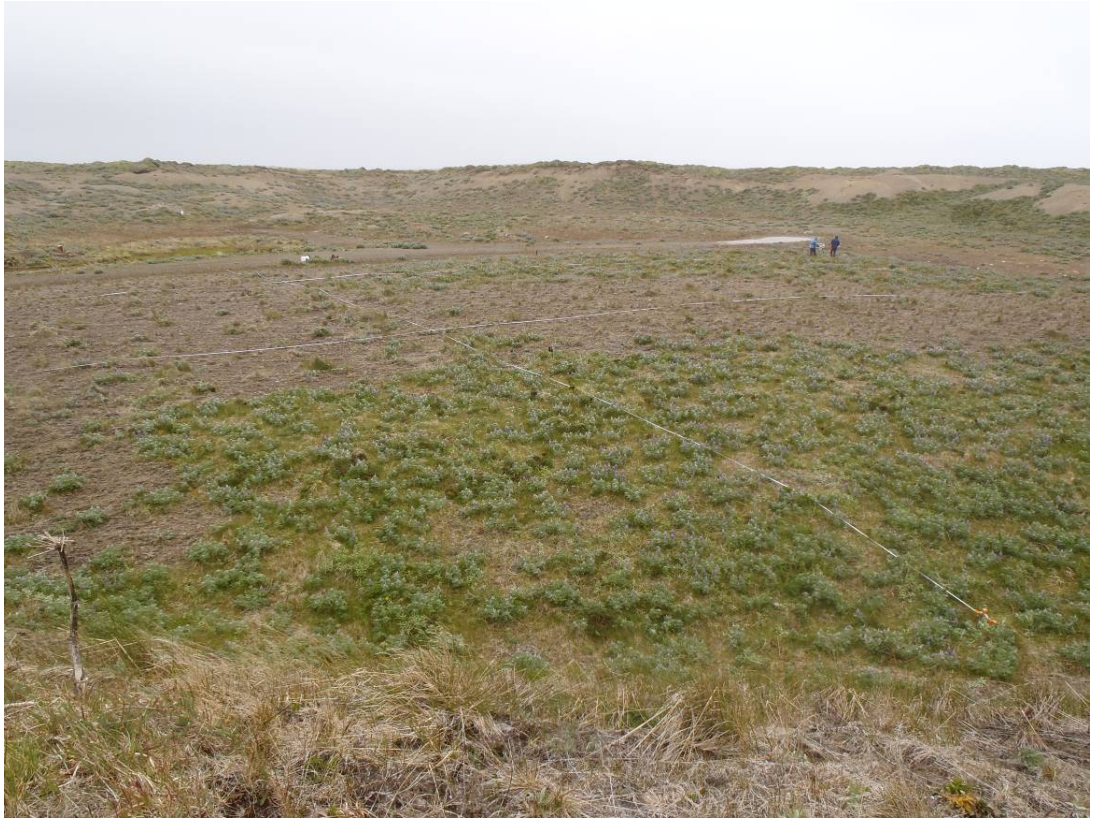
P6200062 – View NW from RR-2 SE

P6200063 – View NW from RR-1 SE



P6200064 – View SW from RR-4 NE

P6200065 – View SW from RR-3 NE



P6200066 – View E across Rifle Range mud pit cap

P6210070 – View N across Rifle Range mud pit cap

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Appendix A-2

Long Shot

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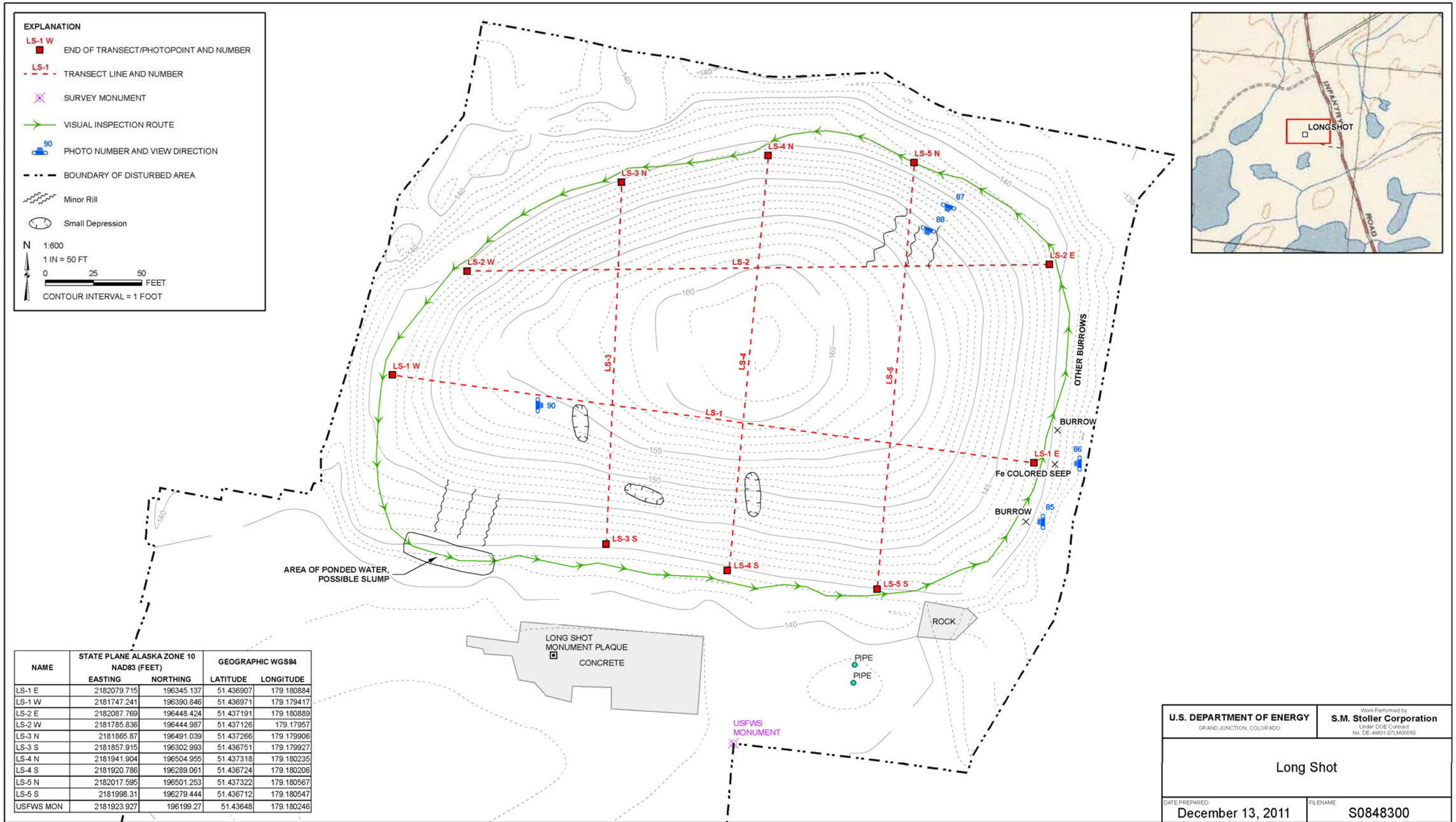

NAME	STATE PLANE ALASKA ZONE 10 NAD83 (FEET)		GEOGRAPHIC WGS84	
	EASTING	NORTHING	LATITUDE	LONGITUDE
LS-1 E	2182079.715	196345.137	51.436907	179.180884
LS-1 W	2181747.241	196390.846	51.436971	179.179417
LS-2 E	2182087.769	196448.424	51.437191	179.180889
LS-2 W	2181785.836	196444.987	51.437126	179.17957
LS-3 N	2181865.87	196491.039	51.437266	179.179906
LS-3 S	2181857.915	196302.993	51.436751	179.179927
LS-4 N	2181941.904	196504.955	51.437318	179.180235
LS-4 S	2181920.786	196289.061	51.436724	179.180206
LS-5 N	2182017.595	196501.253	51.437322	179.180567
LS-5 S	2181998.31	196279.444	51.436712	179.180547
USFWS MON	2181923.927	196199.27	51.43648	179.180246

Figure A–2. Long Shot

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AMCHITKA MUD PIT SITES POST-CLOSURE MONITORING CHECKLIST

Mud Pit Site: Long Shot (LS)	Date of Inspection: June 21, 2011
Responsible Agency: U.S. Department of Energy – Legacy Management	Project Manager: Mark Kautsky
Inspector (name, title, organization): Craig Goodknight, Inspection Team Lead, S.M. Stoller Corp.	

A. General Instructions

1. All checklist items must be completed and detailed comments made to document the results of the site inspection.
2. The completed checklist is part of the field record of the inspection. Additional pages should be used as necessary to ensure that a complete record is made. Number and attach the additional pages upon completion of the inspection.
3 .Any checklist line item marked by an inspector in a SHADED BOX must be fully explained or an appropriate reference to previous reports provided. The explanation should include the inspector's rationale for conclusions and recommendations, if appropriate. Explanations are to be placed on additional attachments and cross-referenced appropriately, and may take the form of sketches, measurements, and/or annotated site maps.
4. The site inspection is a walking inspection of the entire site, including the perimeter and sufficient transects to be able to inspect the entire surface and all features specifically described in this checklist. Attach a drawing indicating the starting and ending points and the direction and pattern of the inspection.
5. A standard set of digital photographs is required. In addition, all anomalous features or new features (such as changes in adjacent area land use) are to be photographed. A photo log entry will be made for each photograph taken.

B. Preparation (to be completed prior to site visit)	YES	NO	EXPLANATION
1. Site as-built plans and site base map reviewed	X		Mud Pit Closure Plans and As-Built
2. Previous inspection reports reviewed	X		2006 Inspection Report
a. Were anomalies or trends detected on previous inspections?		X	
b. Was maintenance performed on areas with anomalies?			Not Applicable
3. Site maintenance and repair records reviewed		X	No previous maintenance activities were done
a. Has site repair resulted in a change from as-built conditions?		X	No detectable changes from as-built condition
b. Are revised as-builts available that reflect repair changes?			Not Applicable. No repairs have been made

C. Site Inspection (to be completed during inspection)	YES	NO	EXPLANATION
1. Adjacent offsite features within mud pit site area			
a. Changes in use of adjacent area?		X	Wildlife refuge
b. Any new roads or trails?		X	Per previous photos and as-built drawings
c. Change in the position of nearby washes?		X	None detected
d. Erosion/deposition of nearby washes?	X		A small reddish-brown seep just E of the mud pit cap and some ponded water just off the SW edge of the mud pit cap as noted below
e. New drainage channels?		X	None detected
f. Change in surrounding vegetation?		X	None detected
2. Security markers; signs			
a. Displacement of site markers, boundary markers, or monuments?		X	USFWS Monument was present/Good condition. Ground Zero Monument was intact.
b. Signs damaged or removed?		X	Signs were installed around mud pit cap margin
3. Mud Pit Cap			
a. Evidence of subsidence?	X		Several small depressions in the S part of the mud pit cap as noted below
b. Evidence of cracking?		X	
c. Evidence of erosion (wind or water)?	X		Some rills on steep slopes in the NE and SW sides of the mud pit cap, as noted below
d. Evidence of animal burrowing?		X	Several small holes along E base of mud pit cap, as noted below
e. Are site markers disturbed? By man?_____ By natural processes?_____		X	

AMCHITKA MUD PIT SITES POST-CLOSURE MONITORING CHECKLIST (continued)

Mud Pit Site: Long Shot (LS)	Date of Inspection: June 21, 2011

C. Site inspection (continued)	YES	NO	EXPLANATION
3. Mud Pit Cap (continued)			
f. Do natural processes threaten the integrity of mud pit cap or site marker?		X	
4. Vegetative cover			
a. Is plant cover adequate to prevent erosion?	X		See discussion in Section 3.0
b. Are weedy annual plants present? Do they require removal?		X	See discussion in Section 3.0
c. Evidence of animals on mud pit cap?		X	See discussion in Section 3.0
d. Evidence of excessive plant mortality?		X	See discussion in Section 3.0
e. Has a vegetative cover log been completed?	X		See Vegetative Cover Log
5. Photo Documentation			
a. Has a photo log been prepared?	X		See Photograph Log
b. How many photos were taken?			17 photos as noted in the Photograph Log

D. Field Conclusions			
1. Imminent hazard to integrity of mud pit cap? (If yes, immediate report required. Note the person or agency the report will be made to.)		X	
2. Are more frequent inspections required?		X	
3. Are existing maintenance actions satisfactory?			Not Applicable. No maintenance was done or required.
4. Are existing repair actions satisfactory?			Not Applicable. No repairs were done or required.
5. Is other maintenance/repair necessary?		X	

6. Rationale for field conclusions: Conclusions were based on walkover visual inspections and plant counts. As many as 6 small holes are along the E base of the mud pit cap (photo P6210085), one down to the geomembrane cover. One small reddish-brown seep (photo P6210086) is just E of the E edge of the mud pit cap – water from this drains to the N. Moderately steep slopes on this mud pit cap have allowed runoff water to erode small rills on the NE and SW parts of the mud pit cap (photos P6210087 and P6210088). The rills are as much as 1.5 ft wide and 8 in. deep (red and white stakes are 1 ft long). Rill formation should decrease with more establishment of vegetation, but this should be monitored in future inspections. Several small depressions are along the S slope and W part (photo P6210090) of the mud pit cap. These may reflect minor subsidence or they may just represent undulations during placement of the mud pit cap surface. These depressions should be monitored during future inspections to see if they increase in size/depth, indicating subsidence. An area of ponded water along the base of the SW edge of the mud pit cap may cause subsidence – trenching may be necessary for it to drain to the E.

7. Factors contributing to or impacting inspection: None noted

E. Certification

I certify that I have conducted an inspection of the Long Shot mud pit cap in accordance with the Post-Closure Monitoring and Inspection Plan for Amchitka Island Mud Pit Release Sites, dated March 2011, as recorded on this checklist, discussion in Section 2.0, field notes, vegetative cover log, photograph log, and photos.

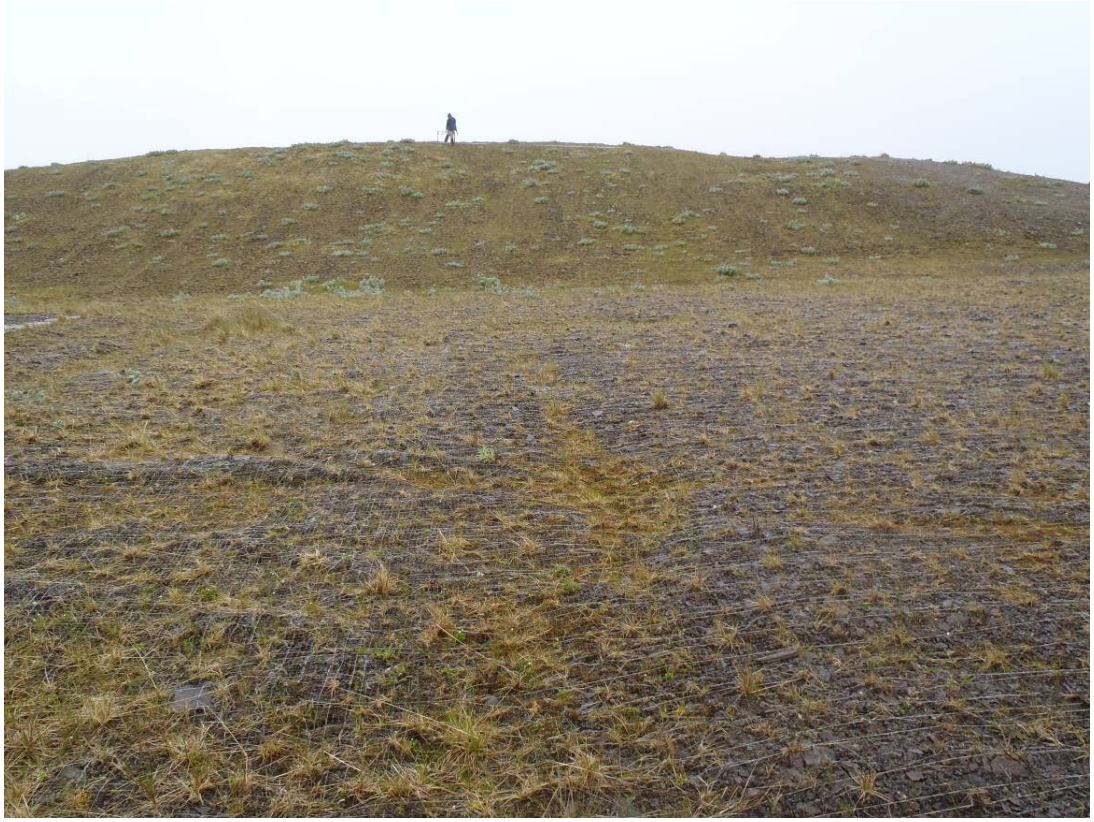
Inspector Printed Name: Craig Goodknight	Inspector Signature:
Title: Inspection Team Lead	Date: 7/15/11

PHOTOGRAPH LOG

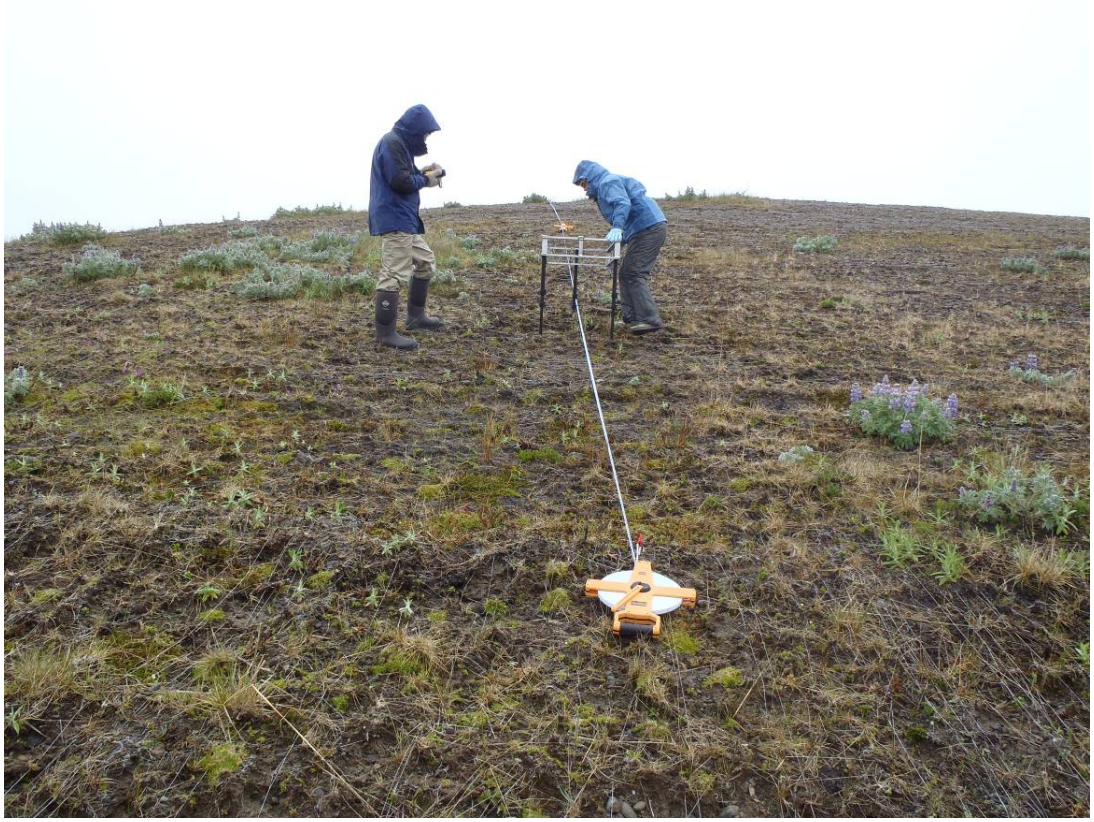
Mud Pit Site: Long Shot (LS)				
Date	**Photo #**	**GPS Location***	**Direction of Photo**	**DESCRIPTION (Photopoints indicated by an *)**
6/21/11	P6210072	See Figure A-2	Northwest	USFWS Monument*
6/21/11	P6210073	See Figure A-2	North	LS mud pit cap from USFWS Monument*
6/21/11	P6210074	See Figure A-2	West	Transect LS-1 E*
6/21/11	P6210075	See Figure A-2	West	Transect LS-2 E*
6/21/11	P6210076	See Figure A-2	South	Transect LS-5 N*
6/21/11	P6210077	See Figure A-2	South	Transect LS-4 N*
6/21/11	P6210078	See Figure A-2	South	Transect LS-3 N*
6/21/11	P6210079	See Figure A-2	East	Transect LS-2 W*
6/21/11	P6210080	See Figure A-2	East	Transect LS-1 W*
6/21/11	P6210081	See Figure A-2	North	Transect LS-3 S*
6/21/11	P6210082	See Figure A-2	North	Transect LS-4 S*
6/21/11	P6210083	See Figure A-2	North	Transect LS-5 S*
6/21/11	P6210085	See Figure A-2	West	Several small holes along E base of mud pit cap
6/21/11	P6210086	See Figure A-2	West	Small reddish-brown seep just E of mud pit cap
6/21/11	P6210087	See Figure A-2	Southwest	Rills on steep slope on NE side of mud pit cap
6/21/11	P6210088	See Figure A-2	South	Rill on steep partly vegetated slope on NE side of mud pit cap
6/21/11	P6210090	See Figure A-2	East	Small depression in W part of mud pit cap

