Long-Term Surveillance and Maintenance Plan for the U.S. Department of Energy Amchitka, Alaska, Site

September 2008

Amchitka 2005
U.S. Fish and Wildlife Service Photo

Long Shot 1965

Long Shot Circa 1969

Long Shot 2001

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Office of Legacy Management

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Acronyms and Abbreviations

ADEC	Alaska Department of Environmental Conservation
AEC	U.S. Atomic Energy Commission
APIA	Aleutian Pribilof Island Association
ANCSA	Alaska Native Claims Settlement Act
BCF	bioconcentration factor
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
CRESP	Consortium for Risk Evaluation with Stakeholder Participation
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DQO	data quality objective
DRI	Desert Research Institute
DRO	diesel-range organics
EDD	Electronic Data Deliverable
EM	Environmental Management [DOE Office of]
ft	feet
GEMS	Geospatial Environmental Management System
kt	kilotons
LM	Legacy Management [DOE Office of]
LTS&M	long-term surveillance and maintenance
MOU	Memorandum of Understanding
NOAA	National Oceanic and Atmospheric Administration
PCB	polychlorinated biphenyl
ROD	Record of Decision
QA/QC	quality assurance/quality control
SAP	Sampling and Analysis Plan
SGZ	Surface Ground Zero
USC	*United States Code*
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

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Executive Summary

This Long-Term Surveillance and Maintenance Plan describes how the U.S. Department of Energy (DOE) intends to fulfill its mission to maintain protection of human health and the environment at the Amchitka, Alaska, Site[1]. Three underground nuclear tests were conducted on Amchitka Island. The U.S. Department of Defense, in conjunction with the U.S. Atomic Energy Commission (AEC), conducted the first nuclear test (Long Shot) to provide data that would improve the United States' capability of detecting underground nuclear explosions. The second nuclear test (Milrow) was a weapons-related test conducted by AEC as a means to study the feasibility of detonating a much larger device. The final nuclear test (Cannikin), the largest United States underground test, was a weapons-related test.

Surface disturbances associated with these tests have been remediated. However, radioactivity remains deep below the surface, contained in and around the test cavities, for which no feasible remediation technology has been identified.

In 2006, the groundwater model (Hassan et al. 2002) was updated using 2005 data collected by the Consortium for Risk Evaluation with Stakeholder Participation. Model simulation results indicate there is no breakthrough or seepage of radionuclides into the marine environment within 2,000 years. The Amchitka conceptual model is reasonable; the flow and transport simulation is based on the best available information and data. The simulation results are a quantitative prediction supported by the best available science and technology. This Long-Term Surveillance and Maintenance Plan is an additional step intended for the protection of human health and the environment. This plan may be modified from time to time in the future consistent with the mission to protect human health.

Effective October 1, 2006, the DOE Office of Legacy Management has the responsibility for the surveillance and maintenance activities described in this report.

[1] Collective name by which DOE refers to the sites on Amchitka Island. This document will refer to the sites collectively as Amchitka, the Amchitka Site, or Amchitka Island.

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1.0 Introduction

Amchitka Island is located near the far western end of the Aleutian Islands, approximately 1,340 miles west-southwest of Anchorage, Alaska (Figure 1–1). It is part of the Aleutian Islands Unit of the Alaska Maritime National Wildlife Refuge, which is administered by the U.S. Fish and Wildlife Service (USFWS). Since World War II, Amchitka has been used by multiple U.S. Government agencies for a variety of military and research activities. From 1943 to 1950, it was used as a forward air base for the U.S. Armed Forces. During the late 1960s and early 1970s, the U.S. Department of Defense (DOD) and the U.S. Atomic Energy Commission (AEC) (predecessor agency to the U.S. Department of Energy [DOE]) used a portion of the island as a site for underground nuclear tests. During the late 1980s and early 1990s, the U.S. Navy constructed and operated a radar station on the island. Amchitka is currently uninhabited and access is not restricted.

Three underground nuclear tests were conducted on Amchitka Island. DOD, in conjunction with AEC, conducted the first nuclear test (named Long Shot) to provide data that would improve the United States' capability of detecting underground nuclear explosions. The second nuclear test (Milrow) was a weapons-related test conducted by AEC as a means to study the feasibility of detonating a much larger device. The final nuclear test (Cannikin), the largest United States underground test, was a weapons-related test and was detonated on November 6, 1971. The fission products from the tests remain in and around the subsurface cavities at each test location (Figure 1–2).

In addition to the three sites that were used for nuclear tests, six additional sites were considered for possible nuclear testing. The other potential sites were designated A, D, E, F, G, and H. Large-diameter emplacement holes were drilled at Sites D and F, but were not used. An exploratory hole was drilled at Site E. Site H was graded in preparation for drilling activities that did not occur. Sites A and G were located and staked, but no further preparation was made. It was estimated that drilling or preparation for drilling at Long Shot, and Sites B (Milrow), C (Cannikin), D, E, F, and H disturbed approximately 195 acres. This area includes access roads and spoils-disposal areas (Merritt and Fuller 1977). Drill Sites D, E, F, and the three test sites contained drilling mud pits that have previously affected the environment. In addition, an asphalt plant located adjacent to Charlie Runway was used for the construction of the runway and support roads on the island.

DOE conducted site characterization investigations in 1993, 1997, 1998, and 2000. Chemical analysis of the 1998 samples of the drilling mud revealed that all drilling mud pits contained diesel-range organics (DRO), low levels of polychlorinated biphenyls (PCBs), and chromium. On the basis of those results, the only contaminants of concern with concentrations that exceeded Alaska Department of Environmental Conservation (ADEC) cleanup levels within each mud pit were DRO.

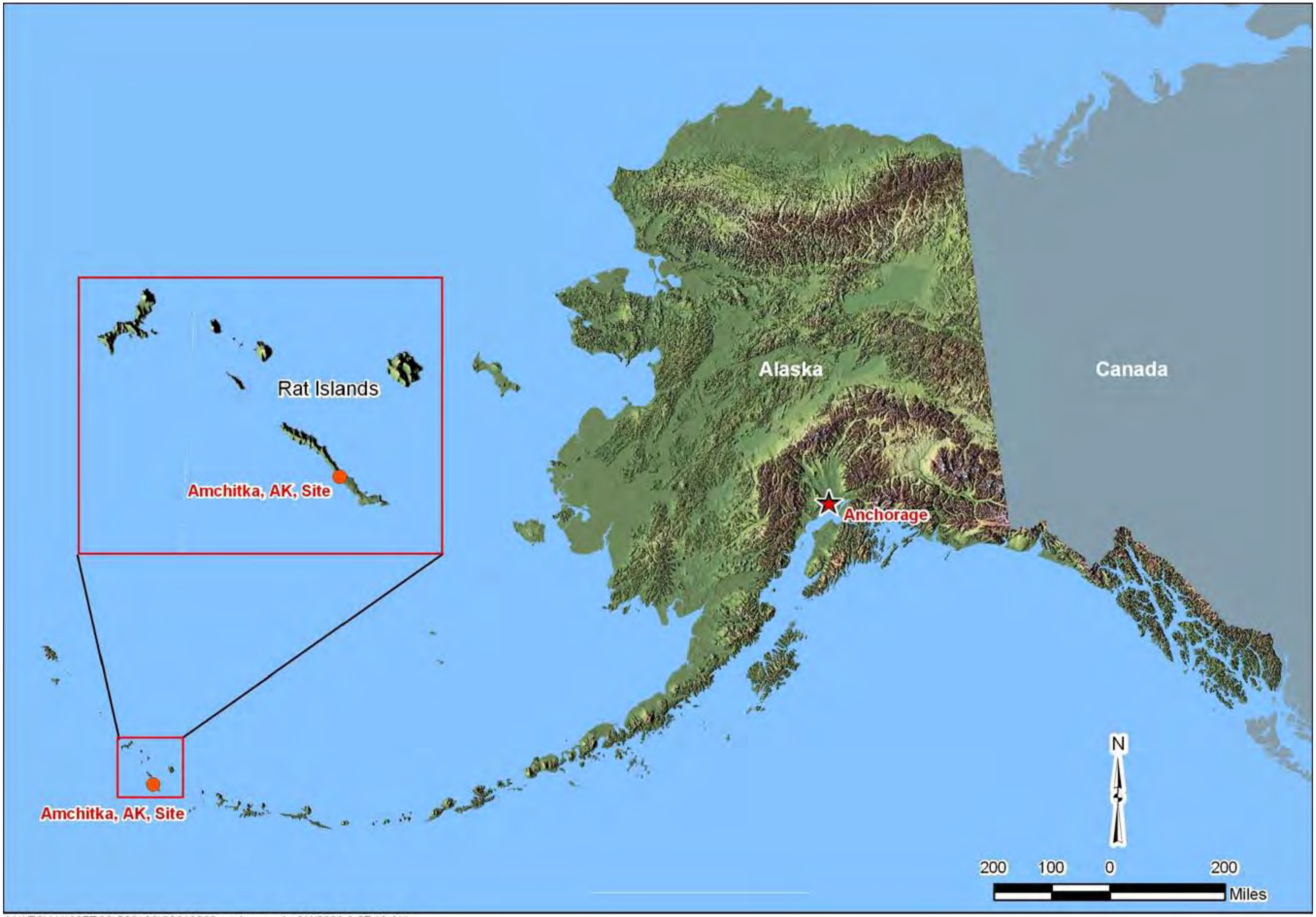

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Figure 1–1. Amchitka Location

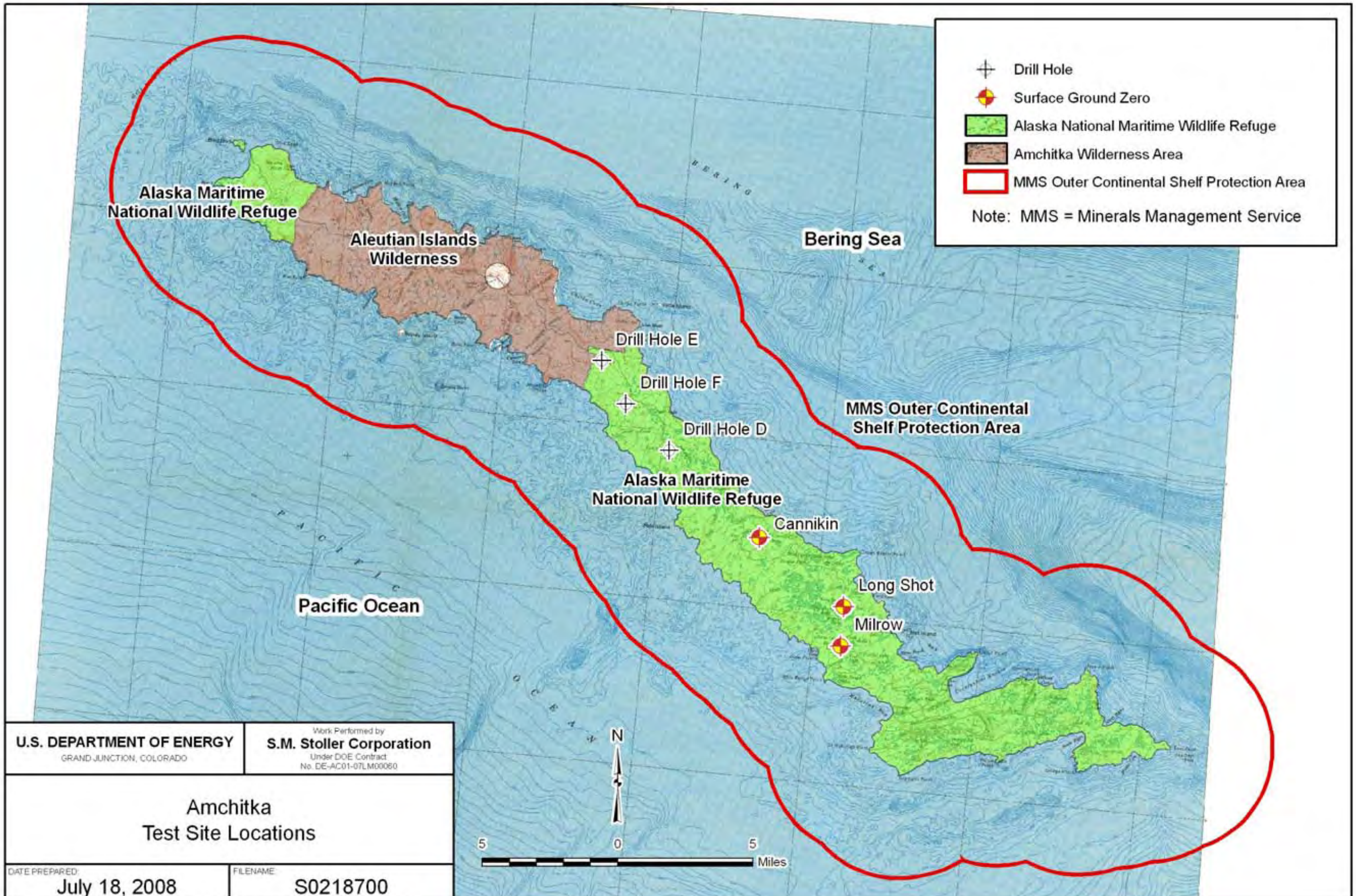

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Figure 1–2. Amchitka Test Site Locations

In 2001, DOE remediated the mud pits and the asphalt plant, and ADEC accepted the work as complete for the surface areas for which DOE is responsible. In 2003, the National Nuclear Security Administration Nevada Site Office submitted a draft Screening Risk Assessment and the *Amchitka Island Surface Closure Report* (DOE 2003). The risk assessment was revised in 2004 and again in 2005. ADEC indicated in a letter that they have reservations about the 2005 draft and suggested it remain as a pre-decisional draft document (Halverson 2006).

ADEC approved the *Amchitka Island Surface Closure Report* (DOE 2003) in September 2004 and stated in their acceptance letter, September 27, 2004, that it was ADEC's "understanding that DOE is conducting the environmental response actions for surface impacts at Amchitka consistent with CERCLA and the National Contingency Plan" and "a proposed plan and record of decision (ROD) are being, or will be, developed."

The aforementioned proposed plan and ROD became one document, the *Record of Decision for Amchitka Surface Closure, Alaska* (DOE 2008). This document was approved by ADEC in August 2008. Both the ROD and subsurface closure plan provide for continuing periodic inspections of the DOE sites on Amchitka through this Long-Term Surveillance and Maintenance (LTS&M) Plan.

Following the closure report for surface activities on Amchitka, the *Subsurface Completion Report for Amchitka Underground Nuclear Test Sites; Long Shot, Milrow and Cannikin* (DOE 2005a) was submitted in 2005. In a letter dated January 5, 2007, ADEC stated, "the department concurs No Further Remedial Action Planned (a.k.a. conditional closure) with Long Term Surveillance and Maintenance (LTSM) is appropriate for the Amchitka Underground Nuclear Test Sites."

At the request of the State of Alaska, DOE funded the Consortium for Risk Evaluation with Stakeholder Participation (CRESP) to conduct an "independent scientific assessment providing a basis for long-term stewardship" (DOE 2002a). The CRESP field sampling was conducted in 2004, and the report was completed in 2005. An addendum to the report was prepared in 2006.

After review of the documentation and condition of its sites on Amchitka Island, DOE made the decision to transition the project from characterization activities to surveillance and maintenance activities. DOE's Office of Legacy Management (LM) is responsible for long-term surveillance and maintenance activities and assumed responsibility on October 1, 2006 (DOE 2004). This LTS&M Plan details how LM will manage the Amchitka, Alaska, Site and is subject to future revisions or modifications.

1.1 Purpose of the Amchitka, Alaska, LTS&M Plan

This plan explains how LM will fulfill its obligations for LTS&M at Amchitka. DOE has accomplished surface remediation through capping the mud pits and closing the asphalt tanks in place. ADEC has accepted this work as being protective of human health and the environment (ADEC 2004).

Radioactive fission products remain in and around the subsurface cavities formed by the nuclear tests. Data collected since the detonations do not indicate that the radionuclides are migrating from the cavities. Other than trace quantities of radionuclides from Long Shot, there was no exposure to humans or the environment from the detonations (Merritt and Fuller 1977). No feasible technology exists for removing the subsurface radioactivity. Because residual radionuclides will remain in and around the cavities, monitoring of biota to determine if radionuclides are being discharged in amounts high enough to be of concern to the human food chain will be conducted. Monitoring of surface water will also be conducted with the collection of seawater for tritium analysis. This LTS&M Plan provides documentation of the required monitoring and maintenance activities for the Amchitka sites.

1.1.1 Surveillance and Maintenance Objectives

This plan meets the following objectives:

- Discuss the collection of data to verify protectiveness of human health and the environment from remaining subsurface residual hazards associated with AEC testing. Develop a Sampling and Analysis Plan (SAP) (a draft of which is included as Appendix A to this LTS&M Plan) that provides the details of the biological monitoring to be performed.
- Report inspection and monitoring data collected and respond to regulatory and other surveillance and maintenance requirements in a fully compliant manner.
- Maintain site records and information such that future custodians can continue to provide effective surveillance and maintenance.
- Plan for contingencies.
- Provide a mechanism for stakeholder and regulator involvement to ensure enduring protection of human health (DOE 2002a).

1.1.2 Protection of the Public and the Environment

DOE will implement institutional controls, including administrative, engineered, and physical (nonengineered) controls, to prevent penetration of the nuclear test cavities and the caps covering the mud pits at the site. Biological monitoring and regular cap inspections will also be employed.

