Missile Defense Agency
Mobile Sensors

Environmental Assessment

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Department of Defense
Missile Defense Agency
7100 Defense Pentagon
Washington, DC 20301-7100

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EXECUTIVE SUMMARY

ES.1 Introduction

The Missile Defense Agency (MDA) prepared this Environmental Assessment (EA) to evaluate the potential environmental impacts of the use of mobile sensors (i.e., radar, telemetry, command and control, and optical systems) from land-based platforms and the use of airborne sensor systems. The use of mobile sensors from sea-based platforms was analyzed in the *Mobile Launch Platform Environmental Assessment* (Missile Defense Agency [MDA], 2004). This EA considers impacts associated with the proposed use of land-based mobile sensors and airborne sensor systems on targets of opportunity. Where appropriate this EA also considers environmental impacts from specific tests identified by the MDA that are proposed to use land-based mobile sensors and airborne sensor systems. Finally, the EA addresses cumulative impacts associated with test events using mobile sensors from land-based platforms and airborne sensor systems.

ES.2 Purpose and Need for Proposed Action

The purpose of the proposed action is to provide increasingly robust and comprehensive realistic test surveillance and tracking data capabilities in support of the MDA's mission to implement an integrated and effective Ballistic Missile Defense System (BMDS). As BMDS capabilities advance, testing events becomes increasingly complex. Sensors are needed at additional locations to capture data from these events. Mobile land- and air-based sensors provide a more versatile and cost effective method for meeting this requirement than construction of fixed assets at required locations. The proposed action requires the transport, set-up, and operation of mobile land-based sensors (i.e., radar, telemetry, command and control, and optical systems) from land-based platforms and set-up and operation of airborne sensor systems.

The MDA needs to collect test surveillance and tracking data (e.g., trajectory, velocity, acceleration, and dispersion) by using a variety of mobile land-based and airborne sensors at various test support positions. The use of the mobile land-based and airborne sensors are needed to provide timely support and observe test launches and intercepts, and to provide surveillance and tracking support during test events to maximize the useful information gained from increasingly complex test events associated with the development of the BMDS.

ES.3 Proposed Action

The MDA proposes to use land-based mobile sensors (i.e., radar, telemetry and communication, command and control, and optical systems) and airborne sensor systems (i.e., optical and infrared systems). A test event may use any combination of mobile land-based and one of the airborne mobile sensors (i.e., HALO-I, HALO-II, or WASP). The land-based mobile sensors would be transportable systems that could operate as autonomous systems or as part of an integrated sensor system. Airborne systems also could operate as autonomous systems, but typically would be part of an integrated sensor system.

Exhibit ES-1 shows the range of land-based mobile sensors considered as part of the proposed action.

Exhibit ES-1. Land-Based Mobile Sensors

Type of Sensor	Specific Sensor Name
Radar	Transportable System X-Band Radar (TPS-X)
	Forward-Based X-Band Radar (FBX-T)
	MK-74 Target Tracking Illuminating System Radar (MK-74)
	MPS-36 Radar
Telemetry	Transportable Telemetry System (TTS)
	Mobile Range Safety System (MRSS)
	Range Safety Telemetry System (RSTS)
Command and Control	Transportable Range Augmentation Control System (TRACS)
Optical Systems	Stabilized High-Accuracy Optical Tracking System (SHOTS)
	Innovative Science and Technology Experimentation Facility (ISTEF)

There are three types of activities associated with using these land-based mobile sensors, pre-operational, operational, and post-operational activities. Pre-operational activities include transporting the sensor, site preparation activities, and checking out sensors; operational activities include activating the sensor; and post-operational activities include disassembling the sensor and transporting the sensor back to the storage or bed down location.

Land-based mobile sensors could be sited at the following locations.

- Vandenberg Air Force Base (AFB), California
- Naval Base Ventura County Port Hueneme/San Nicolas Island/Point Mugu, California
- Pacific Missile Range Facility (PMRF), Hawaii
- Niihau, Hawaii
- U.S. Army Kwajalein Atoll (USAKA)/Ronald Reagan Ballistic Missile Defense Test Site (RTS), Republic of the Marshall Islands (RMI)
- Midway Island
- Wake Island
- White Sands Missile Range (WSMR), New Mexico
- Eareckson Air Force Station (AFS), Alaska

- King Salmon Air Station (AS), Alaska
- Kodiak Launch Complex (KLC), Alaska
- Merle K. (Mudhole) Smith Airport, Cordova, Alaska
- Naval Air Station (NAS) Whidbey Island (NASWI), Washington
- National Aeronautics and Space Administration (NASA) Wallops Island, Virginia

The proposed airborne sensor systems, the High Altitude Observatory-I (HALO-I) and HALO-II, and the Widebody Airborne Sensor Platform (WASP), would be housed in a modified Gulfstream IIB aircraft and a modified DC-10 aircraft, respectively. The airborne sensor systems that would be housed in the HALO-I, HALO-II, or WASP are capable of data collection in the visible through long wavelength infrared (LWIR) spectral regions. The majority of the sensors on the HALO-I, HALO-II, and WASP would be passive sensors that collect and record data via the emissions (visible light and infrared) of the target object. The only active sensor would include solid-state 1.5 μm eye safe laser radar.

Activities associated with airborne sensor systems include flying airborne sensor systems to test support locations; setting up, checking out and performing maintenance on aircraft and airborne sensor systems at the staging and bed down locations; calibration of sensors; activation of sensors; flying airborne sensor systems from staging locations and test support locations back to bed down locations; ensuring safety of personnel operating the sensors; and waste disposal. Operations for airborne sensor systems would include activities at the bed down, staging, and test locations.

Airborne sensors could use the following locations.

Bed Down Locations

- Jones Riverside Airport in Tulsa, Oklahoma
- Majors Army Air Field in Greenville, Texas
- Edwards AFB, California
- Kirtland AFB, New Mexico

Staging Locations

Adak, Alaska	Majuro Island, RMI
Anchorage International Airport, Alaska	McCarran International Airport, Nevada
Anderson AB, Guam	McChord AFB, Washington
Andrews AFB, Maryland	Melbourne International Airport, Florida
Edwards AFB, California	Midway Island
Eglin AFB, Florida	Monterey Airport, California
Elmendorf AFB, Alaska	Nellis AFB, Nevada
MacDill AFB, Florida	Palm Beach International Airport, Florida

Majors Army Air Field, Greenville, Texas	Palm Springs International Airport, California
Harlingen Airport, Texas	PMRF, Hawaii
Hickam AFB, Hawaii	Patrick AFB, Florida
Holloman AFB, NM	Point Mugu, California
Huntsville International Airport, Alabama	Jones Riverside Airport, Oklahoma
Johnston Atoll	San Jose International Airport, California
Kodiak Airport, Alaska	Sea-Tac International Airport, Washington
Lihue International Airport, Hawaii	Travis AFB, California
Kaneohe Bay Marine Corp Air Station, Hawaii	Tulsa International Airport, Oklahoma
Keesler AFB, Mississippi	Tyndall AFB, Florida
Key West NAS, Florida	USAKA/RTS, RMI
Kirtland AFB, New Mexico	Wallops Island (NASA), Virginia
Kodiak Airport, Alaska	Wake Island

Test Locations

- Airspace over Broad Ocean Area
- Airspace over land portion of ranges
    - WSMR, New Mexico
    - Holloman AFB, New Mexico
- Airspace over ocean portion of ranges
    - Eastern Test Range, Patrick AFB, Florida
    - San Nicolas Island, California
    - PMRF, Hawaii
    - Western Range, Vandenberg AFB, California
    - USAKA/ RTS

ES.4 Specific Test Events

Specific land-based mobile sensor and airborne sensor system activities and scenarios have been proposed and are described in Sections 2.1.2 and 2.1.4. Proposed future tests that involve the specific land-based mobile sensors and airborne sensors presented in this EA may rely on the analysis in this document, as appropriate. A range of scenarios for use of mobile sensors from land-based platforms and airborne sensor systems are considered and analyzed in this EA to ensure that reasonably foreseeable activities were analyzed; however, specific future activities not analyzed in this EA would need to be evaluated in subsequent NEPA analyses, as appropriate.

In addition, this EA reviews the development of a temporary off-axis mobile land-based sensor site near Cordova, Alaska.

ES.5 Alternatives

Three alternatives to the proposed action, including the no action alternative, were identified and considered in this EA. These alternatives include:

Alternative 1 – use of land-based mobile sensors but not airborne sensor systems;

Alternative 2 – use of airborne sensor systems but not land-based mobile sensors; and

No Action Alternative - In the no action alternative, MDA would not transport or use mobile land-based sensors or airborne sensors to support MDA test events or to track targets of opportunity to test and calibrate the mobile land-based and airborne sensors. The sensors used for the test events would be the existing fixed land-based sensors as well as any sea-based sensor assets. For the purpose of this EA, MDA assumed that no mobile land-based or airborne sensors would be used during MDA testing events.

ES.6 Alternatives Considered but Not Carried Forward

Under Alternative 1 for mobile land-based sensors, MDA considered other potential test support locations including: Cape Canaveral AFS, Florida; Patrick AFB, Florida; Eglin AFB, Florida; Argentia, Newfoundland; Antigua; and Ascension Island. However, the use of these locations as test support locations for mobile land-based sensors is not reasonably foreseeable and therefore was not analyzed as part of Alternative 1 in this document. If in the future these locations become designated as potential sensor sites for mobile land-based sensors, additional environmental analyses would be prepared as appropriate.

ES.7 Methodology

Thirteen resource areas were considered to provide a context for understanding the potential effects of the proposed action and the severity of potential impacts. The resource areas considered include: air quality, airspace, biological resources, cultural resources, geology and soils, hazardous materials and hazardous waste, health and safety, land use, noise, socioeconomics and environmental justice, transportation and infrastructure, visual resources, and water resources. These areas represent the resources that the proposed mobile sensors may impact.

When appropriate to adequately characterize the potential impacts (i.e., when a resource may be impacted), MDA included site-specific information on the specific locations where proposed activities are reasonably foreseeable.

ES.8 Summary of Environmental Impacts

This section summarizes the conclusions of the analyses based on the application of the described methodology.

Under the proposed action MDA would use both mobile land-based and airborne sensors. Exhibit ES-2 shows the locations considered in the EA under all of the alternatives. There are only eight areas that would use both land-based and airborne mobile sensors.

- Kodiak Airport and KLC, Alaska
- Naval Base Ventura County Port Hueneme/San Nicolas Island/Point Mugu, California
- PMRF, Hawaii
- NASA Wallops Island, Viginia
- USAKA/RTS, Majuro Island, RMI
- Midway Island
- Wake Island
- WSMR

The impacts from the combined use of both types of sensors are presented in the summary of the proposed action. The impacts from using only land-based mobile sensors is presented under Alternative 1 and the impacts from using only airborne sensors is presented under Alternative 2. The No Action Alternative assumes that no mobile land-based or airborne sensors would be used during MDA testing events and therefore, no locations would be impacted.

A summary of potential environmental effects of the Proposed Action, Alternative 1, Alternative 2, and the No Action Alternative is provided in Exhibit ES-3. A summary of potential environmental effects of the proposed specific test events at Cordova, Alaska is presented in Exhibit ES-4.