*GPS location datum AK State Plane NAD 1983

P6210072 – Long Shot USFWS Monument, view NW



P6210073 – View N of LS mud pit cap from USFWS Monument



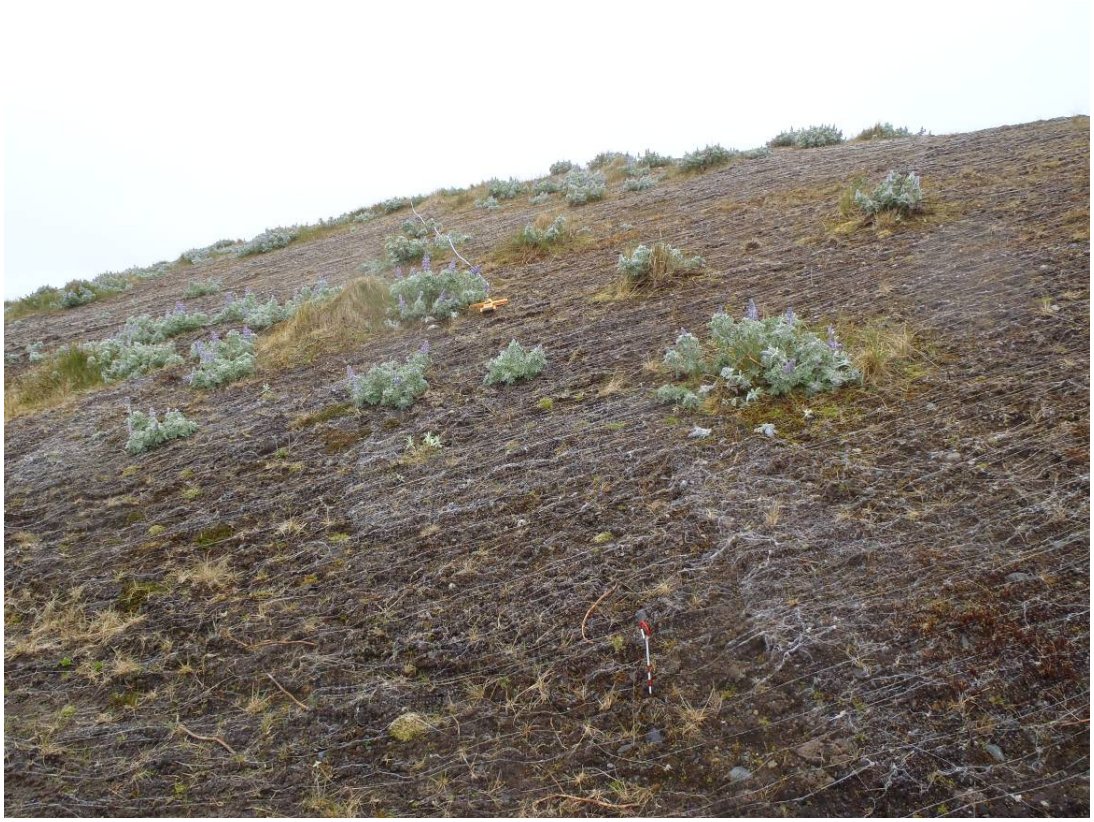
P6210074 – View W from LS-1 E

P6210075 – View W from LS-2 E

P6210076 – View S from LS-5 N

P6210077 – View S from LS-4 N

P6210078 – View S from LS-3 N



P6210079 – View E from LS-2 W

P6210080 – View E from LS-1 W

P6210081 – View N from LS-3 S

P6210082 – View N from LS-4 S

P6210083 – View N from LS-5 S

P6210085 – View W of small hole along E base of mud pit cap

P6210086 – View W of small reddish-brown seep just E of mud pit cap

P6210087 – View SW of rills on steep slope on NE side of mud pit cap

P6210088 – View S of rill on steep, partly vegetated slope on NE side of mud pit cap

P6210090 – View E of small depression in W part of mud pit cap

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Appendix A-3

Cannikin South

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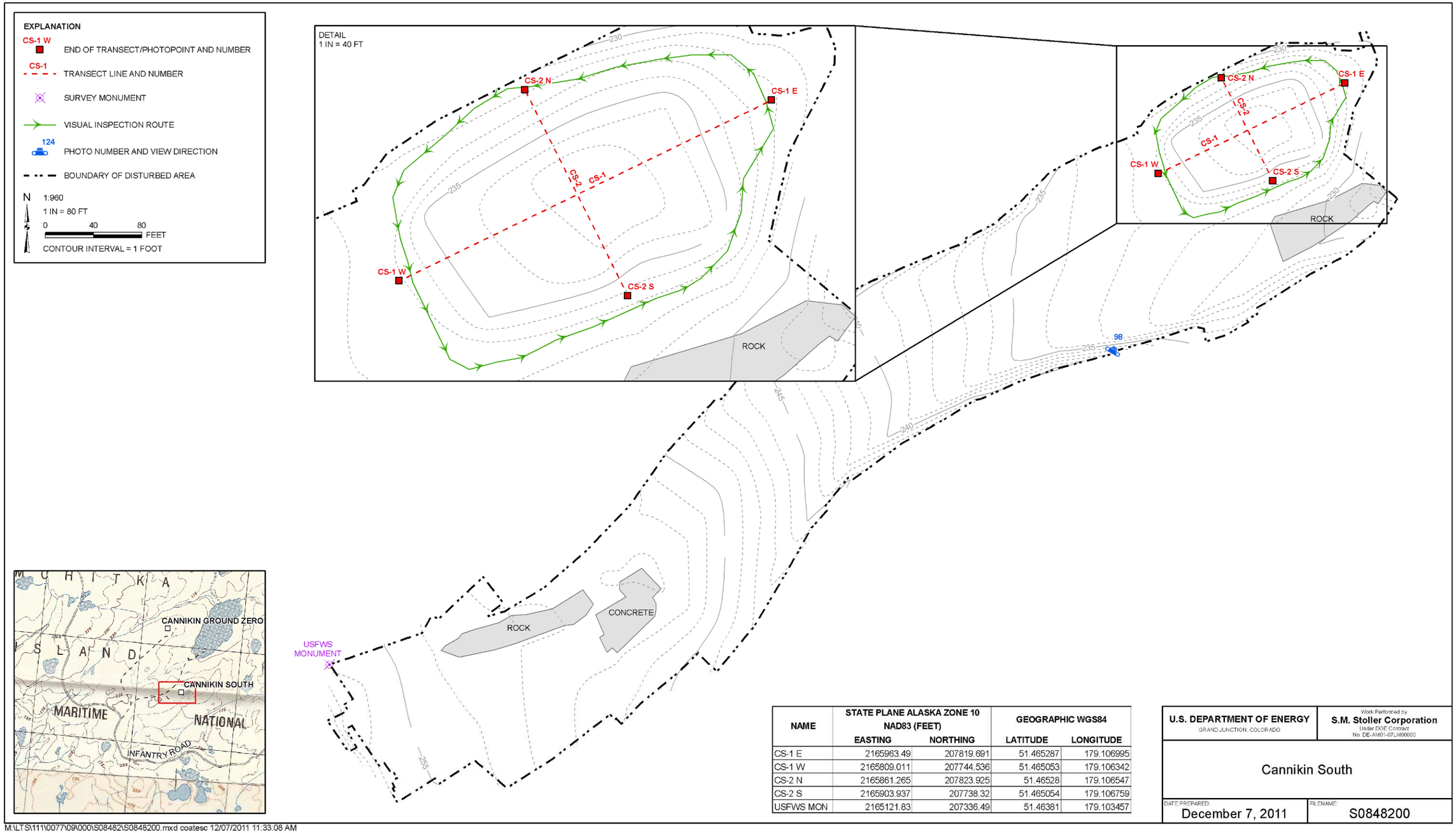

NAME	STATE PLANE ALASKA ZONE 10 NAD83 (FEET)		GEOGRAPHIC WGS84	
	EASTING	NORTHING	LATITUDE	LONGITUDE
CS-1 E	2165963.49	207819.691	51.465287	179.106995
CS-1 W	2165809.011	207744.536	51.465053	179.106342
CS-2 N	2165861.265	207823.925	51.46528	179.106547
CS-2 S	2165903.937	207738.32	51.465054	179.106759
USFWS MON	2165121.83	207336.49	51.46381	179.103457

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION, COLORADO

Work Performed by
S.M. Stoller Corporation
Under DOE Contract
No. DE-AM01-07LM00060

Cannikin South

DATE PREPARED: December 7, 2011

FILENAME: S0848200

Figure A–3. Cannikin South

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AMCHITKA MUD PIT SITES POST-CLOSURE MONITORING CHECKLIST

Mud Pit Site: Cannikin South (CS)	Date of Inspection: June 21, 2011
Responsible Agency: U.S. Department of Energy – Legacy Management	Project Manager: Mark Kautsky
Inspector (name, title, organization): Craig Goodknight, Inspection Team Lead, S.M. Stoller Corp.	

A. General Instructions

1. All checklist items must be completed and detailed comments made to document the results of the site inspection.
2. The completed checklist is part of the field record of the inspection. Additional pages should be used as necessary to ensure that a complete record is made. Number and attach the additional pages upon completion of the inspection.
3. Any checklist line item marked by an inspector in a SHADED BOX must be fully explained or an appropriate reference to previous reports provided. The explanation should include the inspector's rationale for conclusions and recommendations, if appropriate. Explanations are to be placed on additional attachments and cross-referenced appropriately, and may take the form of sketches, measurements, and/or annotated site maps.
4. The site inspection is a walking inspection of the entire site, including the perimeter and sufficient transects to be able to inspect the entire surface and all features specifically described in this checklist. Attach a drawing indicating the starting and ending points and the direction and pattern of the inspection.
5. A standard set of digital photographs is required. In addition, all anomalous features or new features (such as changes in adjacent area land use) are to be photographed. A photo log entry will be made for each photograph taken.

B. Preparation (to be completed prior to site visit)	YES	NO	EXPLANATION
1. Site as-built plans and site base map reviewed	X		Mud Pit Closure Plans and As-Built
2. Previous inspection reports reviewed	X		2006 Inspection Report
a. Were anomalies or trends detected on previous inspections?		X	
b. Was maintenance performed on areas with anomalies?			Not Applicable
3. Site maintenance and repair records reviewed		X	No previous maintenance activities were done
a. Has site repair resulted in a change from as-built conditions?		X	No detectable changes from as-built condition
b. Are revised as-builts available that reflect repair changes?			Not Applicable. No repairs have been made

C. Site Inspection (to be completed during inspection)	YES	NO	EXPLANATION
1. Adjacent offsite features within mud pit site area			
a. Changes in use of adjacent area?		X	Wildlife refuge
b. Any new roads or trails?		X	Per previous photos and as-built drawings
c. Change in the position of nearby washes?		X	None detected
d. Erosion/deposition of nearby washes?		X	None detected
e. New drainage channels?		X	None detected
f. Change in surrounding vegetation?		X	None detected
2. Security markers; signs			
a. Displacement of site markers, boundary markers, or monuments?		X	USFWS Monument was present/Good condition
b. Signs damaged or removed?		X	Signs were installed around mud pit cap margin
3. Mud Pit Cap			
a. Evidence of subsidence?			
b. Evidence of cracking?		X	
c. Evidence of erosion (wind or water)?		X	
d. Evidence of animal burrowing?		X	
e. Are site markers disturbed? By man?_____ By natural processes?_____		X	
f. Do natural processes threaten the integrity of mud pit cap or site marker?		X	

AMCHITKA MUD PIT SITES POST-CLOSURE MONITORING CHECKLIST (continued)

Mud Pit Site: Cannikin South (CS)	Date of Inspection: June 21, 2011

C. Site inspection (continued)	YES	NO	EXPLANATION
4. Vegetative cover			
a. Is plant cover adequate to prevent erosion?	X		See discussion in Section 3.0
b. Are weedy annual plants present? Do they require removal?		X	See discussion in Section 3.0
c. Evidence of animals on mud pit cap ?		X	See discussion in Section 3.0
d. Evidence of excessive plant mortality?		X	See discussion in Section 3.0
e. Has a vegetative cover log been completed?	X		See Vegetative Cover Log
5. Photo Documentation			
a. Has a photo log been prepared?	X		See Photograph Log
b. How many photos were taken?			6 photos as noted in the Photograph Log

D. Field Conclusions			
1. Imminent hazard to integrity of mud pit cap? (If yes, immediate report required. Note the person or agency the report will be made to.)		X	
2. Are more frequent inspections required?		X	
3. Are existing maintenance actions satisfactory?			Not Applicable. No maintenance was done or required.
4. Are existing repair actions satisfactory?			Not Applicable. No repairs were done or required.
5. Is other maintenance/repair necessary?		X	

6. Rationale for field conclusions: Conclusions were based on walkover visual inspections and plant counts.

7. Factors contributing to or impacting inspection: None noted

E. Certification

I certify that I have conducted an inspection of the Cannikin South Mud Pit Site mud pit cap in accordance with the Post-Closure Monitoring and Inspection Plan for Amchitka Island Mud Pit Release Sites, dated March 2011, as recorded on this checklist, discussion in Section 2.0, field notes, vegetative cover log, photograph log, and photos.

Inspector Printed Name: Craig Goodknight	Inspector Signature:
Title: Inspection Team Lead	Date: 7/15/11

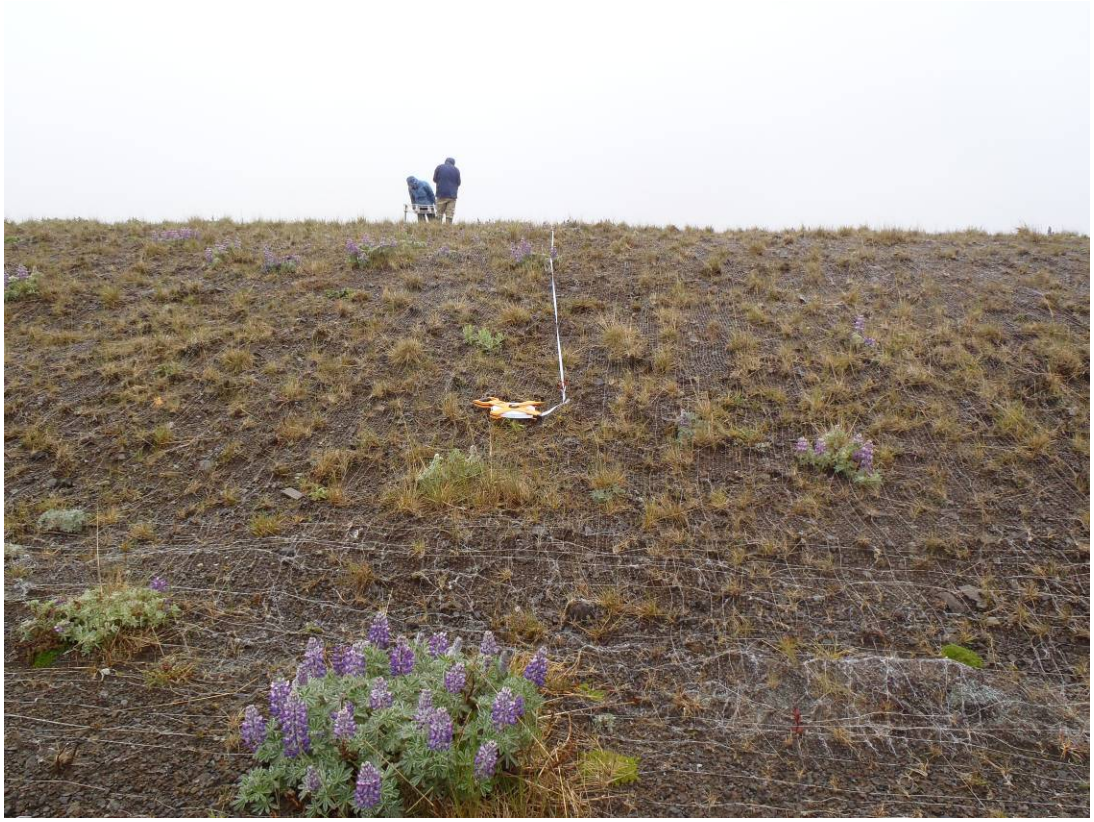
PHOTOGRAPH LOG

Mud Pit Site: Cannikin South (CS)				
Date	**Photo #**	**GPS Location***	**Direction of Photo**	**DESCRIPTION (Photopoints indicated by an *)**
6/21/11	P6210099	See Figure A-3	Northeast	USFWS Monument*
6/21/11	P6210092	See Figure A-3	East-Northeast	Transect CS-1 W*
6/21/11	P6210093	See Figure A-3	North-Northwest	Transect CS-2 S*
6/21/11	P6210094	See Figure A-3	West-Southwest	Transect CS-1 E*
6/21/11	P6210095	See Figure A-3	South-Southeast	Transect CS-2 N*
6/21/11	P6210098	See Figure A-3	Northeast	View of graded area and CS mud pit cap

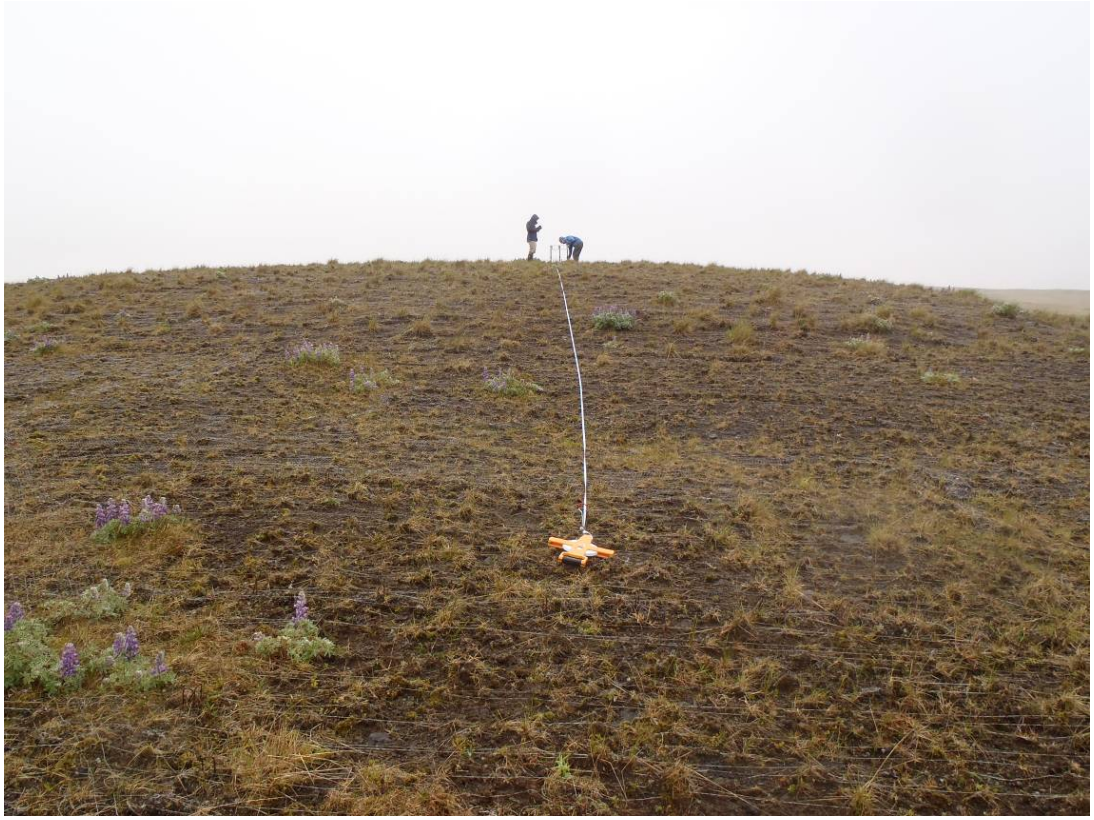
*GPS location datum AK State Plane NAD 1983

P6210099 – Cannikin South USFWS Monument, view NE toward mud pit cap

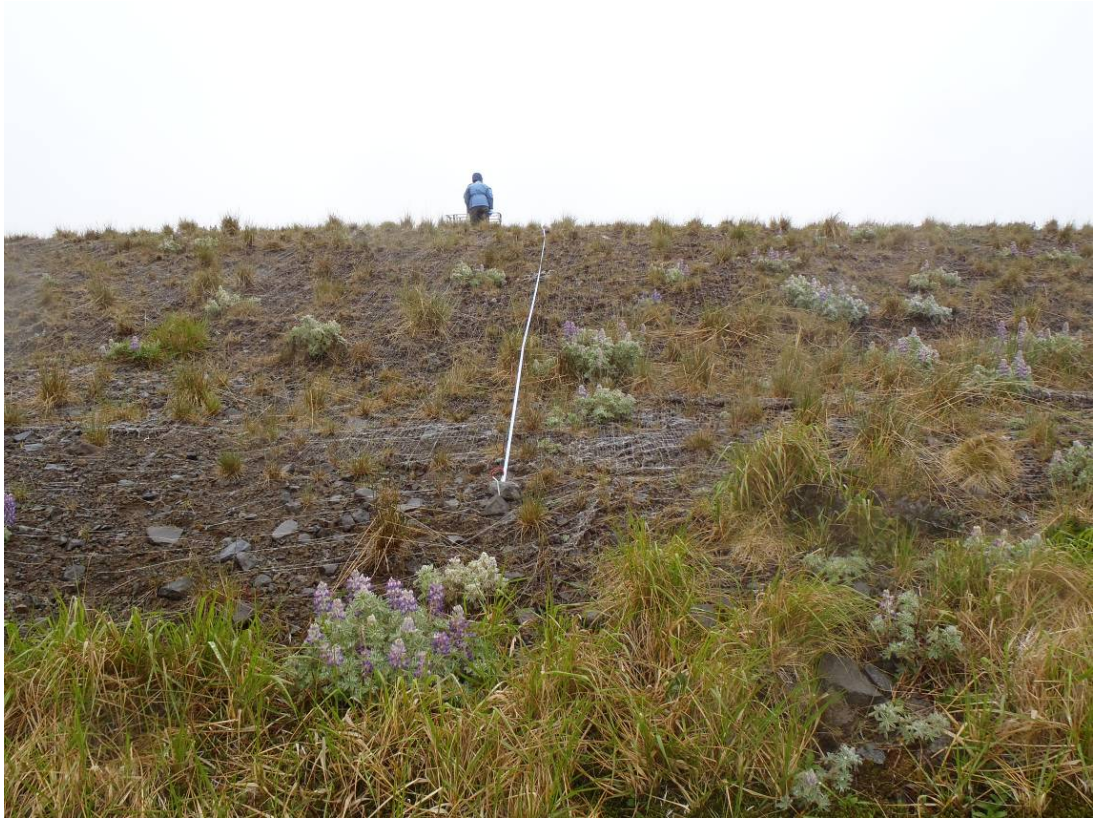
P6210092 – View ENE from CS-1 W



P6210093 – View NNW from CS-2 S



P6210094 – View WSW from CS-1 E



P6210095 – View SSE from CS-2 N

P6210098 – View NE across graded area to CS mud pit cap and Cannikin Lake

Appendix A-4

Cannikin Ground Zero

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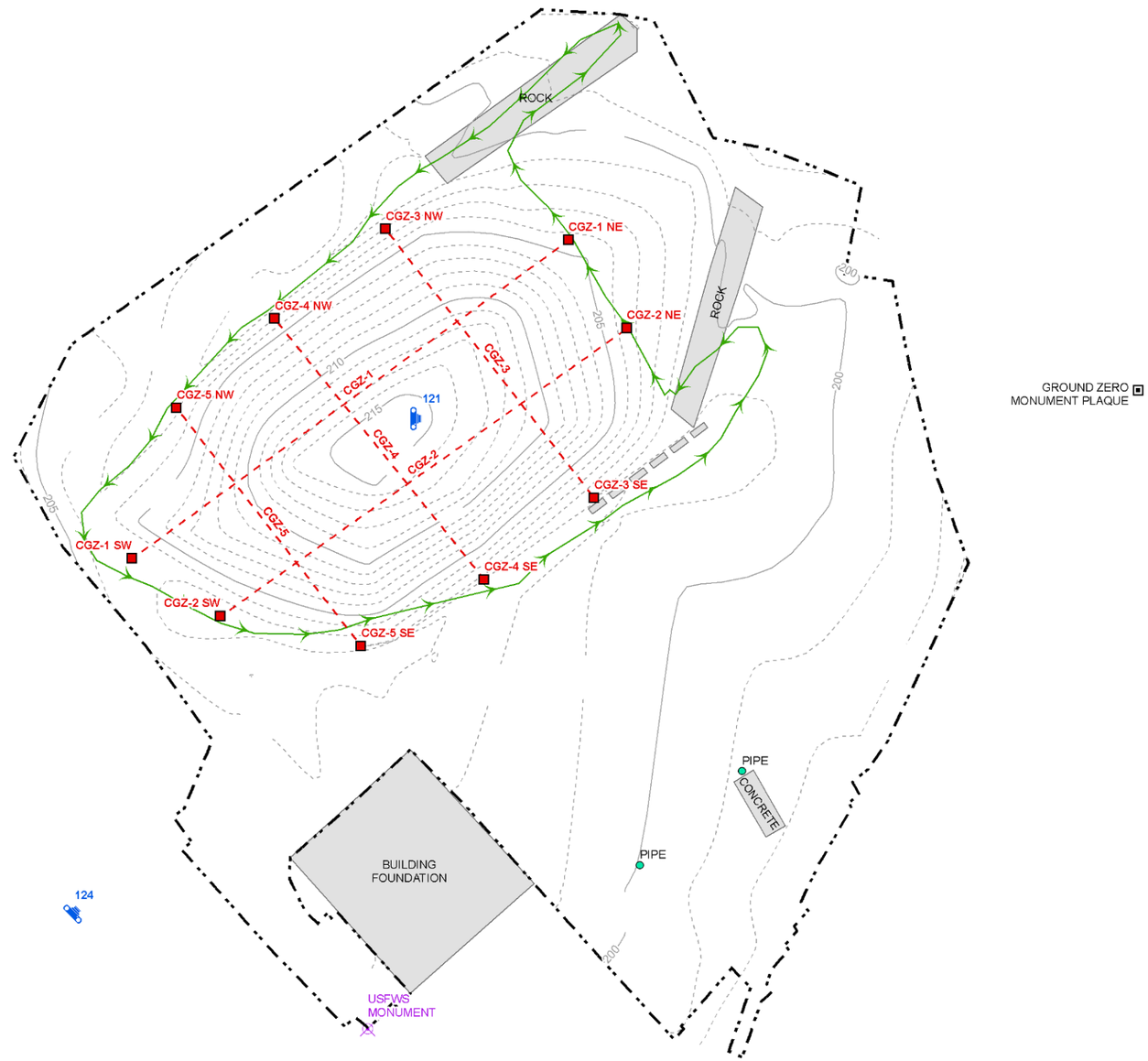
NAME	STATE PLANE ALASKA ZONE 10 NAD83 (FEET)		GEOGRAPHIC WGS84	
	EASTING	NORTHING	LATITUDE	LONGITUDE
CGZ-1 NE	2165165.52	209754.119	51.470425	179.102926
CGZ-1 SW	2164976.807	209616.163	51.470013	179.102142
CGZ-2 NE	2165190.736	209715.897	51.470325	179.103048
CGZ-2 SW	2165015.05	209591.164	51.469952	179.102317
CGZ-3 NW	2165086.393	209758.862	51.470423	179.102579
CGZ-3 SE	2165176.654	209642.306	51.470122	179.103009
CGZ-4 NW	2165038.425	209720.057	51.470308	179.10238
CGZ-4 SE	2165129.041	209606.936	51.470016	179.102811
CGZ-5 NW	2164995.994	209681.364	51.470195	179.102206
CGZ-5 SE	2165075.863	209578.134	51.469927	179.102587
USFWS MON	2165078.89	209413.208	51.469478	179.10265