1.1.2.1 Physical and Institutional Controls

The surface remediation consisted of constructing engineered caps on all mud pits and closing the hot-asphalt tanks in place. Monuments have been placed at each of the surface ground zero sites to indicate the presence of the test cavities. DOE and USFWS will coordinate implementation of administrative and institutional controls to ensure that visitors to the island are aware of the need to protect the designated areas.

1.1.2.2 Data Management and Trends Evaluation

The most likely potential transport mechanism for fission products remaining in and around the test cavities to reach the environment and enter the food chain is by groundwater transporting radionuclides from the cavities into the ocean floor. From there, biota can uptake and bioaccumulate the radionuclides. Ingestion of this biota and the food chain above it suggests that the diet of the Aleutian subsistence population should be considered in the design of a program to monitor this pathway. The commercial marine catch should also be considered because of its volume, speed to market, and distribution extent. At 5-year intervals, DOE will conduct biological sampling of the marine environment surrounding Amchitka. This sampling is briefly summarized in Section 4.2.3 and in the draft SAP in Appendix A, and will be discussed in detail in the stand-alone SAP to be prepared in the 2009−2010 time frame. A discussion of Quality Assurance/Quality Control (QA/QC) will also be a component of the stand-alone SAP.

The data from these monitoring events, along with data from previous studies, will be entered into a DOE database that will be accessible through the LM website at http://www.lm.doe.gov.

As part of the report discussing the results of the biological monitoring, DOE will conduct an analysis to determine if any significant increase or decrease has occurred over time. These results, as well as the inspection checklists and reports, will be submitted to ADEC and, upon request, to other interested parties. DOE or one of its contractors will automatically receive e-mail notification of all earthquakes in the Amchitka region through the U.S. Geological Survey (USGS) Earthquake Hazard site (http://earthquake.usgs.gov/). Appendix B provides historical data on earthquakes within the Rat Island Quadrangle between 1940 and 2005.

Also at 5-year intervals, DOE will conduct a review of this plan to "ensure human health and the environment are adequately protected" (DOE 2002a).

1.1.2.3 Monitoring and On-Site Inspections

Beginning in 2011 and every 5 years thereafter, DOE will conduct an on-site inspection of the mud pit caps and other physical and institutional controls. The mud pit inspections will be conducted as outlined in the *Post-Closure Monitoring and Inspection Plan for Amchitka Island Mud Pit Release Sites* (DOE 2005b). DOE's Office of Environmental Management (EM) inspected the mud pit caps in 2006.

Biological monitoring will also be conducted on a 5-year frequency in conjunction with the cap inspection. The next inspection and biological sampling event is scheduled for 2011. Previous DOE biological monitoring was conducted in 1997 and 2001 and by CRESP in 2004. DOE results are tabulated in Appendix D, and CRESP results that have supporting QA/QC documentation are in Appendix E.

1.1.2.4 Information and Records Management

Section 4.15 discusses the DOE policy for records and data management. DOE has established policies and procedures detailing the retention, access, and retrieval of records associated with DOE sites. These policies and procedures will be reviewed periodically to ensure that records are managed according to current practices.

1.1.2.5 Public Participation

Section 4.14 describes DOE's methods for maintaining public involvement with the Amchitka Site. It is DOE's intent that all interested organizations and individuals with an interest in the site remain informed and participate in the LTS&M activities associated with the site.

1.1.2.6 Regulatory Oversight

DOE will continue to consult with ADEC, USFWS, and the Aleutian Pribilof Island Association (APIA, representing Alaska Native Tribes) regarding all applicable regulatory and DOE policy requirements. Consultation will consist of

- Participation in and oversight of required inspections and sampling events;
- Review of and comment on appropriate documents; and
- Direct contact as necessary.

1.1.3 Criteria Used to Determine if Action Is Needed

1.1.3.1 Decision Criteria Implementing Sound Scientific Practices

Biota monitoring will be an indicator mechanism for determining action at the Amchitka Site. In consultation with ADEC and the Alaska stakeholders, indicator levels will be developed for subsistence users with an appropriate sampling and analysis strategy. Inspectors conducting the 5-year, on-site inspections will evaluate maintenance needs for the physical and institutional controls. Qualifications of the inspectors are detailed in Section 4.6.7.

DOE and ADEC will provide opportunities for stakeholders to participate in dialog with DOE and ADEC about their concerns, suggested improvements, and implementation of the LTS&M Plan.

1.2 Authorities

Numerous statutes, regulations, and DOE policy and guidance documents constitute the framework for this plan. The major ones are discussed in Sections 1.2.1 and 1.2.2.

1.2.1 Executive Orders, DOE Orders, Guidance, Policies, and Commitments

In 1913, President Taft issued Executive Order 1733 to set aside the Aleutian Islands "…as a preserve and breeding ground for native birds…." The order also specified "the establishment of this order shall not interfere with the use of the islands for lighthouse, military or naval purposes…" (Appendix G). This order allowed AEC use of the island as a site for the nuclear tests conducted in the late 1960s and early 1970s.

The primary DOE orders related to the transition process are DOE Order 430.1B, *Real Property and Asset Management*, which specifies the disposition or transition of real property and assets; and DOE Order 413.3, *Program and Project Management for Acquisition of Capital Assets*, which specifies a disciplined process for project management using the critical decision process. Table 1–1 presents a summary of the applicable DOE orders.

Table 1–1. DOE Orders, Policy, and Guidance for Long-Term Surveillance and Maintenance at the Amchitka Site

Regulation or DOE Order	Summary
DOE Order 450.1	Environmental Protection Program—Establishes stewardship practices that are protective of the environment.
DOE Order 5400.5	Establishes the maximum total effective dose equivalent for exposure of the public to radiation (≤100 mrem/yr above background).
DOE Order 430.1B	Establishes approach for real property life-cycle asset management.
DOE Order 413.3	Establishes program management through the critical decision process
DOE Policy 454.1	Ensures that DOE will use institutional controls in the management of resources, facilities, and properties under its control.
DOE Guidance 454.1-1	Provides information to assist DOE with what is necessary and acceptable for implementing DOE Policy 454.1.

Key: mrem/yr = millirem per year

As long-term objectives, DOE will comply with DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and DOE Order 450.1, *Environmental Protection Program*. These orders specify release limits for radium, uranium, and thorium in soil; radon concentration; surface contamination limits in structures; direct gamma exposure rate; and total effective dose equivalent. These documents are provided on the LM website at http://www.directives.doe.gov/directives/read.html.

In April 2001, DOE-EM signed a Letter of Agreement with USFWS (Appendix F) regarding DOE responsibilities on the island. Those areas described in the Letter of Agreement are the areas that require the surveillance and maintenance outlined in this plan.

LM may enter into agreements with APIA and ADEC to ensure continued participation, cooperation, and implementation.

EM has made several commitments regarding long-term management of the Amchitka Site throughout the preparation of site documents. These commitments are detailed in Section 4.0 of this LTS&M Plan and are described in several DOE documents (DOE 2003, DOE 2005b, c, d). With the inclusion of these requirements in this plan, LM recognizes and accepts these commitments.

1.2.2 Legal and Regulatory Authorities

1.2.2.1 Federal Requirements

DOE is responsible for the radioactive and other hazardous materials generated by DOE and AEC at the Amchitka Site. DOE manages the radioactive material at the Amchitka Site under the authority of the Atomic Energy Act of 1954 (42 *United States Code* [U.S.C.] 2011).

The U.S. Environmental Protection Agency (EPA) performed a hazard assessment for Amchitka Island for possible placement on the National Priorities List. The hazard ranking score for the site was below the minimum score required for placement, and Amchitka was not placed[2] on the National Priorities List (DOE/NV 1988).

Federal regulations for protection of threatened and endangered species and cultural resources are also applicable. The details are discussed further in Sections 3.2.4 and 3.3.

Public Law 96-487 designated a portion of Amchitka as a wilderness area and further defined Alaska Native claims on portions of the island.

There are currently no Natural Resource Damage claims for this property.

1.2.2.2 State Requirements

The Amchitka Site is not subject to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); however, ADEC and DOE agreed to a list of applicable or relevant and appropriate requirements for conducting remediation and for determining appropriate cleanup standards. This list is detailed in the *Remedial Action Work Plan Amchitka Island Mud Pit Closures* (DOE 2001b).

Surface cleanup of the Amchitka Site was conducted in 2001 under the State of Alaska's Contaminated Sites program (Title 18 *Alaska Administrative Code* Chapter 75, "Oil and Hazardous Substances Pollution Control"), and details of this remedial action are reported in the *Amchitka Island Surface Closure Report* (DOE 2003). In September 2004, ADEC accepted the surface cleanup as complete (ADEC 2004).

Subsequent to completion and acceptance of surface closure activities, DOE prepared the *Subsurface Completion Report for Amchitka Underground Nuclear Test Sites: Long Shot, Milrow, and Cannikin* (DOE 2005a). In 2007, ADEC approved this report as a conditional closure with long-term surveillance and monitoring as an appropriate subsequent action (ADEC 2007).

Concurrent to ADEC's acceptance of the subsurface completion report, DOE prepared a ROD as an ad hoc mechanism for ADEC and DOE to formalize acceptance of the work. The ROD summarized the surface closure activities and stated that post-closure inspection and monitoring will be conducted as described in the *Post-Closure Monitoring and Inspection Plan for Amchitka Island Mud Pit Release Sites* (DOE 2005b). The ROD was approved by both ADEC and USFWS in August 2008.

This LTS&M Plan details the implementation of actions outlined in the above reports and constitutes formal agreement between DOE and ADEC concerning the required LTS&M actions for the Amchitka Site.

Table 1–2 lists the primary environmental laws and regulatory programs relevant to the Amchitka surface remediation.

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[2]The National Priorities Scores were: 12.06, 0.0 and 0.0 for Long Shot, Milrow, and Cannikin, respectively (DOE 1998). The primary reason for the Long Shot score was the "trace quantities of radioactivity [detected], principally tritium, in water and soil gas samples in the immediate vicinity of surface ground zero" following the test (Merritt and Fuller 1977). The minimum score for National Priorities List ranking is 28.5.

Table 1–2. Significant Environmental Laws and Regulatory Programs

Act/Regulation	Reference
Atomic Energy Act of 1954	42 *United States Code* [U.S.C.] 2011
Wildlife and Fisheries	50 CFR 36.39
CERCLA	42 U.S.C. 9620, 40 CFR 300
Clean Water Act	33 U.S.C. 1251 et seq., 40 CFR 330 Appendix A
Resource Conservation and Recovery Act	42 U.S.C. 6901 et seq., 40 CFR 262 subparts A−C
Wilderness Management Act	16 U.S.C. 1131
Endangered Species Act	16 U.S.C. 1531−1534
National Historic Preservation Act	16 U.S.C. 470, 36 CFR 63, 36 CFR 800
Conservation and Protection of Alaska Fish and Game	Alaska Statutes: 16.20
Environmental Conservation	Alaska Statutes: 46.03
Hazardous Substance Release Control	Alaska Statutes: 46.09
Alaska Oil and Gas Conservation Commission	*Alaska Administrative Code*: Title 18, Chapter 25
Solid Waste Management	*Alaska Administrative Code*: Title 18, Chapter 60
Water Quality Standards	*Alaska Administrative Code*: Title 18, Chapter 70
Oil and Other Hazardous Substances Pollution Control	*Alaska Administrative Code*: Title 18, Chapter 75
Underground Storage Tanks	*Alaska Administrative Code*: Title 18, Chapter 78
Drinking Water	*Alaska Administrative Code*: Title 18, Chapter 80

2.0 Amchitka Island

2.1 Site History

Amchitka has a long and varied history. During the last 2,500 years, Amchitka has been, at various times, home to the Aleut people. Because of modern interest in the island, Amchitka has been the site of several major archaeological expeditions and has a rich and diverse modern history. Appendix H is a table of events that chronicle the modern occupation of the island.

Amchitka's modern history is well documented in a number of sources. Merritt and Fuller (1977) provide abundant information on the physical and ecological setting of Amchitka in *The Environment of Amchitka Island, Alaska*. O'Neill (1994) and Kohlhoff (2002) have written about the underground nuclear tests at the site for the general public, including the societal aspects of the testing. The following Internet sites (accessed June 2006) also provide detailed technical accounts of the Amchitka tests:

http://www.osti.gov/,
www.ims.uaf.edu/research/johnson/amchitka/history,
www.nps.gov/aleu/WWII_in_the_Aleutians.htm, and
www.army.mil/cmh-pg/brochures/aleut/aleut.htm

2.1.1 AEC Nuclear Tests

Three underground nuclear tests were conducted on Amchitka Island between 1965 and 1971. Long Shot (approximately 80 kiloton [kt] yield) was detonated on October 29, 1965. Milrow (approximately 1,000 kt) was detonated on October 2, 1969. Cannikin (less than 5,000 kt) was detonated on November 6, 1971. In addition to the three sites that were used for underground nuclear testing, drilling occurred at three other sites (D, E, and F) where nuclear testing was considered but was not performed. Figure 1–2 shows the test sites, and Table 2–1 shows details of the tests.

Table 2–1. Amchitka Nuclear Test Summary

Name	Date	Yield	Seismic Activity[a]	Purpose	Detonation depth	Locations (Latitude and Longitude)
Long Shot	10/29/65	80 kt	Mb - 6.1	Vela Uniform Program[b]	2,297 feet (ft) below ground surface (bgs) (~720m)	51.424º 179.179º
Milrow	10/02/69	1,000 kt	Mb - 6.5	Weapons related	4,003 ft bgs (~1,178m)	51.403º 179.179º
Cannikin	11/06/71	< 5,000 kt	Mb - 6.8	Weapons Related	5,873 ft bgs (~1,790m)	51.456 º 179.102º

[a]Seismic information on tests from the Earthquake database National Earthquake Information Center. The Mb magnitude is based on the amplitudes of short-period P waves and is typically the magnitude used to describe the yield of the tests.
[b]Vela Uniform was a series of underground nuclear tests carried out to obtain data to differentiate between underground nuclear detonations and earthquakes.
Statistic source: DOE 2000c

2.1.2 Other Federal Military Activities

In late January and early February 1943, the U.S. Army Air Corps occupied Amchitka in response to the Japanese occupation of the islands of Attu and Kiska, about 250 miles and 60 miles, respectively, northwest of Amchitka. The Air Corps occupied the island until 1950. In 1951, DOD drilled exploratory test holes for a proposed nuclear test later conducted in Nevada. From 1959 through 1964, the Air Force used the island as part of the White Alice Systems. From 1988 until closure of the base in 1992, the Navy used the island for a Relocatable Over the Horizon Radar station.

2.2 Location Information

Amchitka is the largest island in the Rat Island Group of the Aleutian Island chain. It is 1,340 statute miles west-southwest of Anchorage, Alaska, and 870 miles east of Petropavlovsk, Kamchatka, Russia. It is bounded by the Bearing Sea to the north and the Pacific Ocean to the south.

2.2.1 Physical Description of Amchitka Island

The island is 42 miles (65 kilometers) long and varies from 1 to 4 miles (2−7 kilometers) in width. The total land area is approximately 116 square miles (300 square kilometers). Amchitka has a rugged coastline, steep cliffs, few sandy beaches, and only one harbor (Constantine). The eastern portion of the island consists of rolling hills dotted with shallow ponds; drainages and rubble ridges are more prominent in the central portion. The west-central region is mountainous, with elevations ranging from about 50 feet (ft) above sea level at the tops of sea cliffs to over 1,100 ft in the interior. The western portion is a barren rocky plateau, shaped by high winds and erosion (Merritt and Fuller 1977). Figure 2–1 is a topographic map of the island.

2.2.2 Legal Descriptions and Surveys

Amchitka Island is located at latitude 51º21’ to 51º39.5’ N and longitude 178º 37’ to 179º 28’ E (Merritt and Fuller 1977). It lies between Township 98 South, Range 230 West, and Township 102 South, Range 230 West, of the Seward Meridian.

2.3 Land Ownership and Use

2.3.1 Alaska National Maritime Wildlife Refuge and Wilderness Designation

Amchitka Island was included in the purchase of Alaska by Secretary of State William Seward on March 30, 1867. President Taft included Amchitka Island in the Aleutian Islands Reservation, which later became the Alaska Maritime National Wildlife Refuge. The island is public land under the jurisdiction of the U.S. Department of Interior, USFWS, for the benefit of the United States of America.

The central portion of the island was designated as part of the Aleutian Island Wilderness area under Public Law 96-487 (Figure 1–2). Figure 2–2 depicts the land management designations for Amchitka, including locations of pending Native American claims.