Exhibit ES-2. Locations Using Mobile Sensors Under Various Alternatives

Location	Proposed Action (Land-based and/or Airborne Sensors)	Alternative 1 (Land-based Sensors Only)	Alternative 2 (Airborne Sensors Only)
Airspace over Broad Ocean Area	X		X
Airspace over land portion of ranges	X		X
Airspace over ocean portion of ranges	X		X
Adak, Alaska	X		X
Anderson AB, Guam	X		X

Location	Proposed Action (Land-based and/or Airborne Sensors)	Alternative 1 (Land-based Sensors Only)	Alternative 2 (Airborne Sensors Only)
Andrews AFB, Maryland	X		X
Anchorage International Airport, Alaska	X		X
Eareckson AFS, Alaska	X	X	
Edwards AFB, California	X		X
Eglin AFB, Florida	X		X
Elmendorf AFB, Alaska	X		X
Harlingen Airport, Texas	X		X
Hickam AFB, Hawaii	X		X
Holloman AFB, New Mexico	X		X
Huntsville International Airport, Alabama	X		X
Johnston Atoll	X		X
Jones Riverside Airport, Oklahoma	X		X
Kaneohe Bay Marine Corp Air Station, Hawaii	X		X
Keesler AFB, Mississippi	X		X
Key West NAS	X		X
King Salmon AS, Alaska	X	X	
Kirtland AFB, New Mexico	X		X
Kodiak Airport and KLC, Alaska	X	X	X
Lihue International Airport, Hawaii	X		X
MacDill AFB, Florida	X		X
McChord AFB, Washington	X		X
Majors Army Air Field, Greenville, Texas	X		X
Majuro Island, RMI	X		X
McCarran International Airport, Nevada	X		X
Melbourne International Airport, Florida	X		X
Nellis AFB, Nevada	X		X
Midway Island	X	X	X
Monterey Airport, California	X		X
Merle K. Smith Airport, Cordova, Alaska	X	X	

Location	Proposed Action (Land-based and/or Airborne Sensors)	Alternative 1 (Land-based Sensors Only)	Alternative 2 (Airborne Sensors Only)
NASA Wallops Island, Virginia	X	X	X
NASWI, Washington	X	X	
Naval Base Ventura County Port Hueneme/San Nicolas Island/Point Mugu, California	X	X	X
Niihau, Hawaii	X	X	
Patrick AFB, Florida	X		X
Palm Beach International Airport, Florida	X		X
Palm Springs International Airport, California	X		X
Riverside Jones International Airport, Oklahoma	X		X
PMRF, Hawaii	X	X	X
San Jose International Airport, California	X		X
Sea-Tac International Airport, Washington	X		X
Travis AFB, California	X		X
Tyndall AFB, Florida	X		X
Tulsa International Airport, Oklahoma	X		X
USAKA/RTS, RMI	X	X	X
Vandenberg AFB, California	X	X	
Wake Island	X	X	X
WSMR, New Mexico	X	X	X

Note: Bold indicates locations where both land-based and airborne sensors would be used.

Exhibit ES-3. Summary of Environmental Impacts from the Proposed Action and Alternatives

Resource Area	Proposed Action	Alternative 1	Alternative 2	No Action Alternative
Air Quality	**Land-based:** Land-based mobile sensors would produce impacts to air quality primarily from the transportation of the systems and the use of generators to power the sensors. In addition, the MDA or test proponent would be required to obtain necessary permits and complete toxicological risk screening before using generators to support tests. **Airborne:** Airborne sensors would produce impacts on air quality primarily from the emissions from the DC-10 and Gulfstream IIB aircraft. **Combined:** Using land-based and airborne mobile sensors would result in the release of volatile organic compounds (VOCs), carbon monoxide (CO), nitrogen oxides (NO_X), sulfur dioxide (SO_2), and particulate matter (PM_{10}). However, even the total emissions of VOCs and NO_X in existing maintenance areas where the sensors may be used do not exceed the *de minimis* thresholds of the regulated emissions.	Using land-based mobile sensors would not result in significant impacts on air quality because none of the ambient air quality *de minimis* regulatory thresholds would be exceeded. In addition, the MDA or test proponent would be required to obtain necessary permits and complete toxicological risk screening before using generators to support tests.	None of the ambient air quality *de minimis* regulatory thresholds would be exceeded from the operation of the DC-10 or Gulfstream IIB aircraft; therefore, ambient air quality would not be significantly impacted.	No mobile sensors would be used; therefore, the ambient air quality would not be impacted.
Airspace	**Land-based:** Appropriate notices would be published on applicable aeronautical charts identifying boundaries of the operating area that may impact aircraft operating in the airspace. Laser light would use a filter that would result in laser light that is eye-safe and would therefore, not impact pilots operating in the airspace. **Airborne:** When in transit the aircraft would operate as any other airplane in the National Airspace System. During testing they would operate at altitudes of between 20,000 and 45,000 feet and would not interfere with commercial airspace. **Combined:** All testing would be coordinated with the appropriate airspace management agency. Notices to Airmen (NOTAMs) and Mariners (NOTMARs) would be issued as appropriate to support tests. No significant impacts to airspace would be expected.	Impacts would be as described for land-based sensors under the Proposed Action. No significant impacts would be expected because appropriate notices would be published.	Impacts would be as described for airborne sensors under the Proposed Action. No significant impacts would be expected because in transit the aircraft would operate as any other airplanes and during testing they would operate at altitudes between 20,000 and 45,000 feet and would not interfere with commercial airspace.	No mobile sensors would be used; therefore, the airspace would not be impacted.
Biological Resources	**Land-based:** Removal of vegetation on previously disturbed land would not cause significant impacts. Noise from generators may startle wildlife but sites would not be adjacent to environmentally sensitive areas and therefore, would not present significant impacts. A site-specific analysis would be required for the placement of a sensor in an undisturbed area that would require grading, clearing, or other ground disturbing activities. Impacts to wildlife from artificial lighting would not be significant. Electromagnetic radiation (EMR) and radio frequency from radars may cause impacts. However, birds are not likely to remain continuously within the radar beam and the power density is not expected to exceed levels that could impact birds; therefore, the likelihood of harmful exposure is remote. **Airborne:** Infrared and optical sensors are passive systems that would not impact biological resources. A plausible airborne sensor,	Impacts would be as described for land-based sensors under the Proposed Action. No significant impacts would be expected to plants or animals as a result of the pre-operational, operational, or post-operational activities associated with land-based sensors.	Infrared and optical sensors are passive systems that would not impact biological resources. A plausible airborne sensor, the LIDAR system, emits an eye-safe laser and would not impact biological resources.	No mobile sensors would be used; therefore, biological resources would not be impacted.

Resource Area	Proposed Action	Alternative 1	Alternative 2	No Action Alternative
	the LIDAR system, emits an eye-safe laser and would not impact biological resources. **Combined:** Because airborne sensors would not impact biological resources, the impacts from the combined use of both types of mobile sensors would be insignificant as described for land-based sensors.			
Cultural Resources	**Land-based:** The site preparation activities and associated area of potential effect would occur on previously disturbed sites and would not impact cultural resources. The land-based sensor systems would not impact non-living resources such as cultural resources. A site-specific analysis would be required for the placement of a sensor in an undisturbed area that would require grading, clearing, or other ground disturbing activities. **Airborne:** Current airborne sensors are passive systems and would not remove, alter, or physically impinge on cultural resources and adverse impacts are not anticipated. A plausible airborne sensor, the LIDAR system, emits an eye-safe laser and would not impact cultural resources. **Combined:** The use of mobile sensors would not impact cultural resources on previously disturbed sites.	The site preparation activities and associated area of potential effect would occur on previously disturbed sites and would not impact cultural resources. The land-based sensor systems would not impact non-living resources such as cultural resources. A site-specific analysis would be required for the placement of a sensor in an undisturbed area that would require grading, clearing, or other ground disturbing activities.	Current airborne sensors are passive systems and would not remove, alter, or physically impinge on cultural resources and adverse impacts are not anticipated. A plausible airborne sensor, the LIDAR system, emits an eye-safe laser and would not impact cultural resources.	No mobile sensors would be used; therefore, cultural resources would not be impacted.
Geology and Soils	**Land-based:** Site preparation activities would occur on previously disturbed sites and would not result in a significant impact on geology or soils. A site-specific analysis would be required for the placement of a sensor in an undisturbed area that would require grading, clearing, or other ground disturbing activities. **Airborne:** These sensors would not impact soils or geology. **Combined:** The use of mobile sensors would not impact geology or soils on previously disturbed sites.	Site preparation activities would occur on previously disturbed sites and would not result in a significant impact on geology or soils. A site-specific analysis would be required for the placement of a sensor in an undisturbed area that would require grading, clearing, or other ground disturbing activities.	Airborne mobile sensors would not impact geology or soils.	No mobile sensors would be used; therefore, geology and soils would not be impacted.
Hazardous Materials and Hazardous Waste	**Land-based:** Use and disposal of hazardous materials and use of fuel storage tanks would be in accordance with applicable regulations; therefore, there would not be any significant impacts. **Airborne:** Use and disposal of hazardous materials would be in accordance with applicable regulations; therefore, there would not be any hazardous waste impacts. **Combined:** Because use and disposal of hazardous materials would be in accordance with applicable regulations, there would not be any hazardous waste impacts from the use of mobile sensors.	Use and disposal of hazardous materials and use of fuel storage tanks would be in accordance with applicable regulations; therefore, there would not be any significant hazardous waste impacts.	Use and disposal of hazardous materials associated with airborne mobile sensors would be in accordance with applicable regulations; therefore, there would not be any hazardous waste impacts.	No mobile sensors would be used; therefore, hazardous materials and hazardous waste would impacts would not occur.
Health and Safety	**Land-based:** EMR/electromagnetic interference surveys would be conducted before activating radar sensors. Implementing range safety procedures would preclude any potential safety hazard to the public or workforce. Optical sensors are passive systems that would not impact health and safety. LIDAR laser light emissions would use a filter which results in eye-safe light that would not impact health and safety. **Airborne:** Current airborne sensors are passive systems and would not impact human health and safety. A plausible airborne sensor, the LIDAR system, emits an eye-safe laser and would not impact	Impacts would be as described for land-based sensors under the Proposed Action. No significant impacts to health and safety would result because all applicable safety procedures regarding radars would be followed.	Current airborne sensors are passive systems and would not impact human health and safety. A plausible airborne sensor, the LIDAR system, emits an eye-safe laser and would not impact health and safety.	No mobile sensors would be used; therefore, health and safety would not be impacted.