EXPLANATION

CGZ-1 SW — END OF TRANSECT/PHOTOPOINT AND NUMBER

CGZ-1 — TRANSECT LINE AND NUMBER

SURVEY MONUMENT

VISUAL INSPECTION ROUTE

124 — PHOTO NUMBER AND VIEW DIRECTION

BOUNDARY OF DISTURBED AREA

N

1:720

1 IN = 60 FT

0 30 60 FEET

CONTOUR INTERVAL = 1 FOOT

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION, COLORADO

Work Performed by
S.M. Stoller Corporation
Under DOE Contract
No. DE-AM01-07LM00060

Cannikin Ground Zero

DATE PREPARED: December 13, 2011

FILENAME: S0848100

M:\LTS\111\0077\09\000\S08481\S0848100.mxd coatesc 12/13/2011 2:02:02 PM

Figure A–4.Cannikin Ground Zero

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AMCHITKA MUD PIT SITES POST-CLOSURE MONITORING CHECKLIST

Mud Pit Site: Cannikin Ground Zero (CGZ)	Date of Inspection: June 22, 2011
Responsible Agency: U.S. Department of Energy – Legacy Management	Project Manager: Mark Kautsky
Inspector (name, title, organization): Craig Goodknight, Inspection Team Lead, S.M. Stoller Corp.	

A. General Instructions

1. All checklist items must be completed and detailed comments made to document the results of the site inspection.
2. The completed checklist is part of the field record of the inspection. Additional pages should be used as necessary to ensure that a complete record is made. Number and attach the additional pages upon completion of the inspection.
3. Any checklist line item marked by an inspector in a SHADED BOX must be fully explained or an appropriate reference to previous reports provided. The explanation should include the inspector's rationale for conclusions and recommendations, if appropriate. Explanations are to be placed on additional attachments and cross-referenced appropriately, and may take the form of sketches, measurements, and/or annotated site maps.
4. The site inspection is a walking inspection of the entire site, including the perimeter and sufficient transects to be able to inspect the entire surface and all features specifically described in this checklist. Attach a drawing indicating the starting and ending points and the direction and pattern of the inspection.
5. A standard set of digital photographs is required. In addition, all anomalous features or new features (such as changes in adjacent area land use) are to be photographed. A photo log entry will be made for each photograph taken.

B. Preparation (to be completed prior to site visit)	YES	NO	EXPLANATION
1. Site as-built plans and site base map reviewed	X		Mud Pit Closure Plans and As-Built
2. Previous inspection reports reviewed	X		2006 Inspection Report
a. Were anomalies or trends detected on previous inspections?		X	
b. Was maintenance performed on areas with anomalies?			Not Applicable
3. Site maintenance and repair records reviewed		X	No previous maintenance activities were done
a. Has site repair resulted in a change from as-built conditions?		X	No detectable changes from as-built condition
b. Are revised as-builts available that reflect repair changes?			Not Applicable. No repairs have been made

C. Site Inspection (to be completed during inspection)	YES	NO	EXPLANATION
1. Adjacent offsite features within mud pit site area			
a. Changes in use of adjacent area?		X	Wildlife refuge
b. Any new roads or trails?		X	Per previous photos and as-built drawings
c. Change in the position of nearby washes?		X	None detected
d. Erosion/deposition of nearby washes?		X	None detected
e. New drainage channels?		X	None detected
f. Change in surrounding vegetation?		X	None detected
2. Security markers; signs			
a. Displacement of site markers, boundary markers, or monuments?		X	USFWS Monument was present/Good condition. Ground Zero Monument was intact.
b. Signs damaged or removed?		X	Signs were installed around mud pit cap margin
3. Mud Pit Cap			
a. Evidence of subsidence?			
b. Evidence of cracking?		X	
c. Evidence of erosion (wind or water)?		X	
d. Evidence of animal burrowing?		X	
e. Are site markers disturbed? By man?_____ By natural processes?_____		X	
f. Do natural processes threaten the integrity of mud pit cap or site marker?		X	

AMCHITKA MUD PIT SITES POST-CLOSURE MONITORING CHECKLIST (continued)

Mud Pit Site: Cannikin Ground Zero (CGZ)	Date of Inspection: June 22, 2011

C. Site inspection (continued)	YES	NO	EXPLANATION
4. Vegetative cover			
a. Is plant cover adequate to prevent erosion?	X		See discussion in Section 3.0
b. Are weedy annual plants present? Do they require removal?		X	See discussion in Section 3.0
c. Evidence of animals on mud pit cap?		X	See discussion in Section 3.0
d. Evidence of excessive plant mortality?		X	See discussion in Section 3.0
e. Has a vegetative cover log been completed?	X		See Vegetative Cover Log
5. Photo Documentation			
a. Has a photo log been prepared?	X		See Photograph Log
b. How many photos were taken?			15 photos as noted in the Photograph Log

D. Field Conclusions			
1. Imminent hazard to integrity of mud pit cap? (If yes, immediate report required. Note the person or agency the report will be made to.)		X	
2. Are more frequent inspections required?		X	
3. Are existing maintenance actions satisfactory?			Not Applicable. No maintenance was done or required.
4. Are existing repair actions satisfactory?			Not Applicable. No repairs were done or required.
5. Is other maintenance/repair necessary?		X	

6. Rationale for field conclusions: Conclusions were based on walkover visual inspections and plant counts.

7. Factors contributing to or impacting inspection: None noted

E. Certification

I certify that I have conducted an inspection of the Cannikin Ground Zero mud pit cap in accordance with the Post-Closure Monitoring and Inspection Plan for Amchitka Island Mud Pit Release Sites, dated March 2011, as recorded on this checklist, discussion in Section 2.0, field notes, vegetative cover log, photograph log, and photos.

Inspector Printed Name: Craig Goodknight	Inspector Signature:
Title: Inspection Team Lead	Date: 7/15/11

PHOTOGRAPH LOG

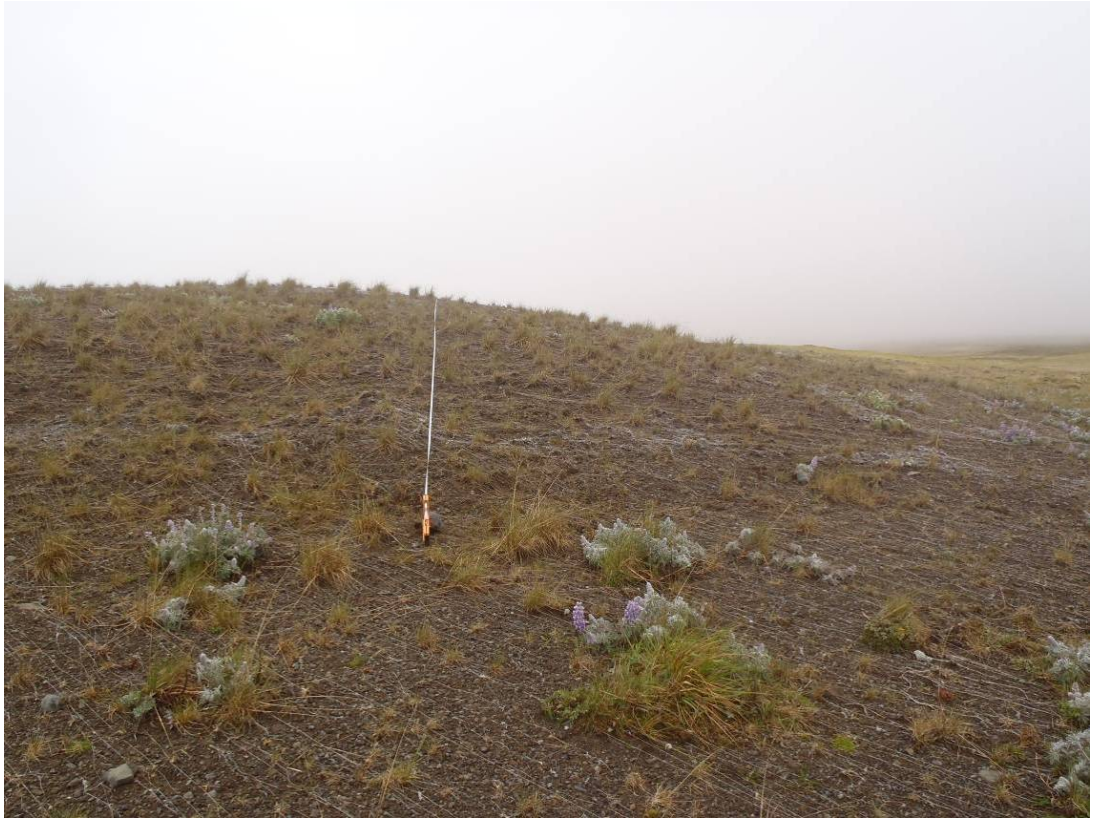
Mud Pit Site: Cannikin Ground Zero (CGZ)				
Date	**Photo #**	**GPS Location***	**Direction of Photo**	**DESCRIPTION (Photopoints indicated by an *)**
6/22/11	P6220106	See Figure A-4	South	USFWS Monument*
6/22/11	P6220107	See Figure A-4	Northeast	Two pipes NE of USFWS Monument*
6/22/11	P6220108	See Figure A-4	North	CGZ mud pit cap from USFWS Monument*
6/22/11	P6220109	See Figure A-4	Southwest	Transect CGZ-1 NE*
6/22/11	P6220110	See Figure A-4	Southeast	Transect CGZ-3 NW*
6/22/11	P6220111	See Figure A-4	Southeast	Transect CGZ- 4 NW*
6/22/11	P6220112	See Figure A-4	Southeast	Transect CGZ-5 NW*
6/22/11	P6220113	See Figure A-4	Northeast	Transect CGZ-1 SW*
6/22/11	P6220114	See Figure A-4	Northeast	Transect CGZ-2 SW*
6/22/11	P6220115	See Figure A-4	Northwest	Transect CGZ-5 SE*
6/22/11	P6220116	See Figure A-4	Northwest	Transect CGZ-4 SE*
6/22/11	P6220117	See Figure A-4	Northwest	Transect CGZ-3 SE*
6/22/11	P6220118	See Figure A-4	Southwest	Transect CGZ-2 NE*
6/22/11	P6220121	See Figure A-4	East	Top of CGZ mud pit cap and Cannikin Lake
6/22/11	P6220124	See Figure A-4	Northeast	CGZ mud pit cap and 3 signs along SE margin

*GPS location datum AK State Plane NAD 1983

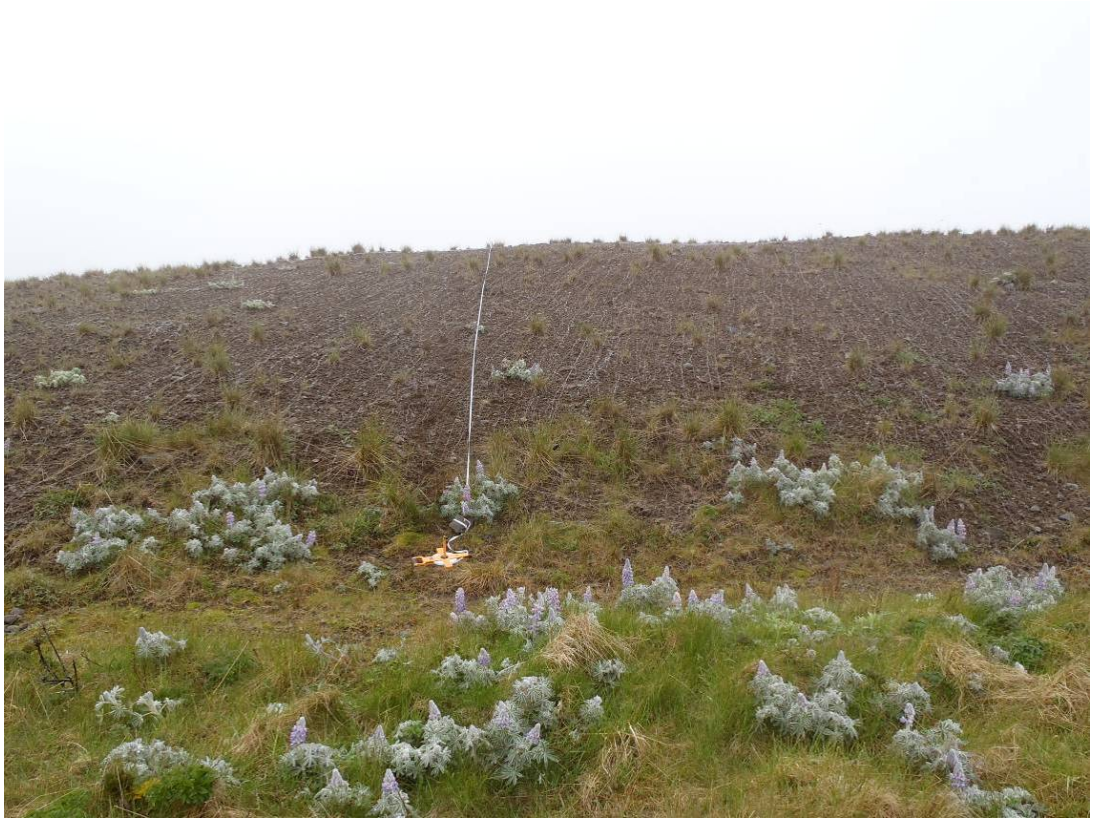
P6220106 – Cannikin Ground Zero USFWS Monument, view S