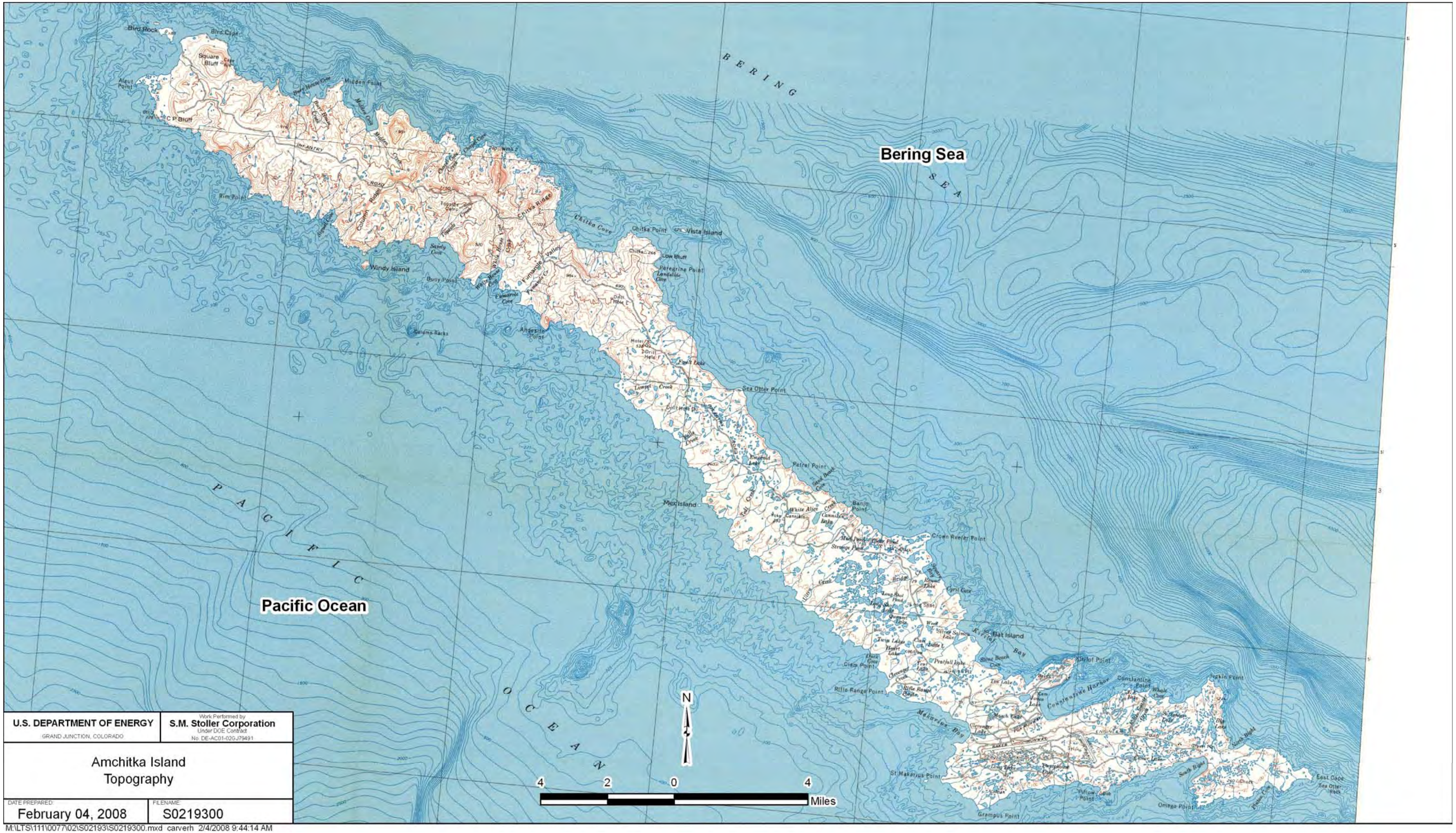

Figure 2–1. Amchitka Island Topography

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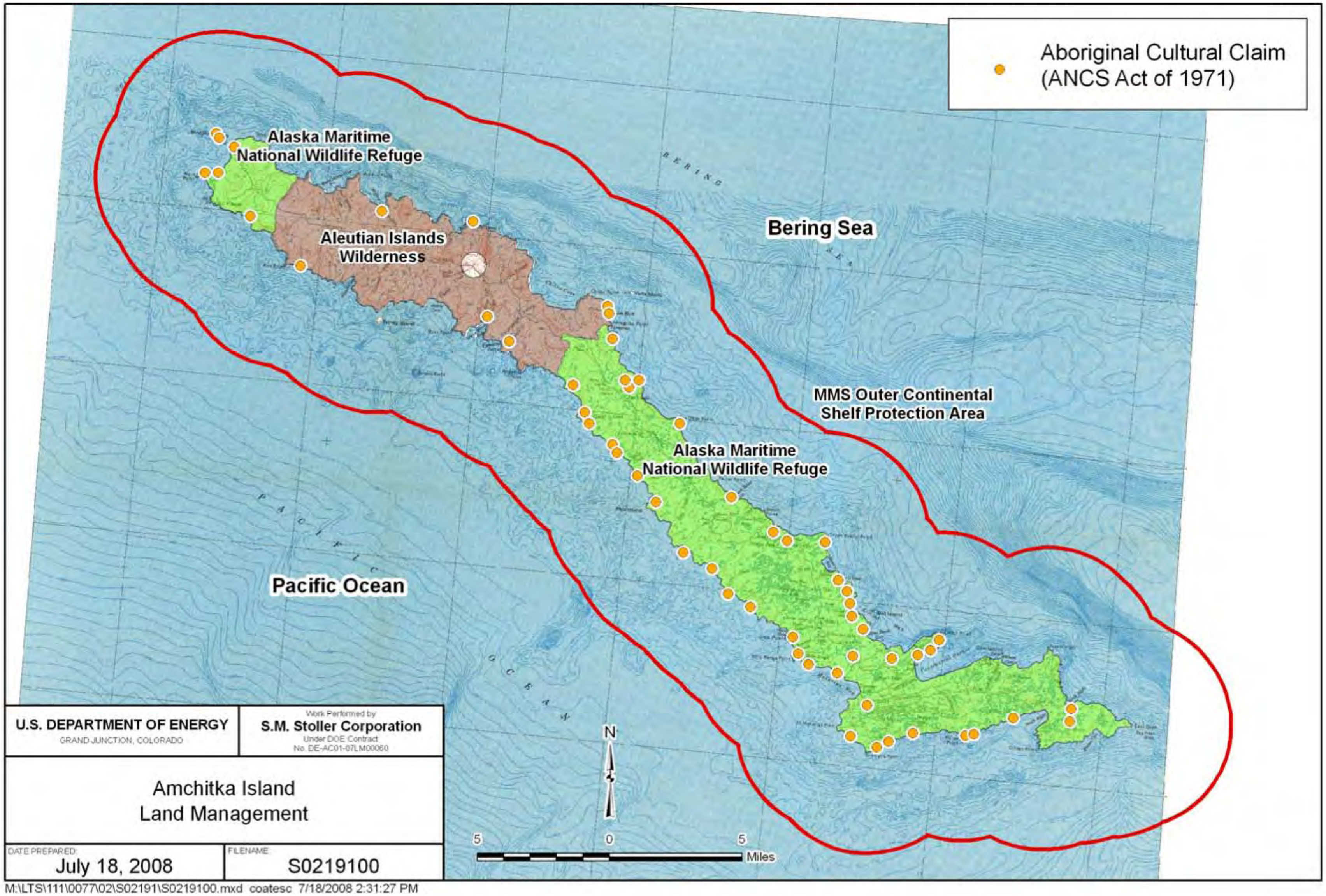

Figure 2–2. Amchitka Island Land Management

2.3.2 DOE Use

DOE retains responsibility for those areas agreed to in the 2001 Letter of Agreement between USFWS and DOE (Appendix G) (DOE 2001a). As detailed in the USFWS *Remedial Action/Removal Action Environmental Assessment Finding of No Significant Impact* (USFWS 2000), DOE has responsibility for only portions of the island. Other federal agencies also have remediation responsibilities on the island. Figure 1–2 depicts the six drilling locations and the hot asphalt plant that are DOE's responsibility for long-term surveillance and maintenance.

2.3.3 Potential Native Claims

One of the unique aspects of the Alaska Native population is that a large percentage still relies on traditional hunting, fishing, and gathering as a basis for their food supply. This has led to years of discussion, legislation, and lawsuits over how to protect and allocate resources among conflicting subsistence, commercial, and sport users (Mertz 1991).

The Alaska National Interest Lands Conservation Act (PL 96-487, 1980) in conjunction with the Alaska Native Claims Settlement Act (ANCSA) (PL 92-203, 1971, as amended) established certain rights for recognized Alaska Natives, including a requirement that rural residents be given priority for subsistence harvests on certain federal lands.

To reconcile differences over previous legislation, ANCSA created 12 regional native corporations, one regional corporation for nonpermanent resident natives, and 220 village corporations. In exchange for relinquishing all aboriginal claims and any aboriginal hunting rights, these corporations were given 44 million acres of land and 1 billion dollars. Part of these agreements allowed the corporations to select claims on federally owned land with a certain portion of wilderness areas eligible for claims (Stadium Group 2003). Currently, there are more than 50 pending Native land selections on Amchitka Island (USFWS 2006). Figure 2–3 indicates the locations of the pending Native claims. These claims are cemetery and historical sites and, if conveyed, come with covenants that restrict activity; settlement would not be permitted. If these claims are conveyed, additional institutional controls would not be necessary.

2.3.4 Recreational, Subsistence, and Commercial Use

The remote location and weather conditions limit the use of Amchitka Island and surrounding waters for recreational use. However, there have been some landings on the island that were apparently for the purpose of recreation. The surrounding waters are fished commercially but are rarely used for subsistence fishing. In 2004 there were 51 landings on the island recorded by the USFWS interview program. As these landings become more frequent, the probability increases for disturbance of the remediated sites. Institutional controls will aid in protection of the DOE sites.

Figure 2–3. Pending Claims on Amchitka Island under ANCSA of 1971 (P.L. 92-203) as amended

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2.4 Mineral, Water, and Surface Rights

2.4.1 Existing Mineral, Water, and Surface Rights

Pyritic (iron ore) zones have been located on the western portion of Amchitka. According to provisions in the Alaska National Interest Lands Conservation Act, these deposits are open for leasing; however, production is unlikely because the area is designated as a wildlife refuge.

Water rights are retained by USFWS at this time.

Upon settlement of the Native claims, surface rights will change and require further evaluation.

2.5 Easements and Access Rights

2.5.1 DOE Areas of Responsibility and Restrictions

A 1986 Memorandum of Understanding (MOU) between USFWS and DOE (Appendix F) (DOE 1986) and Title 50 *Code of Federal Regulations* Part 36.39 (b) (50 CFR 36.39 [b]) restrict access to the island without a special use permit and DOE notification. To meet DOE needs for protection of the engineered caps on the mud pits and to prevent disturbance to the subsurface test cavities, DOE has proposed updating the MOU. Details regarding appropriate restrictions have yet to be determined. Appendix H is a series of maps depicting the areas requiring protection.

2.5.2 Access by Other Federal, State, or Private Entities

DOE does not foresee any need to restrict use of the island for research, data collection, or other activities, provided users are given notice of restrictions designed to avoid disturbance of surface restoration and subsurface contamination.

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3.0 Long-Term Surveillance and Maintenance Baseline Conditions

A total of twelve drilling mud pits (at the six locations) are located at the Long Shot, Milrow, and Cannikin nuclear test sites and at drill sites D, E, and F. An asphalt (hot mix) plant was located at Charlie Runway. All mud pits have been reclaimed and the results accepted by the State of Alaska. Results of DOE sampling indicate that the shallow groundwater was not affected by the drilling mud, and no cleanup of shallow groundwater is necessary (DOE 2000a).

Surface water, sediment, and biological data were collected periodically from 1971 through 2004 to determine any effect from AEC activities on the island and its biota. To date, these data indicate no significant impact from the AEC testing.

3.1 Geology, Hydrology, and Oceanography

Geology, hydrology, and oceanography have been studied extensively at Amchitka because of the nuclear testing done on the island. Most of this work was done in the 1960s and 1970s and is documented in numerous USGS publications from the period (USGS Series 474).

3.1.1 Geology

The island is of volcanic origin, consisting of andesite surface lavas and submarine angular volcanic fragments, pillow lavas, and granodiorite intrusions. Most of the island contains only a thin, discontinuous veneer of unconsolidated sediments overlying the volcanic bedrock. Although Amchitka's origin is volcanic, there is no volcanic vent on the island, and an eruption has not occurred in Holocene time (the last 10,000 years). The nearest active volcanoes are on Semisopochnoi and Little Sitkin, about 40 miles and 20 miles, respectively, north-northeast of Amchitka, and both erupted in the 20th century (Little Sitkin erupted in 1900 and Semisopochnoi erupted in 1987). Over most of the island, organic soils, including peat, overlie the unconsolidated sediments. The island has numerous east-northeast-trending normal faults with modest displacement (Figure 3–1).

Amchitka lies in the western portion of the Aleutian arc, a prominent geologic/oceanographic feature of importance in determining the stability of the island. Although geologists have long recognized that Amchitka lies along an active volcanic area, frequent earthquakes are what brought nuclear testing to Amchitka initially. AEC was attempting to determine if current day (1964) seismic equipment could detect the difference between an earthquake and an underground nuclear test. A magnitude 8.7 earthquake occurred just off the coast of Amchitka on February 4, 1965. In October, Long Shot was detonated for comparison.

During the early work on the island, plate tectonics, first proposed in 1929, was not an accepted theory in geology. By the mid-1970s, in part due to work regarding formation of the Aleutian Islands, data supported the plate tectonics concept and explained the mechanism for continental drift that had been proposed early in the twentieth century. The Aleutian Islands are an expression of the collision of the North American and Pacific tectonic plates. When two ocean plates meet, one plate is forced beneath the other (subduction); in this case, the Pacific plate is forced under the North American plate. In the Aleutians, the subduction increases with the westward curvature of the Aleutian arc. The western Aleutians are surface expressions of the broken crustal blocks and are rotating clockwise away from the arc. Figure 3–2 shows the

Aleutian arc, Aleutian Trench, and other significant features in the geologic and oceanographic interactions in the region. Amchitka Island, as part of this geologic feature, is moving westward at a rate of approximately 2 centimeters per year (Eichelberger et al. 2002). This movement, along with the volcanic activity and earthquakes, indicates that the island is in a geologically active area. The routine occurrence of seismic activity in the area has raised concern over the stability of the test cavities (Eichelberger et al. 2002). However, since the tests, six earthquakes with magnitude greater than 6.7 have occurred, and no adverse affects have been detected.

More detailed discussions of the geology are available in Coats (1962); Carr and Quinlivan (1969); Carr et al (1969); Anderson (1971); Carr et al. (1971); and Avé Lallemant and Oldow (2000).

3.1.2 Hydrology

Amchitka is covered with hundreds of small, shallow ponds up to 330 ft wide and up to 10 ft deep. The smaller ponds are considerably shallower, typically ranging from 12 to 20 inches deep. Ponds are most numerous on the eastern two-thirds of the island (approximately 26 ponds per square mile), where they have developed above marine terraces and are confined by thick vegetation and peat. Many lakes in this region lack a definite inlet or outlet. Fewer ponds are present on the western third of the island, where they typically occupy bedrock depressions. Larger pond sediments are either floc (suspension of low-density detrital organic material) over gravel, organic silts over gravel, or clean gravel. The bottoms of smaller ponds are usually composed of peat or fine sediment covered with floc. Watersheds on Amchitka Island are generally limited to 1 to 3 miles in length, since all streams drain perpendicular to the long axis of the island into either the Bering Sea or the Pacific Ocean. Streams on the eastern part of the island flow slowly through tundra-covered watersheds, range from 3 to 10 ft wide, are up to 12 inches deep, and are characterized by low gradients and low flow velocities. Streams in the central and western regions range from 6 to 13 ft wide and are up to 14 inches deep. Most of the streams in the island flow year-round. During relatively dry periods, stream flows are sustained by base flow from soils and the underlying weathered bedrock; surface runoff and base flow contribute to flows during wet periods.

The hydrogeology beneath the surface of Amchitka Island is governed by the dynamics of the seawater intrusion typical of islands. The groundwater system consists of a freshwater lens floating on seawater. To sustain this lens, there must be active groundwater circulation. Rainfall that infiltrates is fresher, and less dense, than the underlying seawater. Continued recharge results in the buildup of a lens of fresh water floating above the seawater and the flow of fresh water from the center of the island outward to the ocean. Groundwater flow is generally characterized by recharge along a shallow water table, downward flow in the interior of the island, and upward flow approaching the coast, with freshwater discharge in seeps along the ocean floor. The nearly saturated subsurface conditions, combined with low hydraulic conductivity and high rainfall, lead to significant runoff and the development of shallow groundwater zones that rapidly discharge water in springs and seeps rather than allow deep infiltration. Data collected from shallow and deep boreholes on Amchitka confirm this conceptual flow model (Chapman 2006).