Resource Area	Proposed Action	Alternative 1	Alternative 2	No Action Alternative
	health and safety. **Combined:** The impacts from the combined use of both types of mobile sensors would be insignificant as described for both above.			
Land Use	**Land-based:** Site preparation activities would occur on previously disturbed sites and would not result in a significant impact on land use. The operation of the land based sensors would not preclude any existing land uses; therefore, the operation would not result in a significant impact on land use. A site-specific analysis would be required to place a sensor in an undisturbed area that would require grading, clearing, or other ground disturbing activities. **Airborne:** These sensors would operate from existing airports or military bases and their use would be consistent with the existing land use; therefore, land use would not be impacted. **Combined:** Because land-based sensors would not impact land use and airborne sensors would operate from facilities where their use would be consistent with the existing land use, there would be no impacts to land use from the combined use of mobile sensors.	Site preparation activities would occur on previously disturbed sites and would not result in a significant impact on land use. The operation of the land based sensors would not preclude any existing land uses; therefore, the operation would not result in a significant impact on land use.	Airborne sensors would operate from facilities where their use would be consistent with the existing land use and therefore land use would not be impacted.	No mobile sensors would be used; therefore, land use would not be impacted.
Noise	**Land-based:** Because the location of land-based mobile sensors would be in previously disturbed areas that are not located on or adjacent to an environmentally sensitive resource, no noise sensitive receptors would be located near equipment and personnel would be required to wear appropriate hearing protection. **Airborne:** The noise produced during takeoff and landing would be consistent with noise produced at the airports where these activities occur. Under the proposed action, planes carrying the airborne sensors would climb to altitudes between 20,000 and 45,000 feet and would not be audible from the ground. Operation of the planes and use of the airborne sensors would not impact noise sensitive areas or populations. **Combined:** The use of appropriate hearing protection measures would prevent impacts to personnel from exposure to noise associated with land-based sensors. Noise associated with takeoff and landing of airplanes would take place in areas that are accustomed to this type of activity. Noise from the operations of airborne sensors would not be audible on the ground.	Impacts would be as described for land-based sensors under the Proposed Action. The use of hearing protection would prevent impacts to personnel.	Airborne sensors takeoff and land from facilities where these types of activities would be consistent with existing operations. The operations of planes and the use of airborne sensors would not be audible from the ground. Therefore, there would not be any noise impacts	No mobile sensors would be used; therefore, noise impacts would not occur.
Socioeconomics and Environmental Justice	**Land-based:** Test locations are designed to accommodate additional temporary personnel; test staff would not exceed existing infrastructure capacity. No environmental justice impacts would occur because populations that fall under the protection of environmental justice are not located on the test sites. If impacts occur outside the boundary of a test site, such areas should be reviewed for environmental justice concerns. **Airborne:** Locations used for airborne sensors have been designed to accommodate additional temporary personnel. Because these activities would occur at existing airfields or at altitudes between 20,000 and 45,000 feet, no environmental justice populations would be affected.	Impacts would be as described for land-based sensors under the Proposed Action. All test locations would be designed to accommodate temporary personnel associated with land-based sensors. No environmental justice impacts would occur because populations that fall under the protection of environmental justice are not located on the test sites. If impacts occur outside the boundary of a test site, such areas should be reviewed for environmental justice concerns.	Impacts would be as described for airborne sensors under the Proposed Action. Because test locations were designed to accommodate additional temporary personnel no socioeconomics impacts would be expected. Because activities would take place at existing locations there would be no impacts to environmental justice.	No mobile sensors would be used; therefore, socioeconomics and environmental justice would not be impacted.

Resource Area	Proposed Action	Alternative 1	Alternative 2	No Action Alternative
	Combined: The proposed action would not impact socioeconomics or environmental justice. Testing locations are designed to accommodate additional temporary personnel; test staff would not exceed existing infrastructure capacity. No environmental justice impacts would occur because populations that fall under the protection of environmental justice are not located on the test sites. If impacts occur outside the boundary of a test site, such areas should be reviewed for environmental justice concerns.			
Transportation and Infrastructure	**Land-based:** The predicted injury rate from transporting land-based mobile sensors by truck would not be significant. C-130 transport aircraft would operate as any other airplane in the National Airspace System and would not impact air transportation. **Airborne:** The relatively infrequent flights (30 total test events per year) of the Gulfstream IIB and DC-10 planes would result in a negligible increase in air traffic; therefore, transportation would not be impacted. **Combined:** The combined impacts from land-based and airborne sensors resulting from implementing the proposed action would be insignificant for the reasons described under land-based and airborne sensors above.	Impacts would be as described for land-based sensors under the Proposed Action. Insignificant impacts would result from transport of land-based mobile sensors by both road and air.	Impacts would be as described for airborne sensors under the Proposed Action. Infrequent flights related to the use of airborne sensors would not result in significant impacts to air transportation.	No mobile sensors would be used; therefore, transportation would not be impacted.
Visual Resources	**Land-based:** Temporary set up of antennas, radars, and signal collection dishes may impact the aesthetic setting. Because of the temporary nature of tests and because set up would be in previously disturbed areas, no significant impact on visual resources would be associated with the use of land-based sensors. **Airborne:** The planes carrying the airborne sensors would takeoff and land from existing facilities, which would be consistent with current visual setting at the airports where these activities occur. **Combined:** The combined impacts from land-based and airborne sensors resulting from implementing the proposed action would be insignificant for the reasons described above.	Impacts would be as described for land-based sensors under the Proposed Action. The temporary nature of the tests would cause the visual impacts to be insignificant.	Impacts would be as described for airborne sensors under the Proposed Action. The airplanes carrying airborne sensors would takeoff and land from existing facilities and would be consistent with the visual setting at the airports.	No mobile sensors would be used; therefore, visual resources would not be impacted.
Water Resources	**Land-based:** The location of land-based mobile sensors would be located in previously disturbed areas that are not located on or adjacent to an environmentally sensitive resource, which include sensitive water related resources (wetlands, floodplain). Telemetry, command and control, and optical sensors are passive systems that would not impact water resources. Radar operations would not impact non-living resources such as water resources. LIDAR emits a low power laser beam that would not impact water resources. **Airborne:** Current airborne sensors are passive systems and would not impact on water resources. A plausible airborne sensor, the LIDAR system, emits an eye-safe laser and would not impact water resources. **Combined:** The combined impacts from land-based and airborne sensors resulting from implementing the proposed action would be insignificant for the reasons described under land-based and airborne sensors above.	Land-based mobile sensors would not impact water resources.	Current airborne sensors are passive systems and would not impact on water resources. A plausible airborne sensor, the LIDAR system, emits an eye-safe laser and would not impact water resources.	No mobile sensors would be used; therefore, water resources would not be impacted.

Exhibit ES-4. Summary of Environmental Impacts from the Use of Land-Based Mobile Sensors at Cordova, Alaska

Resource Area	Proposed Action	No Action Alternative
Air Quality	The development and operation of the proposed off-axis site would result in the emissions of VOCs, CO, NO_X, PM, including diesel particulates, and SO_2 would impact the ambient air quality. However, the amount of emissions would be below regulated *de minimis* values and would not result in a significant impact on airquality.	Implementation of the no action alternative would not result in any impact on air quality.
Airspace	The development and operation of the proposed off-axis site would not impact airspace; the sensors to be used would not affect aircraft operations or communications.	Implementation of the no action alternative would not result in any impact on airspace.
Biological Resources	The development of the proposed off-axis site would result in the loss of up to 0.5 acres of pioneering and buffer vegetative habitat adjacent to the active Merle K. Smith (Cordova) Airport. Because the area is an active airport, the operation of the sensor would not result in a new impact on biological resources. The impacts on biological resources would not be significant.	Implementation of the no action alternative would not result in any impact on biological resources.
Cultural Resources	The location of the proposed off-axis site is in an area that has been previously disturbed does not contain any cultural resources that would be eligible for listing in the National Register.	Implementation of the no action alternative would not result in any impact on cultural resources.
Geology and Soils	The development of the proposed off-axis site (clearing and grading activities) would not result in significant adverse impacts on the soil or geology, as the area has been previously disturbed by past activities.	Implementation of the no action alternative would not result in any impact on geology or soils.
Hazardous Materials and Waste	All activities would adhere to appropriate and relevant regulations and would not represent a significant impact associated with hazardous materials and waste handling and disposal.	Implementation of the no action alternative would not result in any impact on hazardous materials and waste.
Health and Safety	Prior to operating any radar at the proposed off-axis site, MDA or the Alaska Aerospace Development Corporation would complete an EMR/electromagnetic interference survey that considers Hazards of Electromagnetic Radiation to Personnel (HERP), Hazards of Electromagnetic Radiation to Fuels (HERF), and Hazards of Electromagnetic Radiation to Ordnance (HERO), as appropriate. The analysis would provide recommendations for sector blanking and safety systems to minimize exposures, and would not result in a significant impact on health and safety. The use of an RSTS from the Lodge, adjacent to KLC, would not result in an adverse impact on health or safety	Implementation of the no action alternative would not result in any impact on health and safety.

Resource Area	Proposed Action	No Action Alternative
Land Use	Because the location of the proposed action would be on an area that was previously disturbed and the proposed development and operation of the site would not preclude or adversely affect any of the existing land uses, the proposed off-axis site would not impact land use. The development of the Lodge site would change the current grazing land use in 1 acre to developed land, resulting in a minor impact.	Implementation of the no action alternative would not result in any impact on land use.
Noise	The location of the proposed off-axis site is adjacent to an active runway and day-time construction would not result in a substantial new source of noise. During operation of the proposed off-axis site, the generators would be housed in a shelter and would have sound attenuating equipment (muffler) to reduce the potential noise impacts associated with night-time use. Therefore, the development and operation of the proposed off-axis site would not result in a significant impact on noise. The generators associated with the operation of the RSTS at the Lodge site would have noise attenuation equipment and would not result in a substantial change over the ambient noise levels.	Implementation of the no action alternative would not result in any impact on noise.
Socioeconomics and Environmental Justice	The development and operation of the proposed off-axis site at the Merle K. Smith Airport would not result in a significant impact on socioeconomics. The temporary influx of 35 personnel to the region would not represent a substantial change in the population or require additional infrastructure.	Implementation of the no action alternative would not result in any impact on socioeconomics or environmental justice.
Transportation and Infrastructure	The equipment associated with the proposed off-axis site in Cordova would be transported from King Salmon, Alaska via barge or aircraft and would not result in a significant impact on transportation.	Implementation of the no action alternative would not result in any impact on infrastructure or transportation.
Visual Resources	The development of the proposed off-axis site and its operation would alter the visual setting of the area. However, because the facility is an active airport and contains various towers and antennas, the placement of additional antennas and support equipment in the same location would not result in a significant impact on visual resources.	Implementation of the no action alternative would not result in any impact on visual resources.
Water Resources	The development and operation of the proposed off-axis facility would not impact water resources. The site preparation and construction activities would result in increased stormwater runoff that would enter the onsite streams, resulting in short-term impacts. The operation of the proposed off-axis site would not impact water resources. The proposed off-axis site is located in an area that has been previously disturbed and the project would not impact the hydrological properties of the wetland system or alter its current function or value.	Implementation of the no action alternative would not result in any impact on water resources.

ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
AADC	Alaska Aerospace Development Corporation
AFB	Air Force Base
AFS	Air Force Station
AS	Air Station
BACT	Best Available Control Technology
BMDS	Ballistic Missile Defense System
BOA	Broad Ocean Area
BST	Boresight Tower
CAA	Clean Air Act
CERCLA	Comprehensive Emergency Response, Cleanup and Liability Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species
CNEL	Community Noise Equivalent Level
CO	carbon monoxide
dB	Decibel
dBA	A-weighted decibel
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DoD	Department of Defense
DOT	Department of Transportation
DNL	Day/night Average Sound Level
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EIS	Environmental Impact Statement
EMF	Electromagnetic Frequency
EMR	Electromagnetic Radiation
EPA	Environmental Protection Agency
EO	Executive Order
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FBX-T	Forward Based X-Band Radar-Transportable
FEMA	Federal Emergency Management Agency
FL	Flight Level
FTS	Flight Termination System
GPS	Global Positioning System
HALO	High Altitude Observatory
HC	hydrocarbon
HERF	Hazards of Electromagnetic Radiation to Fuels
HERO	Hazards of Electromagnetic Radiation to Ordnance

HERP	Hazards of Electromagnetic Radiation to Personnel
HMCC	Hazardous Material Control Coordinator
HWM	Hazardous Waste Manager
Hz	Hertz or cycles per second
IEEE	Institute of Electronic and Electrical Engineers
IFR	Instrumented Flight Rule
IFT	Integrated Flight Test
IRPA	International Radiation Protection Association
ISTEF	Innovative Science and Technology Experimentation Facility
KLC	Kodiak Launch Complex
L_{eq}	Equivalent Noise Level
LWIR	Long Wavelength Infrared
MDA	Missile Defense Agency
MOA	Memorandum of Agreement
MPEL	Maximum Permissible Exposure Level
MSL	Mean Sea Level
MTS	Mobile Telemetry System
MRSS	Mobile Range Safety System
MWIR	Medium Wavelength Infrared
NAAQS	National Ambient Air Quality Standards
NAS	Naval Air Station
NASA	National Aeronautics and Space Administration
NASWI	Naval Air Station Whidbey Island
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOAA	National Oceanic and Atmospheric Administration
NORAD	North American Aerospace Defense Command
NOTAM	Notice to Airmen
NOTMAR	Notice to Mariners
NOTW	Navy Owned Treatment Works
NO_X	Nitrogen Oxides
NRHP	National Register of Historic Places
NWAPA	Northwest Air Pollution Authority
NWR	National Wildlife Refuge
O_3	Ozone
OSHA	Occupational Safety and Health Administration
PCBs	Polyclorinated Biphenyls
PM	particulate matter
PMRF	Pacific Missile Range Facility
RCRA	Resource Conservation and Recovery Act
RF	radiofrequency
RMI	Republic of the Marshall Islands
RSTS	Range Safety Telemetry System

RTS	Ronald Reagan Ballistic Missile Defense Test Site (Reagan Test Site)
SAP	Satellite Accumulation Point
SARA	Superfund Authorization and Amendments
SCB	Southern California Bight
SHPO	State Historic Preservations Officer
SHOTS	Stabilized High-Accuracy Optical Tracking System
SIP	State Implementation Plan
SO_2	sulfur dioxide
SWIR	Short Wavelength Infrared
THAAD	Terminal High Altitude Area Defense
TMCC	Transportable Mission Control Center
TOC	Total Organic Compounds
TRACON	Terminal Radar Approved CONtrol
TSCA	Toxic Substances Control Act
TTS	Transportable Telemetry System
TRACS	Transportable Range Augmentation Control System
TSCA	Toxic Substances Control Act
TSP	total suspended particulates
TTS	Transportable Telemetry System
UES	U.S. Army Kwajalein Atoll Environmental Standards and Procedures
UHF	Ultra High Frequency
U.S.	United States
USC	United States Code
USAKA	U.S. Army Kwajalein Atoll
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VFR	Visual Flight Rule
VHF	Very High Frequency
VOC	volatile organic compound
WASP	Widebody Airborne Sensor Platform
WDOE	Washington Department of Ecology
WSMR	White Sands Missile Range

1 PURPOSE AND NEED

1.1 Background

The National Environmental Policy Act (NEPA) of 1969, as amended; the Council on Environmental Quality (CEQ) regulations that implement NEPA (Code of Federal Regulations [CFR], Title 40, Parts 1500-1508); Department of Defense (DoD) Instruction 4715.9 *Environmental Planning and Analysis*; applicable service environmental regulations that implement these laws and regulations; and Executive Order (EO) 12114, *Environmental Effects Abroad of Major Federal Actions* direct DoD lead agency officials to consider potential environmental impacts and consequences when authorizing or approving Federal actions.

Within DoD, the Missile Defense Agency (MDA) is responsible for developing, testing, and fielding an integrated ballistic missile defense system (BMDS). The BMDS would provide a layered defense, consisting of various land-, sea-, and air-based weapon, sensor and communications, command and control platforms that would be used to defeat incoming ballistic missiles. To develop and test the components of various land-, sea- and air-based sensor platforms, MDA requires the use of the mobile sensors.

This Environmental Assessment (EA) evaluates the potential environmental impacts of the use of mobile sensors (i.e., radar, telemetry, command and control, and optical systems) from land-based platforms and the use of airborne sensor systems. The use of mobile sensors from sea-based platforms was analyzed in the *Mobile Launch Platform Environmental Assessment* (Missile Defense Agency [MDA], 2004). This EA will consider environmental impacts from specific tests identified by the MDA that are proposed to use land-based mobile sensors and airborne sensor systems. Finally, the EA will address cumulative impacts associated with test events using mobile sensors (i.e., radar, telemetry, command and control, and optical systems) from land-based platforms and airborne sensor systems. This EA is being prepared to determine whether the impacts of the proposed action are significant impacts that would require the preparation of an Environmental Impact Statement (EIS).

Specific tests have been proposed and are in various stages of planning. One specific test event using mobile land-based sensors located in Cordova, Alaska, is described in Section 2.2. Proposed future tests with potential impacts within the parameters of those discussed in this EA may rely on the analysis in this document, as appropriate.

1.2 Purpose

The purpose of the proposed action is to provide increasingly robust and comprehensive realistic test surveillance and tracking data capabilities in support of the MDA's mission to implement an integrated and effective Ballistic Missile Defense System (BMDS). As BMDS capabilities advance, testing events becomes increasingly complex. Sensors are needed at additional locations to capture data from these events. Mobile land- and air-based sensors provide a more versatile and cost effective method for meeting this requirement rather than construction of fixed assets at required locations. The proposed action requires the transport, set-up, and operation of mobile land-based sensors (i.e., radar, telemetry, command and control, and optical systems) from land-based platforms and set-up and operation of airborne sensor systems.

1.3 Need

The MDA has a requirement to develop, test, deploy, and prepare for decommissioning a BMDS to provide a defensive capability for the United States (U.S.), its deployed forces, friends, and allies against ballistic missile threats. To meet its mission, MDA needs to collect test surveillance and tracking data (e.g., trajectory, velocity, acceleration, and dispersion) by using a variety of mobile land-based and airborne sensors at various test support positions. The use of the mobile land-based and airborne sensors are needed to provide timely support and observe test launches and intercepts, and to provide surveillance and tracking support during test events to maximize the useful information gained from increasingly complex test events associated with the development of the BMDS.

1.4 Scope of Analysis

This EA considers impacts associated with the proposed use of land-based mobile sensors and airborne sensor systems on targets of opportunity; it also identifies specific activities and resources that would require analysis to support test activities carried out to develop and integrate the BMDS. Appendix A of this document summarizes the findings of previous analyses of the sensor systems at various site-specific locations considered under the proposed action and the alternatives. The description of the affected environment and the impact analysis contained in this EA focuses on the general characteristics of the specific resource and whether the specific resource would be impacted. When appropriate, i.e., when a resource may be impacted, MDA reviewed the site-specific conditions of the affected environment and completed a site-specific impact analysis. For example, air quality could be impacted by the proposed action; therefore, MDA reviewed the current attainment status of each proposed testing location and evaluated the impact of the emissions of the land-based and airborne mobile sensor on that particular site.

In addition, MDA will analyze the use of a specific suite of mobile land-based sensors at the Merle K. (Mudhole) Smith Airport near Cordova, Alaska.

1.4.1 Land-Based Sensor Systems and Activities

The proposed mobile sensors analyzed for land-based applications are identified in Exhibit 1-1.

Exhibit 1-1. Mobile Land-Based Sensors

Type	Sensor System
Radar	Transportable System X-Band Radar (TPS-X)
	Forward-Based X-Band Radar (FBX-T)
	MK-74 Target Tracking Illuminating System Radar (MK-74)
	MPS-36 Radar
Telemetry	Transportable Telemetry System (TTS)
	Mobile Range Safety System (MRSS)
	Range Safety Telemetry System (RSTS)
Command and Control	Transportable Range Augmentation Control System (TRACS)
Optical	Stabilized High-Accuracy Optical Tracking System (SHOTS)
Optical Laser	Innovative Science and Technology Experimentation Facility (ISTEF)

Activities associated with land-based mobile sensors addressed in this EA include transporting mobile sensors to the appropriate land-based locations; site preparation activities at a previously disturbed location; setting up and checking out sensors at land-based locations; calibration of sensors; activation and operation of the sensors; transporting sensors from land-based locations back to storage locations; ensuring safety of personnel operating the sensor systems; and waste disposal.

For the land-based mobile sensors, Section 3 of this EA presents the general characteristics of the affected environment by resource area, and Section 4 presents the impacts on each resource area. When appropriate, MDA reviewed the site-specific conditions and impacts (e.g., air quality) for the following locations where the proposed mobile land-based sensors would be used.

- Vandenberg Air Force Base (AFB), California
- Naval Base Ventura County Port Hueneme/San Nicolas Island/Point Mugu, California
- Pacific Missile Range Facility (PMRF), Hawaii
- Niihau, Hawaii
- U.S. Army Kwajalein Atoll (USAKA)/Ronald Reagan Ballistic Missile Defense Test Site (RTS), Republic of the Marshall Islands (RMI)
- Midway Island;
- Wake Island
- White Sands Missile Range (WSMR), New Mexico
- Eareckson Air Force Station (AFS), Alaska
- King Salmon Air Station (AS), Alaska
- Kodiak Launch Complex (KLC), Alaska

- Merle K. Smith Airport, Cordova, Alaska
- Naval Air Station Whidbey Island (NASWI), Washington
- Wallops Island, Virginia

1.4.2 Airborne Sensor Systems and Activities

The proposed airborne sensor systems include the High Altitude Observatory-I (HALO-I), HALO-II, and the Widebody Airborne Sensor Platform (WASP). Activities associated with airborne sensor systems addressed in this EA include flying airborne sensor systems to test support locations; setting up and checking out airborne sensor systems at the staging and bed down locations; calibration of sensors; activation of sensors; flying airborne sensor systems from test support locations back to bed down locations; ensuring safety of personnel operating the sensor systems; and waste disposal. Operations for airborne sensor systems would include activities at bed down, staging, and test locations.

The MDA assumed that a total of 30 tests per year would occur: 10 test events using the HALO-I, 10 test events using the HALO-II, and 10 test events using the WASP. For the airborne sensors, Section 3 presents the general characteristics of the affected environment by resource area, and Section 4 presents the impacts on each resource area. When appropriate, MDA reviewed the site-specific conditions and impacts (e.g., air quality) from the following bed down, staging and test locations where the proposed airborne sensors would be used.

Bed Down Locations

- Jones Riverside Airport in Tulsa, Oklahoma (current bed down locations for HALO- I/II)
- Majors Army Air Field in Greenville, Texas (current bed down location for WASP)
- Edwards AFB, California
- Kirtland AFB, New Mexico

Staging Locations

Adak, Alaska	Majuro Island, RMI
Anchorage International Airport, Alaska	McCarran International Airport, Nevada
Anderson AB, Guam	McChord AFB, Washington
Andrews AFB, Maryland	Melbourne International Airport, Florida
Edwards AFB, California	Midway Island
Eglin AFB, Florida	Monterey Airport, California
Elmendorf AFB, Alaska	Nellis AFB, Nevada
MacDill AFB, Florida	Palm Beach International Airport, Florida

Majors Army Air Field, Greenville, Texas	Palm Springs International Airport, California
Harlingen Airport, Texas	PMRF, Hawaii
Hickam AFB, Hawaii	Patrick AFB, Florida
Holloman AFB, NM	Point Mugu, California
Huntsville International Airport, Alabama	Jones Riverside Airport, Oklahoma
Johnston Atoll	San Jose International Airport, California
Kodiak Airport, Alaska	Sea-Tac International Airport, Washington
Lihue International Airport, Hawaii	Travis AFB, California
Kaneohe Bay Marine Corp Air Station, Hawaii	Tulsa International Airport, Oklahoma
Keesler AFB, Mississippi	Tyndall AFB, Florida
Key West NAS, Florida	USAKA/RTS, RMI
Kirtland AFB, New Mexico	Wallops Island (NASA), Virginia
Kodiak Airport, Alaska	Wake Island

Test Locations

- Airspace over Broad Ocean Area
- Airspace over land portion of ranges
  - WSMR, New Mexico
  - Holloman AFB, New Mexico
- Airspace over ocean portion of ranges
  - Eastern Test Range, Patrick AFB, Florida
  - San Nicolas Island, California
  - PMRF, Hawaii
  - Western Range, Vandenberg AFB, California
  - USAKA/RTS

1.5 Related Environmental Documentation

The CEQ NEPA implementing regulations state that agencies shall incorporate material by reference when the effect will be to cut down on bulk without impeding agency and public review of the action. The incorporated material must be cited in the statement and its content briefly described. The NEPA analyses identified below have been incorporated by reference and impact determinations have been summarized, as appropriate, in this document (see Appendix A).