P6220107 – View NE (N57E) of 2 pipes from USFWS Monument

P6220108 – View N of CGZ mud pit cap from USFWS Monument



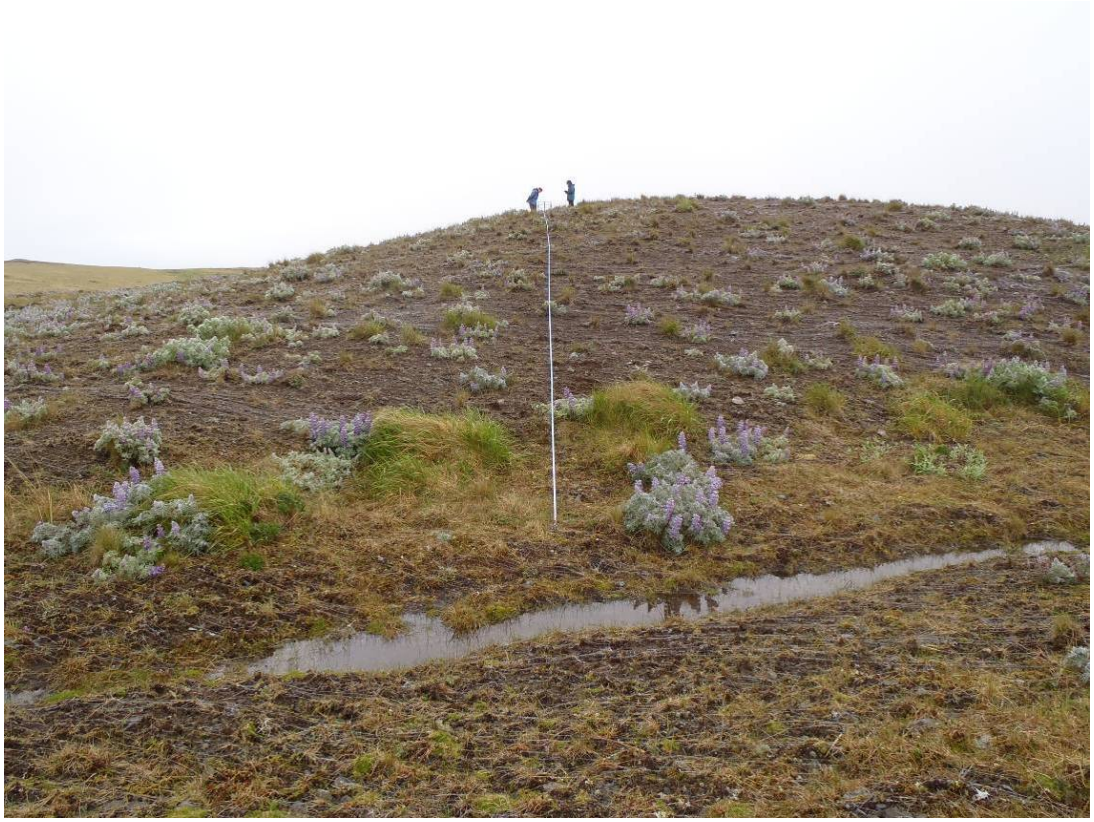
P6220109 – View SW from CGZ-1 NE



P6220110 – View SE from CGZ-3 NW

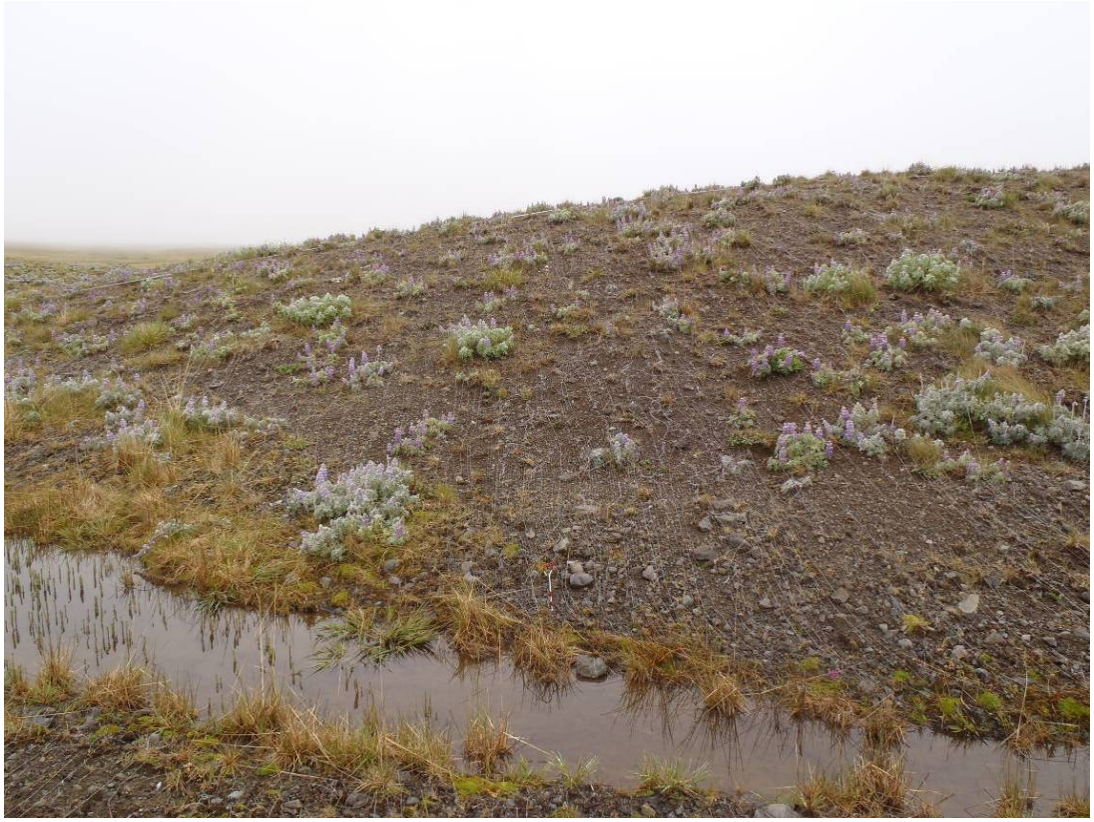
P6220111 – View SE from CGZ- 4 NW

P6220112 – View SE from CGZ-5 NW

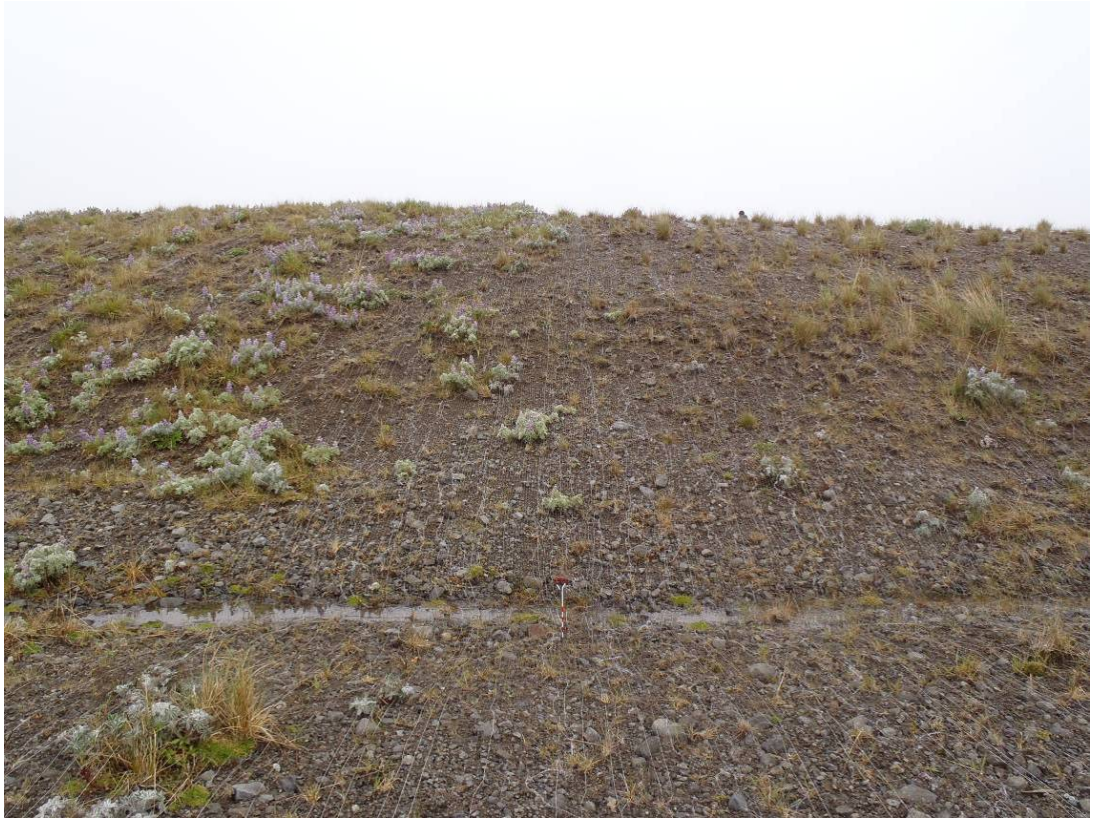


P6220113 – View NE from CGZ-1 SW

P6220114 – View NE from CGZ-2 SW



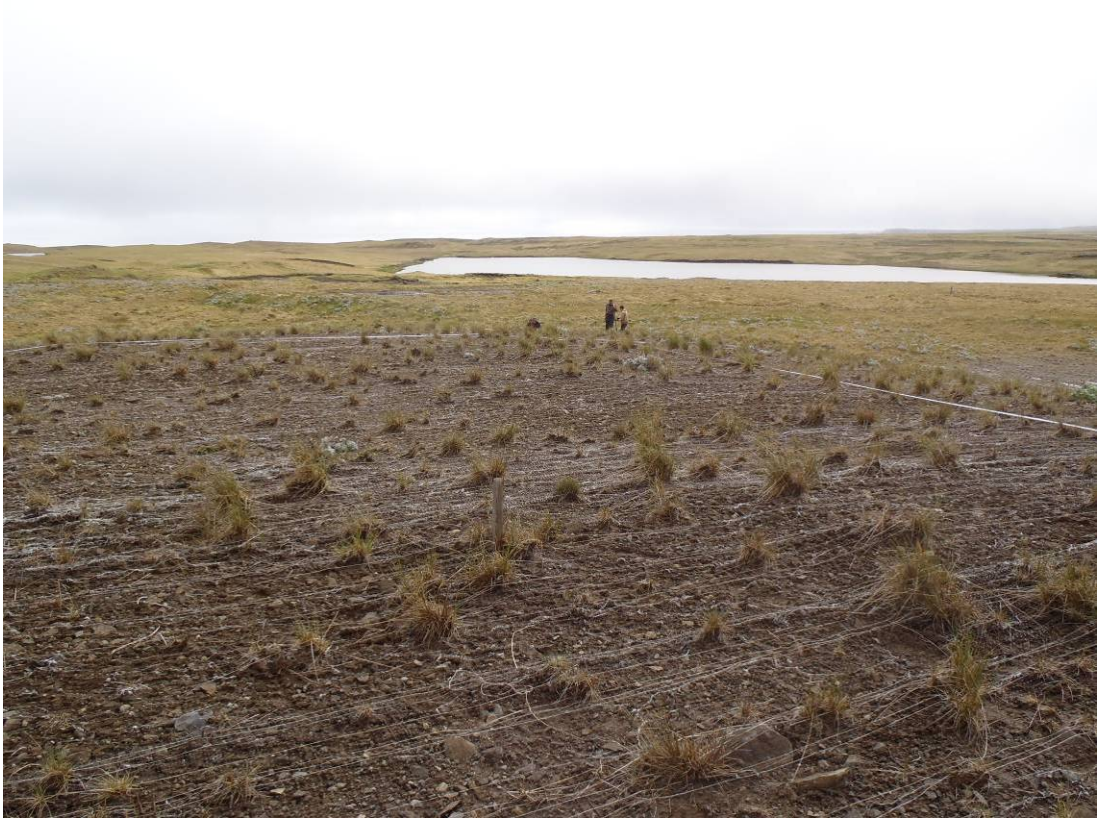
P6220115 – View NW from CGZ-5 SE



P6220116 – View NW from CGZ-4 SE

P6220117 – View NW from CGZ-3 SE

P6220118 – View SW from CGZ-2 NE



P6220121 – View E across CGZ mud pit cap toward Cannikin Lake

P6220124 – View NE of CGZ mud pit cap and 3 signs along SE margin

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Appendix A-5

Drill Site D

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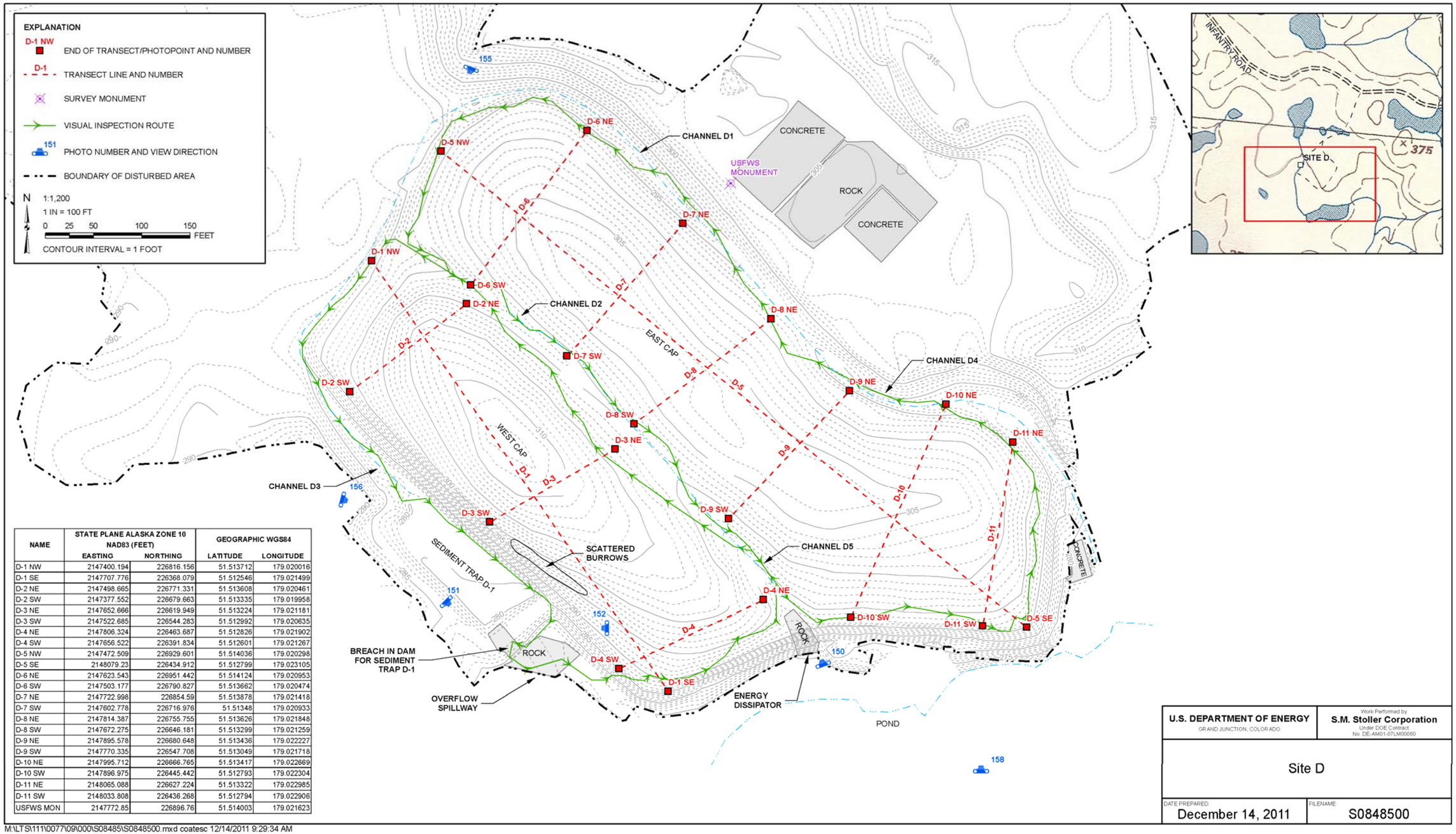

NAME	STATE PLANE ALASKA ZONE 10 NAD83 (FEET)		GEOGRAPHIC WGS84	
	EASTING	NORTHING	LATITUDE	LONGITUDE
D-1 NW	2147400.194	226816.156	51.513712	179.020016
D-1 SE	2147707.776	226368.079	51.512546	179.021499
D-2 NE	2147498.665	226771.331	51.513608	179.020461
D-2 SW	2147377.552	226679.663	51.513335	179.019958
D-3 NE	2147652.666	226619.949	51.513224	179.021181
D-3 SW	2147522.685	226544.283	51.512992	179.020635
D-4 NE	2147806.324	226463.687	51.512826	179.021902
D-4 SW	2147656.522	226391.834	51.512601	179.021267
D-5 NW	2147472.509	226929.601	51.514036	179.020298
D-5 SE	2148079.23	226434.912	51.512799	179.023105
D-6 NE	2147623.543	226951.442	51.514124	179.020953
D-6 SW	2147503.177	226790.827	51.513662	179.020474
D-7 NE	2147722.998	226854.59	51.513878	179.021418
D-7 SW	2147602.778	226716.976	51.51348	179.020933
D-8 NE	2147814.387	226755.755	51.513626	179.021848
D-8 SW	2147672.275	226646.181	51.513299	179.021259
D-9 NE	2147895.578	226680.648	51.513436	179.022227
D-9 SW	2147770.335	226547.708	51.513049	179.021718
D-10 NE	2147995.712	226666.765	51.513417	179.022669
D-10 SW	2147896.975	226445.442	51.512793	179.022304
D-11 NE	2148065.088	226627.224	51.513322	179.022985
D-11 SW	2148033.808	226436.268	51.512794	179.022906
USFWS MON	2147772.85	226896.76	51.514003	179.021623

M:\LTS\111\0077\09\000\S08485\S0848500.mxd coatesc 12/14/2011 9:29:34 AM

Figure A–5. Drill Site D

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AMCHITKA MUD PIT SITES POST-CLOSURE MONITORING CHECKLIST

Mud Pit Site: Drill Site D	Date of Inspection: June 22 and 23, 2011
Responsible Agency: U.S. Department of Energy – Legacy Management	Project Manager: Mark Kautsky
Inspector (name, title, organization): Craig Goodknight, Inspection Team Lead, S.M. Stoller Corp.	

A. General Instructions

1. All checklist items must be completed and detailed comments made to document the results of the site inspection.
2. The completed checklist is part of the field record of the inspection. Additional pages should be used as necessary to ensure that a complete record is made. Number and attach the additional pages upon completion of the inspection.
3. Any checklist line item marked by an inspector in a SHADED BOX must be fully explained or an appropriate reference to previous reports provided. The explanation should include the inspector's rationale for conclusions and recommendations, if appropriate. Explanations are to be placed on additional attachments and cross-referenced appropriately, and may take the form of sketches, measurements, and/or annotated site maps.
4. The site inspection is a walking inspection of the entire site, including the perimeter and sufficient transects to be able to inspect the entire surface and all features specifically described in this checklist. Attach a drawing indicating the starting and ending points and the direction and pattern of the inspection.
5. A standard set of digital photographs is required. In addition, all anomalous features or new features(such as changes in adjacent area land use) are to be photographed. A photo log entry will be made for each photograph taken.

B. Preparation (to be completed prior to site visit)	YES	NO	EXPLANATION
1. Site as-built plans and site base map reviewed	X		Mud Pit Closure Plans and As-Built
2. Previous inspection reports reviewed	X		2006 Inspection Report
a. Were anomalies or trends detected on previous inspections?	X		Minor water erosion noted on mud pit cap in 2006 inspection
b. Was maintenance performed on areas with anomalies?		X	Only minor erosion on unvegetated mud pit cap
3. Site maintenance and repair records reviewed		X	No previous maintenance activities were done
a. Has site repair resulted in a change from as-built conditions?		X	No detectable changes from as-built condition
b. Are revised as-builts available that reflect repair changes?			Not Applicable. No repairs have been made

C. Site Inspection (to be completed during inspection)	YES	NO	EXPLANATION
1. Adjacent offsite features within mud pit site area			
a. Changes in use of adjacent area?		X	Wildlife refuge
b. Any new roads or trails?		X	Per previous photos and as-built drawings
c. Change in the position of nearby washes?		X	None detected
d. Erosion/deposition of nearby washes?		X	None detected
e. New drainage channels?	X		Breach in dam for Sediment Trap D-1 just W of Overflow Spillway, as noted below
f. Change in surrounding vegetation?		X	None detected
2. Security markers; signs			
a. Displacement of site markers, boundary markers, or monuments?		X	USFWS Monument was present/Good condition
b. Signs damaged or removed?		X	Signs were installed around mud pit cap margins
3. Mud Pit Cap			
a. Evidence of subsidence?		X	
b. Evidence of cracking?		X	
c. Evidence of erosion (wind or water)?		X	Minor water erosion noted in 2006 has not recurred as noted below
d. Evidence of animal burrowing?		X	Several small holes are along SW side of W mud pit cap, as noted below
e. Are site markers disturbed? By man?_____ By natural processes?_____		X	

AMCHITKA MUD PIT SITES POST-CLOSURE MONITORING CHECKLIST (continued)

Mud Pit Site: Drill Site D	Date of Inspection: June 22 and 23, 2011

C (continued). Site Inspection (to be completed during inspection)	YES	NO	EXPLANATION
f. Do natural processes threaten the integrity of mud pit cap or site marker?		X	
4. Vegetative cover			
a. Is plant cover adequate to prevent erosion?	X		See discussion in Section 3.0
b. Are weedy annual plants present? Do they require removal?		X	See discussion in Section 3.0
c. Evidence of animals on mud pit cap?		X	See discussion in Section 3.0
d. Evidence of excessive plant mortality?		X	See discussion in Section 3.0
e. Has a vegetative cover log been completed?	X		See Vegetative Cover Log
5. Photo Documentation			
a. Has a photo log been prepared?	X		See Photograph Log
b. How many photos were taken?			29 photos as noted in the Photograph Log

D. Field Conclusions			
1. Imminent hazard to integrity of mud pit cap? (If yes, immediate report required. Note the person or agency the report will be made to.)		X	
2. Are more frequent inspections required?		X	
3. Are existing maintenance actions satisfactory?			Not Applicable. No maintenance was done or required.
4. Are existing repair actions satisfactory?			Not Applicable. No repairs were done or required.
5. Is other maintenance/repair necessary?		X	

6. Rationale for field conclusions: Conclusions were based on walkover visual inspections and plant counts.
Minor water erosion noted on the mud pit caps in the 2006 inspection report has not recurred because vegetation has largely covered the mud pit caps, resulting in a decrease in the occurrence of erosion by runoff water. Sometime after the 2006 inspection, a breach occurred in the dam for Sediment Trap D-1, southwest of the west mud pit cap. The breach is just W of the Overflow Spillway, as shown in photos P6220151, P6220152, and P6220156. Because of the breach, Sediment Trap D-1 cannot hold the runoff water it was designed for and runoff water continues to drain to the southeast away from the mud pit cap. This may not be a bad condition, but any progress of this erosion should be monitored in future inspections. The area of scattered small holes along the SW edge of the W mud pit cap should be monitored for increase in area and any causes of erosion. The steep, rocky, unvegetated slope along the SW edge of the W mud pit cap is erosion prone (photo P6230156) and should be monitored for signs of this during future inspections.

7. Factors contributing to or impacting inspection: None noted

E. Certification

I certify that I have conducted an inspection of the Drill Site D mud pit cap in accordance with the Post-Closure Monitoring and Inspection Plan for Amchitka Island Mud Pit Release Sites, dated March 2011, as recorded on this checklist, discussion in Section 2.0, field notes, vegetative cover log, photograph log, and photos.

Inspector Printed Name: Craig Goodknight	Inspector Signature:
Title: Inspection Team Lead	Date: 7/15/11

PHOTOGRAPH LOG

Mud Pit Site: Drill Site D				
Date	**Photo #**	**GPS Location***	**Direction of Photo**	**DESCRIPTION (Photopoints indicated by an *)**
6/22/11	P6220125	See Figure A-5	West	USFWS Monument*
6/22/11	P6220127	See Figure A-5	Southeast	Transect D-5 NW*
6/22/11	P6220128	See Figure A-5	Northeast	Transect D-6 SW*
6/22/11	P6220129	See Figure A-5	Northeast	Transect D-7 SW*
6/22/11	P6220130	See Figure A-5	Northeast	Transect D-8 SW*
6/22/11	P6220131	See Figure A-5	Northeast	Transect D-9 SW*
6/22/11	P6220132	See Figure A-5	North-Northeast	Transect D-10 SW*
6/22/11	P6220133	See Figure A-5	North	Transect D-11 SW*
6/22/11	P6220134	See Figure A-5	Northwest	Transect D-5 SE*
6/22/11	P6220135	See Figure A-5	South	Transect D-11 NE*
6/22/11	P6220136	See Figure A-5	South-Southwest	Transect D-10 NE*
6/22/11	P6220137	See Figure A-5	Southwest	Transect D-9 NE*
6/22/11	P6220138	See Figure A-5	Southwest	Transect D-8 NE*
6/22/11	P6220139	See Figure A-5	Southwest	Transect D-7 NE*
6/22/11	P6220140	See Figure A-5	Southwest	Transect D-6 NE*
6/22/11	P6220141	See Figure A-5	Southeast	Transect D-1 NW*
6/22/11	P6220142	See Figure A-5	Northeast	Transect D-2 SW*
6/22/11	P6220143	See Figure A-5	Northeast	Transect D-3 SW*
6/22/11	P6220144	See Figure A-5	East-Northeast	Transect D-4 SW*
6/22/11	P6220145	See Figure A-5	Northwest	Transect D-1 SE*
6/22/11	P6220146	See Figure A-5	West-Southwest	Transect D-4 NE*
6/22/11	P6220147	See Figure A-5	Southwest	Transect D-3 NE*
6/22/11	P6220148	See Figure A-5	Southwest	Transect D-2 NE*
6/22/11	P6220150	See Figure A-5	Northwest	Energy dissipator which spills drainage from Channel D5
6/22/11	P6220152	See Figure A-5	West-Northwest	Water in Sediment Trap D-1 and breach in SW end of dam to left
6/22/11	P6220151	See Figure A-5	Southeast	View of breach to right of Overflow Spillway for Sediment Trap D-1
6/23/11	P6230156	See Figure A-5	Southeast	Sediment Trap D-1, breach in right end of dam, and steep rocky slope on SW side of W mud pit cap.
6/23/11	P6230155	See Figure A-5	Southwest	NW ends of the two mud pit caps and 2 signs along margin
6/23/11	P6230158	See Figure A-5	North	View across pond to S end of E mud pit cap.

*GPS location datum AK State Plane NAD 1983

P6220125 – Drill Site D USFWS Monument, view W

P6220127 – View SE from D-5 NW

P6220128 – View NE from D-6 SW

P6220129 – View NE from D-7 SW

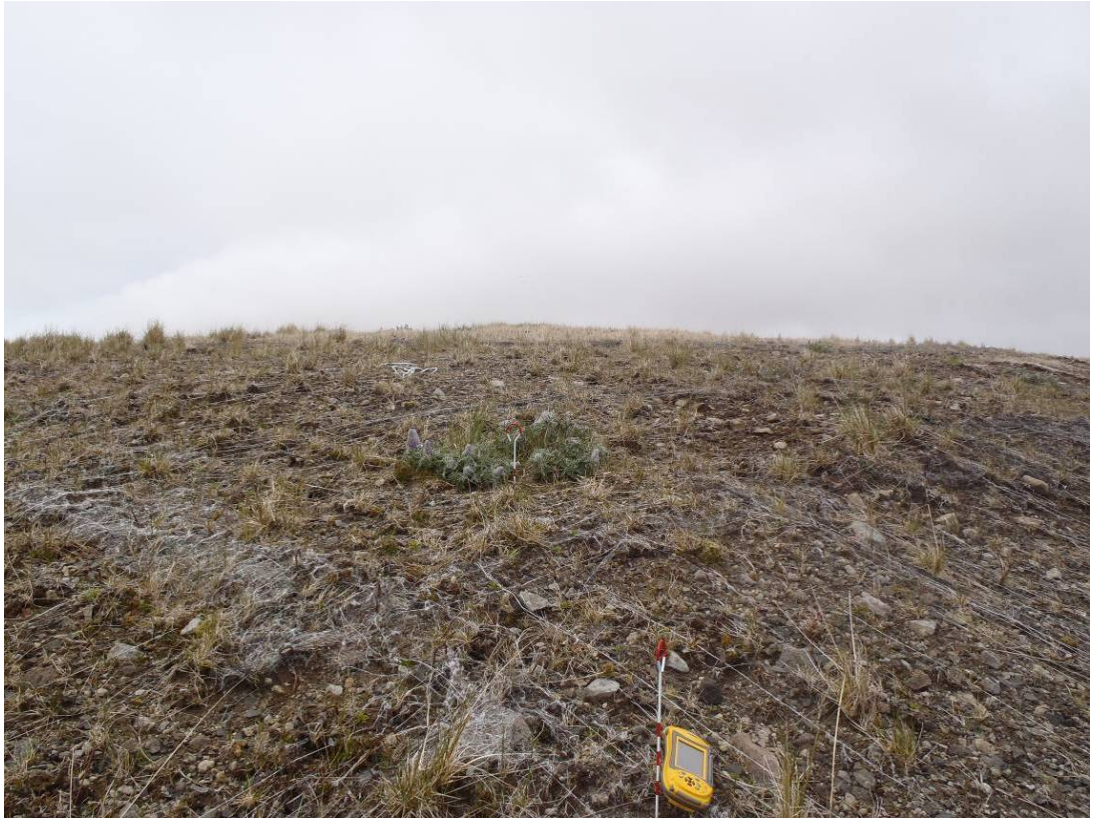
P6220130 – View NE from D-8 SW

P8030010 – View NE from D-8 SW (2006)