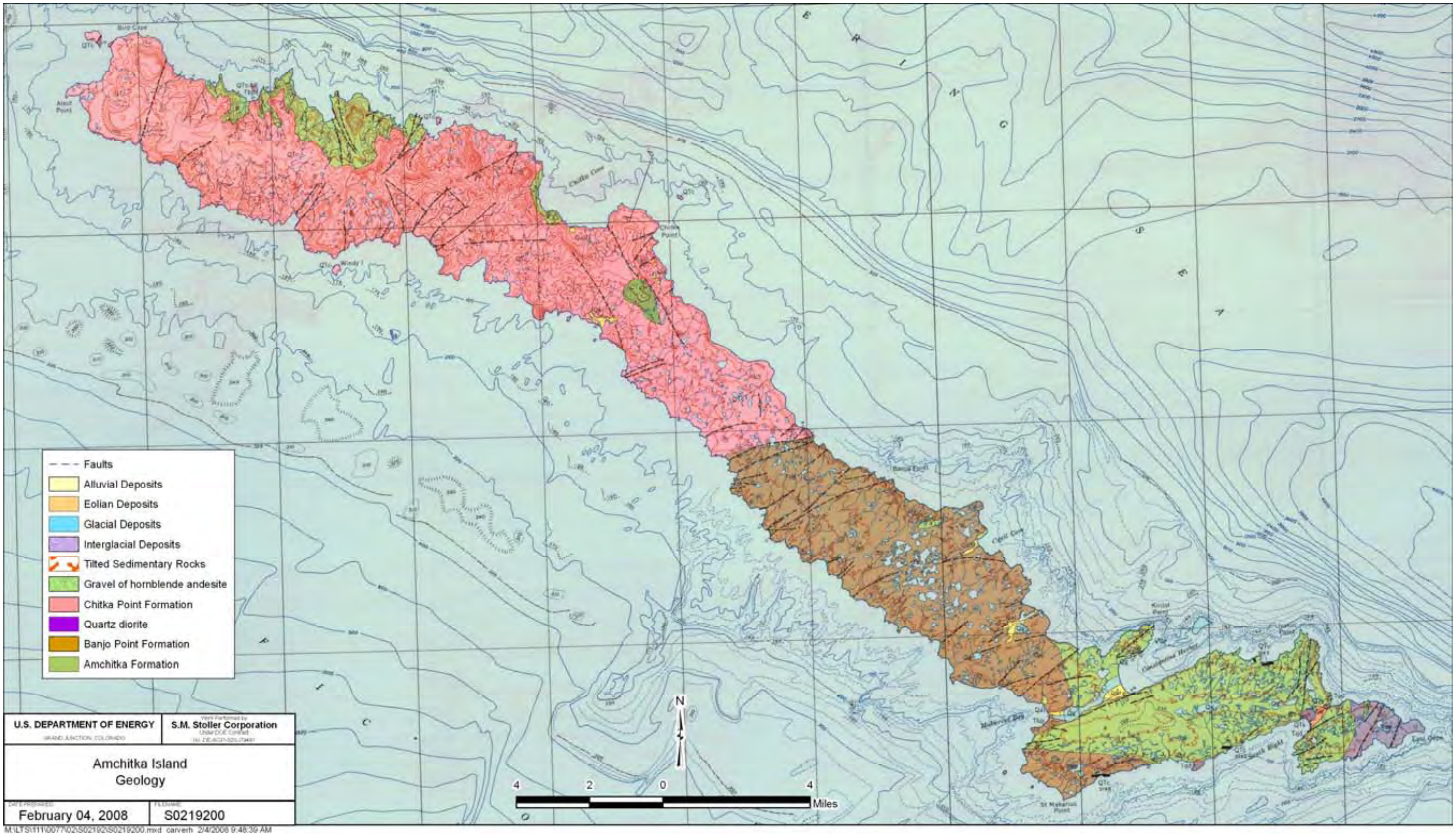

Figure 3–1. Amchitka Island Geology

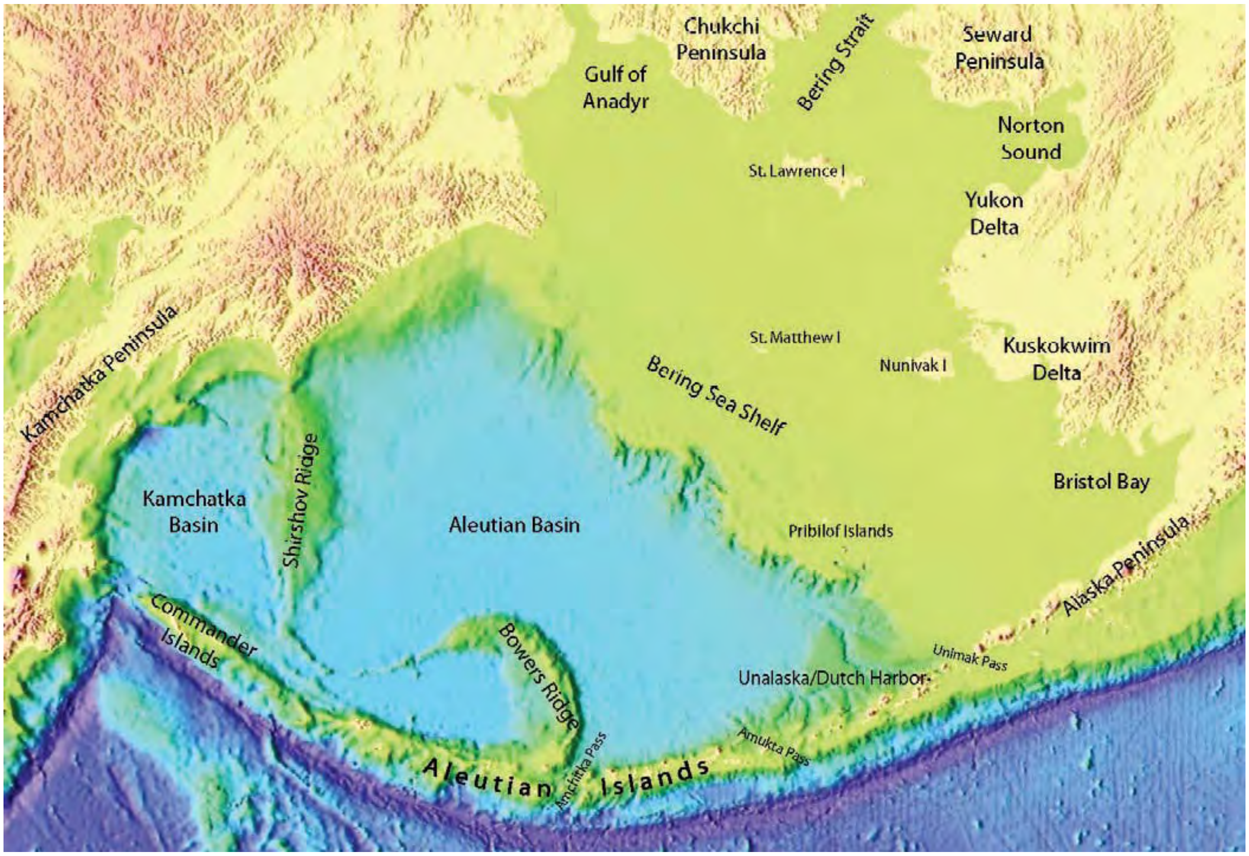

Figure 3–2. Physical Oceanography of the Aleutian Islands and Major Landmarks of the Bering Sea
Source: Base map from the USGS Coastal and Marine Geology Program.

3.1.2.1 Summary of Groundwater Chemical Data

EPA began the Amchitka Long-Term Hydrological Monitoring Plan (LTHMP) in 1977. EPA's Environmental Monitoring Systems Laboratory in Las Vegas, Nevada, performed the sample collection and analysis. Appendix C provides a table of the results for the previous two sampling events (1997 and 2001) for the Amchitka Site. This table also outlines the EPA Long-Term Hydrological Monitoring Program. Also included in Appendix C is the representative groundwater chemistry from the tests provided as Table 1−2 in the 2002 Desert Research Institute (DRI) modeling report (Hassan et al. 2002).

3.1.2.2 Groundwater Modeling

The potential pathway for exposure to the fission products in the test cavities is groundwater migrating through the subsurface and discharging radionuclides into the ocean waters. Fenske (1972) and Wheatcraft (1995) performed groundwater modeling prior to the more extensive modeling done by DRI. DRI's modeling effort that was completed in 2002 was intended to predict radionuclide release locations, travel times from test date to release, duration of the releases, and rates of releases (Hassan et al. 2002). Results from the DRI work indicated release locations 0.16 to 2.8 miles (0.25−4.5 kilometers) from the shore.

CRESP reviewed previous modeling efforts and conducted another modeling program using different input assumptions and concentrating only on the Long Shot test. Subsequent to the CRESP model results, DRI revised its 2002 model using data generated by CRESP as input data. The revised DRI model was completed in February 2006. This LTS&M Plan incorporates the results of the revised DRI model.

3.1.2.3 Conclusions of the Groundwater Modeling

DRI 2002 Modeling

DRI performed probabilistic modeling of groundwater flow and transport at the three nuclear test sites on the island. Each model examined two-dimensional processes in a cross section orthogonal to the island's axis and extending from the axis to parts of the seafloor bottom located far from shore. Density-dependent groundwater flow as affected by water salinity was accounted for, as was the associated transport of key radionuclides released from the respective test cavities. Each probabilistic simulation, which was termed a realization, accounted for 2,200 years of transport.

The probabilistic modeling indicated that the shortest travel time for radionuclide transport from test cavity to the ocean would be at the Long Shot site because this test occurred at a relatively shallow depth, about 2,297 ft (720 meters [m]) below ground surface, where groundwater velocities are high in comparison to those at greater depths. All of the realizations with the Long Shot model produced breakthrough of test-related radionuclides at the groundwater/ocean interface (sea floor) within the 2,200-year simulation period. The mean of the predicted peak tritium concentration at the sea floor in the Long Shot simulations was 25 to 30 years after the test. The mean of the projected peak carbon-14 concentration at the sea floor was observed at about 100 years after the test.

The DRI modeling of radionuclide transport from the deeper Milrow and Cannikin test cavities (about 4,003 and 5,873 ft [1,220 and 1,790 m] below ground surface, respectively) produced noticeably longer travel times for tritium to reach the sea floor. Eight percent of the realizations for Milrow did not show any breakthrough of tritium within the 2,200-year simulation period, and 30 percent of the Cannikin simulations indicated no breakthrough within this time span. The mean of computed peak tritium concentrations at the sea floor in the probabilistic simulations was about 100 years after testing for both the Milrow and Cannikin sites.

CRESP Modeling

Modeling of radionuclide migration in the CRESP study was limited to the Long Shot site. Rather than conduct a probabilistic modeling assessment of transport, CRESP examined eight different cross-sectional model scenarios, each consisting of a unique combination of model input parameters. Of the original eight simulations, five were ultimately considered to be potentially representative of flow and transport conditions between the Long Shot site and the ocean. Three of these five model runs assumed homogeneity of the volcanic-derived rock through which contaminants would migrate, and the remaining two took into account the potential for a higher-permeability andesite layer that intercepts the cross-section that was used in the modeling.

The CRESP simulations based on homogeneous media produced conservative (i.e., nonreactive) groundwater travel times from the Long Shot cavity to the sea floor that ranged from 1,400 to

4,700 years. The modeling runs that accounted for the andesite layer resulted in shorter predicted travel times, which ranged from 400 to 1,400 years. The five simulations considered potentially representative of the Long Shot site predicted that fresh water discharged within 66 to 98 ft (20 to 30 m) from the island shore, and the offshore edge of the salinity transition zone discharged about 4,430 to 5,120 ft (1,350 to 1,560 m) from the shore.

DRI 2006 Modeling

The 2002 groundwater model results included a mean (expected) value and a standard deviation (measure of uncertainty). The standard deviation was large as a result of uncertainties in exact parameter values and their variability in the subsurface. The most significant uncertainty was the porosity assigned to the fracture system. Uncertainty in the transition zone location also led to large variation in transport results from one realization to the next.

The 2006 modeling assumes that groundwater moves predominantly through fractures in the rock and considers multiple realizations of the flow field by drawing values of hydraulic conductivity, recharge, and porosity from the fracture distributions. An additional separate sensitivity case was also presented addressing uncertainty in the matrix diffusion process.

The CRESP independent science study provided new data regarding both porosity and the location of the transition zone. These data, along with new bathymetric profiles, were used to verify the Amchitka groundwater models, revise and update the model parameter distributions, and reduce uncertainty in the model results (Hassan and Chapman 2006).

Through a series of analyses, it was found that the new data provided by CRESP were consistent with the conceptual framework and range of parameter values used in the 2002 groundwater flow and transport model. The 2002 model was verified through a number of components. First, the high-resolution bathymetric data obtained by Johnson and Stewart (CRESP 2005) closely matched the profiles used in the models. Second, the posterior distributions for recharge, hydraulic conductivity, and their ratio (all constrained by the transition zone location information from CRESP 2005) are encompassed within the original prior distributions used in the 2002 model, verifying that the original distributions were wide enough to include the new data. Third, the updated flow solution results in an ensemble mean matching the head and chemistry data within one standard deviation of the original models. When the new data provided better control on parameter ranges, the wide range of uncertainty was trimmed from both sides, resulting in a new set of possible solutions encompassed within the original set of possible solutions. Though the CRESP data indicate a deeper transition zone at Milrow than indicated by site chemistry data, the possibility of a deeper transition zone was accounted for in the 2002 model by the wide ranges of recharge and hydraulic conductivity considered.

After the models were updated with the new CRESP data, the resulting groundwater fluxes had the same distribution as the original model. A dramatic reduction in uncertainty was achieved by conditioning on all available data sets. The parameter distributions cover a much narrower range than those originally used in the 2002 model. Using the new porosity profiles from CRESP (2005) resulted in very slow flow velocities, orders of magnitude slower than the velocities produced by the 2002 model. With the new porosities, radionuclides require thousands of years to reach the sea floor. No breakthrough resulted for any of the three test sites within the 2000-year model time frame in the 2006 model, despite ignoring all retardation mechanisms (sorption, radionuclide trapping in glass, matrix diffusion, and radioactive decay). In the 2002 model, the standard deviation of mass flux was larger than the mean, implying that the lower limit for radionuclide mass flux was essentially zero. This is now indicated by the CRESP data and was included in the possibilities presented by Hassan et al. (DOE 2002).

3.1.3 Oceanography

The Aleutian Ridge is an elongate, curved rim that rises from the sea floor, extends westward from the Bering Shelf, and separates the Pacific Ocean from the Bering Sea. Along the ridge are 167 named and over 300 unnamed islands that rise above sea level and form the Aleutian Islands. Amchitka Island, situated near the western end of the Aleutian chain, is an elongate, narrow landmass between Amchitka Pass and Oglala Pass. Amchitka Pass is one of only three deep passes in the Aleutians, although all 14 passes allow significant flow between the North Pacific and the Bering Sea. Although there is a general flow pattern in the Bering Sea, influenced by the northward inflow of relatively fresh, warm water from the Alaskan Stream, and exiting with southward flow forming the Kamchatka Current, inside the basin, complex subcurrents and flows are present (Loughlin and Ohtani 1999).

Reed and Stabeno (1999) determined in the early 1990s that Amchitka Pass has bidirectional flow, that is, northward (inflow) on the eastern side of the pass and southward (outflow) on the western side. This results in complex currents around Amchitka Island, partially influenced by the presence of Bowers Ridge, a northward extension of the Aleutian Arc (Figure 3–2). Due to the complex topography of the sea floor in the region, a number of convoluted, highly variable currents exist in and around the waters bordering Amchitka (DOE 2003).

3.2 Ecology

Amchitka’s coastline is rugged, with sea cliffs, isolated sandy and gravel beaches, and grassy slopes. The lowest elevations are on the eastern third of the island and are characterized by isolated, shallow ponds and heavily vegetated drainages. The central portion of the island has higher elevations, is more prone to wind erosion, and has fewer lakes. The westernmost 3 miles of the island are barren. The area contains a windswept, rocky plateau with sparse vegetation, except for areas (e.g., stream drainages) protected from the wind. The average surface elevation at the western end of the island is approximately 800 ft. The highest elevation on the island is approximately 1,160 ft (Merritt and Fuller 1977).

Amchitka is characterized by a pronounced maritime climate, including frequent storms, strong winds, and cloudy skies. There is no prevailing wind on Amchitka, although during the summer months the winds are generally out of the southwest. The mean wind speed between December and February is 30 miles per hour; between March and May it is 26 miles per hour, between June and August it is 22 miles per hour, and between September and November it is 27 miles per hour. The maximum recorded wind velocity on Amchitka is 115 miles per hour. The ocean moderates temperatures, which average 31 °F in January and 48 °F in August. Annual precipitation is about 33 inches, including approximately 71 inches of snow (Merritt and Fuller 1977). The conversion of snowpack to inches of water is dependent on several variables, such as area of cover and density. As a rule of thumb, 10 inches of snow is equivalent to about 1 inch of water.

3.2.1 Terrestrial

The island's topography defines two broad vegetation categories: wetland tundra and upland tundra. Wetland communities cover much of the low-lying southeastern half of the island; upland communities dominate the slopes in the northwestern half.

Raptors, seabirds, shorebirds, waterfowl, and upland game birds represent the 131 species of birds recorded on and near the island; approximately 30 species breed on the island. Among other species commonly found on the island are the bald eagle, peregrine falcon, and Aleutian cackling goose.

The only mammal on Amchitka is the Norway rat, believed to have been introduced on the island during World War II (Merritt and Fuller 1977). In 1921, arctic fox were introduced on the island under a fox-farming permit. Because of the fox's impact on island bird populations, USFWS started an eradication program, and by 1960 all the fox, along with feral cats and dogs from World War II were removed (USFWS 2000).

The numerous freshwater ponds on the island support a few fish species. Dolly Varden, a salmonid, and three species of stickleback are present in both a landlocked and an anadromous (i.e., migrating up streams from the ocean to spawn in fresh water) form (USFWS 2000).

3.2.2 Wetlands

Wetlands are areas where water covers the soil or is present either at or near the surface of the soil all year or for varying periods of time during the year, including during the growing season. Although Alaska has not designated specific regions of Amchitka as wetlands, they cover much of the southeastern lowlands. Wetland tundra plant communities include shallow ponds and extensive meadows. Although some of the island's ponds do not contain vascular plants, many support emergent plant communities composed of arctic rush, sedges, shortawn foxtail, and burrweed (USFWS 2000).

3.2.3 Marine

The marine algal flora of Amchitka is diverse; about 120 algal species have been reported from the island coast. Zonation within the algal community is related to exposure, and characteristic assemblages occur throughout the intertidal and shallow subtidal regions.

Numerous waterfowl species, such as green-winged teal, mallard, and red-throated loons, are year-round residents. Marine bird species occupy many nesting sites around the perimeter of the island.

A number of marine mammals occur in or migrate through the area of Amchitka. The northern sea otter and harbor seal are commonly seen on the island. Steller sea lions are permanent residents.

The marine fisheries resources of the Aleutian Islands are abundant and diverse. Ninety-two fish species have been described in Amchitka's nearshore environment (USFWS 2000).