- Missile Defense Agency, 2004. *Mobile Launch Platform Environmental Assessment*, June.

- Missile Defense Agency, 2003. *Airborne Laser Supplemental Environmental Impact Statement*, June.

- Naval Air Station Whidbey Island (NASWI), 2003. P-162 Consolidated Fuel Facility Environmental Assessment, January.

- Naval Surface Warfare Center (NSWC), Port Hueneme Division, 2000. Virtual Test Capability (VTC), Surface Warfare Engineering Facility (SWEF) Environmental Assessment, May.

- National Aeronautics and Space Administration, 1997. *Environmental Assessment for Range Operations Expansion at the NASA Goddard Space Flight Center, Wallops Flight Facility, Wallops Island, Virginia*.

- U.S. Army Space and Missile Defense Command, 1999. Wake Island Launch Center (WILC) Supplemental Environmental Assessment, October.

- Ballistic Missile Defense Organization, 2000. National Missile Defense (NMD) Deployment Final Environmental Impact Statement, July.

- U.S. Army Space and Missile Defense Command, 2002. *Theater High Altitude Area Defense (THAAD) Pacific Test Flights Environmental Assessment*, December.

- U.S. Army Space and Missile Defense Command, 2002. White Sands Missile Range (WSMR), New Mexico Liquid Propellant Targets (LPT) Environmental Assessment, May.

- U.S. Army Space and Missile Defense Command, 2003. *Ground-Based Midcourse Defense Extended Test Range Environmental Impact Statement*, July.

- U.S. Army Space and Missile Defense Command, 2004. Use of Tributyl Phosphate (TBP) in the Intercept Debris Measurement Program (IDMP) at White Sands Missile Range (WSMR) Environmental Assessment, April 27.

- U.S. Army Space and Strategic Defense Command, 1993. Supplemental Environmental Impact Statement, Proposed Actions at U.S. Army Kwajalein Atoll, December.

- U.S. Army Space and Strategic Defense Command, 1995. U.S. Army Kwajalein Atoll (USAKA) Temporary Extended Test Range (ETR) Environmental Assessment, October 19.

- U.S. Department of the Air Force, 1997. Program Definition and Risk Reduction (PDRR) Phase of the Airborne Laser (ABL) Program Final Environmental Impact Statement, April.

- U.S. Department of the Navy, Naval Air Warfare Center, Weapons Division, 2002. Final Environmental Impact Statement/Oversea Environmental Impact Statement, Point Mugu Sea Range, March.

- U.S. Department of the Navy, Pacific Missile Range Facility (PMRF), Barking Sands, 1998. *Pacific Missile Range Facility Enhanced Capability Final Environmental Impact Statement*, December.

2 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

2.1 Proposed Action

The MDA proposes to use land-based mobile sensors (i.e., radar, telemetry and communication, command and control, and optical systems) and airborne sensor systems (i.e., optical and infrared systems). The land-based mobile sensors would be transportable systems that could operate as autonomous systems or as part of an integrated sensor system. Airborne systems also could operate as autonomous systems, but typically would be part of an integrated sensor system. A test event may use any combination of mobile land-based and one of the airborne mobile sensor systems (i.e., HALO-I, HALO-II, or WASP).

For the purposes of this EA, MDA assumed that a land-based mobile sensor would be used up to 10 times per year at each location outlined in Section 1.4.1. MDA assumed the following conditions associated with the use of each land-based mobile sensor.

- The transportation of a sensor would be performed via tractor-trailer, a C-130 transport plane, a C-5 transport plane, or similar aircraft.
- The sensor would be set up in a previously disturbed area that is not located on or adjacent to an environmentally sensitive resource (i.e., threatened or endangered species, wetlands, cultural resource, national park, recreation area, refuge, monument, or a populated area).
- No previously undisturbed areas or environmentally sensitive resource area would be cleared of vegetation or graded to set up or operate the sensor.
- If a previously disturbed area cannot be found or is inappropriate for the needs of the sensor or test event, a site-specific analysis in accordance with NEPA would be performed, as appropriate.
- The sensor would require power from a portable generator and temporary lighting, as necessary.
- Up to 20 individuals would be required to support a test event.
- Each test event would last one week (seven days).
- The sensors and support equipment would operate for eight hours per day during the test event for a total of 56 hours per test event, or a total of 560 hours of operation at a particular location (total hours for 10 tests).
- Integration of sensors consists of the transmission or delivery of data to an integration facility. Activities occurring at integration facilities are outside the scope of the EA.

For the purposes of this EA, MDA assumed that the airborne sensors would be carried by either a HALO-I or HALO-II (i.e., a Gulfstream IIB aircraft), or a WASP (i.e., a DC-10 aircraft). MDA assumed the following conditions with the use of airborne sensors.

- The HALO-I/II and/or WASP would take off from its bed down location and travel to a staging area at or near the proposed test site.
- For the purposes of analysis, each test event would last one week (seven days), encompassing all pre-, post- and mission events including dry runs and full mission dress rehearsals. However, actual test events could last from as few as two days to as many as four weeks.
- Up to 12 individuals would be required for HALO-I and up to 7 individuals would be required for HALO-II tests to support mission activities, with up to 15 additional individuals to support all other HALO aircraft ground operations, to include data reduction. Up to 35 individuals would be required to support WASP on any given test event.
- A total of 30 test events per year would occur; 10 involving the HALO-I, 10 involving the HALO-II, and 10 involving the WASP.
- The HALO-I/II or WASP would remain airborne at an altitude of between 6,096 and 13,716 meters (20,000 to 45,000 feet) for seven hours per day during the test event.
- All fueling would be performed at a bed down or staging location.
- Any required shore power or support generators for the aircraft are considered to be part of the existing infrastructure of a bed down or staging area and were considered outside of the scope of this EA

Specific land-based mobile sensor and airborne sensor system activities have been proposed and are described in Sections 2.1.2 and 2.1.4, respectively. Proposed future tests that involve the specific land-based mobile sensors and airborne sensor systems presented in this EA may rely on the analysis in this document, as appropriate. A range of scenarios for use of mobile sensors from land-based platforms and airborne sensor systems are considered for analysis in this EA to ensure that reasonably foreseeable uses are analyzed; however, specific future activities not analyzed in this EA would need to be evaluated in subsequent NEPA analyses, as appropriate.

The following sections discuss the land-based mobile sensors and the airborne sensor systems, which are followed by a discussion of site-specific activity involving land-based mobile sensors in Cordova Alaska.

2.1.1 Land-Based Mobile Sensors

Land-based mobile sensors that would be used include radar, telemetry and dual mode telemetry systems (receive and transmit systems), command and control platforms, and optical systems that include laser systems. Radars are active sensors that emit radio frequency energy toward an object and measure the energy of radio waves reflected from the object. Most modern radars operate in a frequency range of about 300 megahertz to 30 gigahertz, which corresponds to a wavelength range of one meter to one centimeter. Radar bands are defined in Exhibit 2-1.

Exhibit 2-1. Frequency Bands for Radars

Radar Band	Lower Bound Frequency (megahertz)	Upper Bound Frequency (megahertz)
L-Band	1,000	2,000
S-Band	2,000	4,000
C-Band	4,000	8,000
X-Band	8,000	12,000
K-Band (includes Ka and Ku bands)	12,000	40,000

Telemetry systems are passive sensors that detect objects by radio frequencies. Telemetry equipment may be used in conjunction with radars giving the telemetry a vector to track a target. Dual mode systems include both passive (receivers) and active (transmitters) elements. The passive elements include telemetry sensors, while the active elements include ultra high frequency (UHF) and very high frequency (VHF) antennas. The command and control systems are passive systems that manage the data input and output from the various sensors and other tracking locations. Optical sensors operate in the visible range and are generally passive sensors that detect objects by collecting light energy or radiation emitted in wavelengths visible to the human eye. Optical infrared sensors are generally passive sensors that detect heat energy or infrared radiation from an object. Infrared electromagnetic radiation has wavelengths longer than the red end of visible light and shorter than microwaves (roughly between one and 100 microns). Finally, optical laser systems (LIDAR) are active systems that emit laser light to measure the flight characteristics of a target. Exhibit 2-2 presents a description of the frequencies associated with the mobile land-based sensors.

Exhibit 2-2. Frequency and Description of Mobile Land-based Sensors

Frequency	Ionization	Description	Mobile Sensor
Greater than 1,000 THz	Ionizing Radiation	Cosmic Rays Gamma Rays X-rays Ultra violet light	LIDAR
1,000 THz	Non-Ionizing Radiation	Visible light	LIDAR Optical Sensors
100 THz		Infrared	Airborne Sensors and LIDAR (record infrared data)
10 THz			
1 THz			None
100 GHz		Microwave Region	None

Frequency	Ionization	Description	Mobile Sensor
10 GHz		(Microwave oven 2.45 GHz) (Radars 300 MHz to 100 GHz)	TPS-X and FBX-T (8 – 12 GHz) Mk-74 (8-12 GHz) Mk-74 and MPS-36 (4 – 8 GHz)
1 GHz			TTS (receives 1 – 4 GHz signals)
100 MHz		Ultra-high Frequency (UHF) Very-high Frequency (VHF)	MRSS and RSTS
10 MHz		FM Radio CB Radio	None
1 MHz		Short-wave Radio AM Radio	None
100 KHz			None
10 KHz		Sound Wave Region (non-electromagnetic)	None
1 KHz			
100 Hz			

Notes:
Hz = Hertz = Cycles per second Tera = 10^{12} Giga = 10^{9}
Mega = 10^{6} Kilo = 10^{3}

2.1.1.1 Radar

The following radars provide the range of land-based mobile sensors addressed within the proposed action.

- TPS-X
- FBX-T
- MK-74
- MPS-36

Because the operation of the various radars involves the emission of electromagnetic frequencies, personnel, aircraft and ship hazard areas associated with each system and its specific operational characteristics would be developed. Such distances would be developed in accordance with appropriate military standards and instructions developed by the DoD, including:

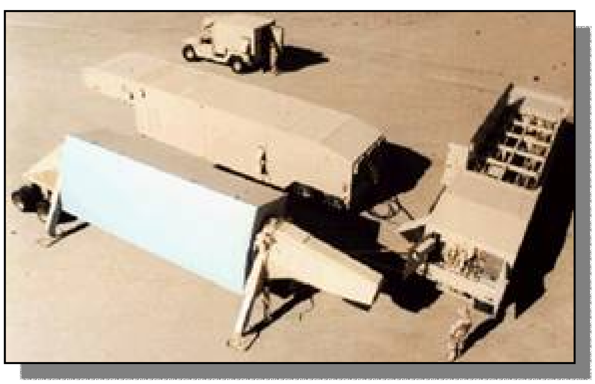
- MIL-STD-464A Ship Main Beam Electromagnetic Environment,
- MIL-STD-464A Fixed Wing Aircraft Electromagnetic Environment,
- MIL-STD-461E External/Safety Critical Aircraft Electronic Equipment Subassemblies and Equipment, and

- DoD Instruction 6055.11, "Protection of DoD Personnel from Exposure to Radiofrequency Radiation and Military Exempt Lasers."