P6220131 – View NE from D-9 SW

P6220132 – View NNE from D-10 SW

P6220133 – View N from D-11 SW



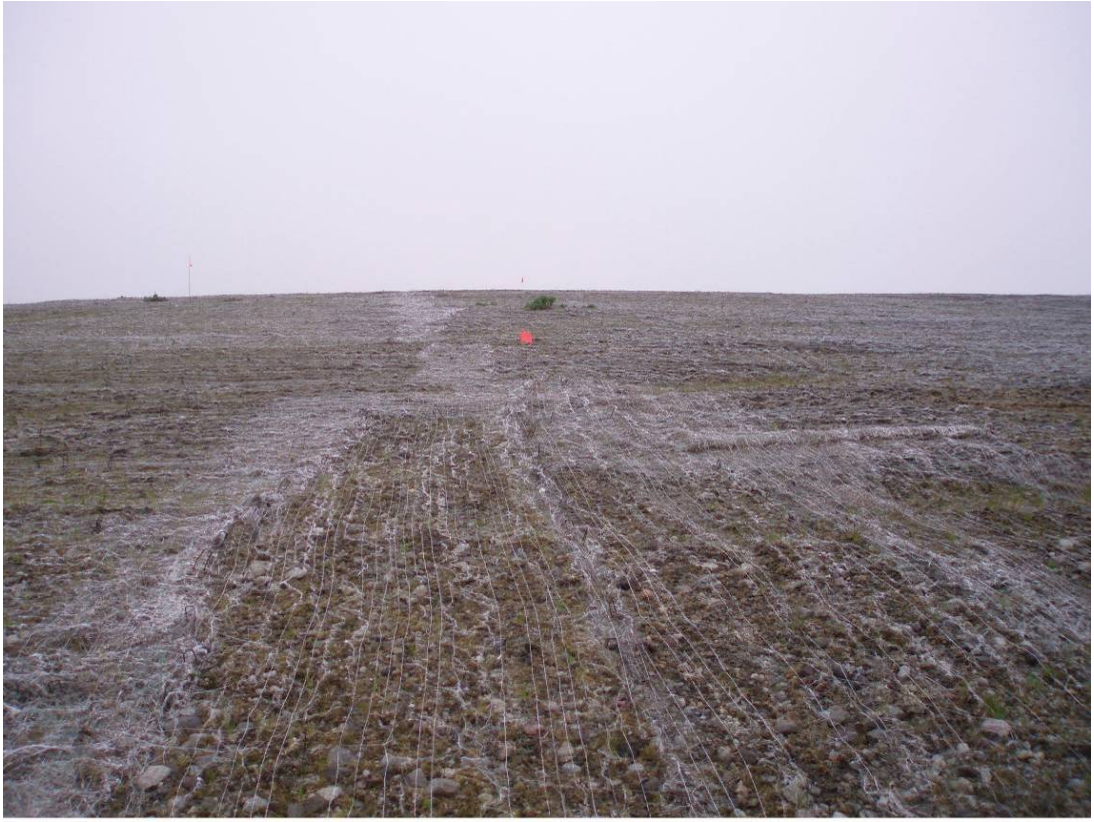
P6220134 – View NW from D-5 SE

P6220135 – View S from D-11 NE

P6220136 – View SSW from D-10 NE

P6220137 – View SW from D-9 NE

P6220138 – View SW from D-8 NE



P8030018 – View SW from D-8 NE (2006)

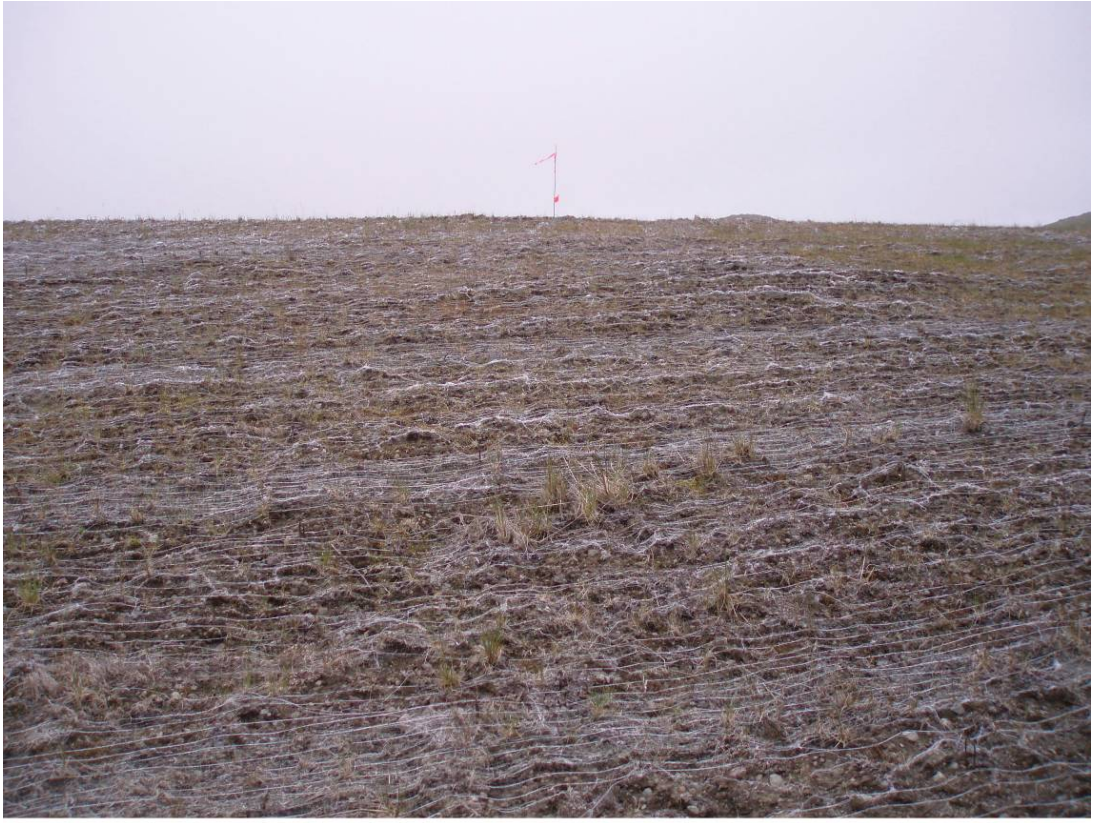
P6220139 – View SW from D-7 NE

P6220140 – View SW from D-6 NE

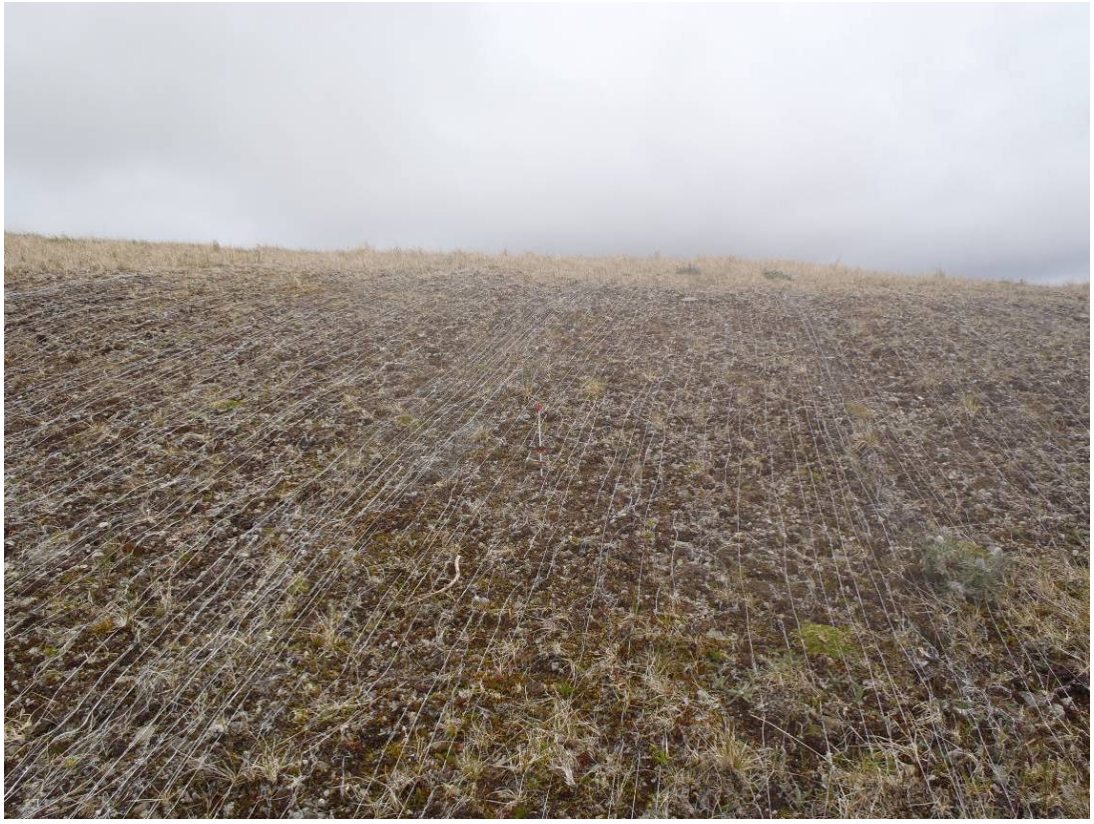
P6220141 – View SE from D-1 NW

P6220142 – View NE from D-2 SW

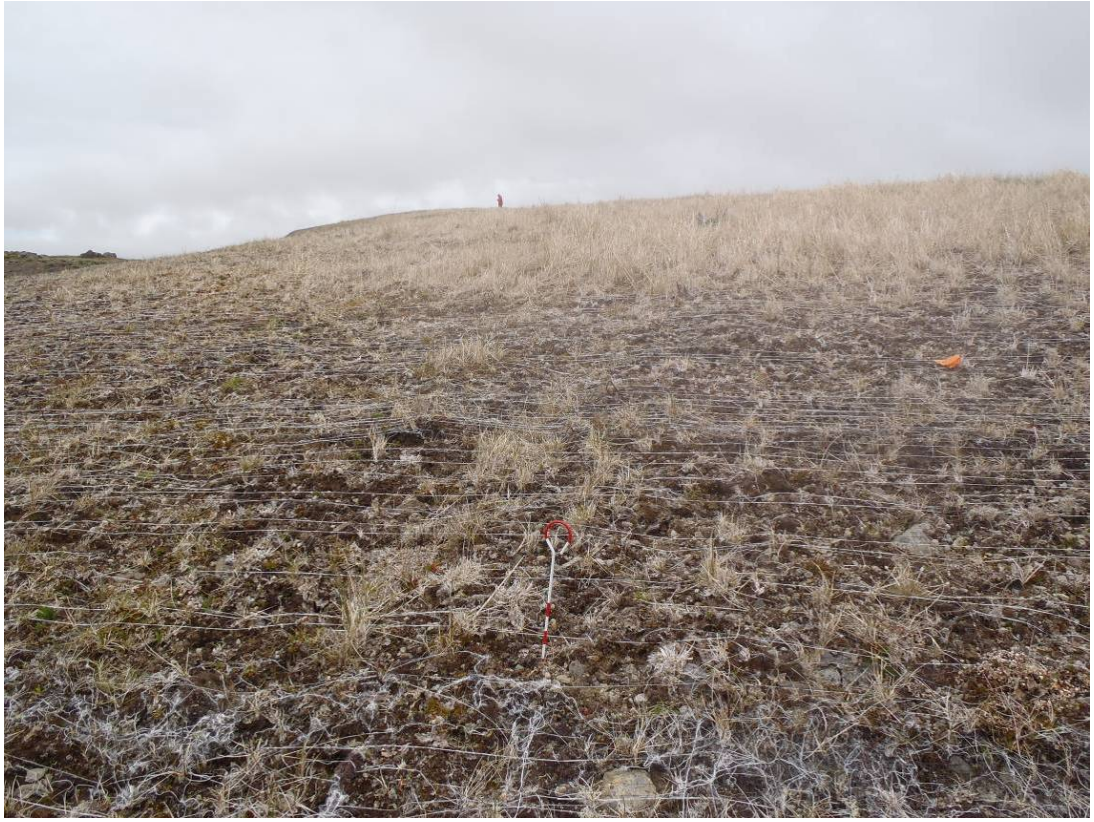
P6220143 – View NE from D-3 SW



P8030023 – View NE from D-3 SW (2006)



P6220144 – View ENE from D-4 SW

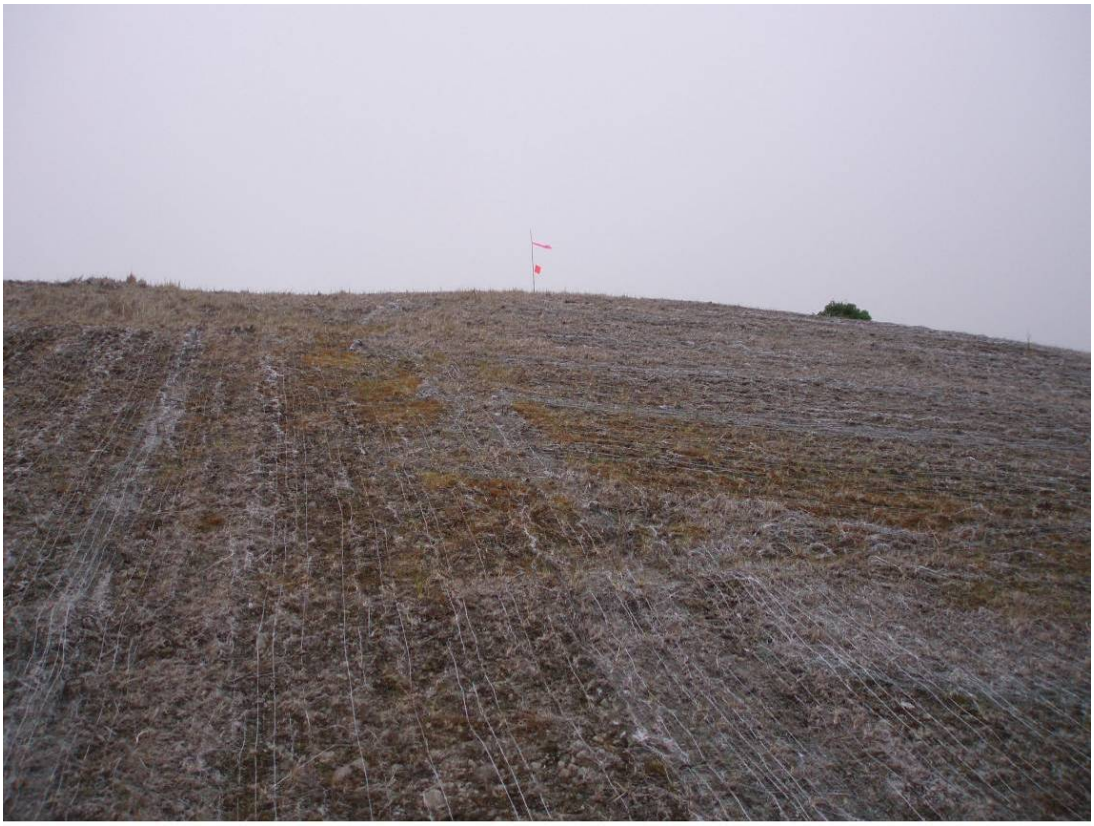


P6220145 – View NW from D-1 SE

P6220146 – View WSW from D-4 NE

P6220147 – View SW from D-3 NE

P6220148 – View SW from D-2 NE



P8030028 – View SW from D-2 NE (2006)

P6220150 – View NW of energy dissipater where drainage spills from Channel D5

P6220152 – View WNW of water in Sediment Trap D-1 and breach in SW end of dam to left

P6220151 – View SE of breach to right of Overflow Spillway for Sediment Trap D-1

P6230156 – View SE of Sediment Trap D-1, breach in right end of dam, and steep rocky slope on SW side of mud pit cap

P6230155 – View SW of NW ends of the two mud pit caps and two signs along margin

P6230158 – View N across pond to S end of E mud pit cap

Appendix A-6

Drill Site F

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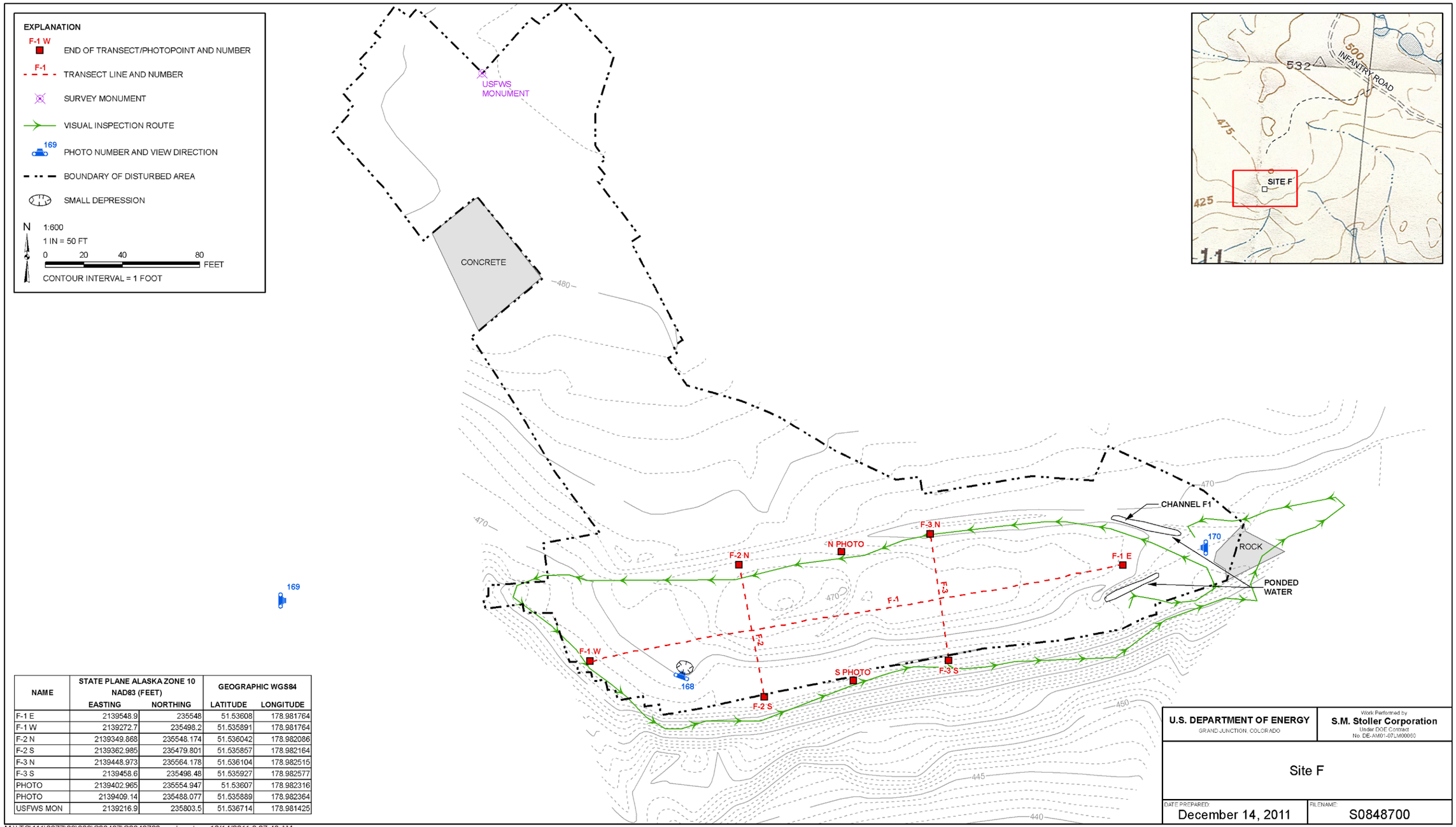

NAME	STATE PLANE ALASKA ZONE 10 NAD83 (FEET)		GEOGRAPHIC WGS84	
	EASTING	NORTHING	LATITUDE	LONGITUDE
F-1 E	2139548.9	235548	51.53608	178.981764
F-1 W	2139272.7	235498.2	51.535891	178.981764
F-2 N	2139349.868	235548.174	51.536042	178.982086
F-2 S	2139362.985	235479.801	51.535857	178.982164
F-3 N	2139448.973	235564.178	51.536104	178.982515
F-3 S	2139458.6	235498.48	51.535927	178.982577
PHOTO	2139402.965	235554.947	51.53607	178.982316
PHOTO	2139409.14	235488.077	51.535889	178.982364
USFWS MON	2139216.9	235803.5	51.536714	178.981425

Figure A–6. Drill Site F

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AMCHITKA MUD PIT SITES POST-CLOSURE MONITORING CHECKLIST

Mud Pit Site: Drill Site F	Date of Inspection: June 23, 2011
Responsible Agency: U.S. Department of Energy – Legacy Management	Project Manager: Mark Kautsky
Inspector (name, title, organization): Craig Goodknight, Inspection Team Lead, S.M. Stoller Corp.	

A. General Instructions

1. All checklist items must be completed and detailed comments made to document the results of the site inspection.
2. The completed checklist is part of the field record of the inspection. Additional pages should be used as necessary to ensure that a complete record is made. Number and attach the additional pages upon completion of the inspection.
3. Any checklist line item marked by an inspector in a SHADED BOX must be fully explained or an appropriate reference to previous reports provided. The explanation should include the inspector's rationale for conclusions and recommendations, if appropriate. Explanations are to be placed on additional attachments and cross-referenced appropriately, and may take the form of sketches, measurements, and/or annotated site maps.
4. The site inspection is a walking inspection of the entire site, including the perimeter and sufficient transects to be able to inspect the entire surface and all features specifically described in this checklist. Attach a drawing indicating the starting and ending points and the direction and pattern of the inspection.
5. A standard set of digital photographs is required. In addition, all anomalous features or new features (such as changes in adjacent area land use) are to be photographed. A photo log entry will be made for each photograph taken.