The waters off the coast of Alaska constitute one of the world's premiere fishing grounds. "The domestic groundfish fishery off Alaska is an important segment of the U.S. fishing industry. With a total catch of 2.0 million metric tons (t), a retained catch of 1.9 million t, and an ex-vessel value of $543 million in 2001, it accounted for 47% of the weight and 17% of the ex-vessel value of total U.S. domestic landings as reported in Fisheries of the United States, 2001. The groundfish fisheries accounted for the largest share of the ex-vessel value of all commercial fisheries off Alaska in 2001 (56%), while the Pacific salmon fishery was second with $189 million or 19% of the total Alaska ex-vessel value. The value of the shellfish catch amounted to $124 million or 13% of the total for Alaska. The gross values of the 2001 groundfish catch after primary processing was approximately $1.4 billion" (Hiatt 2005). Appendix K is a table listing metric tons of fish caught from 1965 through 2005 in the Bering Sea/Aleutian Island sector.

3.2.4 Threatened and Endangered Species

3.2.4.1 Federal Listings

The Steller sea lion and the northern sea otter are currently the only federally recognized threatened or endangered animal species that inhabit Amchitka. A portion of Amchitka has been designated as critical habitat for the Steller sea lion, which has established rookeries in the area (Figure 3–4). There are no federally listed or candidate plant species on Amchitka.

The Steller sea lion was first listed as threatened in 1990. In 1997, the species was reclassified into two distinct population segments under the Endangered Species Act. The reclassification was based on biological information collected since the species was listed as threatened in 1990. The Steller sea lion population segment west of Longitude 144°W was reclassified as endangered; the listing for the remainder of the U.S. Steller sea lion population remained as threatened (NOAA 2001). The two sea lion rookeries cannot be approached within 3 nautical miles by a vessel or within one-half statutory mile by land (50 CFR 223.202). Figure 3–4 shows the areas on Amchitka that are designated as critical habitat.

The northern sea otter was first listed on August 9, 2005. It is currently designated as threatened in the southwest area of Alaska that includes the Aleutian Islands, Alaska Peninsula coast, and Kodiak Archipelago (70 FR 46365−46386).

The Aleutian cackling goose[3], listed as an endangered species in 1973 and reclassified as threatened in 1990, is abundant on Amchitka and uses the island as a breeding ground. On March 20, 2001, the Aleutian cackling goose was de-listed in its entire range (66 FR 15643−15656).

3.2.4.2 State Listings

The State of Alaska has a category called Species of Special Concern. This list includes the Aleutian cackling goose, Steller sea lion, and sea otter, all of which are present in the Amchitka area (listed at http://www.adfg.state.ak.us/special/esa/esa_home.php, accessed 21 August 2008).

[3]The species when listed was called the Aleutian Canada goose. Since then, the species has been designated as the Aleutian cackling goose. *Federal Register* notices use the term Aleutian Canada goose.

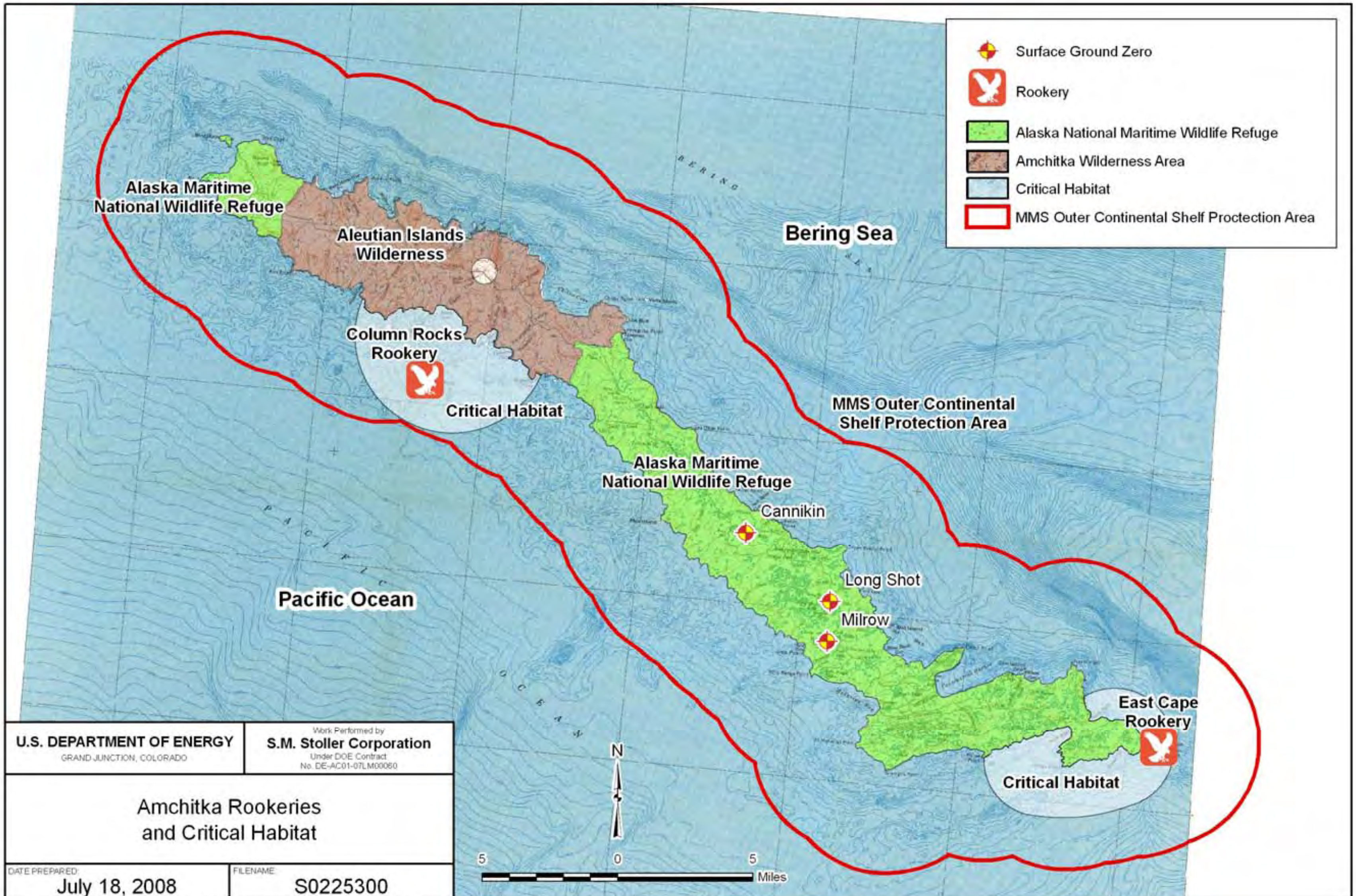

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Figure 3–3. Amchitka Rookeries and Critical Habitat

3.2.4.3 Critical Habitats

Critical habitats are defined by the Endangered Species Act (16 U.S.C. 1531−1534) as:

> (i) The specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features (I) essential to the conservation of the species and (II) that may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species. ‘‘Conservation’’ is defined in section 3 as meaning the use of all methods and procedures needed to bring the species to the point at which listing under the Act is no longer necessary. The primary regulatory effect of critical habitat is the section 7(a)(2) requirement that Federal agencies shall insure that any action they authorize, fund, or carry out is not likely to result in the destruction or adverse modification of designated critical habitat.

The Steller sea lion and the northern sea otter both have critical habitats designated on Amchitka Island. Figure 3–4 shows the Steller sea lion critical habitat location on Amchitka; Table 3–1 provides location information.

Table 3–1. Amchitka Island Steller Sea Lion Critical Habitat

Critical Habitat	From		To		NOAA Chart	Notes
	Lat.	Long.	Lat.	Long.		
	51° 22.5’N	179° 28.0’E	51° 21.5’N	179° 25.0’E	16440	East Cape
	51° 32.5’N	178° 49.5’E			16440	Column Rocks

Source: http://www.fakr.noaa.gov/protectedresources/stellers/habitat.htm, accessed 21 August 2008.

3.3 Cultural Resources

USFWS has the responsibility for managing Amchitka, which is part of the Alaska Maritime National Wildlife Refuge. DOE has no responsibility for the cultural resources on the island, other than training its employees regarding protection and preservation of these resources. Most of the cultural resources that are on the island coincide with the Native claims depicted on Figure 2–2 and are on the coastal portions of the island. DOE activity on the island will be restricted in those areas USFWS designates as having culturally sensitive resources.

3.4 Remedial Actions

The surface and the subsurface remedial activities at Amchitka are addressed separately due to the nature of the available technology and the residual radioactivity. Surface remediation has been completed; for the subsurface, it was determined that long-term monitoring is the most effective alternative because no feasible technology has been identified to remove the residual radioactivity from the cavities.

3.4.1 Surface

3.4.1.1 AEC Activities

In 1972 and 1973, AEC conducted site demobilization and restoration activities that consisted of:

- Plugging, sealing, and capping drill holes;
- Disposing of contaminated fluids, equipment, and materials off-island;
- Removing and disposing of all AEC-associated buildings, equipment, and associated surface facilities;
- Contouring and revegetating disturbed areas; and
- Placing the material and equipment that became contaminated during Cannikin re-entry into the re-entry borehole.

At the time of these AEC activities, there was a requirement for continued monitoring of surface waters in the area of the Long Shot site, and the mud pits at Long Shot were left intact for that purpose.

3.4.1.2 DOE Activities

Drilling operations for the three large-diameter emplacement holes and numerous small-diameter instrument and hydrologic test holes generated large volumes of drilling mud, which consisted of a mixture of rock cuttings, bentonite, diesel fuel, and other compounds, including chrome lignosulfonate. In order to properly dispose of this material, DOE conducted site characterization activities in 1993, 1997, and 1998 and conducted a pre-construction engineering study in 2000.

In the 1998 investigation, chemical analysis of the drilling mud indicated that all drilling mud pits contained concentrations of DRO, polycyclic aromatic hydrocarbons, low levels of PCBs, and chromium. The only contaminants of concern with concentrations above ADEC cleanup levels within each mud pit were DRO. Mean concentrations of contaminants in water overlying the drilling mud were well below applicable ecological criteria in all drilling mud pits. Sampling of the surface water drainages of each drill site revealed that contaminants within the sediment affected by drilling mud were DRO and PCBs. The investigation in June of 2000 involved gathering chemical data on the shallow groundwater downgradient of the drilling mud pits. Sampling results indicated that drilling mud did not affect the shallow groundwater, and no cleanup of shallow groundwater is necessary (DOE 2000b).

The asphalt plant was located adjacent to Charlie Runway and consisted of two underground storage tanks. The tanks were located side-by-side about 22 ft apart and had a storage capacity of approximately 25,000 gallons each (DOE 2003). Historical records suggest that the tanks held asphalt used in constructing and maintaining the nearby runways. A sample of one of the tanks was collected in 1995 and was analyzed for metals, total halogens, PCBs, hydrocarbons, and British thermal unit (Btu) content (USACE 1996). Hydrocarbons were the only analytes present above detection limits: 309,000 parts per million (ppm) and 124,000 ppm of “unknown petroleum” compounds per tank. The Btu content was 18,000 Btu per pound. No associated piping or distribution system was observed during the remediation of the asphalt plant. Approximately 17,430 gallons of water were treated at the Drill Site D water treatment plant, and

6,953 gallons of used oil and 3,923 gallons of water from the tanks were transported to Alaska Pollution Control, Inc., in Palmer, Alaska, for reclamation. The two tanks were filled with native soil and left in place.

Sixteen shallow monitor wells at Milrow and Long Shot were plugged and abandoned as part of the remedial activities. Well plugging consisted of removing the PVC well casing and filling the borehole with a bentonite slurry. Wells W-2 through W-9, W-11, W-12, W-14, W-16, W-17, and W-19 were abandoned at the Milrow site, and wells WL-1 and WL-2 were abandoned at the Long Shot site. Data for these wells, other historical wells, and remaining wells are available in Appendix J and on the LM website using the Geospatial Environmental Mapping System (GEMS) at http://gems.lm.doe.gov.

These surface remediation activities are documented in the *Amchitka Island Surface Closure Report* (DOE 2003), which was submitted to the State in April 2004.

3.4.2 Subsurface

The deep subsurface at each site remains contaminated with fission products as a result of the underground detonations. No remedy is known for the radioactivity that exists from the blast deep in the subsurface. Because no remedy is known and because past nuclear testing has created an environmental liability, DOE prepared the Subsurface Completion Report in September 2006, which provides a recommendation of no further remedial action and a long-term surveillance and maintenance strategy for the subsurface (DOE 2006c).

3.5 Baseline Conditions

3.5.1 Surface Conditions

ADEC accepted the Surface Closure Report in September 2004 (ADEC 2004). The surface ROD was subsequently submitted (DOE 2008). The surface ROD was not a CERCLA-type ROD, but an ad hoc mechanism for ADEC and DOE to formalize acceptance of the work. The ROD summarized the surface closure activities and stated that post-closure inspection and monitoring will be conducted as described in the *Post-Closure Monitoring and Inspection Plan for Amchitka Island Mud Pit Release Sites* (DOE 2005b). Both ADEC and USFWS approved the ROD in August 2008.

3.5.1.1 Site Markers, Signs, and Monuments

Each underground nuclear test on Amchitka Island has a surface ground zero (SGZ). During AEC restoration activities in 1973, a concrete slab was poured over the emplacement hole at each site, and a permanent monument with bronze tablets was erected to mark the SGZ. The monument information is included in Appendix G for all three sites.

3.5.1.2 Mud Pit Covers

The remaining exposed mud pits from testing were stabilized and capped with engineered covers during the spring and summer of 2001. The 2006 inspection of the vegetation planted on the mud pit covers in 2001 found coverage to vary inversely with elevation. The higher elevations were deficient in vegetation coverage ("less than 50 percent on grid"); the lower elevations were not deficient (DOE 2006b). However, to prevent possible erosion of the covers and remedy the deficiency, a site visit was conducted in June 2008 to nonintrusively revegetate the covers at Sites D, E, and F.

The next regular 5-year site visit is planned for 2011.

3.5.1.3 Surface Ecological and Human Health Risk Status

The *Human Health and Ecological Risk Assessment for the Amchitka Mud Pit Release Sites, Amchitka Island, Alaska* was included as Appendix J to the Surface Closure report (DOE 2003). The risk assessment concluded that the historical releases of drilling mud do not pose an unacceptable risk to ecological[4] or human receptors (workers or part-time subsistence users). The mud pit stabilization and covers have eliminated the source that historically may have leaked to streams and ponds. The residual material in the ponds and streams does not pose substantial risk to the ecological receptors and will diminish over time.

3.5.2 Subsurface Conditions

ADEC accepted the final Subsurface Completion Report (DOE 2006c) in January 2007 (ADEC 2007). The Screening Risk Assessment report (DOE 2005d) that followed the draft Subsurface Completion Report was recommended by ADEC to remain a draft, pre-decisional document (ADEC 2006).

No remedy is known for the radioactive products remaining from the nuclear detonations contained deep within the cavities. Numerous and extensive environmental and biological studies have been conducted on and around Amchitka since the early 1970s to detect leakage via the most likely pathway, groundwater transport and discharge into the ocean, as depicted in conceptual model (Figure 3–4). No study concluded that test-related radionuclides have migrated from the test cavities. Other than naturally occurring radiation, detected radiation in the environment is likely from atmospheric nuclear-test fallout or ocean dumping.

"There has been essentially no escape of radionuclides from the sites of the Long Shot, Milrow, and Cannikin underground nuclear detonations. Radionuclide values for Amchitka samples are similar to those for comparable samples from other geographical areas. The only radioactivity of Amchitka nuclear test origin that was detected consisted of trace quantities of radionuclides, principally tritium, in water and soil gas samples in the immediate vicinity of surface ground zero for the Long Shot detonation" (Merritt and Fuller 1977). Subsequent results from long-term monitoring of groundwater and shallow surface waters by EPA show that detected tritium concentrations are declining faster than by radioactive decay alone.

[4] Benthic macroinvertebrate communities; aquatic plants; freshwater fish; omnivorous, herbivorous, and piscivorous birds.