TPS-X

The TPS-X radar is a transportable wide-band, X-band, single faced, phased array radar system of modular design (shown in Exhibit 2-3). The TPS-X is the User Operational Evaluation System Terminal High Altitude Area Defense (THAAD) radar currently being used in the test bed for the FBX-T. The radar transmits random bursts of energy to identify and track an object and does not transmit continuous radar beam or energy. In addition, its control software can be programmed to limit the three-dimensional area that the radar would survey. The radar consists of five individual units: Antenna Equipment Unit, Electronic Equipment Unit, Cooling Equipment Unit, Operator Control Unit, and a power unit. The Antenna Equipment Unit includes all transmitter and beam steering components as well as power distribution and cooling systems. The Electronic Equipment Unit houses the signal and data processing equipment, operator workstations, and communications equipment. The Cooling Equipment Unit contains the fluid-to-air heat exchangers and pumping system to cool the antenna array and power supplies. If power were not provided by a commercial line, a power unit would be used. The power unit would use a self-contained trailer with a noise-dampening shroud that contains a diesel generator, governor and associated controls, a diesel fuel tank, and air-cooled radiators. The fuel tank of the generator would be filled from a fuel truck as necessary. Each individual unit is housed on a separate trailer interconnected with power and signal cabling, as required.

Exhibit 2-3. TPS-X Radar



The TPS-X would be powered by two 750 kilowatt generators (1.5 megawatt or 1,500 kilowatt total), or via shore power from fixed power lines. Approximately 4,800 square meters (60 by 80 meters) would be required to set up the mobile TPS-X. The transportation of the TPS-X would require either five tractor-trailers, three C-5, or four C-17 aircraft.

Forward Based X-Band Radar-Transportable

The FBX-T is a relocatable, wide-band, phased array radar that operates in a portion of the X-band spectrum. The radar uses the hardware/software design of the TPS-X radar with the addition of addition of algorithms and software modules. The FBX-T uses the Antenna Equipment Unit, Electronic Equipment Unit, and Cooling Equipment Unit designed for the TPS-X.

The FBX-T would be powered by two 750 kilowatt generators (1.5 megawatt total), or via shore power from fixed power lines. Approximately 4,800 square meters (60 by 80 meters) would be required to set up the mobile FBX-T. The transportation of the FBX-T would require either five tractor-trailers, three C-5 aircraft, or four C-17 aircraft.

Mk-74

The Mk-74 radar (shown in Exhibit 2-4) is a C-band and X-band tracking radar that requires pointing data from other sensors to acquire targets at long range. The

Exhibit 2-4. Mk-74 Radar

Mk-74 was formerly a weapon system illuminator for the Standard Missile-2 in the anti-air warfare role and may now be used to support BMDS testing. The X-band continuous wave radiates with a power of 5 kilowatts. The C-band (4 to 8 gigahertz) radiates with a peak power of 165 kilowatts and an average power of 5 kilowatts. There are numerous support equipment items including an operator console, heating, ventilation, and air conditioning, cooling water, and electrical power conditioning. It would use elevations and operation times similar to the TPS-X; however, the peak power of the Mk-74 is considerably lower than the TPS-X.

The Mk-74 would be powered by a 250 kilowatt generator, or via shore power from fixed power lines. Approximately 144 square meters (12 by 12 meters) would be required to set up the mobile Mk-74. The transportation of the Mk-74 would require either three tractor-trailers or two C-130s or similar aircraft.

MPS-36

Exhibit 2-5. MPS-36 Radar

The MPS-36 radar, as shown in Exhibit 2-5, is C-band tracking radar (4,000 to 8,000 MHz) with a 1 MW peak power output. The entire MPS-36 radar system includes an operations module, a pedestal trailer for the radar, a maintenance module, and associated cables.

The MPS-36 radar would be powered by a 500 kilowatt generator or via shore power from fixed power lines. Approximately 144 square meters (12 by 12 meters) would be needed to set up the mobile MPS-36 radar system. The transportation of the MPS-36 radar system would require three tractor-trailers or two C-130 or similar aircraft.

Exhibit 2-6. Radar Boresight Tower

For each radar system, a temporary radar boresight tower (BST) would be erected to calibrate the radar system (see Exhibit 2-6). The BST is a calibration target that would be used to refine the radar's angle measurement accuracy. The system would consist of a small weatherproof environmental enclosure that houses the electronic equipment, and up to a 100-foot "crank-up" tower that holds a transponder that can send and receive signals from the radar system. The tower would be accurately surveyed and erected on compacted soil or gravel to prevent settling. The guy wire system would extend out approximately 50 feet in each direction of the BST. The system would require a 5 kilowatt generator, and would require an area of approximately 25 square meters with a clear line of sight to the radar system.

2.1.1.2 Telemetry

The following telemetry units provide the range of mobile land-based sensors addressed within the proposed action.

- TTS
- MRSS
- RSTS

The telemetry units collect and process instrumentation data, send and receive communications and track-space-positioning information (TSPI) for use by the test management command and control. Telemetry systems typically collect and process data and transmit data to other command, control, and battle management systems. Such systems include satellite communication antennas to transmit data to other sensors and tracking stations. In addition, some telemetry systems can function as a flight termination system (FTS) that transmit mission termination signals to a target or interceptor should it vary from a planned trajectory.

Transportable Telemetry System

The TTS is a long-range, high data rate telemetry collection, processing, and data transmission system. The TTS is a standalone system capable of supporting flight tests from remote areas with minimal or no test infrastructure (see Exhibit 2-7). Over-the-horizon voice and data communications would be provided through a built-in satellite communications system. Each TTS would have a satellite uplink/downlink terminal.

Exhibit 2-7. Single TTS Unit

As part of the overall system architecture, a dedicated TTS Earth station would provide connectivity between deployed TTS units and the MDA net or the Defense Research and Engineering Network. The system configuration would consist of two primary telemetry shelters, two 7-meter (23-foot) antennas, two power shelters, and a SATCOM antenna and shelter. The SATCOM antenna would transmit via C-band or Ku Band, via a highly focused beam. TTS is capable of sea-based operations, as analyzed in the Mobile Launch Platform EA. (MDA, 2004) In a secondary role, TTS would be used to augment existing range assets, either independently or in conjunction with a Range Safety System.

The TTS would be powered by two 100 kilowatt generators, or via a shore power from fixed power lines. Approximately 625 square meters (25 by 25 meters) would be required to set up the mobile TTS. The transportation of the TTS would require either four tractor-trailers or two C-130s or similar aircraft.

Mobile Range Safety System

The MRSS could be used as a standalone telemetry system or as a mobile RSTS. Exhibit 2-8 shows some of the equipment that would be typical of this system including two 1-kilowatt transmitters, two telemetry antennas, two Global Positioning System (GPS) antennas, a surveillance radar, an operational shelter measuring 2 by 6 meters (8 by 20 feet) (expandable to 6 by 7 meters [20 by 24 feet]), a communication shelter with a satellite terminal providing interactive or receive-only communication. The communications subsystem includes a Very Small Aperture Terminal capable of data transmission, one Inmarsat System for voice and data transmissions, and four VHF and UHF transceivers. The system would also have its own power generation system, an interface to existing power sources, an automatic power transfer switching system, and an uninterruptible power supply for the sub systems.

Exhibit 2-8. MRSS

The MRSS would be powered by two 100 kilowatt generators and a 50 kilowatt generator powering the communication shelter, or via a shore power from fixed power lines. Approximately 280 square meters (16 by 16 meters) would be required to set up the MRSS. The transportation of the MRSS would require either four tractor-trailers or two C-130 or similar aircraft.

Range Safety and Telemetry System

The RSTS includes two mobile systems that provide range flight safety, command destruct, and telemetry receiving support with GPS. The RSTS provides the range safety and telemetry functions necessary to track and verify a safe rocket flight within prescribed boundaries, as well as the capability to terminate an errant rocket.

Each mobile RSTS consists of a Mobile Operations Center, two high gain 5.4 meter Mobile Antenna Systems, omni-directional Command Destruct system antennas for short range, and directional antennas (integral with the 5.4 meter auto-tracking antennas) for long-range flight trajectories.

The two mobile RSTS systems can operate in conjunction with each other, or as independent unit. Under most circumstances, the one RSTS unit would be located at the launch site, and one would be located at a mission designated off-axis or down-range site. Under such a scenario, the first system would monitor the initial boost phase of flight, then hand off responsibility to the off-axis or down-range system to avoid limited communication between the rocket and RSTS unit at the launch site.

Each mobile RSTS would be powered by two 100 kilowatt generators and a 50 kilowatt generator powering the Mobile Operations Center, or via a shore power from fixed power lines. Approximately 280 square meters (16 by 16 meters) would be required to set up each RSTS. The transportation of the RSTS would require either four tractor-trailers or two C-130 or similar aircraft.

2.1.1.3 Command and Control

The follow presents a discussion on the command and control equipment associated with mobile land-based sensors.

Transportable Range Augmentation Control System

The TRACS is a mobile, self-contained mission control center designed to support mission planning, execution, real-time data collection/processing, communications, mission control, flight safety, and post-mission data analysis (see Exhibit 2-9.). The TRACS is designed to augment existing range capabilities or provide complete support at remote locations. The TRACS provides interface capabilities to connect external sensors such as GPS, radar, telemetry, communications, optics, and satellite systems typically found at existing test ranges. The TRACS may also connect to instrumentation assets drawn from "test asset pools" using versatile interfaces used by the DoD instrumentation community. The Mobile Telemetry System, a Flight Termination System Transmitter Trailer (with frequency surveillance enclosure), and

Exhibit 2-9. TRACS

power generation equipment can augment the TRACS. The exact configuration of the TRACS is subject to range support requirements.

A 100 kilowatt generator would power TRACS, or the system would be powered via shore power from fixed power lines. Approximately 60 square meters (6 by 10 meters) would be required to set up the TRACS. The transportation of the TRACS would require either one tractor-trailer or one C-130 or similar aircraft.

2.1.1.4 Optical Systems

The following optical systems provide the range of land-based mobile sensors addressed under the proposed action.

- SHOTS
- ISTEF

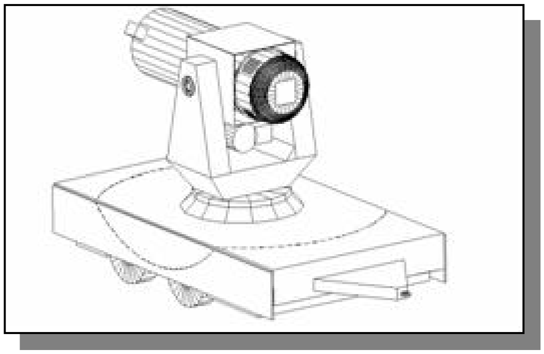
Optical systems are passive systems that record the data from the visible and infrared spectra.

Stabilized High-Accuracy Optical Tracking System

The SHOTS (shown in Exhibit 2-10) is a mobile optical unit with a primary and secondary imaging system. The primary imaging system includes a high resolution, high frame-rate, visible and infrared (mid- or long-wave) camera, and a focal length telescope measuring about 50 to 76 centimeters (20 to 30 inches) in diameter. Its secondary imaging system has wide field-of-view visible and medium wavelength infrared (MWIR) imaging system cameras for coarse acquisition. Additional camera and telescopes can be placed on the SHOTS platform.