B. Preparation (to be completed prior to site visit)	YES	NO	EXPLANATION
1. Site as-built plans and site base map reviewed	X		Mud Pit Closure Plans and As-Built
2. Previous inspection reports reviewed	X		2006 Inspection Report
a. Were anomalies or trends detected on previous inspections?	X		Minor water erosion on mud pit cap and a small area of subsidence were noted in 2006 inspection
b. Was maintenance performed on areas with anomalies?		X	Only minor erosion and a small subsidence on the unvegetated mud pit cap
3. Site maintenance and repair records reviewed		X	No previous maintenance activities were done
a. Has site repair resulted in a change from as-built conditions?		X	No detectable changes from as-built condition
b. Are revised as-builts available that reflect repair changes?			Not Applicable. No repairs have been made

C. Site Inspection (to be completed during inspection)	YES	NO	EXPLANATION
1. Adjacent offsite features within mud pit site area			
a. Changes in use of adjacent area?		X	Wildlife refuge
b. Any new roads or trails?		X	Per previous photos and as-built drawings
c. Change in the position of nearby washes?		X	None detected
d. Erosion/deposition of nearby washes?		X	None detected
e. New drainage channels?		X	None detected
f. Change in surrounding vegetation?		X	None detected
2. Security markers; signs			
a. Displacement of site markers, boundary markers, or monuments?		X	USFWS Monument was present/Good condition
b. Signs damaged or removed?		X	Signs were installed around mud pit cap margin
3. Mud Pit Cap			
a. Evidence of subsidence?	X		Vegetation noted below has covered the small area of subsidence seen in the 2006 inspection
b. Evidence of cracking?		X	
c. Evidence of erosion (wind or water)?		X	Ponded water in Channel F1 at the E end of the mud pit cap could lead to future erosion
d. Evidence of animal burrowing?		X	
e. Are site markers disturbed? By man?_____ By natural processes?_____		X	
f. Do natural processes threaten the integrity of mud pit cap or site marker?		X	

AMCHITKA MUD PIT SITES POST-CLOSURE MONITORING CHECKLIST (continued)

Mud Pit Site: Drill Site F	Date of Inspection: June 23, 2011

C. Site inspection (continued)	YES	NO	EXPLANATION
4. Vegetative cover			
a. Is plant cover adequate to prevent erosion?	X		See discussion in Section 3.0
b. Are weedy annual plants present? Do they require removal?		X	See discussion in Section 3.0
c. Evidence of animals on mud pit cap?		X	See discussion in Section 3.0
d. Evidence of excessive plant mortality?		X	See discussion in Section 3.0
e. Has a vegetative cover log been completed?	X		See Vegetative Cover Log
5. Photo Documentation			
a. Has a photo log been prepared?	X		See Photograph Log
b. How many photos were taken?			12 photos as noted in the Photograph Log

D. Field Conclusions			
1. Imminent hazard to integrity of mud pit cap? (If yes, immediate report required. Note the person or agency the report will be made to.)		X	
2. Are more frequent inspections required?		X	
3. Are existing maintenance actions satisfactory?			Not Applicable. No maintenance was done or required.
4. Are existing repair actions satisfactory?			Not Applicable. No repairs were done or required.
5. Is other maintenance/repair necessary?		X	

6. Rationale for field conclusions: Conclusions were based on walkover visual inspections and plant counts.
Minor water erosion noted on the mud pit cap in the 2006 inspection report has not recurred because vegetation has largely covered the mud pit cap, resulting in a decrease in the occurrence of erosion by runoff water.
As shown in the photograph (P6230168) the small depression or subsidence noted in 2006 is now covered by vegetation and the depth of the subsidence is less than 1 ft (the red and white stakes are 1 ft long).
Ponded water at the E end of the mud pit cap (photo P6230170) is associated with Channel F1 – minor trenching and filling should be done to allow the water to drain away from the mud pit cap, as designed.

7. Factors contributing to or impacting inspection: None noted

E. Certification

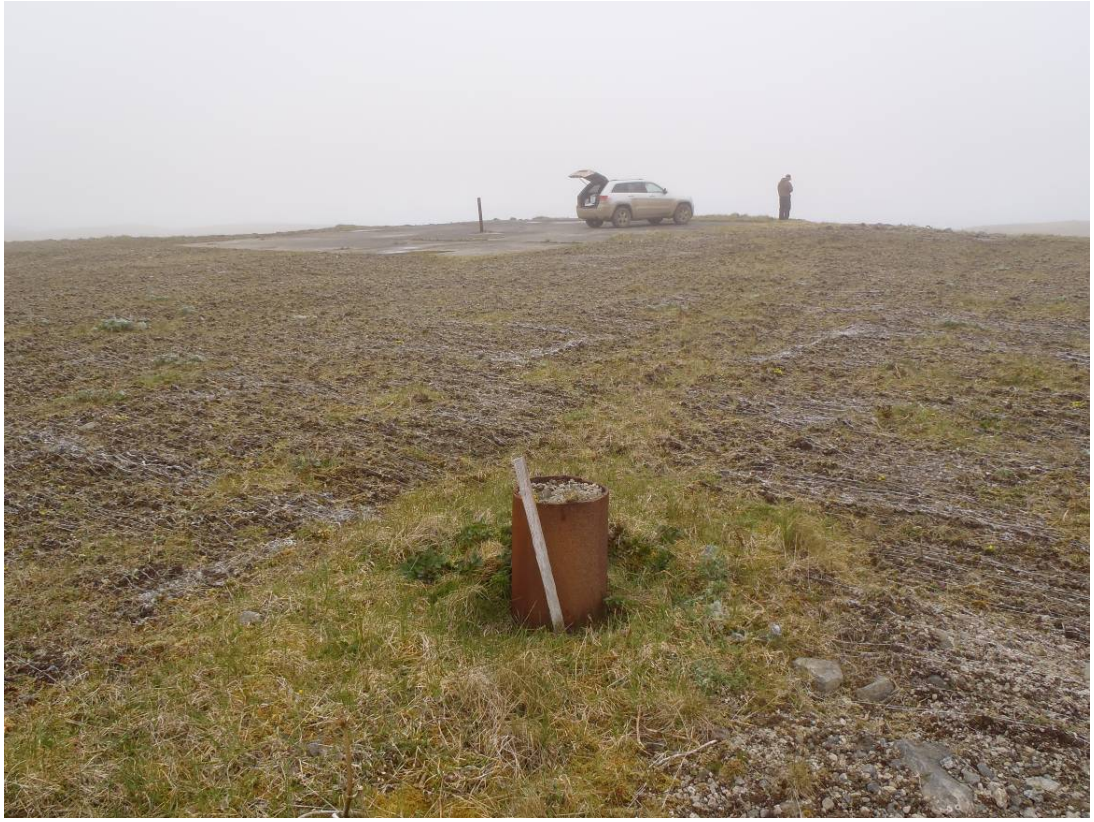
I certify that I have conducted an inspection of the Drill Site F mud pit cap in accordance with the Post-Closure Monitoring and Inspection Plan for Amchitka Island Mud Pit Release Sites, dated March 2011, as recorded on this checklist, discussion in Section 2.0, field notes, vegetative cover log, photograph log, and photos.

Inspector Printed Name: Craig Goodknight	Inspector Signature:
Title: Inspection Team Lead	Date: 7/15/11

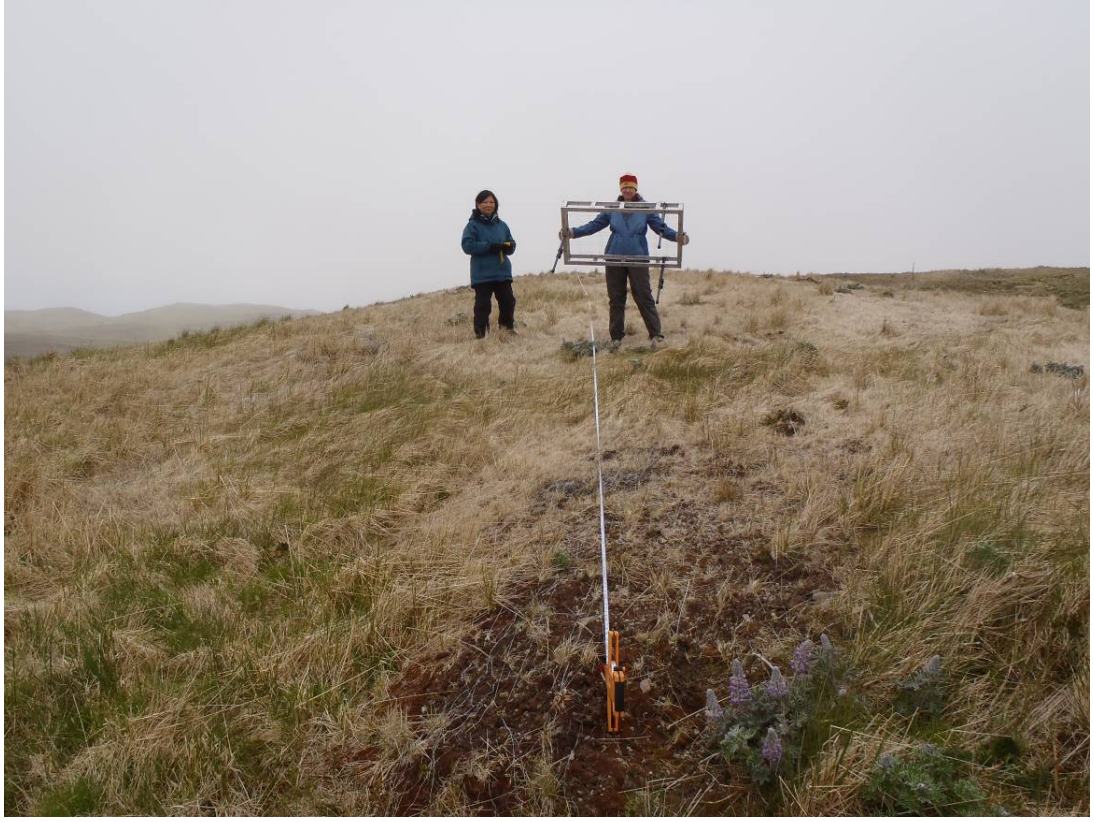
PHOTOGRAPH LOG

Mud Pit Site: Drill Site F				
Date	**Photo #**	**GPS Location***	**Direction of Photo**	**DESCRIPTION (Photopoints indicated by an *)**
6/23/11	P6230159	See Figure A-6	South	USFWS Monument*
6/23/11	P6230160	See Figure A-6	West	Transect F-1 E*
6/23/11	P6230161	See Figure A-6	South	Transect F-3 N*
6/23/11	P6230162	See Figure A-6	South	North photopoint*
6/23/11	P6230163	See Figure A-6	South	Transect F-2 N*
6/23/11	P6230164	See Figure A-6	East	Transect F-1 W*
6/23/11	P6230165	See Figure A-6	North	Transect F-2 S*
6/23/11	P6230166	See Figure A-6	North	South photopoint*
6/23/11	P6230167	See Figure A-6	North	Transect F-3 S*
6/23/11	P6230168	See Figure A-6	North	Small subsidence area covered by vegetation
6/23/11	P6230169	See Figure A-6	East	View of W end of Site F mud pit cap and one sign
6/23/11	P6230170	See Figure A-6	West	View of E end of Site F mud pit cap, one sign, and ponded water in Channel F1

*GPS location datum AK State Plane NAD 1983



P6230159 – Drill Site F USFWS Monument, view S



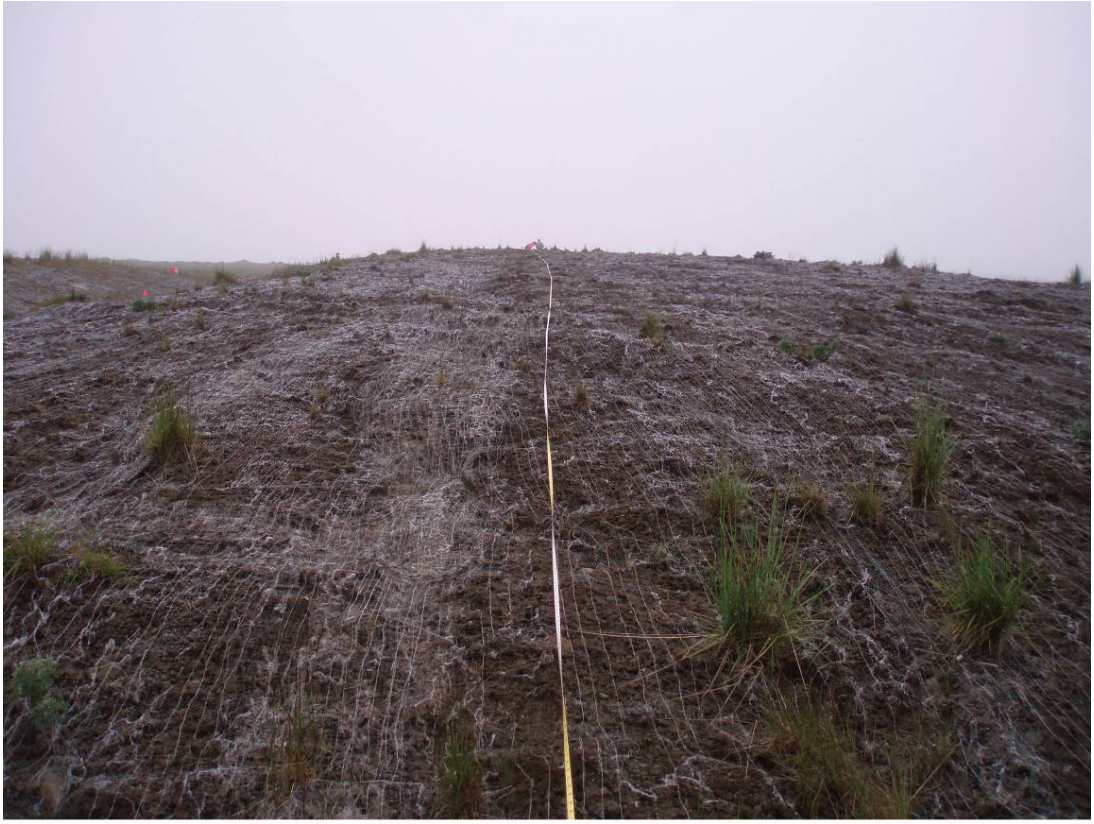
P6230160 – View W from F-1 E

P6230161 – View S from F-3 N

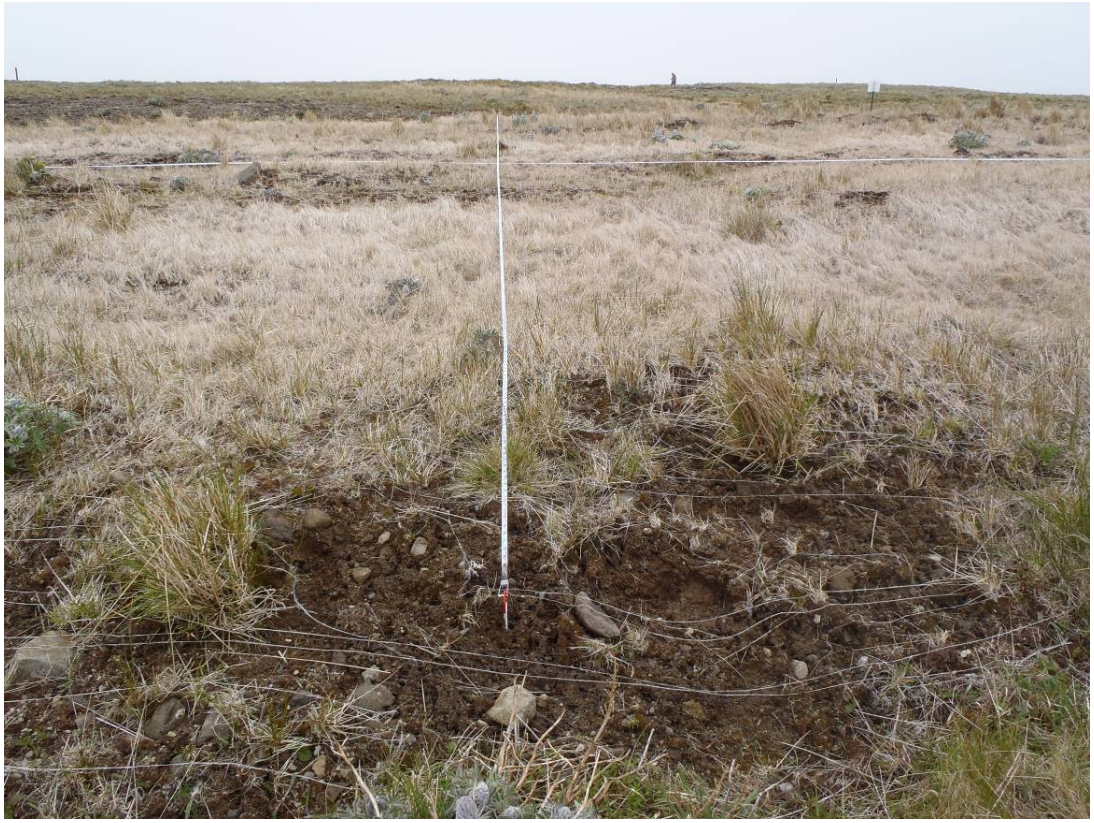
P6230162 – View S from North photopoint

P6230163 – View S from F-2 N

P6230164 – View E from F-1 W



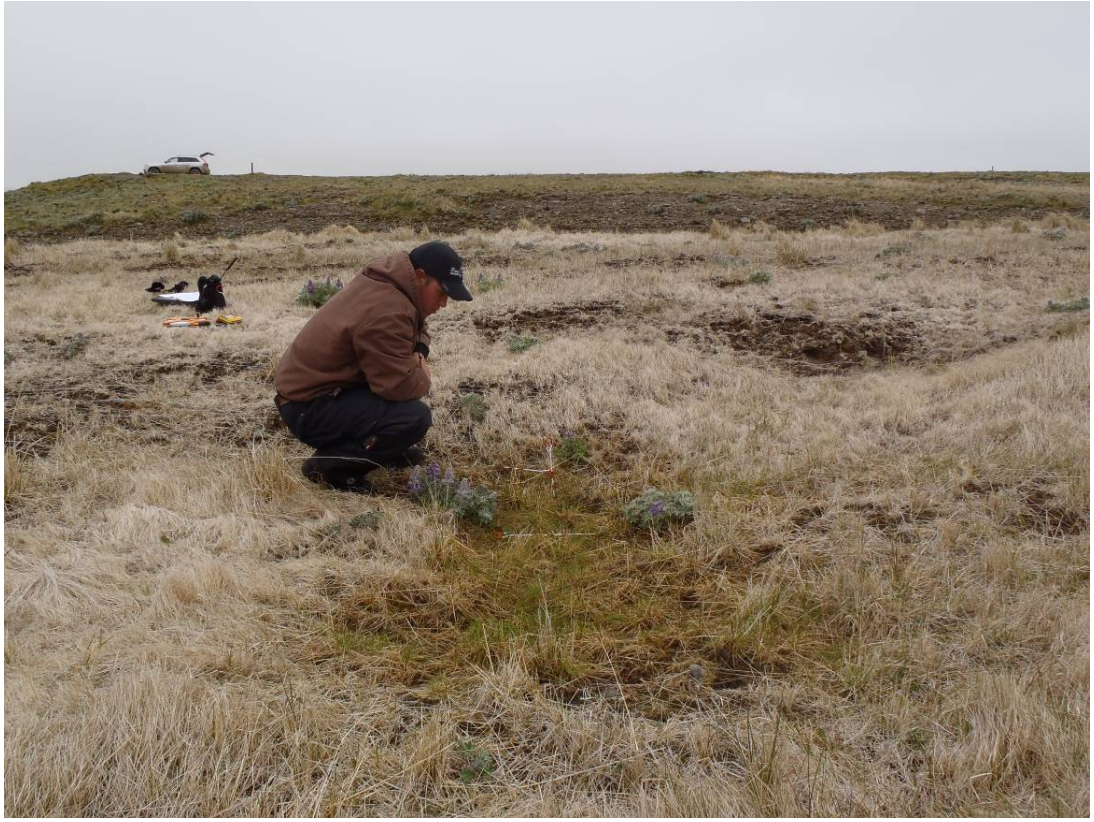
P8020010 – View E from F-1 W (2006)



P6230165 – View N from F-2 S

P6230166 – View N from South photopoint

P6230167 – View N from F-3 S



P6230168 – View N of small subsidence area covered by vegetation

P8020012 – View of minor subsidence (2006)

P6230169 – View E of W end of Site F mud pit cap and one sign

P6230170 – View W of E end of Site F mud pit cap, one sign, and ponded water in Channel F1

Appendix A-7

Drill Site E

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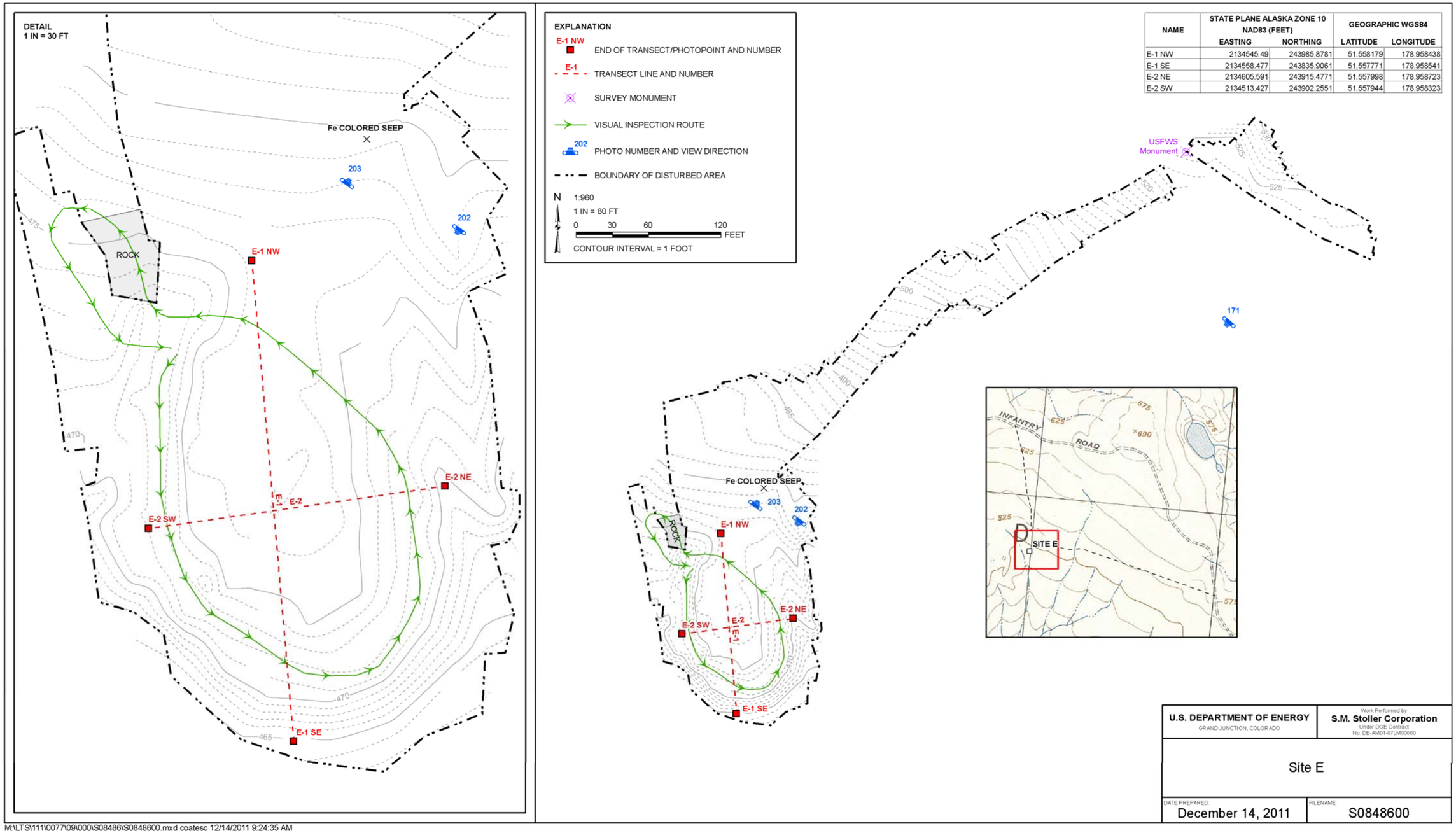

NAME	STATE PLANE ALASKA ZONE 10 NAD83 (FEET)		GEOGRAPHIC WGS84	
	EASTING	NORTHING	LATITUDE	LONGITUDE
E-1 NW	2134545.49	243985.8781	51.558179	178.958438
E-1 SE	2134558.477	243835.9061	51.557771	178.958541
E-2 NE	2134605.591	243915.4771	51.557998	178.958723
E-2 SW	2134513.427	243902.2551	51.557944	178.958323

Figure A–7. Drill Site E

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AMCHITKA MUD PIT SITES POST-CLOSURE MONITORING CHECKLIST

Mud Pit Site: Drill Site E	Date of Inspection: June 23 and 24, 2011
Responsible Agency: U.S. Department of Energy – Legacy Management	Project Manager: Mark Kautsky
Inspector (name, title, organization): Craig Goodknight, Inspection Team Lead, S.M. Stoller Corp.	