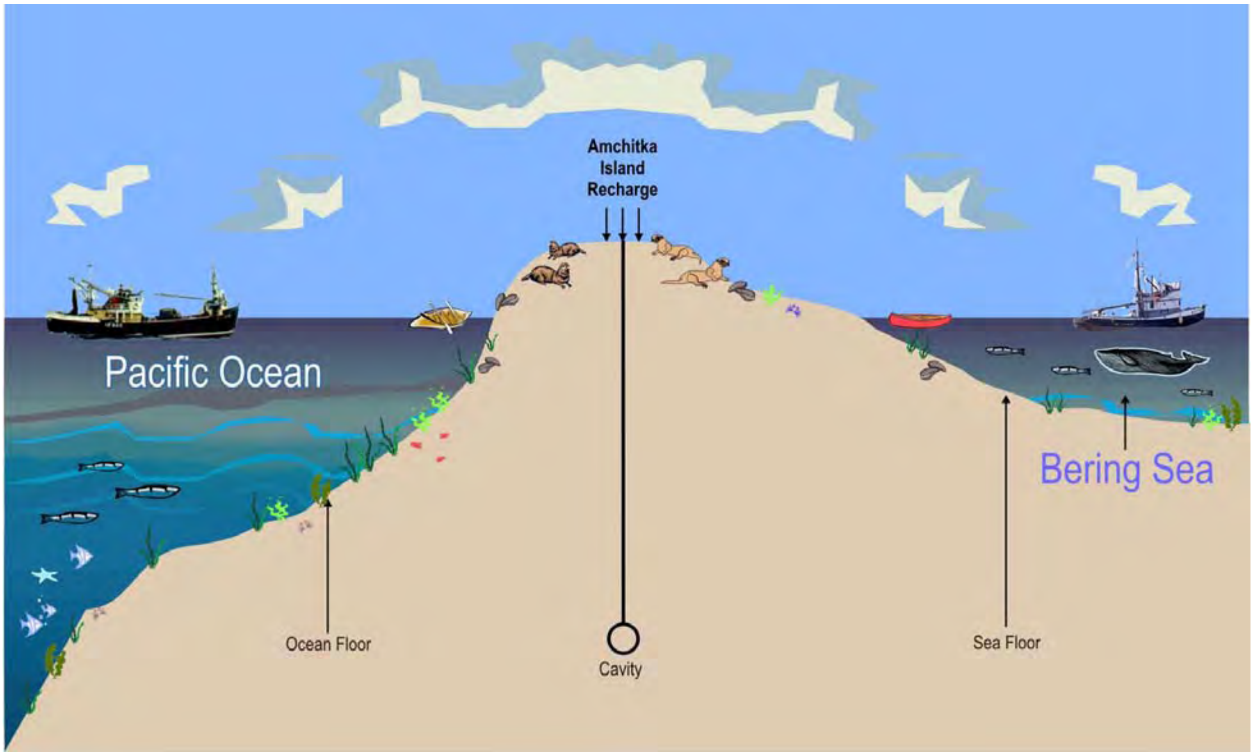

Figure 3–4. Idealized Conceptual Model

3.5.2.1 Radiobiological Studies

The University of Washington College of Fisheries in Seattle, Washington, conducted radiobiological studies on Amchitka from 1969 to 1979. The final annual report (DOE 1982) concluded:

> Conclusions from the results of the recent analyses are a reiteration of the results stated in Nelson and Seymour (1975a); namely, "(1) no new radionuclides are present; (2) the most abundant radionuclides are naturally occurring beryllium-7 (^{7}Be) and potassium-40 (^{40}K); (3) the trace quantities of fission products and induced radionuclides are from world fallout; and (4) a trace of ^{3}H contamination remains in some Long Shot ponds, as previously reported." It is concluded from the results of analyses of samples collected between September 1969, and December 1978 as reported in this and the eight previous progress reports, that there were no radionuclides of Milrow or Cannikin origin in the water, plants, or animals of Amchitka Island.

These studies included some of the same marine species sampled in later studies as well other biota from the marine environment.

Greenpeace reported that the test sites on Amchitka were leaking (Miller 1996). DOE contracted with EPA's Environmental Monitoring Systems Laboratory in Las Vegas, Nevada, to conduct a similar study to verify Greenpeace's reported results. Also participating in the 1997 work were representatives from ADEC, APIA, Greenpeace, and Los Alamos National Laboratory. The Amchitka Island Special Sampling Study 1997 conducted by EPA reached the following conclusion: "Comparison of ^{137}Cs concentrations in the marine alga *Fucus distichus* from Bering Sea and North Pacific Ocean transects (CN-4, MR-4, and BKG-2) at Amchitka Island stream discharges show no differences in the mean and standard deviation values" (DOE 2000a). Dasher et al. (2000) concluded that the elevated levels were associated with global fallout rather than the Amchitka tests.

3.5.2.2 Recent Sampling Results

The recent CRESP study (CRESP 2005) using biota sampling to assess the effect of nuclear testing at Amchitka on human health and the environment concluded that no threat existed. CRESP conducted additional actinide analyses of samples (CRESP 2006) that confirmed the original findings and concluded that:

- The foods tested are safe to eat, with radionuclide levels below published human health guidance levels;
- Our data do not suggest that radionuclides in biota collected from Amchitka are attributable to the Amchitka test shots; and
- A combination of sedentary and mobile organisms at different trophic levels is ideal for a continued biomonitoring program at Amchitka.

A compilation of maximum radionuclide concentrations for biota samples collected at Amchitka Island and at Kiska Island by CRESP is given in Table 3−2**Error! Reference source not found.**. Kiska Island is approximately 80 miles west of Amchitka Island. Kiska samples were obtained to provide data from an area that is considered outside the range of the three nuclear tests. Comparison of the Amchitka data (column 2) with Kiska data (column 3) shows that the data are similar. These results also show that the CRESP-measured radionuclide concentrations are significantly lower than food safety standards and guidelines (FAO/WHO 2008).

Table 3–2. CRESP Maximum Values for Reported Analytes

Radionuclides of Interest[a]	CRESP Amchitka Maximum Value[b] in pCi/g-ww	CRESP Kiska Maximum Value[b] in pCi/g–ww	Number of Detections/Number of Analyses
Co-60	1.6	<MDA[c]	1/281
Sr-90	<MDA[c]	<MDA[c]	0/95
I-129	0.0133	<MDA[c]	1/145
Cs-137	0.489	0.0125	28/281
Eu-152	0.110	<MDA[c]	1/271
U-234	0.13	0.14	153/172
U-235	0.00535	0.00686	45/172
U-236	0.00119	0.000308	4/172
U-238	0.118	0.121	157/172
Pu-238	0.00332	<MDA[c]	3/172
Pu-239/240	0.00843	0.00239	27/172
Am-241	0.00128	0.00202	17/385

pCi/g-ww = picocuries per gram wet weight.
[a]List of radionuclides includes those with reported results in the 2006 data available at the CRESP website (www.cresp.org).
[b]Data obtained from the CRESP website database. Results found to be false positives by CRESP are excluded from the table. Table I−3 presents a tabulation of the highest detected values, grouped by species, converted to pCi/kg.
[c]"<MDA" indicates that all samples were below the minimum detectable activity for the particular radionuclide.

The CRESP data consist of data for 7 species of macroalgae, 6 species of grazers or filter feeders, 11 species of fish, 5 species of birds (including eggs of 2 species), octopus, and 1 sea lion (captured in a subsistence hunt by Aleuts). The following radionuclides were analyzed: Cs-137, I-129, Co-60, Eu-152, Am-241, Sr-90, Pu-238, Pu-239/240, U-234, U-235, U-236, and U-238.

3.5.2.3 Estimated Human Health Risk

In addition to the comparisons made above and as part of establishing initial conditions discussed in this plan, an exposure scenario was postulated to provide realistic but still conservative risk estimates based on the CRESP data for Amchitka and the Kiska reference sites. Because the two data sets are similar, the data were combined; the maximum values were reported for each radionuclide detected and were tabulated corresponding to the biota in column 1 of Table 3-3. To simplify the calculations, it was also assumed that the receptor would ingest the entire annual dietary intake of about 4.2×10^4 grams of seafood. (Appendix I, Table I-1, lists Aleut dietary intake in the form of each of the species evaluated in Table 3–3). Based on the maximum concentrations (in the upper left of each cell), the resulting risk estimate [5] (last column) provides an estimate of an upper bound to the potential human health risk from subsistence or commercial catch consumption of seafood from Amchitka or Kiska. (For example, the total estimated risk for *Fucus*, 1.1×10^{-4}, is the sum of each calculated risk in the *Fucus* row, shown in bold in the lower right in each cell.)

Based on current conditions at the Amchitka site, the ingestion pathway (of harvested seafood) would be the only potential pathway for risk to human health from the test-cavity-associated radionuclides. However, there is no evidence that the measured radionuclide concentrations used in this calculation originated from any of the test cavities under Amchitka Island. Tritium has not been detected in seawater, and Amchitka radionuclide concentrations in biota are similar to concentrations from the baseline (or control) site, Kiska.

The assumptions used for the risk estimate calculations in Table 3-3 are (1) the amount ingested is 150 grams per day (equivalent to consuming about 5 ounces of seafood per day); (2) the ingestion frequency is 365 days per year (resulting in about 5.5×10^4 grams per year); (3) the exposure duration is 70 years (a typical assumption of 30 years is recommended by EPA for CERCLA assessments); and (4) 100 percent of the ingested seafood contains the radionuclide concentrations.

The current radionuclide levels in seafood obtained from waters in and around Amchitka and Kiska indicate that the risk levels are at about 10^{-5} to 10^{-4} at both locations, depending on the species ingested. These risks are calculated from the actual, combined, maximum concentration values reported by CRESP. Although potential for migration from the three test cavities cannot and should not be discounted, there is currently no evidence of migration.

[5] Risk values were determined by Argonne National Laboratory.

Table 3–3. Maximum Detected Radionuclide Concentrations in Biota and the Corresponding Estimated Risk for the Subsistence Harvester Scenario from Amchitka and Kiska Islands

		Radionuclide Analytes								
Biota		**Cs-137**	**Am-241**	**Pu-238**	**Pu-239+240**	**U-234**	**U-235**	**U-236**	**U-238**	**Total Estimated Risk**
Alaria fistulosa	CRESP[a] (Bq/kg)	<MDA[c]	<MDA[c]	0.015	0.207	2.060	0.160	0.022	2.110	
	Risk[b]			**2.6×10^{-7}**	**7.5×10^{-6}**	**2.1×10^{-5}**	**1.6×10^{-6}**	**2.1×10^{-7}**	**2.6×10^{-5}**	**5.7×10^{-5}**
Fucus	CRESP[a] (Bq/kg)	<MDA[c]	0.035	<MDA[c]	0.059		0.254	0.044	4.470	
	Risk[b]		**4.9×10^{-7}**		**2.1×10^{-6}**	**5.1×10^{-5}**	**2.4×10^{-6}**	**4.2×10^{-7}**	**5.6×10^{-5}**	**1.1×10^{-4}**
Rock Jingle	CRESP[a] (Bq/kg)	<MDA[c]	0.047	<MDA[c]	0.060	0.583	0.064	0.011	0.451	
	Risk[b]		**6.7×10^{-7}**		**2.1×10^{-6}**	**5.8×10^{-6}**	**6.4×10^{-7}**	**1.0×10^{-7}**	**5.6×10^{-6}**	**1.5×10^{-5}**
Blue Mussel	CRESP[a] (Bq/kg)	<MDA[c]	0.025	<MDA[c]	<MDA[c]	0.949	0.045	<MDA[c]	0.844	
	Risk[b]		**3.5×10^{-7}**			**9.4×10^{-7}**	**4.4×10^{-7}**		**1.0×10^{-5}**	**1.2×10^{-5}**
Dolly Varden	CRESP[a] (Bq/kg)	0.780	<MDA[c]	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	
	Risk[b]	**3.0×10^{-6}**								**3.0×10^{-6}**
Black Rockfish	CRESP[a] (Bq/kg)	0.189	0.029	<MDA[c]	<MDA[c]	2.180	0.116	<MDA[c]	1.830	
	Risk[b]	**7.1×10^{-7}**	**4.0×10^{-7}**			**2.1×10^{-5}**	**1.1×10^{-6}**		**2.3×10^{-5}**	**4.6×10^{-5}**
Walleye Pollock	CRESP[a] (Bq/kg)	0.461	0.022	<MDA[c]	0.020	0.857	0.053	<MDA[c]	0.779	
	Risk[b]	**1.7×10^{-6}**	**3.3×10^{-7}**		**7.1×10^{-7}**	**8.4×10^{-6}**	**5.0×10^{-7}**		**9.6×10^{-6}**	**2.1×10^{-5}**
Halibut	CRESP[a] (Bq/kg)	0.446	<MDA[c]	<MDA[c]	0.0173	1.200	0.048	<MDA[c]	0.900	
	Risk[b]	**1.7×10^{-6}**			**6.1×10^{-7}**	**1.2×10^{-5}**	**4.7×10^{-7}**		**1.1×10^{-5}**	**2.6×10^{-5}**
Pacific cod	CRESP[a] (Bq/kg)	0.602	0.015[d]	<MDA[c]	<MDA[c]	0.290	<MDA[c]	<MDA[c]	0.257	
	Risk[b]	**2.2×10^{-6}**	**2.1×10^{-7}**			**2.8×10^{-6}**			**3.1×10^{-6}**	**8.3×10^{-6}**

Bq/kg = becquerel per kilogram
[a] CRESP data. Results found to be false positives by CRESP are excluded from the table.
[b]Risk estimated by Argonne National Laboratory. The risk assumptions are given in Section 3.5.2.3.
[c]"<MDA" indicates that all samples were below the minimum detectable activity for the particular radionuclide.
[d]A value of 14.9 Bq/Lg was reported for AM-241 for a Pacific Cod sample but was considered a false positive.

3.5.2.4 Groundwater Modeling

Recent numeric simulation results (Hassan and Chapman 2006), based on CRESP data, indicate that migration from a test cavity to the sea floor (breakthrough) will not occur within the next 2,000 years (the time frame of the model). This prediction is based on conservative fracture groundwater flow and does not employ various retardation mechanisms (sorption, radionuclide trapping in glass [solidified, melted rock in the bottom of the test cavity], matrix diffusion, and radioactive decay). The simulation is grounded on a conceptual model and relies on estimates or measurements of various parameters. Uncertainty in the conceptual model or the parameters translates into prediction uncertainty. An efficient and effective monitoring program outlined in this LTS&M Plan adds an extra measure of safety.

3.5.3 Organizations and Programs Monitoring the Arctic Marine Environment

Currently, numerous organizations routinely conduct marine monitoring near Amchitka Island. This section lists some of these organizations and their current programs.

3.5.3.1 National Oceanic and Atmospheric Administration (NOAA) Programs

Fisheries

- Alaska Fisheries Science Center
- Alaska Regional Office
- Endangered Species Act
- Fish Statistics and Economics
- NOAA Fisheries
- Protected Resources Habitat Conservation
- Science and Technology
- Scientific publications
- Seafood inspection
- Sustainable Fisheries Act

Ocean

- Marine Protected Areas (Executive Order 13158)
- Marine sanctuaries
- Nautical charts
- National Geodetic Survey
- Oil and chemical spills
- Photo library
- Undersea Research Program
- Undersea Volcano Monitoring—Real-Time
- Undersea Volcanoes—Vents Program

Research

- Fisheries research
- Geomagnetics
- National Centers for Coastal Ocean Science
- Natural hazards
- NOAA research
- Oceanic and coastal research
- Science centers links
- Tsunami Research Program
- Undersea Research Program

3.5.3.2 Alaska Department of Environmental Conservation

- Alaska Monitoring and Assessment Program
- Fish Monitoring Program

3.5.3.3 Alaska Department of Fish and Game (Subsistence Fishing)

- Subsistence technical papers
- Tribal consultation policy
- Subsistence Harvests of Pacific Halibut in Alaska, 2004 Summary
- Subsistence Harvests of Pacific Halibut in Alaska, 2004 Final Report

3.5.3.4 Alaska Fisheries Science Center

- Fisheries Monitoring & Analysis Division
- National Marine Mammal Laboratory
- Resource Assessment & Conservation Engineering Division
- Resource Ecology & Fisheries Management Division

3.5.3.5 North Pacific Research Board

- Ocean monitoring
- Bering Sea Integrated Ecosystem Research Program
- Migration patterns and spatial connectivity
- Seasonal diets of exploited fish stocks
- LTK studies related to other RFP priorities
- Other marine mammal research

3.6 Database Development Using Existing Data

Historical data that are of acceptable quality and are available in formats that allow insertion into DOE's Site Environmental Evaluation for Projects (SEEPro) database will be used, including data collected prior to and immediately after the underground nuclear tests, as well as more recent data. These data will be available on the LM website (http://www.lm.doe.gov).

3.6.1 Terrestrial

All data will be entered into the database if the data meet the Data Quality Objective (DQO) requirements and are available in an electronic data deliverable (EDD) format. Biological data from previous investigations will be input into the database if they meet the DQOs that were developed for biological monitoring at Amchitka (included as Appendix I to this LTS&M Plan).

3.6.2 Marine

All data meeting DQOs and available in an EDD format will be incorporated into SEEPro and used to develop the baseline condition. Biological data from previous investigations will be input into the database if they meet the DQOs. To be useful, the data must meet several conditions:

- Be in an electronic data deliverable package;
- Previous data must be available in a numerical format;
- All data must have an identifiable location;
- Some type of QA/QC with respect to sample collection, handling, and analysis must be available for review; and
- Laboratory codes and qualifiers must be depicted and understood.

3.6.3 Historical Borehole Data

During the 2001 field season, most DOE-managed wells were plugged and abandoned (DOE 2003). Information on individual wells can be found using GEMS, DOE's online interactive system on the LM website (http://gems.lm.doe.gov). Appendix J contains information on historical borehole data from many reports produced over the years. The data include information on wells drilled for various technical endeavors undertaken on Amchitka Island and their subsequent abandonment.

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4.0 Amchitka Island Site Long-Term Surveillance and Maintenance Program

4.1 Applicable Plans and Documentation

USFWS has issued a Remedial/Removal Action Environmental Assessment and Finding of No Significant Impact (USFWS 2000). That document assigned specific areas of responsibility to each of the entities that have used Amchitka since 1945. As a result, DOE conducted the surface cleanup of the Amchitka Site in 2001, and details of that remedial action are reported in the *Amchitka Island Surface Closure Report* (DOE 2003). In September 2004, ADEC accepted the surface cleanup as complete.

Subsequent to completion and acceptance of surface closure activities, DOE prepared the *Subsurface Completion Report for Amchitka Underground Nuclear Test Sites: Long Shot, Milrow, and Cannikin* (DOE 2005a). In 2007, ADEC approved that report as a conditional closure with long-term surveillance and monitoring as appropriate subsequent actions.