The SHOTS would be powered by a 50 kilowatt generator, or via a shore power from fixed power lines. Approximately 24 square meters (4 by 6 meters) would be required to set up the SHOTS. The transportation of the SHOTS would require either one tractor-trailer or one C-130 or similar aircraft.

Exhibit 2-10. SHOTS



Innovative Science and Technology Experimentation Facility - Rapid Optical Beam Steering (ROBS) Mobile Optical Tracking System

The ISTEF is an electro-optical observatory engaged in both developing and demonstrating innovative scientific approaches critical to defending against theater and strategic missiles. It is owned by the Science and Technology Directorate of the Missile Defense Agency and operated by Nichols Research Corporation. The management of ISTEF is performed by the Research Development Test & Evaluation Division (NRaD of the Naval Command Control and Ocean Surveillance Center in San Diego, California). The location of the facility at Kennedy Space Center yields frequent "target" opportunities free of launch costs and also enables ISTEF to provide specific support to NASA and other government agencies, when requested. Example concepts include advanced laser radars, simultaneous active and passive imaging, and sparse coherent LIDAR receiver arrays. Researchers can obtain information on targets through high-resolution spatial/spectral passive imaging (from ultraviolet through infrared) of boosting rockets and simultaneous active signature analysis of laser illuminated hard body and plume targets.

The ISTEF system that would be used by MDA is the Rapid Optical Beam Steering (ROBS) Mobile Optical Tracking System (Exhibit 2-11). This rapid-retargeting multiple-object tracking and imaging system would simultaneously collect mid-wavelength infrared and 3-D position data on missile targets. The sensor suite would consist of: (1) a mid-infrared wide-angle camera; (2) a mid-infrared high-resolution camera; and (3) a solid-state 1.5 µm eye safe laser radar. This system would be mounted on a flatbed trailer and would require an operations support trailer and a power source.

Exhibit 2-11. ROBS Mobile

The ROBS Mobile Optical Tracking System would be powered by an 80 kilowatt generator or via a shore power from fixed power lines. Approximately 32 square meters (4 by 8 meters) would be required to set up the ROBS Mobile Optical Tracking System. The transportation of the ROBS Mobile Optical Tracking System would require either one tractor-trailer or one C-130 aircraft.

Exhibit 2-12 presents a summary of the mobile land-based sensor systems, their approximate power requirements, the transportation requirements and their associated hazard areas.

Exhibit 2-12. Mobile Land-Based Sensors

Type	Sensor System	Power Required (kilowatts)	Transport Requirements	Controlled Hazard Area (meters)	Uncontrolled Hazard Area (meters)	Airspace Hazard Area (meters)
Radar	TPS-X	1,500	Three C-5s or Four C-17s	125*	125*	514
	FBX-T	1,500	Three C-5s or Four C-17s	125*	125*	514
	MK-74	250	Two C-130s or Three Tractor Trailers	309	390	1,128
	MPS-36	500	Two C-130s or Four Tractor Trailers	234	528	114
Telemetry	TTS with CGI and/or other satellite comm.	100	Two C-130s or Four Tractor Trailers	Negligible	17	None
	MRSS	200	Two C-130s or Four Tractor Trailers	33.5	76	None
	RSTS	200	Two C-130s or Four Tractor Trailers	33.5	76	None

Type	Sensor System	Power Required (kilowatts)	Transport Requirements	Controlled Hazard Area (meters)	Uncontrolled Hazard Area (meters)	Airspace Hazard Area (meters)
Command and Control	TRACS	100	One C-130s or One Tractor Trailer	None	None	None
Optical/ LIDAR	SHOTS	50	One C-130 or One Tractor Trailer	None	None	None
	ISTEF	80	One C-130 or One Tractor Trailers	None	None	None

Notes:
* Values are for ground hazard areas, as the radar would be directed above the surface of the ground. The controlled hazard area above ground surface extends out to approximately 3,700 meters and the uncontrolled hazard area extends out to approximately 5,800 meters.
Source: SMDC, 2003; SN/Raytheon, 2005; EMC Range Support, 2005.

2.1.2 Land-Based Mobile Sensor Activities

There are three types of activities associated with using land-based mobile sensors, pre-operational, operational, and post-operational activities. Pre-operational activities include transporting the sensor, site preparation activities, and checking out sensors; operational activities include activating the sensor; and post-operational activities include disassembling the sensors and transporting the sensor back to the storage or bed down location.

The resource areas that would be affected by pre-operational, operational, and post-operational activities for land-based mobile sensors are presented in Section 3 and the impacts on such resource areas are presented in Section 4. When appropriate, MDA reviewed the site-specific conditions and impacts (e.g., air quality) from the following locations where the proposed mobile land-based sensors would be used.

- Vandenberg AFB, California
- Naval Base Ventura County Port Hueneme/San Nicolas Island/Point Mugu, California
- PMRF, Hawaii
- Niihau, Hawaii
- USAKA/RTS, RMI
- Midway Island
- Wake Island
- WSMR, New Mexico
- Eareckson AS, Alaska
- King Salmon AS, Alaska
- KLC, Alaska

- Merle K. Smith Airport, Cordova, Alaska
- NASWI, Washington
- NASA Wallops Island, Virginia

Exhibit 2-13 shows the activities associated with using land-based mobile sensors in each operational stage.

Exhibit 2-13. Activities Associated with Using Land-Based Mobile Sensors

Stage	Activity
Pre-Operational	Transportation to appropriate location
	Improving existing access roads to proposed site
	Grading of site
	Trenching to install communications and power lines
	Installing grave pad or pouring concrete pad
	Installing bore site tower (radar only)
	Establishing radio frequency keep out zones, as appropriate
	Installing chain link fencing
	Removal of vegetation in the vicinity of the sensor pad
	Calibration and integration of sensors
	Housing sensor personnel near site
Operational	Activation
	Establish and mark hazard control areas
	Operation of diesel generators and refueling of fuel tanks
	Housing sensor personnel near site
Post-Operational	Dissembling sensors
	Removal of communications and infrastructure
	Removal and/or disposal of diesel fuel, coolant, and/or wastewater
	Storing sensor on site if longer term
	Backfilling of trenches or removal of concrete or gravel pads/access roads/security fences

Note: All land-disturbing activities would proceed in accordance with the assumptions presented in Section 2.1.

Pre-Operational Activities

Pre-operational activities include transporting the sensor to the appropriate land-based location. Sensors could be transported by surface (via rail or highway) or air transport (via C-17, C-5 or C-130 aircraft). All transportation within the U.S. would be performed in accordance with appropriate Department of Transportation (DOT) approved procedures, packaging and routing, as well as appropriate Occupational Safety and Health Administration (OSHA) and DoD safety requirements. Preparation activities at the proposed sensor location, including set-up and maintenance of sensor systems would be included as part of pre-operational activities. Sites may require minor grading or site preparation, such as trenching to install power distribution systems or to install communication lines. In addition, temporary above ground storage tanks may be installed to provide fuel for the generators. All above ground storage tanks would be double-walled tanks or would have appropriate secondary containment systems that meet or exceed Federal, State, and local standards. Secondary containment systems would be constructed for sensors like the FBX-T that use liquid cooling. Other sanitation measures including water tanks would be provided as needed. A maximum 5,000 square meter (53,820 square foot) concrete, gravel or crushed coral pad would be required to support land-based mobile sensors. Any development of a pad greater than 1 acre would require a permit issued under the National Pollution Discharge Elimination System.

Operational Activities

Sensors would require high power testing on a periodic basis. This testing typically involves tracking satellites for calibration purposes. Operational activities include the use of the sensor system to support a test event and the integration of mobile sensors with the existing fixed based sensors via transmission or delivery of data to an integration facility. This EA addresses the transmission of data to an integration facility but does not address activities associated with the operation of an integration facility. All fueling operations and responses to incidental releases would be performed in accordance with site-specific standard operating procedures; should no such procedures exist for a particular site, MDA or the test proponent would prepare and issue standard operating procedures.

MDA or the test proponent would identify the controlled and uncontrolled hazard areas and such areas would be clearly marked to exclude personnel from entering such areas during operation. In addition, Notices to Airmen (NOTAMs) or Notices to Mariners (NOTMARs) would be issued, as appropriate, if such areas would extend into navigable waters or airspace.

Post-Operational Activities

Post-operational activities would include disassembling the sensor system and returning the system to its storage location. The antennas of some sensors (e.g., TTS) that would remain at one location for multiple tests would be stored in a down position between tests. All unused fuel, coolants, or lubricants would be returned to the supplier or transferred to a permanent and permitted storage facility or tank at the test site. All wastewater and solid waste would be disposed of in accordance with applicable and relevant Federal, State, and local standards.

2.1.3 Airborne Sensor Systems

Airborne sensor systems include the High Altitude Observatory (HALO-I and HALO-II) and the WASP. The majority of the sensors on the HALO and WASP airborne platforms sensors would be passive sensors that collect and record data via the emissions (visible light and infrared) of the target object. The only active sensor would include solid-state 1.5 µm eye safe laser radar (LIDAR), as described under the ISTEF land-based mobile sensor system.

Jones Riverside Airport in Tulsa, Oklahoma, is the current bed down location of the HALO-I and HALO-II aircraft and the Majors Army Air Field in Greenville, Texas, is the bed down location of the WASP aircraft. The operations at a bed down location, other than the sensor calibration activities and take-off and landing associated with the forecasted test events, are considered to be ongoing activities and are outside the scope to this EA. The following subsections discuss the HALO and WASP airborne sensor system platforms.

High Altitude Observatory

The HALO collects calibrated radiometric imagery and serves as a test bed for user programs. The HALO consists of two sensors suites, HALO-I and II, housed in modified Gulfstream IIB aircraft that would operate at altitudes up to 13,716 meters (45,000 feet). Both are capable of data collection in the visible through long wavelength infrared (LWIR) spectral regions. The HALO-I (shown in Exhibit 2-14) contains multiple user customizable sensors for collecting radiometric imagery, spectra, and signatures. It collects infrared data for high-speed visible and infrared photodocumentation. Specific user instrumentation can be added, such as the Remote Optical Characterization Sensor Suite, for lethality flight tests. HALO-I sensors have an acquisition range greater than 100 kilometers (54 nautical miles).

Exhibit 2-14. HALO-I

The HALO-II system consists of a set of five subsystems that provide integrated data collection. These include pointing, acquisition, tracking, a real-time processor, and surveillance processor subsystems. The system also includes six cameras and all necessary equipment to provide real-time and surveillance processing in the cabin. The

HALO-II system includes two sensors suites: an acquisition suite, which includes two MWIR sensors and a visible sensor, and a tracking suite, which includes one MWIR, one LWIR, and a visible sensor. The HALO-II has an acquisition range greater than 1,000 kilometers (540 nautical miles).

Widebody Airborne Sensor Platform

The WASP performs target acquisition and tracking. It provides a data collection/captive-carry airborne test bed in a modified DC-10 aircraft. The WASP consists of a Prime Sensor System truth sensor, a primary enclosure for three captive-carry sensors, and a secondary enclosure with open port or window viewing for an additional guest sensor. Based on the data requirements, the WASP can house customer-provided sensor systems. The Prime Sensor System is an extremely sensitive multiple band, high pointing accuracy system, essentially the same system used in HALO-II. It has UHF satellite communication, and the sensors have an acquisition range greater than 1,000 kilometers (540 nautical miles).