A. General Instructions

1. All checklist items must be completed and detailed comments made to document the results of the site inspection.
2. The completed checklist is part of the field record of the inspection. Additional pages should be used as necessary to ensure that a complete record is made. Number and attach the additional pages upon completion of the inspection.
3. Any checklist line item marked by an inspector in a SHADED BOX must be fully explained or an appropriate reference to previous reports provided. The explanation should include the inspector's rationale for conclusions and recommendations, if appropriate. Explanations are to be placed on additional attachments and cross-referenced appropriately, and may take the form of sketches, measurements, and/or annotated site maps.
4. The site inspection is a walking inspection of the entire site, including the perimeter and sufficient transects to be able to inspect the entire surface and all features specifically described in this checklist. Attach a drawing indicating the starting and ending points and the direction and pattern of the inspection.
5. A standard set of digital photographs is required. In addition, all anomalous features or new features (such as changes in adjacent area land use) are to be photographed. A photo log entry will be made for each photograph taken.

B. Preparation (to be completed prior to site visit)	YES	NO	EXPLANATION
1. Site as-built plans and site base map reviewed	X		Mud Pit Closure Plans and As-Built
2. Previous inspection reports reviewed	X		2006 Inspection Report
a. Were anomalies or trends detected on previous inspections?	X		Minor water erosion noted on mud pit cap in 2006 inspection
b. Was maintenance performed on areas with anomalies?		X	Only minor erosion on unvegetated mud pit cap
3. Site maintenance and repair records reviewed		X	No previous maintenance activities were done
a. Has site repair resulted in a change from as-built conditions?		X	No detectable changes from as-built condition
b. Are revised as-builts available that reflect repair changes?			Not Applicable. No repairs have been made.

C. Site Inspection (to be completed during inspection)	YES	NO	EXPLANATION
1. Adjacent offsite features within mud pit site area			
a. Changes in use of adjacent area?		X	Wildlife refuge
b. Any new roads or trails?		X	Per previous photos and as-built drawings
c. Change in the position of nearby washes?		X	None detected
d. Erosion/deposition of nearby washes?	X		An area of small reddish-brown seeps is just N of the mud pit cap as noted below
e. New drainage channels?		X	None detected
f. Change in surrounding vegetation?		X	None detected
2. Security markers; signs			
a. Displacement of site markers, boundary markers, or monuments?		X	USFWS Monument was present/Good condition
b. Signs damaged or removed?		X	Signs were installed around mud pit cap margin
3. Mud Pit Cap			
a. Evidence of subsidence?		X	
b. Evidence of cracking?		X	
c. Evidence of erosion (wind or water)?		X	Minor water erosion noted in 2006 has not recurred as noted below
d. Evidence of animal burrowing?		X	
e. Are site markers disturbed? By man?_____ By natural processes?_____		X	
f. Do natural processes threaten the integrity of mud pit cap or site marker?		X	

AMCHITKA MUD PIT SITES POST-CLOSURE MONITORING CHECKLIST (continued)

Mud Pit Site: Drill Site E	Date of Inspection: June 23 and 24, 2011

C. Site inspection (continued)	YES	NO	EXPLANATION
4. Vegetative cover			
a. Is plant cover adequate to prevent erosion?	X		See discussion in Section 3.0
b. Are weedy annual plants present? Do they require removal?		X	See discussion in Section 3.0
c. Evidence of animals on mud pit cap?		X	See discussion in Section 3.0
d. Evidence of excessive plant mortality?		X	See discussion in Section 3.0
e. Has a vegetative cover log been completed?	X		See Vegetative Cover Log
5. Photo Documentation			
a. Has a photo log been prepared?	X		See Photograph Log
b. How many photos were taken?			8 photos as noted in the Photograph Log

D. Field Conclusions			
1. Imminent hazard to integrity of mud pit cap? (If yes, immediate report required. Note the person or agency the report will be made to.)		X	
2. Are more frequent inspections required?		X	
3. Are existing maintenance actions satisfactory?			Not Applicable. No maintenance was done or required.
4. Are existing repair actions satisfactory?			Not Applicable. No repairs were done or required.
5. Is other maintenance/repair necessary?		X	

6. Rationale for field conclusions: Conclusions were based on walkover visual inspections and plant counts. Minor water erosion noted on the mud pit cap in the 2006 inspection report has not recurred because vegetation has largely covered the mud pit cap, resulting in a decrease in the occurrence of erosion by runoff water. Small reddish-brown seeps are in a small area about 30 - 50 feet N of the mud pit cap. The flow and drainage from the seeps should be checked in future inspections to ensure that they do not disturb the mud pit cap.

7. Factors contributing to or impacting inspection: None noted

E. Certification

I certify that I have conducted an inspection of the Drill Site E mud pit cap in accordance with the Post-Closure Monitoring and Inspection Plan for Amchitka Island Mud Pit Release Sites, dated March 2011, as recorded on this checklist, discussion in Section 2.0, field notes, vegetative cover log, photograph log, and photos.

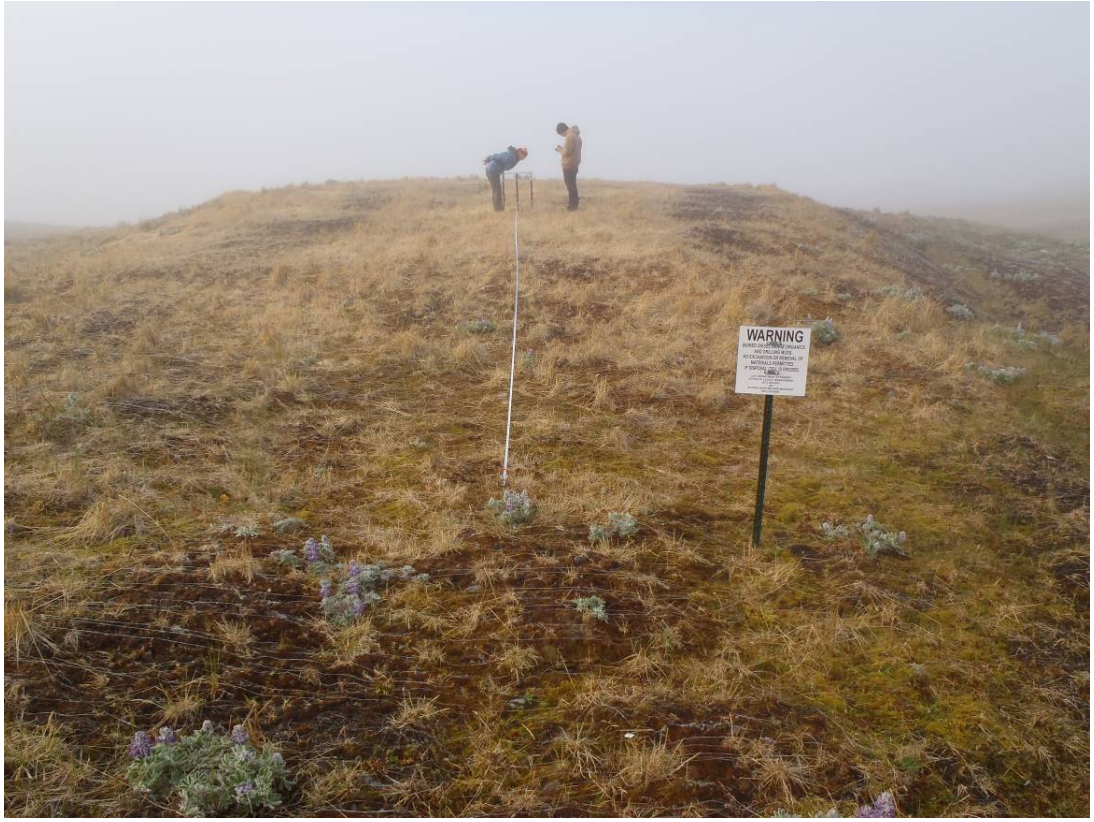
Inspector Printed Name: Craig Goodknight	Inspector Signature:
Title: Inspection Team Lead	Date: 7/15/11

PHOTOGRAPH LOG

Mud Pit Site: Drill Site E				
Date	**Photo #**	**GPS Location***	**Direction of Photo**	**DESCRIPTION (Photopoints indicated by an *)**
6/24/11	P6240197	See Figure A-7	Southwest	USFWS Monument*
6/24/11	P6240198	See Figure A-7	South	Transect E-1 NW*
6/24/11	P6240199	See Figure A-7	East	Transect E-2 SW*
6/24/11	P6240200	See Figure A-7	North	Transect E-1 SE*
6/24/11	P6240201	See Figure A-7	West	Transect E-2 NE*
6/23/11	P6230171	See Figure A-7	Southwest	View of Site E from well pad
6/24/11	P6240202	See Figure A-7	Southwest	View of Site E mud pit cap and 3 signs along margin
6/24/11	P6240203	See Figure A-7	North	Small area of reddish-brown seeps N of mud pit cap

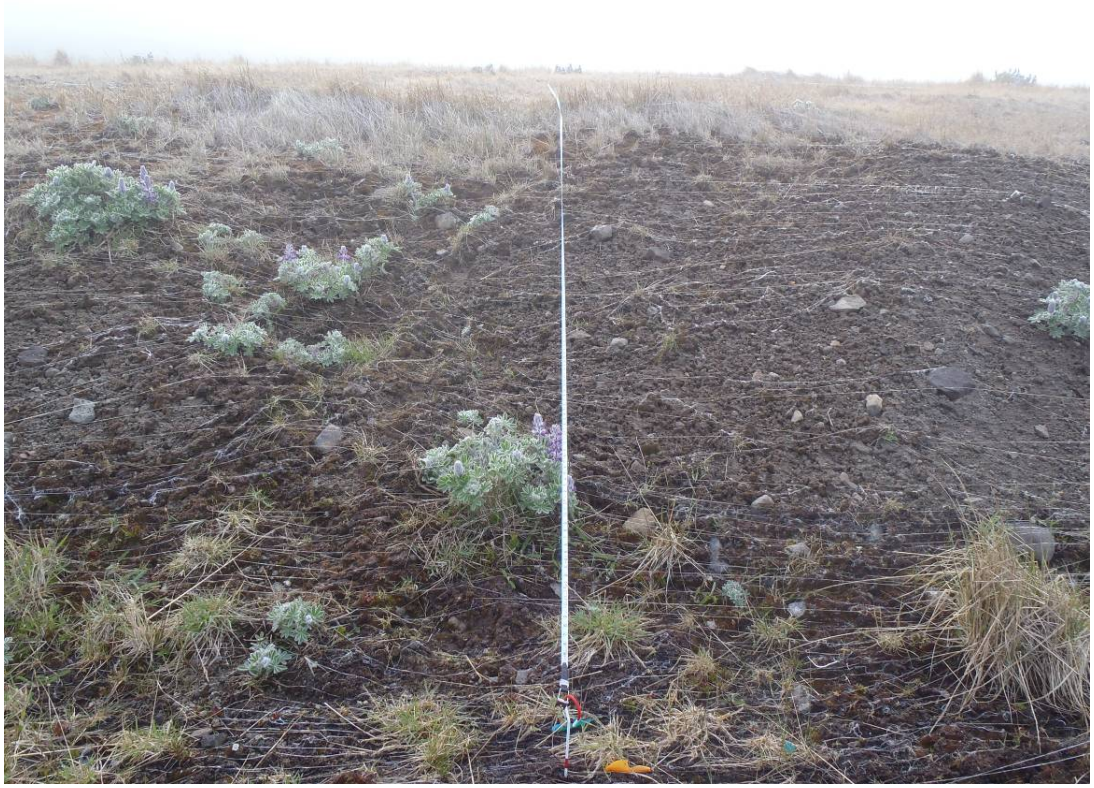
*GPS location datum AK State Plane NAD 1983

P6240197 – Drill Site E USFWS Monument, view SW



P6240198 – View S from E-1 NW

P8020002– View S from E-1 NW (2006)



P6240199 – View E from E-2 SW

P6240200 – View N from E-1 SE

P6240201 – View W from E-2 NE

P6230171 – View SW of Site E from pad for hole UAE-7 c/h

P6240202 – View SW of Site E mud pit cap and three signs along margin

P6240203 – View N of small area of reddish-brown seeps N of mud pit cap

Appendix B

Vegetation Survey

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Appendix B-1

Rifle Range

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The Rifle Range mud pit cap is located approximately 5.5 miles northwest of Constantine Harbor in the lowland tundra topoenvironment. The undisturbed community surrounding the mud pit cap is a crowberry meadow with an abundant grass and sedge component. Absolute vegetation cover in the undisturbed community approaches 100 percent. The elevation of the mud pit cap is about 17 meters (56 ft), and the surface of the mud pit cap was contoured to match the surrounding terrain; the mud pit cap surface is not appreciably higher than the adjacent area and it has very little slope.

Total vegetation cover increased from about 29 percent to just over 44 percent between the 2006 and 2011 survey periods, and the increase is significant (Table 4 and Table 5 in Section 3.0). Species richness also increased between the two survey periods from 14 taxa in 2006 to 21 taxa in 2011. Most of the vegetation cover on the Rifle Range mud pit cap was from vascular species, and about half of the cover could be attributed to the red fescue (*Festuca rubra*) and Bering's tufted hairgrass (*Deschampsia beringensis*), the two species that were seeded in 2001. Nootka lupine (*Lupinus nootkatensis*), thought to be an important early successional species on Amchitka Island, was the second most abundant species on the mud pit cap. Litter cover increased from approximately 10 percent in 2006 to a little over 25 percent in 2011, while exposed mineral soils with no vegetation or litter cover accounted for only about 31 percent of the surface area sampled in 2011. The three most abundant vascular species had frequency values of nearly 50 percent or greater, indicating that they were adequately distributed across the mud pit cap. Compared with other mud pit caps surveyed in 2011, the Rifle Range mud pit cap had the highest cover for vascular species and among the lowest cover values for nonvascular species. In terms of total vegetation cover, four mud pit caps had higher values and two mud pit caps had lower values.

Table B-1 shows the mean cover and frequency of occurrence for the vegetative cover of the Rifle Range mud pit cap. Absolute cover for each species is calculated as the percentage of points intercepted by that species out of the total number of points sampled. It is an estimate of the amount of substrate "covered" by that species via vertical projection. Relative cover is the mean cover of a species compared to other vegetative entities. It is calculated as the percentage of points intercepted by one species compared to the total number of points intercepted by all vegetative entities and it may be used to assess the relative importance of one species or group of species in an assemblage or plant community. Frequency is the percentage of frames in which a species occurs out of the total number of frames sampled and it provides some information about the distribution of a species across the mud pit cap (e.g. if a species occurs with high frequency, it is probably widely distributed across the mud pit cap).

Vegetation recovery on the Rifle Range mud pit cap is progressing very well, as evidenced by increases in cover of both seeded and colonizing species, increases in species richness, and increases in plant litter, which should improve soil organic inputs. The low profile of the mud pit cap compared to the surrounding terrain and the low elevation of the mud pit cap on the island contribute to more favorable conditions for vegetation recovery than on other mud pit caps. The Rifle Range mud pit cap should continue to recover on its current trajectory without additional revegetation efforts.

Table B–1. Mean Cover and Frequency of Occurrence for Entities Sampled on the Rifle Range Mud Pit Cap During the 2011 Vegetation Survey.

Entity[a]	Absolute Cover (%)	Relative Cover (%)	Frequency (%)
Vascular Species			
Subshrubs			
Empetrum nigrum	0.42	0.94	8
Total Subshrub Cover	**0.42**	**0.94**	
Graminoids			
Festuca rubra	15.21	34.22	86
Deschampsia beringensis	5.10	11.48	60
Carex macrochaeta	3.09	6.95	30
Phleum alpinum	0.14	0.31	5
Agrostis mertensii	0.07	0.16	3
Poa stenantha	0.07	0.16	3
Bromus sitchensis	0.03	0.08	1
Total Graminoid Cover	**23.72**	**53.36**	
Forbs			
Lupinus nootkatensis	10.76	24.22	49
Achillea millefolium	2.36	5.31	35
Anaphalis margaritacea	1.42	3.20	21
Angelica lucida	1.28	2.89	10
Chamerion latifolium	0.97	2.19	21
Equisetum arvense	0.52	1.17	11
Koenigia islandica	0.17	0.39	6
Arnica unalaschcensis	0.14	0.31	4
Platanthera dilatata	0.14	0.31	5
Taraxacum officinale	0.10	0.23	1
Pinguicula vulgaris	0.07	0.16	1
Conioselinum chinense	0.03	0.08	1
Primula cuneifolia	0.03	0.08	1
Total Forb Cover	**18.02**	**40.55**	
Total Vascular Cover	**42.15**	**94.84**	
Nonvascular Growth Forms			
Moss	2.33	5.23	29
Total Nonvascular Cover	**2.33**	**5.23**	
Total Vegetation Cover	**44.48**	**100.08**	
Nonvegetation Entities			
Bare Ground	30.59		74
Litter	25.52		98
Total Nonvegetation Cover	**56.11**		

[a] Within functional groups, species are sorted in order of descending absolute cover. A total of 80 frames were sampled across four transects.

Appendix B-2

Long Shot

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The Long Shot mud pit cap is approximately 7.5 miles northwest of Constantine Harbor. The mud pit cap is located near the upper elevation limit of the lowland tundra topoenvironment and is surrounded by crowberry meadow interspersed with several ephemeral pools. Absolute vegetation cover in the undisturbed community around the mud pit cap is close to 100 percent. Elevation at the top of the mud pit cap is 50 meters (165 ft), and the surface of the mud pit cap is higher than the surrounding terrain. The slope of the mud pit cap surface and height above grade is greater for Long Shot than for most of the other mud pit caps. The Long Shot mud pit cap is also one of the largest of the seven mud pit caps in terms of total area.

Total vegetation cover increased from 49 percent in 2006 to 57 percent in 2011. The increase is statistically significant (Table 4 and Table 5 in Section 3.0), but the magnitude of the increase between the two sample periods was smaller at Long Shot than at most of the other mud pit caps surveyed (Figure 2 in Section 3.0). Species richness increased from 13 taxa in 2006 to 22 taxa in 2011, making species richness higher on the Long Shot mud pit cap than on the other mud pit caps. A pattern of colonization in which graminoids and forbs were becoming established around the periphery of the mud pit cap was noted at Long Shot, which may have contributed to increase in species richness. Just over half of the vegetation cover on the Long Shot mud pit cap was from vascular species. Red fescue (*Festuca rubra*), a seeded grass, was the most abundant vascular species, followed by Nootka lupine (*Lupinus nootkatensis*). Litter cover decreased between the two survey periods from 17 percent in 2006 to about 9 percent in 2011. About 34 percent of the area surveyed on the Long Shot mud pit cap was bare mineral soil with no cover by vegetation or plant litter. Frequency values for red fescue were 95 percent, indicating its occurrence was widespread across the mud pit cap. Compared with other mud pit caps surveyed in 2011, the Long Shot mud pit cap had the second highest total cover value and was near the median of values for vascular species cover.

Table B-2 shows the mean cover and frequency of occurrence for the vegetative cover of the Long Shot mud pit cap. Absolute cover for each species is calculated as the percentage of points intercepted by that species out of the total number of points sampled. It is an estimate of the amount of substrate "covered" by that species via vertical projection. Relative cover is the mean cover of a species compared to other vegetative entities. It is calculated as the percentage of points intercepted by one species compared to the total number of points intercepted by all vegetative entities and it may be used to assess the relative importance of one species or group of species in an assemblage or plant community. Frequency is the percentage of frames in which a species occurs out of the total number of frames sampled and it provides some information about the distribution of a species across the mud pit cap (e.g. if a species occurs with high frequency, it is probably widely distributed across the mud pit cap).

Vegetation cover, especially for vascular species, is recovering more slowly on the Long Shot mud pit cap than on the Rifle Range mud pit cap, as would be expected by its higher elevation on the island and by its higher elevation above the surrounding grade. Increases in species richness and vegetation cover, evidence of colonization from the surrounding community, and high frequency values for red fescue indicate that vegetation recovery of the site is still progressing. Vegetation conditions on the Long Shot mud pit cap should continue to improve, albeit more slowly, with time. Further revegetation efforts are probably not warranted unless the vegetation currently established on the mud pit cap experiences a setback, or if it is required to stabilize erosion. If further revegetation efforts are desired on the Long Shot mud pit cap, revegetation plans should recognize that red fescue and several nonvascular species are already widely

distributed, and plans should minimize impacts to the fragile vegetation that has already become established on the mud pit cap.

Table B–2. Mean Cover and Frequency of Occurrence for Entities Sampled on the Long Shot Mud Pit Cap During the 2011 Vegetation Survey

Entity[a]	Absolute Cover (%)	Relative Cover (%)	Frequency (%)
Vascular Species			
Subshrubs			
Empetrum nigrum	0.84	1.46	12
Total Subshrub Cover	**0.84**	**1.46**	
Graminoids			
Festuca rubra	20.75	36.36	95
Deschampsia beringensis	1.04	1.82	20
Carex macrochaeta	0.77	1.35	17
Agrostis mertensii	0.14	0.24	4
Elymus macrourus	0.05	0.08	1
Poa stenantha	0.05	0.08	2
Phleum alpinum	0.02	0.04	1
Total Graminoid Cover	**22.81**	**39.96**	
Forbs			
Lupinus nootkatensis	4.29	7.52	26
Chamerion latifolium	0.99	1.74	27
Draba stenopetala	0.63	1.11	15
Anaphalis margaritacea	0.36	0.63	9
Potentilla villosa	0.23	0.40	5
Koenigia islandica	0.11	0.20	3
Angelica lucida	0.11	0.20	2
Platanthera dilatata	0.07	0.12	2
Achillea millefolium	0.05	0.08	2
Primula cuneifolia	0.05	0.08	2
Veronica americana	0.05	0.08	2
Equisetum arvense	0.02	0.04	1
Pinguicula vulgaris	0.02	0.04	1
Saxifraga sp.	0.02	0.04	1
Total Forb Cover	**7.00**	**12.27**	
Total Vascular Cover	**30.65**	**53.69**	
Nonvascular Growth Forms			
Moss	25.93	45.42	87
Lichen	0.52	0.91	13
Total Nonvascular Cover	**26.45**	**46.33**	
Total Vegetation Cover	**57.09**	**100.02**	
Nonvegetation Entities			
Bare Ground	34.15		88
Litter	8.83		85
Total Nonvegetation Cover	**42.98**		

[a] Within functional groups, species are sorted in order of descending absolute cover. A total of 123 frames were sampled across five transects.

Appendix B-3

Cannikin South

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The Cannikin South mud pit cap is approximately 13.5 miles northwest of Constantine Harbor. The mud pit cap is in the lower extent of upland tundra topoelevational unit. The undisturbed plant community is a crowberry meadow with vegetation cover approaching 100 percent. The mud pit cap is located on a large hill, but the slopes of the mud pit cap are relatively gentle, and the grade of the mud pit cap is similar to that of the surrounding terrain. The elevation at the top of the mud pit cap is 72 meters (237 ft). Much of the area immediately adjacent to the mud pit cap has been disturbed and is covered in angular rock that supports very little vegetation. The total area of the Cannikin South mud pit cap is small compared to the areas of other mudpit caps.