Concurrent to the acceptance of the subsurface completion report, DOE also prepared the *Record of Decision (ROD) for the Amchitka, Alaska, Site Surface Closure* (DOE 2008) in agreement with both ADEC and DOE to formalize acceptance of the work. The ROD summarized the surface closure activities and stated that post-closure inspection and monitoring will be conducted as described in the *Post-Closure Monitoring and Inspection Plan for Amchitka Island Mud Pit Release Sites* (DOE 2005b). The ROD was approved by both ADEC and USFWS in August 2008.

4.2 Environmental Long-Term Surveillance and Maintenance

4.2.1 Surface Long-term Surveillance and Monitoring

Beginning in 2006, the mud pits at Amchitka will be monitored for subsidence, erosion, and vegetation cover on a 5-year basis. The requirements for these activities are detailed in the *Post-Closure Monitoring and Inspection Plan for Amchitka Island Mud Pit Release Sites* (DOE 2005b).

4.2.2 Long-term Surveillance and Monitoring of the Subsurface (Biological Monitoring)

The ocean around Amchitka Island is biologically rich; food chains lead to local human populations practicing subsistence fishing and to populations around the world obtaining sustenance through commercial fishing. Subsistence populations that rely on the fishery are some distance from the island itself and include Aleut villages such as Adak, Atka, Nikolski, and Unalaska (ADF&G 2002). Commercial fishing occurs around the island except for the Steller sea lion rookery restrictions at East Cape and Column Rocks. Nonmarketable items collected in commercial fishing (such as halibut cheeks) also form part of the diets of subsistence populations (CRESP 2006). If radionuclides migrate from test cavities through underground aquifers to the marine environment in the future, these radionuclides may enter the food chain near the island, and monitoring of the near-island biota will test for potential leakage and assess human radiological risk based on observed levels. Data from CRESP (2005) clearly show that (1) radionuclide levels in samples of biota around Amchitka during the summer of 2004 were consistent with expected baseline levels from global fallout and (2) there is no evidence of radionuclides from testing on the island. No systematic offshore sampling for tritium from nuclear testing has been done. Tritium, believed to be the fastest-moving radionuclide in groundwater, should be present if one or more cavities are leaking. If tritium is not present, the source of reported observations of plutonium and uranium-236 are not likely to originate from the Amchitka cavities. Modeling indicates that groundwater transport of radioactive constituents to the marine environment will not occur in the next 2000 years (Hassan and Chapman 2006).Monitoring will provide a basis for determining if radionuclides are transported through groundwater into the ocean and accumulated by the biota.

4.2.3 Sampling and Analysis of Biota, Amchitka Test Sites

A draft draft SAP is included in Appendix A of this LTS&M Plan. The draft draft SAP details the expected procedures and protocols for the biota sampling to be conducted near Amchitka Island. The draft SAP will be updated in 2009 to 2010 for use in the 2011 5-year inspection and sampling events.

Detailed below are brief discussions of how radionuclides, biota, and analytical methods were selected for this plan. More detailed discussions, along with development of the DQOs, are included in Appendix I.

4.2.3.1 Radionuclides Targeted for Monitoring

Table 4–1 shows the radionuclides of interest for the Amchitka tests with relevant information on physical properties. There is no indication that any of the radionuclides have reached the ocean through the subsurface. Monitoring will focus on the more mobile isotopes that, if mobilized, are expected to reach the ocean first, but will also check for other isotopes even though those isotopes are not expected. A discussion of how the particular radionuclides of interest were selected is presented in Appendix I. The radionuclides of interest listed in Table 4–1 can be monitored by two basic approaches: in groups by gross measurements of alpha, beta, and gamma activity or individually by analysis of specific radionuclides. The first approach has advantages and disadvantages over the second approach. The chief advantage is the relatively low analytical cost, which allows more samples to be analyzed with available funding and thus gives greater probability of detecting potential food contamination. Disadvantages include the fact that gross analyses will not show which isotopes are responsible for observed levels of radioactivity, that naturally occurring radioactivity contributes to gross measurements, and that the results cannot be compared directly to baseline data.

The analytical approach that DOE has decided to use for Amchitka monitoring is a hybrid of the two approaches and is designed to determine if radionuclides are entering the food chain from the Amchitka test cavities. Gross beta measurements will detect beta-emitting isotopes, including tritium, Cl-36, Sr-90, Tc-99, and I-129 that may reach the marine environment. Tritium, Cl-36, Tc-99, and I-129 may all travel rapidly (relative to other analytes) through the aquifer and should be the first isotopes to arrive in the marine environment. Gross beta analyses will be supplemented with gross alpha measurements for species expected to bioaccumulate uranium, plutonium, and americium. Migration of plutonium, uranium, and americium should be substantially retarded within the freshwater aquifer, and these radionuclides are not expected to reach the ocean for thousands of years, if at all (Hassan and Chapman 2006). Because of its toxicity, Americium-241 was retained even though it is a daughter product. Total uranium was added to the list because uranium isotope values associated with the exposure to the food chain are all included. Gross gamma analysis will also be performed to demonstrate its use as a screening tool for future sampling events. High-resolution gamma spectroscopy will be employed to detect Cs-137 and other gamma-emitting radionuclides. Seawater will be sampled and analyzed for tritium, a beta emitter. This list of analytic methods and analytes including total uranium was established with stakeholders and DOE during a 2-day February 2007 meeting in Anchorage, Alaska (See Appendix I, Section I3.4, and Table I−2).

After demonstrating that the gross measurements are adequate to provide a basis for decision-making, DOE proposes to do only the gross screening, unless values are detected that warrant analysis of individual isotopes. Although DOE does not propose to analyze specific radionuclides after the first two sampling events, adequate sample size will be collected so that radionuclide analyses can be conducted, if necessary.

4.2.3.2 Biota to Be Monitored

A cross-section of biological species will be monitored to detect if radionuclides in the food chain for human receptors are bioaccumulating radionuclides associated with the Amchitka tests. The monitoring scheme will be designed to detect increases in radionuclides that are present in the food chain. The biological species selected for this program are a subset of those sampled by CRESP (2005) and are deemed to be representative of the Aleut diet. Proposed species (and seawater) for sampling and radionuclides for selected analysis are provided in Table 4–2. Surface sediment samples will not be collected on Amchitka Island.

The algal kelp species *Alaria fistulosa* and *Fucus distichus L.* tend to concentrate plutonium, uranium, and americium and will be monitored to ensure food safety. *A. fistulosa* and *F. distichus* were selected on the basis of their high bioaccumulation factors for these elements (Table 4–3). Detected levels (CRESP 2005) of plutonium, uranium, and americium in samples of these organisms collected around Amchitka Island are consistent with expected background levels, which are not associated with the nuclear tests.

Halibut (*Hippoglossus stenolepis*) is a major source of food for the Aleuts and will be monitored for gamma-emitting isotopes to ensure food safety. Cod, Dolly Varden, greenling, and rockfish will also be sampled.

Samples of individual organisms will be analyzed where sample size is adequate. Composite samples may be collected where individual samples do not provide sufficient material for analysis. Equal numbers of samples will be collected directly offshore from the Long Shot, Cannikin, and Milrow tests. The samples will be collected along transects from the individual test site offshore. The offshore transect will be based on previous monitoring locations and the transect limit on water depth with consideration of the likelihood that currents and ocean mixing zones would mask any meaningful concentrations of radionuclides if samples were collected far from the shore. Samples also will be collected from Kiska as a control population.

Fleshy fronds will be analyzed for *A. fistulosa*, and samples without attachments will be analyzed for *F. distichus*. Soft body tissue will be collected for mussels, and muscle samples will be collected from fish. Eggs from the glaucous-winged gull will be sampled, as they are consumed by the Aleuts at certain times during the year. Where possible, sampling locations will be determined with Global Positioning System equipment to allow the location to be noted.

Table 4–1. Potential Radionuclides of Interest and Relevant Properties

Isotope	Isotopic Symbol	Naturally Occurring	Decay Mechanism	Half-Life (years except where noted)
Tritium	^{3}H	X	beta	12.30
Carbon-14	^{14}C	X	beta	5,730
Aluminum-26	^{26m}Al		beta	6.34 sec
Chlorine-36	^{36}Cl	X	beta	3.01×10^{5}
Argon-39	^{39}Ar		beta	269
Potassium-40	^{40}K	X	beta	1.28×10^{9}
Calcium-41	^{41}Ca		Electron capture	10.3×10^{4}
Nickel-59	$^{59-}$Ni		Electron capture	7.6×10^{4}
Nickel-63	^{63}Ni		beta	100.1
Krypton-85	^{85}Kr		beta	10.73
Stronium-90	^{90}Sr		beta	29.10
Zirconium-93	^{93}Zr		beta	15.3×10^{5}
Niobium-93	^{93m}Nb			16.13
Niobium-94	^{94}Nb		beta	2.03×10^{4}
Technicium-99	^{99}Tc	X	beta	2.13×10^{5}
Palladium-107	^{107}Pd		beta	6.5×10^{6}
Cadmium-113	^{113m}Cd		beta	14.1
Tin-121	^{121m}Sn		beta	27.06 hours
Tin-126	^{126}Sn		beta	1.0×10^{5}
Iodine-129	^{129}I		beta	1.57×10^{7}
Cesium-135	^{135}Cs		beta	2.30×10^{7}
Cesium-137	^{137}Cs		gamma	30.17
Samarium-151	^{151}Sm		beta	90.00
Europium-150	^{150}Eu		Electron capture	36.9
Europium-152	^{152}Eu		beta	13.53
Europium-154	^{154}Eu		beta	8.59
Holmium-166	^{166m}Ho		beta	1200
Thorium-232	^{232}Th	X	alpha	1.405×10^{10}
Uranium-232	^{232}U		alpha	68.9
Uranium-233	^{233}U		alpha	1.56×10^{5}
Uranium-234	^{234}U	X	alpha	2.45×10^{5}
Uranium-235	^{235}U	X	alpha	7.03×10^{8}
Uranium-236	^{236}U		alpha	2.34×10^{7}
Uranium-238	^{238}U	X	alpha	4.47×10^{9}
Neptunium-237	^{237}Np		alpha	2.14×10^{6}
Plutonium-238	^{238}Pu		alpha	87.7
Plutonium-239	^{239}Pu		alpha	2.41×10^{4}
Plutonium-240	^{240}Pu		alpha	6,560
Plutonium-241	^{241}Pu		beta	14.35
Plutonium-242	^{242}Pu		alpha	3.73×10^{5}
Americium-241	^{241}Am		alpha	432.70
Americium-242	^{242}Am		beta	16.02 hours
Americium-243	^{243}Am		alpha	7,370

Source: Bowen (2001)

Table 4–2. Amchitka Monitoring: Sampling Species and Radionuclides for Selected Analysis

Species to be Sampled	Cesium-137 (gamma spectroscopy)	Americium-241	Tritium	Plutonium-239+240	Uranium (total)	Gross Alpha	Gross Beta	Gross Gamma
Biota								
Cod	X	X	Not analyzed	X	X	X	X	X
Dolly Varden	X	X	Not analyzed	X	X	X	X	X
Greenling (kelp or rock)	X	X	Not analyzed	X	X	X	X	X
Halibut	X	X	Not analyzed	X	X	X	X	X
Rockfish (black or dusky)	X	X	Not analyzed	X	X	X	X	X
Sea Urchin	X	X	Not analyzed	X	X	X	X	X
Mussels	X	X	Not analyzed	X	X	X	X	X
Chitons (gumboots)	X	X	Not analyzed	X	X	X	X	X
Gull eggs	X	X	Not analyzed	X	X	X	X	X
Kelp *(Alaria f,. Fucus sp)*	X	X	Not analyzed	X	X	X	X	X
Environment								
Seawater medium	Not analyzed	Not analyzed	X	Not analyzed	Not analyzed	Not analyzed	Not analyzed	Not analyzed

Table 4–3. Bioaccumulation Factors for Isotopes

Radionuclide	BAF for Fish (L/kg)	Source	BAF for Marine Mammals (L/kg)	Source	BAF for Crustaceans (L/kg)	Source	BAF for Mollusks (L/kg)	Source	BAF for Plants (L/kg)	Source
Tritium	1	A	1	B	1	A	1	A	1	A
Carbon-14	2×10^4	A	2×10^4	D	2×10^4	A	5×10^4	A	1×10^4	A
Chlorine-36	0.05	A	0.9	E	0.05	A	1	A	0.05	A
Strontium-90	2	A	1	C	2	A	1	A	5	A
Yttrium-90	20	A	200	B	1,000	A	1,000	A	1,000	A
Technetium-99	30	A	600	B	1,000	A	1,000	A	1,000	A
Iodine-129	10	A	30	B	10	A	10	A	1,000	A
Cesium-137	100	A	300	F	30	A	30	A	50	A
Samarium-151	500	A	300	B	1,000	A	5,000	A	3,000	A
Europium-152	350	A	90	B	1,000	A	7,000	A	3,000	A
Gadolinium-152	500	A	300	B	2,000	A	5,000	A	3,000	A
Uranium-234	1	A	0.3	B	10	A	30	A	100	A
Uranium-236	1	A	0.3	B	10	A	30	A	100	A
Uranium-238	1	A	0.3	B	10	A	30	A	100	A
Total Uranium	10	A	G		10	A	30	A	100	A
Neptunium-237	10	A	10	B	100	A	400	A	50	A
Plutonium-239	40	A	3	C	300	A	3,000	A	2,000	A
Plutonium-240	40	A	3	C	300	A	3,000	A	2,000	A
Plutonium-241	40	A	3	C	300	A	3,000	A	2,000	A
Americium-241	50	A	1	B	500	A	2×10^4	A	8,000	A

Notes:
BAF = bioaccumulation factor
L/kg = liters per kilogram
A = International Atomic Energy Agency (IAEA) (1985)
B = Calculated using the BAF for fish and trophic transfer factors calculated from IAEA (1985).
C = Office of Naval Research (1997)
D = Similar carbon isotope ratios in predators and prey (DeNiro and Epstein 1978; DeNiro and Epstein 1981; Peterson and Fry 1987) and IAEA (1985) value for fish.
E = Calculated using uptake factors from Baes et al. (1984), assumed food ingestion rates, and formulas in EPA (1999).
F = Watson et al. (1999)
G = Will be calculated once site-specific data are available.

4.2.3.2 Timing of Monitoring

Initially, monitoring will be performed every 5 years. On the basis of estimated breakthrough times, especially as represented by the 2006 DRI modeling (DOE 2006c), and the time required for biological uptake of the radionuclides, every 5 years is adequate to detect any elevated radionuclide concentrations related to the Amchitka tests.

4.2.3.3 Analysis of Data

A two-way analysis of variance test to compare the baseline populations on Kiska to Amchitka's populations will be done when appropriate. Two-way analysis of variance will be performed for each analyte (with positive detections) in each species at each sample location. The analysis will determine whether there is a statistically significant increase in the targeted radionuclide in the targeted species at the location being evaluated that is not associated with a similar increase at the baseline location. Alpha (the probability that a statistical test will generate a false-positive error) will be set at 0.05 (for the tests). This is expected to produce false positive increases for 5 percent of the tests. If significantly more than 5 percent of the statistical tests show increases, or if large increases are observed, DOE will compare the increases to adopted baseline levels. If the increases are approaching these, DOE will investigate likely sources for the increase. After DOE has established adequate data points, trending analysis will also be done.

4.3 Well Maintenance

The two monitoring wells at Long Shot that were once part of the EPA's Long-Term Hydrologic Monitoring Program (GZ-1 and GZ-2) will be abandoned at the time of the 2011 site inspection. Additionally, an open and cased borehole of greater than 300-ft depth present at Site E will also be abandoned in 2011.

4.4 Directions and Logistics to Reach Amchitka Island

DOE will likely lease a suitable vessel for transport of personnel, equipment, and material to Amchitka Island for LTSM inspections. Personnel will likely fly into Dutch Harbor or Adak and be picked up by the vessel for the last leg of the journey to Amchitka.

4.5 Permits

DOE will submit a Special Use Permit application (50 CFR 36.39) to USFWS to obtain authorization to conduct monitoring activities. If USFWS changes the regulation, arrangements will still be made to notify USFWS of DOE presence on the island.

Federal agencies conducting activities that may affect the coastal zone in Alaska are required to document consistency with the requirements of the Alaska Coastal Management Program. This program is administered by the Alaska Department of Natural Resources and may require a consistency review and certification. The consistency review and certification involves the examination of project activities in relation to established state and regional coastal zone management standards and a certification that such standards would be met. DOE will contact the Alaska Department of Natural Resources prior to commencing LTS&M activities.

4.5.1 Access to Wilderness Area

At this time DOE sees no need to have access to the wilderness area.

4.6 Marine Sampling and On-Site Inspections

DOE will conduct inspection of its test sites on the island concurrently with the cover inspections at 5-year intervals beginning in 2011. Marine biota sampling will be conducted in the same calendar year as on-site inspections.

4.6.1 Actions Required Prior to Site Visit

Several actions are required prior to any travel to the island to perform surveillance and maintenance. The permits mentioned in Section 4.5 must be obtained. The inspections will be planned around crucial periods for the breeding of the Aleutian cackling goose and take into consideration habits of the Steller sea lion and the northern sea otter. The typical breeding period for all species on the island is from mid-May to mid-July. Doe will plan its LTSM activities, in consultation with the USFWS, accordingly.

4.6.2 Surface Inspection Frequency

The mud pit sites will be inspected every 5 years as detailed in the *Post-Closure Monitoring and Inspection Plan for Amchitka Island Mud Pit Release Sites* (DOE 2005b).

4.6.3 Marine Sampling Frequency

The draft SAP included as Appendix A of this LTS&M Plan will be updated before DOE begins sampling seawater and marine biota in 2011. The approved LTS&M Plan will provide the framework and carry forward to the draft draft SAP for the details. Initially, sampling will not be less than once every 5 years. Depending on final revisions to the draft SAP, more frequent sampling may be possible by coordinating the sampling with others sampling in the vicinity if efficiencies can be realized and the technical requirements of regulators and stakeholders are satisfied.