Total vegetation cover increased significantly on the Cannikin South mud pit cap between the survey periods (Table 4 and Table 5 in Section 3.0). Absolute vegetation cover was approximately 22 percent in 2006 and approximately 38 percent in 2011. Species richness declined from 10 taxa to 9 taxa between the two survey periods, and species richness was lower on the Cannikin South mud pit cap than on any of the other mud pit caps surveyed in 2011. Lower species richness on the Cannikin South mud pit cap is likely a function of the smaller spatial extent of the mud pit cap. All but about 4 percent of the vegetation cover on the Cannikin South Mud pit cap was from vascular species, and grass cover accounted for the vast majority of the vascular species cover. Red fescue (*Festuca rubra*) and Bering's tufted hairgrass (*Deschampsia beringensis*), both seeded species, strongly dominated the species assemblage on the Cannikin South mud pit cap. Litter cover nearly doubled between 2006 and 2011, from 12 percent to 23 percent, and bare ground accounted for nearly 40 percent of the area sampled in 2011. Red fescue occurred in 100 percent of the frames sampled on the Cannikin South mud pit cap in 2011, and Bering's tufted hairgrass occurred in nearly three-fourths of the frames, indicating that both species are widely distributed. Compared with other mud pit caps surveyed in 2011, the Cannikin South mud pit cap had the second lowest total vegetation cover value but the third highest vascular vegetation cover value.

Table B-3 shows the mean cover and frequency of occurrence for the vegetative cover of the Cannikin South mud pit cap. Absolute cover for each species is calculated as the percentage of points intercepted by that species out of the total number of points sampled. It is an estimate of the amount of substrate "covered" by that species via vertical projection. Relative cover is the mean cover of a species compared to other vegetative entities. It is calculated as the percentage of points intercepted by one species compared to the total number of points intercepted by all vegetative entities and it may be used to assess the relative importance of one species or group of species in an assemblage or plant community. Frequency is the percentage of frames in which a species occurs out of the total number of frames sampled and it provides some information about the distribution of a species across the mud pit cap (e.g. if a species occurs with high frequency, it is probably widely distributed across the mud pit cap).

Vegetation is continuing to recover on the Cannikin South mud pit cap, primarily due to the seeded grasses. Colonization of non-seeded species from the surrounding plant community is probably occurring more slowly on the Cannikin South mud pit cap than on many of the other mud pit caps because of the extent of disturbed surface and rocky substrate surrounding the mud pit cap. However, the seeded species are distributed extensively across the mud pit cap surface, and total vegetation cover continues to increase. Vegetation cover should continue to increase as grasses tiller and spread. Recovery on the Cannikin South mud pit cap will likely proceed somewhat more slowly than on mud pit caps located in the lowland tundra topoenvironment

because conditions on mud pit caps located in the upland tundra topoenvironment are generally less favorable for germination and establishment.

Table B–3. Mean Cover and Frequency of Occurrence for Entities Sampled on the Cannikin South Mud Pit Cap During the 2011 Vegetation Survey

Entity[a]	Absolute Cover (%)	Relative Cover (%)	Frequency (%)
Vascular Species			
Graminoids			
Festuca rubra	22.22	57.82	100
Deschampsia beringensis	6.57	17.11	73
Carex macrochaeta	1.76	4.58	27
Elymus macrourus	0.65	1.69	17
Agrostis mertensii	0.09	0.24	3
Total Graminoid Cover	**31.30**	**81.43**	
Forbs			
Lupinus nootkatensis	2.22	5.78	20
Chamerion latifolium	0.37	0.96	13
Koenigia islandica	0.09	0.24	3
Potentilla villosa	0.09	0.24	3
Total Forb Cover	**2.78**	**7.23**	
Total Vascular Cover	**34.07**	**88.66**	
Nonvascular Growth Forms			
Moss	4.26	11.08	43
Lichen	0.09	0.24	3
Total Nonvascular Cover	**4.35**	**11.32**	
Total Vegetation Cover	**38.43**	**99.98**	
Nonvegetation Entities			
Bare Ground	38.80		100
Litter	22.87		100
Total Nonvegetation Cover	**61.67**		

[a] Within functional groups, species are sorted in order of descending absolute cover. A total of 30 frames were sampled across two transects.

Appendix B-4

Cannikin Ground Zero

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The Cannikin Ground Zero mud pit cap is approximately 14 miles northwest of Constantine Harbor. It is located in the lower extent of the upland tundra topoenvironment. The undisturbed surrounding plant community is a crowberry meadow with absolute vegetation cover approaching 100 percent. Graminoids and forbs are abundant and relatively diverse in the undisturbed meadow. The elevation at the top of the mud pit cap is 65.5 meters (215 feet), and the mud pit cap sits above the surrounding grade with moderate slopes, similar to those on the Long Shot mud pit cap. In terms of total surface area, the Cannikin Ground Zero mud pit cap is in the middle of the range of the seven mud pit caps surveyed.

Total vegetation cover increased on the Cannikin Ground Zero mud pit cap from about 13 percent in 2006 to almost 23 percent in 2011. The increase between the two survey periods is statistically significant (Table 4 and Table 5 in Section 3.0). Species richness increased by two taxa as well, from 12 in 2006 to 14 in 2011. Nearly all of the vegetation cover on the Cannikin Ground Zero mud pit cap in 2011 was from vascular species. Only about 1.5 percent of the absolute vegetation cover of the mud pit cap was from mosses and lichens. The seeded grasses, red fescue (*Festuca rubra*) and Bering's tufted hairgrass (*Deschampsia beringensis*), were the most abundant vascular species, followed by Nootka lupine (*Lupinus nootkatensis*). Frequency values of red fescue and Bering's tufted hairgrass were at least 50 percent. Litter cover increased from 13 percent to approximately 20 percent between the two survey periods, and bare ground accounted for about 58 percent of the total area sampled in 2011. Compared with other mud pit caps surveyed in 2011, the Cannikin Ground Zero mud pit cap had the lowest total vegetation cover, the lowest cover from vascular species, and the highest percentage of bare ground.

Table B-4 shows the mean cover and frequency of occurrence for the vegetative cover of the Cannikin Ground Zero mud pit cap. Absolute cover for each species is calculated as the percentage of points intercepted by that species out of the total number of points sampled. It is an estimate of the amount of substrate "covered" by that species via vertical projection. Relative cover is the mean cover of a species compared to other vegetative entities. It is calculated as the percentage of points intercepted by one species compared to the total number of points intercepted by all vegetative entities and it may be used to assess the relative importance of one species or group of species in an assemblage or plant community. Frequency is the percentage of frames in which a species occurs out of the total number of frames sampled and it provides some information about the distribution of a species across the mud pit cap (e.g. if a species occurs with high frequency, it is probably widely distributed across the mud pit cap).

The slow recovery of the Cannikin Ground Zero mud pit cap compared with most of the other mud pit caps is likely a consequence of its location in the upland tundra topoenvironmental unit and its elevation above the surrounding terrain. Although recovery is progressing slowly on the Cannikin Ground Zero mud pit cap, both vegetation cover and litter, which provide important organic materials for soil development, continue to increase. Recovery on the Cannikin Ground Zero mud pit cap will likely proceed somewhat more slowly than on mud pit caps located in the lowland tundra topoenvironment because conditions on mud pit caps located in the upland tundra topoenvironment are generally less favorable for germination and establishment.

Table B–4. Mean Cover and Frequency of Occurrence for Entities Sampled on the Cannikin Ground Zero Mud Pit Cap During the 2011 Vegetation Survey

Entity[a]	Absolute Cover (%)	Relative Cover (%)	Frequency (%)
Vascular Species			
Graminoids			
Festuca rubra	8.42	37.15	76
Deschampsia beringensis	5.15	22.73	50
Carex macrochaeta	1.79	7.91	21
Elymus macrourus	0.27	1.19	10
Agrostis mertensii	0.18	0.79	5
Poa stenantha	0.13	0.59	5
Total Graminoid Cover	**15.95**	**70.35**	
Forbs			
Lupinus nootkatensis	3.36	14.82	23
Equisetum arvense	0.49	2.17	6
Achillea millefolium	0.49	2.17	8
Chamerion latifolium	0.36	1.58	11
Potentilla villosa	0.18	0.79	6
Veronica americana	0.18	0.79	6
Angelica lucida	0.04	0.20	2
Veronica serpyllifolia	0.04	0.20	2
Total Forb Cover	**5.15**	**22.73**	
Total Vascular Cover	**21.10**	**93.08**	
Nonvascular Growth Forms			
Moss	1.25	5.53	24
Lichen	0.31	1.38	2
Total Nonvascular Cover	**1.57**	**6.92**	
Total Vegetation Cover	**22.67**	**100.00**	
Nonvegetation Entities			
Bare Ground	57.75		100
Litter	19.58		98
Total Nonvegetation Cover	**77.33**		

[a] Within functional groups, species are sorted in order of descending absolute cover. A total of 62 frames were sampled across five transects.

Appendix B-5

Drill Site D

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The Drill Site D mud pit cap is approximately 18.5 miles northwest of Constantine Harbor. It is located in crowberry stripe community of the upland tundra topoenvironmental unit. The undisturbed adjacent community is a mosaic of black crowberry (*Empetrum nigrum*)–dominated vegetation interspersed with barren stripes composed of a mixture of rock, cobble, and mineral soils. The spatial extent of the vegetated patches far exceeds that of the barren stripes at this elevation, and the vegetated patches have nearly 100 percent cover. In addition to black crowberry, grasses, sedges, forbs, and lichens are abundant in the undisturbed community adjacent to the mud pit cap. The elevation of the mud pit cap is about 95 meters (310 feet) at the top. The Drill Site D mud pit cap consists of two parallel berms that are above the surrounding grade and have moderate slopes. This mud pit cap is the largest of the mud pit caps in terms of total area.

Total absolute vegetation cover increased significantly (Table 4 and Table 5 in Section 3.0) on the Drill Site D mud pit cap between the two survey periods. Mean total cover was approximately 17 percent in 2006 and was just over 50 percent in 2011. Species richness also increased from 8 taxa in 2006 to 14 taxa in 2011. More than half of the total vegetation cover on the Drill Site D mud pit cap was from cryptogams, primarily mosses. Of the vascular species, red fescue (*Festuca rubra*) and Berings's tufted hairgrass (*Deschampsia beringensis*) were the most abundant species. Both grasses were seeded in 2001 and again in 2008. Cover from colonizing species totaled less than 2 percent. The frequency of occurrence of red fescue was over 95 percent, indicating that it was widely distributed across the mud pit cap. Average litter cover was nearly 42 percent in 2011, up from 30 percent in 2006, and bare ground accounted for only about 7 percent of the area sampled. The high cover of litter and low exposure of bare ground are an effect of the 2008 planting, which resulted in an extensive thatch of biomass left from the growing season subsequent to planting, particularly on the tops of the berms. While the layer of thatch may be restricting growth of the seeded species in the short-term, it will decompose and add organic material to the soil, which will improve growing conditions over the next decade. The standing dead plant material will also function to trap seed and facilitate colonization of species from the surrounding plant community. Compared with other mud pit caps surveyed in 2011, The Drill Site D mud pit cap had only about 7 percent less cover than the mud pit cap with the highest total cover value but had among the lowest cover of vascular vegetation.

Table B-5 shows the mean cover and frequency of occurrence for the vegetative cover of the Drill Site D mud pit cap. Absolute cover for each species is calculated as the percentage of points intercepted by that species out of the total number of points sampled. It is an estimate of the amount of substrate "covered" by that species via vertical projection. Relative cover is the mean cover of a species compared to other vegetative entities. It is calculated as the percentage of points intercepted by one species compared to the total number of points intercepted by all vegetative entities and it may be used to assess the relative importance of one species or group of species in an assemblage or plant community. Frequency is the percentage of frames in which a species occurs out of the total number of frames sampled and it provides some information about the distribution of a species across the mud pit cap (e.g. if a species occurs with high frequency, it is probably widely distributed across the mud pit cap).

The magnitude of increase in total vegetation cover between the 2006 and 2011 sample periods was higher for the Drill Site D mud pit cap than for any of the lower elevation mud pit caps, which were not seeded in 2008.

Table B–5. Mean Cover and Frequency of Occurrence for Entities Sampled on the Drill Site D Mud Pit Cap During the 2011 Vegetation Survey

Entity[a]	Absolute Cover (%)	Relative Cover (%)	Frequency (%)
Vascular Species			
Graminoids			
Festuca rubra	15.75	30.93	96
Deschampsia beringensis	3.48	6.84	43
Carex macrochaeta	0.54	1.06	15
Agrostis mertensii	0.02	0.04	1
Poa stenantha	0.02	0.04	1
Total Graminoid Cover	**19.82**	**38.90**	
Forbs			
Veronica serpyllifolia	0.54	1.06	10
Chamerion latifolium	0.48	0.94	14
Lupinus nootkatensis	0.39	0.77	5
Potentilla villosa	0.10	0.20	4
Veronica americana	0.06	0.12	2
Anaphalis margaritacea	0.06	0.12	1
Koenigia islandica	0.04	0.08	1
Platanthera dilatata	0.02	0.04	1
Senecio pseudoarnica	0.02	0.04	1
Total Forb Cover	**1.72**	**3.38**	
Total Vascular Cover	**21.54**	**42.28**	
Nonvascular Growth Forms			
Moss	25.08	49.24	85
Lichen	4.33	8.50	40
Total Nonvascular Cover	**29.42**	**57.74**	
Total Vegetation Cover	**50.95**	**100.02**	
Nonvegetation Entities			
Litter	41.83		99
Bare Ground	7.21		36
Total Nonvegetation Cover	**49.05**		

[a] Within functional groups, species are sorted in order of descending absolute cover. A total of 134 frames were sampled across 11 transects.

Appendix B-6

Drill Site F

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The Drill Site F mud pit cap is approximately 21.5 miles northwest of Constantine Harbor and is located in the crowberry stripe community of the upland topoenvironmental unit. The undisturbed adjacent community is a mosaic of black crowberry (*Empetrum nigrum*)–dominated vegetation interspersed with barren stripes composed of a mixture of rock, cobble, and mineral soils. The spatial extent of the vegetated patches exceeds that of the barren stripes, but the barren stripes are somewhat more extensive than in the community surrounding Drill Site D. The vegetated patches are less diverse than on the crowberry-dominated communities occurring at lower elevations, though they still include grasses, sedges, and lichens. Cover in the vegetated patches is close to 100 percent. The elevation at the top of the Drill Site F mud pit cap is 145 meters (475 feet), and the mud pit cap is not appreciably higher than the surrounding grade. In terms of total area, it is one of the smaller mud pit caps.

Absolute total vegetation cover increased from about 8 percent in 2006 to nearly 58 percent in 2011, and the difference is significant (Table 4 and Table 5 in Section 3.0). The Drill Site F mud pit cap had the lowest total vegetation cover of the mud pit caps in 2006 and the highest total cover of the mud pit caps in 2011. Species richness doubled, from five taxa to 10 taxa, between the two survey periods. Almost three-fourths of the vegetation cover on the Drill Site F mud pit cap was from vascular species. Red fescue (*Festuca rubra*) and Berings's tufted hairgrass (*Deschampsia beringensis*) strongly dominated the vegetation. Both grasses were seeded in 2001 and again in 2008. Longawn sedge (*Carex macrochaeta*) was the most abundant colonizing species, and it provided about 3 percent of the total cover. Litter cover increased from 20 percent in 2006 to about 38 percent in 2011, and bare ground accounted for only 4 percent of the total area sampled in 2011. The thatch created by the reseeding effort in 2008 was less extensive on the Drill Site F mud pit cap than on the Drill Site D mud pit cap. Compared with the other mud pit caps surveyed in 2011, the Drill Site F mud pit cap had the highest total cover and second highest cover from vascular species.

Table B-6 shows the mean cover and frequency of occurrence for the vegetative cover of the Drill Site F mud pit cap. Absolute cover for each species is calculated as the percentage of points intercepted by that species out of the total number of points sampled. It is an estimate of the amount of substrate "covered" by that species via vertical projection. Relative cover is the mean cover of a species compared to other vegetative entities. It is calculated as the percentage of points intercepted by one species compared to the total number of points intercepted by all vegetative entities and it may be used to assess the relative importance of one species or group of species in an assemblage or plant community. Frequency is the percentage of frames in which a species occurs out of the total number of frames sampled and it provides some information about the distribution of a species across the mud pit cap (e.g. if a species occurs with high frequency, it is probably widely distributed across the mud pit cap).

The magnitude of increase in total vegetation cover between the 2006 and 2011 sample periods was higher for the Drill Site F mud pit cap than any of the lower-elevation mud pit caps, which were not seeded in 2008. Although germination and establishment conditions are much less favorable at the elevation where this mud pit cap is located, the low profile of the mud pit cap surface coupled with the successful reseeding effort of 2008 have resulted in a vegetation recovery trajectory that is much better than would be expected otherwise. Increases in vascular cover, species richness, and litter indicate that the Drill Site F mud pit cap is recovering well, and recovery should continue, barring any further disturbance of the mud pit cap.

Table B–6. Mean Cover and Frequency of Occurrence for Entities Sampled on the Drill Site F Mud Pit Cap During the 2011 Vegetation Survey

Entity[a]	Absolute Cover (%)	Relative Cover (%)	Frequency (%)
Vascular Species			
Graminoids			
Festuca rubra	25.48	44.10	100
Deschampsia beringensis	9.29	16.07	74
Carex macrochaeta	3.17	5.50	49
Total Graminoid Cover	**37.94**	**65.67**	
Forbs			
Lupinus nootkatensis	1.43	2.47	17
Veronica serpyllifolia	0.79	1.37	23
Angelica lucida	0.56	0.96	9
Veronica americana	0.40	0.69	11
Chamerion latifolium	0.24	0.41	9
Achillea millefolium	0.16	0.27	3
Potentilla villosa	0.08	0.14	3
Total Forb Cover	**3.65**	**6.32**	
Total Vascular Cover	**41.59**	**71.99**	
Nonvascular Growth Forms			
Moss	15.40	26.65	74
Lichen	0.79	1.37	20
Total Nonvascular Cover	**16.19**	**28.03**	
Total Vegetation Cover	**57.78**	**100.01**	
Nonvegetation Entities			
Litter	37.86		100
Bare Ground	4.37		29
Total Nonvegetation Cover	**42.22**		

[a] Within functional groups, species are sorted in order of descending absolute cover. A total of 35 frames were sampled across three transects.

Appendix B-7

Drill Site E

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The Drill Site E mud pit cap is approximately 24 miles northwest of Constantine Harbor. It is located in the upland topoenvironmental unit, and the undisturbed surrounding vegetation is characteristic of the crowberry stripe community. The undisturbed adjacent community is a mosaic of black crowberry (*Empetrum nigrum*)–dominated vegetation interspersed with barren stripes composed of a mixture of rock, cobble, and mineral soils. The spatial extent of the vegetated patches exceeds that of the barren stripes, but the barren stripes are somewhat more extensive than in the community surrounding Drill Sites D and F. The vegetated patches are less diverse than on the crowberry-dominated communities occurring at lower elevations, though they still include grasses, sedges, and lichens. Cover in the vegetated patches is close to 100 percent. The elevation at the top of the Drill Site E mud pit cap is approximately 145 meters (475 feet). The mud pit cap sits above grade and has moderate slopes, but much of the surrounding terrain is hilly, and the surface of the mud pit cap is not appreciably different. In terms of total area, Drill Site E is one of the smaller mud pit caps.

Absolute total vegetation cover was significantly higher in 2011 than in 2006 (Table 4 and Table 5 in Section 3.0), increasing from 8 percent to 56 percent between the two survey periods. Species richness also increased, from four taxa in 2006 to 11 taxa in 2011. A little more than half of the total vegetation cover on the Drill Site E mud pit cap was from vascular species, and all but about 4 percent of the vascular cover was from red fescue (*Festuca rubra*) and Berings's tufted hairgrass (*Deschampsia beringensis*). Both species were seeded in 2001 and 2008. Litter cover doubled between the two survey periods, from 20 percent in 2006 to a little more than 40 percent in 2011. Bare ground accounted for only about 2 percent of the area sampled on the Drill Site E mud pit cap in 2011, and standing dead material from the 2008 seeding effort was conspicuous. Compared with the other mud pit caps surveyed in 2001, the Drill Site E mud pit cap had only had about 1.5 percent less total vegetation cover than the mud pit cap with the greatest cover and had the third highest cover from vascular species.

Table B-7 shows the mean cover and frequency of occurrence for the vegetative cover of the Drill Site E mud pit cap. Absolute cover for each species is calculated as the percentage of points intercepted by that species out of the total number of points sampled. It is an estimate of the amount of substrate "covered" by that species via vertical projection. Relative cover is the mean cover of a species compared to other vegetative entities. It is calculated as the percentage of points intercepted by one species compared to the total number of points intercepted by all vegetative entities and it may be used to assess the relative importance of one species or group of species in an assemblage or plant community. Frequency is the percentage of frames in which a species occurs out of the total number of frames sampled and it provides some information about the distribution of a species across the mud pit cap (e.g. if a species occurs with high frequency, it is probably widely distributed across the mud pit cap).

The magnitude of increase in total vegetation cover between the 2006 and 2011 sample periods was higher for the Drill Site E mud pit cap than for any of the lower-elevation mud pit caps, which were not seeded in 2008. Because of the harsher conditions associated with the upper-elevation mud pit caps, vegetation recovery is expected to progress slowly. The seeding effort in 2008 resulted in substantial increases in total vegetation cover and likely reduced the total amount of time required for recovery on the Drill Site E mud pit cap. As the litter on the mud pit cap continues to decompose, conditions conducive to germination and establishment should continue to improve.

Table B–7. Mean Cover and Frequency of Occurrence for Entities Sampled on the Drill Site E Mud Pit Cap During the 2011 Vegetation Survey

Entity[a]	Absolute Cover (%)	Relative Cover (%)	Frequency (%)
Vascular Species			
Graminoids			
Festuca rubra	13.61	24.17	90
Deschampsia beringensis	12.13	21.54	80
Carex macrochaeta	0.56	0.99	17
Agrostis mertensii	0.09	0.16	3
Total Graminoid Cover	**26.39**	**46.87**	
Forbs			
Lupinus nootkatensis	1.67	2.96	17
Chamerion latifolium	1.48	2.63	30
Achillea millefolium	0.28	0.49	7
Anaphalis margaritacea	0.19	0.33	7
Angelica lucida	0.09	0.16	3
Equisetum arvense	0.09	0.16	3
Veronica americana	0.09	0.16	3
Total Forb Cover	**3.89**	**6.91**	
Total Vascular Cover	**30.28**	**53.77**	
Nonvascular Growth Forms			
Moss	26.02	46.21	97
Total Nonvascular Cover	**26.02**	**46.21**	
Total Vegetation Cover	**56.30**	**99.98**	
Nonvegetation Entities			
Litter	41.48		100
Bare Ground	2.22		20
Total Nonvegetation Cover	**43.70**		

[a] Within functional groups, species are sorted in order of descending absolute cover. A total of 30 frames were sampled across two transects.