4.6.4 Inspection and Sample Collection Maps

4.6.4.1 Surface Locations

The surface locations and maps detailed in the *Post-Closure Monitoring and Inspection Plan for Amchitka Island Mud Pit Release Sites* (DOE 2005b) will be employed. The draft SAP (Appendix A of this LTS&M Plan) provides a more detailed discussion of other surface location designations.

4.6.4.2 Marine Catch Locations

Biota samplers will be given a map (to be developed) with enough information to locate all sampling locations by using Global Positioning System technology. Locations will be documented at the time of catch. Unlike the surface maps, this map will be generated in the field from a preprinted outline map of the island. Marine catch location designations are discussed in the draft SAP.

4.6.5 Inspection Checklist

To the extent possible, inspection checklists will be used to document current activities and provide a level of consistency between inspections. At the conclusion of a site inspection, inspectors will note revisions to the checklist (and the map) in anticipation of the next site inspection. Revisions to the checklist (and map) may include inspection instructions addressing new observations, or notes about maintenance conducted since the previous inspection, or progressive changes in site conditions.

4.6.5.1 Surface

All findings from the site inspections will be documented on a post-closure monitoring checklist for submittal to DOE and for future reference and monitoring. The checklists will be included with the draft SAP.

4.6.6 Inspection Procedure

4.6.6.1 Surface

Mud pit cover inspections will follow the protocol outlined in *Post-Closure Monitoring and Inspection Plan for Amchitka Island Mud Pit Release Sites* (DOE 2005b).

4.6.6.2 Marine

A protocol will be part of the draft SAP to ensure that representative samples of subsistence species are collected. The protocol will be developed in consultation with Aleut subsistence consumers and the National Marine Fisheries Service.

4.6.7 Inspection/Monitoring Personnel

DOE may contract some of the sampling and monitoring work to qualified personnel from native tribes, local companies, and government agencies as long as there is no conflict of interest. Contractors will be required to provide credentials that indicate a high level of experience in the required fields. Résumés and project personnel will be screened carefully prior to the project.

4.6.7.1 Surface

All project personnel will be trained and qualified to perform their assigned tasks. Objective evidence of qualifications may include academic credentials, personal résumés, registrations and licenses, and training records.

Personnel qualifications will be evaluated against assigned responsibilities, and any identified training needs will be addressed prior to inspections. Training will be based on regulatory requirements, scope of work, QA/QC requirements, appropriate health and safety plans, and applicable work instructions. Training, except for the archaeological training, will be conducted by DOE or its representative and will meet DOE instructor qualifications.

4.6.7.2 Marine

Personnel who are routinely involved in procuring the catch used in commercial fishing will be employed, with oversight and aid from trained monitoring/shipping personnel. The qualifications of personnel will be evaluated against assigned responsibilities, and any identified training needs will be addressed prior to sampling events. Training will be based on regulatory requirements, scope of work, QA/QC requirements, appropriate health and safety plans, and applicable work instructions.

4.7 Follow-Up Inspections

The need for follow-up inspections will be determined on the basis of observation and scientific data and recommendations of DOE personnel with expertise in the appropriate areas.

4.7.1 Criteria for Follow-Up Inspections

4.7.1.1 Surface

DOE may conduct follow-up inspections if the following occurs:

- A condition is identified during the routine site inspection, or other site visit, that requires personnel with specific expertise to return to the site to evaluate the condition; or
- A citizen, employee, or federal, state, or local agency notifies DOE that conditions at the site are substantially changed.

Once a condition or concern is identified at the site, DOE will evaluate the information and decide how to respond with an appropriate action.

Specific conditions that may necessitate a follow-up inspection include unauthorized intrusion, violation of institutional controls, vandalism, or the need to revisit the site to evaluate, define, or conduct maintenance tasks.

In the event of an incident or activity that threatens or compromises institutional controls or poses a risk of exposure to or release of known contaminants, DOE may, as appropriate, notify USFWS and ADEC, begin the DOE occurrence notification process (DOE Order 232.1), respond with an immediate follow-up inspection, and begin emergency measures to contain or prevent dispersion of constituents. At any time, DOE may request the assistance of local authorities to confirm the seriousness of a condition at the site before scheduling a follow-up inspection or initiating other action.

The public may use the 24-hour numbers monitored at the DOE office in Grand Junction, Colorado (970-248-6070 or 877-695-5322), to request information about the site or to notify DOE of site concerns.

4.7.1.2 Tectonic Events

Significant tectonic activity on the island of Amchitka will be investigated. Tectonic activity is considered an earthquake of magnitude 6.7 or greater or volcanic activity. The occurrence of an earthquake cannot be used alone as an indicator of the need for a follow-up inspection. Appendix B details earthquake events with magnitudes greater than 6.0 and 6.7 within the Rat Island Quadrangle. Between 1940 and 2005, there have been 106 earthquakes of magnitudes greater than 5.0, averaging 1.6 events per year. Volcanic activity on a nearby island will also not trigger an automatic response. Should a significant tectonic activity raise concerns, DOE will consult with ADEC regarding appropriate actions.

4.8 Quality Assurance/Quality Control

DQOs for the Amchitka LTS&M Plan are geared toward providing data that will alert DOE to any change in the radionuclide content in the food chain. These DQOs are site specific and deal with the biota selected, the radionuclides selected, and the laboratory analytical methods.

4.8.1 Data Quality Objectives

Appendix I contains the DQOs developed for the site along with development documentation and justification for the sampling parameters.

4.8.2 Compliance with the *Quality Assurance Manual*

The *Quality Assurance Manual* (LMS/POL/S04320) implements the requirements and philosophy of DOE Order 414.1C, *Quality Assurance*. This manual also includes the requirements of other standards that are regularly imposed by DOE, other DOE orders, or regulators. Subpart A of 10 CFR 830, "Quality Assurance Requirements"; ANSI/ASQ E4–2004, *Quality Systems for Environmental Data and Technology Programs: Requirements with Guidance for Use*; ISO 9001-2000, *Quality Management Systems Requirements;* and ISO 14001-2004, *Environmental Management Systems*, have been included. All these standards are similar in content.

The intent of the *Quality Assurance Manual* is to provide a QA management system that incorporates the requirements and philosophy of DOE.

4.9 Health and Safety

Health and safety requirements and procedures for DOE activities are consistent with DOE orders, federal regulations, and applicable codes and standards. The DOE Worker Safety and Health Program serves as the basis for the contractor's health and safety program. Specific guidance is provided in the *U.S. Department of Energy Office of Legacy Management Project Safety Plan* (DOE 2006a). This project safety plan identifies specific hazards associated with the anticipated scope of work and provides direction for the control of these hazards. During the pre-inspection briefing, personnel are required to review the plan to ensure that they have an understanding of the potential hazards and the health and safety requirements associated with the work to be performed.

4.10 Site Maintenance

Signage—During routine site inspection, DOE will inspect signs and evaluate the need for replacement or repair.

Surface Ground Zero Marker—During routine site inspection, DOE will inspect the SGZ markers.

Engineered Caps—During routine site inspection, DOE will inspect the engineered caps as detailed in the *Post-Closure Monitoring and Inspection Plan for Amchitka Island Mud Pit Release Sites* (DOE 2005b).

4.11 Institutional and Physical Controls

Institutional controls serve to inform visitors of previous activities on the island and to prevent penetration of the nuclear test cavities and caps covering the mud pits at the sites. In the past, DOE has relied on the remoteness of the island for a measure of protection, but with the increase in commercial fishing activity in the area, additional controls are required. DOE will establish a combination of institutional, engineered, and physical controls, including notifications, engineered barriers, and administrative mechanisms, to help ensure that previous remedial actions remain protective.

Amchitka Island needs enforceable controls to ensure continued safety and security. DOE will rely on USFWS for primary oversight, since USFWS is the land manager. USFWS oversight will not lessen DOE's responsibility for its Amchitka test sites. DOE will work in federal partnership with USFWS for the safety and security at the test sites.

DOE sees no need to restrict access to the island or to the areas under its purview. There is no likely scenario in which subsistence or commercial fishermen accessing the island would be of concern. Activities at Constantine Harbor dock are well away from DOE locations. DOE will provide information to USFWS detailing each DOE location requiring restrictions. Appendix H contains a map and a list of coordinates for each location that requires protection from surface disturbance and ground penetration.

There is no need for DOE to be notified of all activities on the island, but any actions that require land surface penetration anywhere on the island would be of interest to DOE. Although DOE has no objection to use of the island for research and other purposes, caution requires that DOE review any request for surface disturbance to ensure that the proposed action is well away from sensitive test areas. DOE will revise the MOU with USFWS to include review of any actions regarding excavation, heavy equipment use, or construction of buildings and structures. To provide additional notification at each test location, a monument stating the restriction is placed directly over the test cavity.

DOE requires specific restrictions for the mud pits, drilling locations, and test sites. In the revised MOU with USFWS, DOE wants to ensure that no activity is allowed in certain areas. DOE has controls in the form of engineered caps for the mud pits. The asphalt tanks were buried in place according to ADEC regulations. The mud pits and drilling locations are included in the restricted areas to ensure that they are protected from surface disturbance and penetration by users of the island. The subsurface test cavities present the most significant contamination deep under the island that must be protected from accidental or intentional penetration.

DOE wants to update the MOU with USFWS to include the restricted areas and to require notification of proposed activities. The revised agreement should detail each agency's responsibilities with regard to maintaining and enforcing the institutional controls. If Native land claims are settled, USFWS will notify DOE of parcels to be placed into Native custody; if necessary, DOE can develop legal language to be added to the deeds that protect DOE locations on Amchitka Island.

4.12 Periodic Remedy Review

It is currently assumed that inspections will continue until the 100-year time frame typical of this type of monitoring has been reached. Every 5 years DOE will conduct a review of the selected remedies to determine if they are still the appropriate solutions for the Amchitka Site. Remedy performance and monitoring requirements will be reviewed. Any needed changes can be incorporated into a revision of this plan. Changes will be made to this LTS&M Plan in consultation with ADEC, APIA, and USFWS.

4.13 Event Response

If a recognized standard for ingestion is exceeded, DOE will consult with ADEC, APIA, and USFWS about appropriate action. The action could be a public warning about affected biota or temporary catch restrictions or some other effective action.

As stated previously in Section 4.7.1.2, should a significant tectonic activity raise concerns, DOE will consult with ADEC regarding appropriate actions.

4.14 Public Participation Plan

Promoting public involvement in the surveillance and maintenance process at the Amchitka Site ensures that citizens' concerns are addressed and that relevant public information is provided. Active citizen involvement also promotes understanding of, and encourages informed participation in, the project by the general public. DOE encourages public participation by providing site information to stakeholders via LM's Internet website, providing documents to the public, and conducting public meetings for residents of the region.

4.14.1 Meetings

4.14.1.1 Briefings for Tribal, State, and Local Officials

DOE will continue to hold briefings with APIA, which represents regional tribes, and with state and local officials, as needed, to discuss new data trends or DOE activities.

4.14.1.2 Meetings with Regional Tribes and Citizen Groups

DOE will hold public meetings with regional stakeholder groups to address community concerns or issues as needed.

4.14.1.3 Public Meetings

DOE will hold additional public meetings as needed.

4.14.2 Information Repository

To facilitate public understanding of DOE's activities, DOE will continue to maintain an information repository at the APIA office in Anchorage, Alaska. Copies of key documents are kept in the information repository and at the DOE office in Grand Junction, Colorado. The information repository addresses are:

Aleutian Pribilof Islands Association, Inc.
131 East International Airport Rd.
Anchorage, Alaska 99518
Phone: (907) 276-2700
Fax: (907) 279-4351
E-mail: apiai@apiai.org

U.S. Department of Energy Office of Legacy Management
2597 B¾ Road
Grand Junction, CO 81503
Phone: (970) 248-6000
Fax: (970) 248-6040
E-mail: lm.records@gjo.doe.gov

4.14.3 Website

DOE will maintain a webpage for the Amchitka Site. Key documents will be available online. The LM website address is http://www.lm.doe.gov/.

4.14.4 News Releases and Editorials

DOE will issue news releases and community advisories to announce public meetings regarding LM documents or activities as required.

4.14.5 Information Contacts

The purpose of the contact effort is to ensure that public and key community leaders, including federal, state, tribal, and local government officials, are kept informed of site activities and status changes. Contact information is maintained for the following:

- Aleutian Pribilof Islands Association.
- Federal, state, and local elected officials.
- Alaska Department of Environmental Conservation.
- U.S. Fish and Wildlife Service.
- Interest groups and interested citizens.

The key information contacts are listed in Appendix L.

4.15 Records and Data Management

Site surveillance and maintenance records are maintained at the DOE Legacy Management office in Grand Junction, Colorado. These records have been selected because they contain critical information needed to ensure the continued management and the follow-on actions and controls (including property management) required to protect public health and the environment and to demonstrate compliance with applicable legal requirements.

Classified data will remain at the Nevada DOE office, but LM will have access to the data should it be required.

This surveillance and maintenance record collection does not include information pertaining to employee or public health and safety issues with respect to former site operations. Records and data management procedures will be reviewed and revised on a regular basis to ensure that current procedures and technologies are employed.

The DOE National Nuclear Security Administration will be responsible for records pertaining to former employees or health and safety issues associated with former site operations. DOE will maintain Amchitka Site records in full compliance with all federal records management requirements, including:

- 36 CFR Parts 1220–1238, "National Archives and Records Administration."
- 44 U.S.C. Chapter 29, "Records Management by the Archivist of the United States and by the Administrator of General Services," Chapter 31, "Records Management by Federal Agencies," and Chapter 33, "Disposal of Records."

4.15.1 Access and Retrieval

In accordance with the provisions of the Freedom of Information Act, records retained by DOE for the Amchitka Site activities are available to stakeholders. A limited number of key documents will be made available electronically on the LM Internet website. In addition, DOE will place copies of selected site documents at local and regional Alaska libraries, including the APIA regional library.

4.15.2 Pre-Surveillance and Maintenance Record Collection

The National Archives and Records Administration Regional Records Center in Denver, Colorado, is the designated facility for archived Amchitka Site records. DOE will retain custody of the records sent to that facility and will be responsible for their destruction when the records are no longer needed. All records with permanent value will be transferred to and will be the responsibility of the National Archives and Records Administration, Rocky Mountain Region, in Denver. DOE has established records disposition schedules that provide the authority for the transfer or disposal of records.

4.15.3 Site Drawings, Maps, and Photographs

Amchitka Site conditions were documented with as-built drawings and maps. Aerial photographs of Amchitka were taken periodically. These drawings, maps, and photographs will be maintained in the permanent site record at the DOE office in Grand Junction, Colorado.

Map data are maintained in the GEMS database. The site map data will be used to generate maps for site inspections. New inspection maps will be prepared that show the locations of items of interest noted during previous inspections. Each site inspection map will indicate the year of the inspection and inspection purpose.

Site record drawings represent final site conditions and site features. These drawings will be managed in the permanent Amchitka Site records file.

Photographs taken during various phases of the Amchitka work will be posted on the website. These photographs provide a visual record to complement the as-built drawings and maps.

Photographs also will be taken during subsequent site inspections to document current conditions, especially new or changed conditions, at the site. Comparison of current photographs with the baseline set of photographs will be useful to document steady or changing conditions at the site over time.

4.16 Geospatial Environmental Management System (GEMS)

GEMS provides a dynamic mapping and environmental monitoring data display for the DOE sites. Stakeholders can use GEMS to view a map of the site, photographs, and monitoring data. Some Amchitka data are currently in the database and online; validation of the remaining data is in process. To access this data, go to the LM home page at http://www.lm.doe.gov/ and click on the Legacy Management map. Amchitka is located on the Alaska map. Once the information is input, click on Alaska to bring up the sites in the Alaska page. Select the GEMS button and follow the instructions.

4.17 Budget and Funding

At federal facilities such as the Amchitka Site, the authority to ensure long-term implementation of programs to protect human health and the environment originates in the U.S. Congress and is delegated to an appropriate federal agency, in this case DOE.

DOE recognizes the significance of maintaining adequate funding levels for long-term surveillance and maintenance. Funding is also a major concern of the stakeholders. DOE will request adequate funds to implement this LTS&M Plan through the annual appropriation process.

5.0 References

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50 CFR 36.39 Subpart F. U.S. Department of the Interior, U.S. Fish and Wildlife Service, Alaska National Wildlife Refuges, "Refuge Specific Regulations," *Code of Federal Regulations*, October 1, 2007.

16 U.S.C. 470. *United States Code,* Title 16, Chapter 1A, Subchapter II, Section 470, "National Historic Preservation Act."

16 U.S.C. 1531 et seq. *United States Code,* Title 16, Chapter 35, "Endangered Species," Sections 1531 et seq.

42 U.S.C. 2011. *United States Code,* Title 42, Chapter 23, Division A, Subchapter I, Part 2011, "Atomic Energy Act of 1954."

44 U.S.C. 29. *United States Code*, Title 44, Chapter 29, "Records Management by the Archivist of the United States and by the Administrator of General Services."

44 U.S.C. 31. *United States Code,* Title 44, Chapter 31, "Records Management by Federal Agencies."

44 U.S.C. 33. *United States Code*, Title 44, Chapter 33, "Disposal of Records."

18 AAC 75.325. *Alaska Administrative Code,* Title 18, Chapter 75, Section 325, "Site Cleanup Rules: Purpose, Applicability, and General Provisions."

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