2.1.4 Airborne Sensor Systems Activities

The resource areas that would be affected by pre-operational, operational, and post-operational activities for airborne sensors are presented in Section 3 and the impacts on such resource areas are presented in Section 4. When appropriate, MDA reviewed the site-specific conditions and impacts (e.g., air quality) from the specific beddown, staging and test locations where the proposed airborne sensors would be used. The home station (bed down) location for the HALO-I and II aircraft is the Jones Riverside Airport in Tulsa, Oklahoma, while the bed down location for the WASP is the Majors Army Air Field in Greeville, Texas. Currently, the HALO-I, HALO-II, and WASP aircraft are based at those locations which house the airborne sensor systems and support equipment. The staging locations are defined as the physical locations for the aircraft and crew members, away from the home station, which would (1) be capable of providing both applicable aircraft and sensor support requirements; (2) be used to support pre-, post-, or mission flights, and (3) be used to support crew rest requirements. The test locations would be those locations where the airborne sensors would operate during a test event. For the purposes of this EA, it is assumed that no new infrastructure would be required (i.e., runways, taxiways, or hangars) and that data collection would occur in airspace that is appropriately designated to permit these types of activities.

Bed Down Locations

- Jones Riverside Airport in Tulsa, Oklahoma (current bed down site for HALO-I/II)
- Majors Army Air Field in Greenville, Texas (current bed down site for WASP)
- Edwards AFB, California
- Kirtland AFB, New Mexico

Staging Locations

Adak, Alaska	McCarran International Airport, Nevada
Anchorage International Airport, Alaska	McChord AFB, Washington
Anderson AB, Guam	Melbourne International Airport, Florida
Andrews AFB, Maryland	Midway Island
Edwards AFB, California	Monterey Airport, California
Eglin AFB, Florida	Nellis AFB, Nevada
Elmendorf AFB, Alaska	Palm Beach International Airport, Florida
Harlingen Airport, Texas	Palm Springs International Airport, California
Hickam AFB, Hawaii	PMRF, Hawaii
Holloman AFB, NM	Patrick AFB, Florida
Huntsville International Airport, Alabama	Point Mugu, California
Johnston Atoll	Jones Riverside Airport, Oklahoma
Kaneohe Bay Marine Corp Air Station, Hawaii	San Jose International Airport, California
Kodiak Launch Complex, Alaska	Sea-Tac International Airport, Washington
Keesler AFB, Mississippi	Travis AFB, California
Key West NAS, Florida	Tulsa International Airport, Oklahoma
Kirtland AFB, New Mexico	Tyndall AFB, Florida
Lihue International Airport, Hawaii	USAKA/RTS, RMI
MacDill AFB, Florida	Wallops Island (NASA), Virginia
Majors Army Air Field, Greenville, Texas	Wake Island
Majuro Island, RMI	

Test Locations

- Airspace over Broad Ocean Area
- Airspace over land portion of ranges
  - WSMR, New Mexico
  - Holloman AFB, New Mexico
- Airspace over ocean portion of ranges
  - Eastern Test Range, Patrick AFB, Florida
  - San Nicolas Island, California
  - PMRF, Hawaii
  - Western Range, Vandenberg AFB, California
  - USAKA/RTS

Exhibit 2-15 shows the activities associated with using airborne sensor systems for each operational stage.

Exhibit 2-15. Activities Associated with Using Airborne Sensor Systems

Stage	Activity
Pre-Operational	Sensors Installation
	Flight to test location
	Cool down of sensors
	Refueling
	Calibration
	Dry run with ground-based sensor tracking
Operational	Sensors cool down
	Activation
	Data link for data download
Post-Operational	Flight back to bed down location
	Refueling at staging location
	Disposal of wastes and/or coolants at bed down location

Pre-Operational Activities

Pre-operational activities include transporting the airborne sensor system from the bed down location to a staging area near the test event location. Activities associated with transportation of the airborne sensor system from the bed down location to the test event location would be the same as other aircraft activity in the area. In general, the airborne sensor system would fly to the staging area near the test event location several days prior to the test event. Sensor maintenance would typically occur at the bed down location, but could also occur at the staging location. Range integration testing and calibration would be performed at the staging location. Integration of sensors consists of the transmission or delivery of data to an integration facility. Activities occurring at integration facilities are outside the scope of this EA. The airborne sensor system may stop over at a separate staging location during transit to refuel. Other pre-mission activities include but are not limited to an Internal Readiness Test, a Target of Opportunity Flight, a Dry Run and a full mission Dress Rehearsal.

Once at the final staging area, a Large Area Tracking and Ranging C-band transponder pod could be installed. The transponder transmits a signal that would be received by land-based telemetry systems to accurately locate the three-dimensional location of the airborne platform. The airborne sensor system would conduct three to six hours of nighttime sensor calibrations. The calibration activities include observing Targets of Opportunity (other aircraft or fixed objects) to ensure that the sensors are calibrated to specific climatic conditions, recording and data transfer operations function properly, and that all mechanical parts on the sensors are functioning properly.

A dry run would be conducted where a ground-based sensor tracks the plane in-flight during the day. A full mission dress rehearsal would be conducted before the test.

Operational Activities

Operational activities include the activation of sensors on the airborne system to support a test event. On test day, the aircraft would take off and remain aloft for several hours before the sensors begin collecting data to allow the sensors and optical windows to cool down to the ambient temperature at 6,096 meters (20,000 feet) or 13,716 meters (45,000 feet) altitude. The total flight time for the airborne sensor system would be approximately seven hours.

Post-Operational Activities

Post-operational activities for airborne sensor systems would include transporting the sensor system from the final staging area back to the bed down location. The airborne platform may require a stop over at a staging location to refuel on the way back to the bed down location. Aircraft and sensor maintenance would typically occur at the bed down location but could also occur at the staging location. Other post-operational activities could include waste removal/disposal, sensor removal, and recalibration of the sensor.

2.2 Specific Test Event and Location – Cordova, Alaska

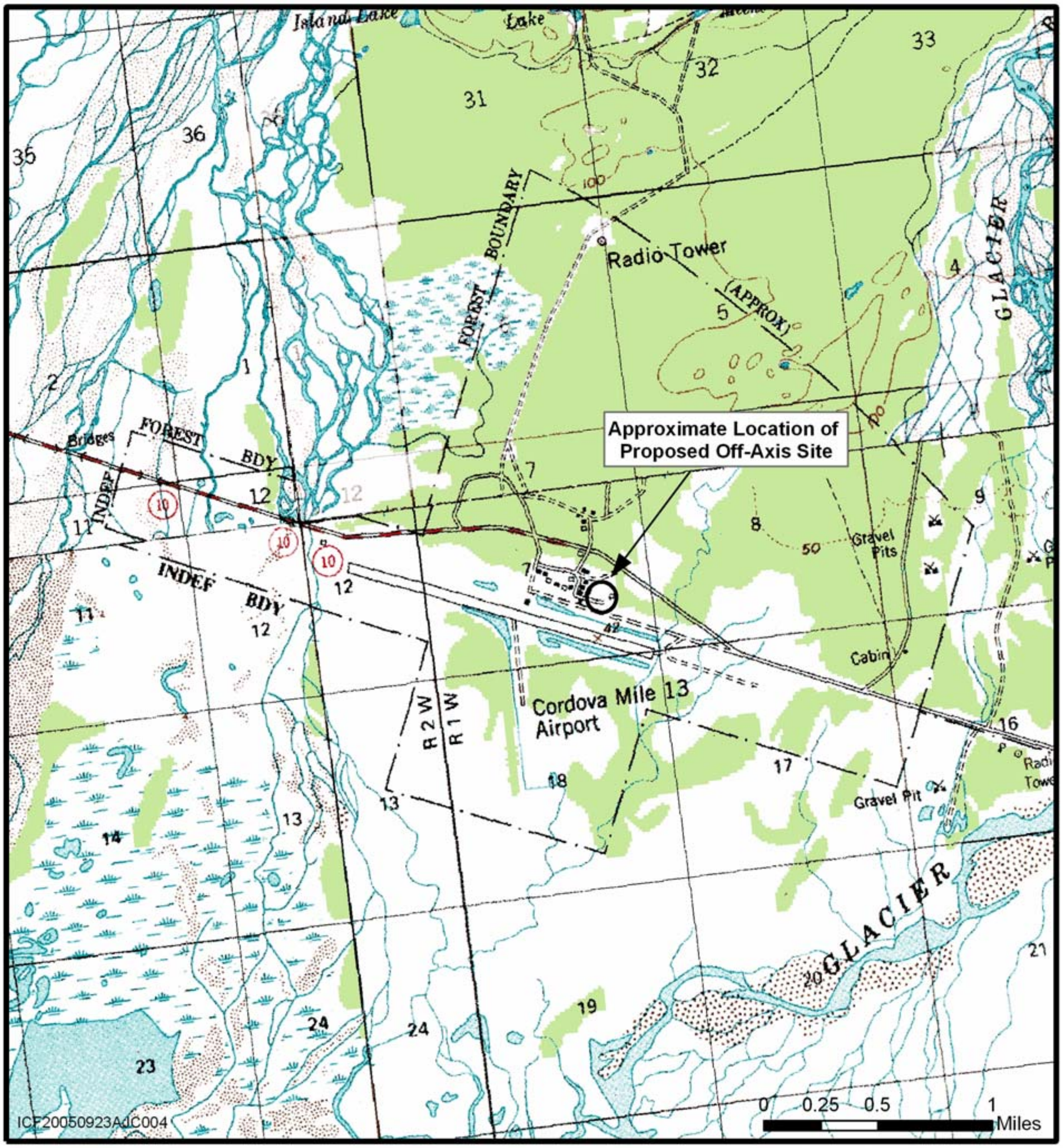
MDA has defined the Merle K. Smith Airport, Cordova, Alaska, as a location to establish an off-axis site to station mobile land-based sensors to support current and future MDA missile test events. The proposed off-axis site in Cordova would be used to station various land-based mobile sensors to record and transmit data to the missile flight safety officer's console at the Kodiak Launch Complex. Exhibit 2-16 shows the general location of the Kodiak Launch Complex and the Merle K. Smith Airport (Cordova). Exhibit 2-17 shows the location of the Kodiak Launch Complex and the proposed RSTS system at the Lodge Site. Exhibits 2-18 and 2-19 show the regional location and approximate specific location of the proposed off-axis site at the Merle K. Smith Airport, respectively.

Exhibit 2-16. General Location of Kodiak Launch Complex and the Merle K. Smith Airport

Exhibit 2-17. Location of Kodiak Launch Complex and Proposed RSTS System at the Lodge Site

Exhibit 2-18. Regional Location of Proposed Off-Axis Site at the Merle K. Smith Airport

Exhibit 2-19. Approximate Location of Proposed Off-Axis Site at the Merle K. Smith Airport



Under the proposed action, a 1.2-acre parcel of land (approximately 240 by 220 feet) at the Merle K. Smith Airport would be leased by the Alaska Aerospace Development Corporation (AADC) for up to 1 year. An off-axis site would be established on the 1.2 acre parcel to host the set up and operation of a variety of mobile land-based sensors. Currently, AADC is negotiating with the Merle K. Smith Airport to identify a suitable location at the airport for a multi-year lease for a parcel of land up to 3.5 acres for the off-axis site once the current lease expires. At this time the potential location for the multi-year off-axis site is unknown, and therefore, is not ready for analysis in this Environmental Assessment. Once a site is selected, the appropriate level of review and analysis in accordance with NEPA would be completed, as necessary.

Under the proposed action, the site would provide telemetry tracking stations with real-time data transfer to the Missile Flight Safety Officers' consoles located at the KLC and other locations. The off-axis site would be used during the powered flight portion of a target or interceptor missile. The proposed sensors that would be used at the site include the following telemetry equipment.

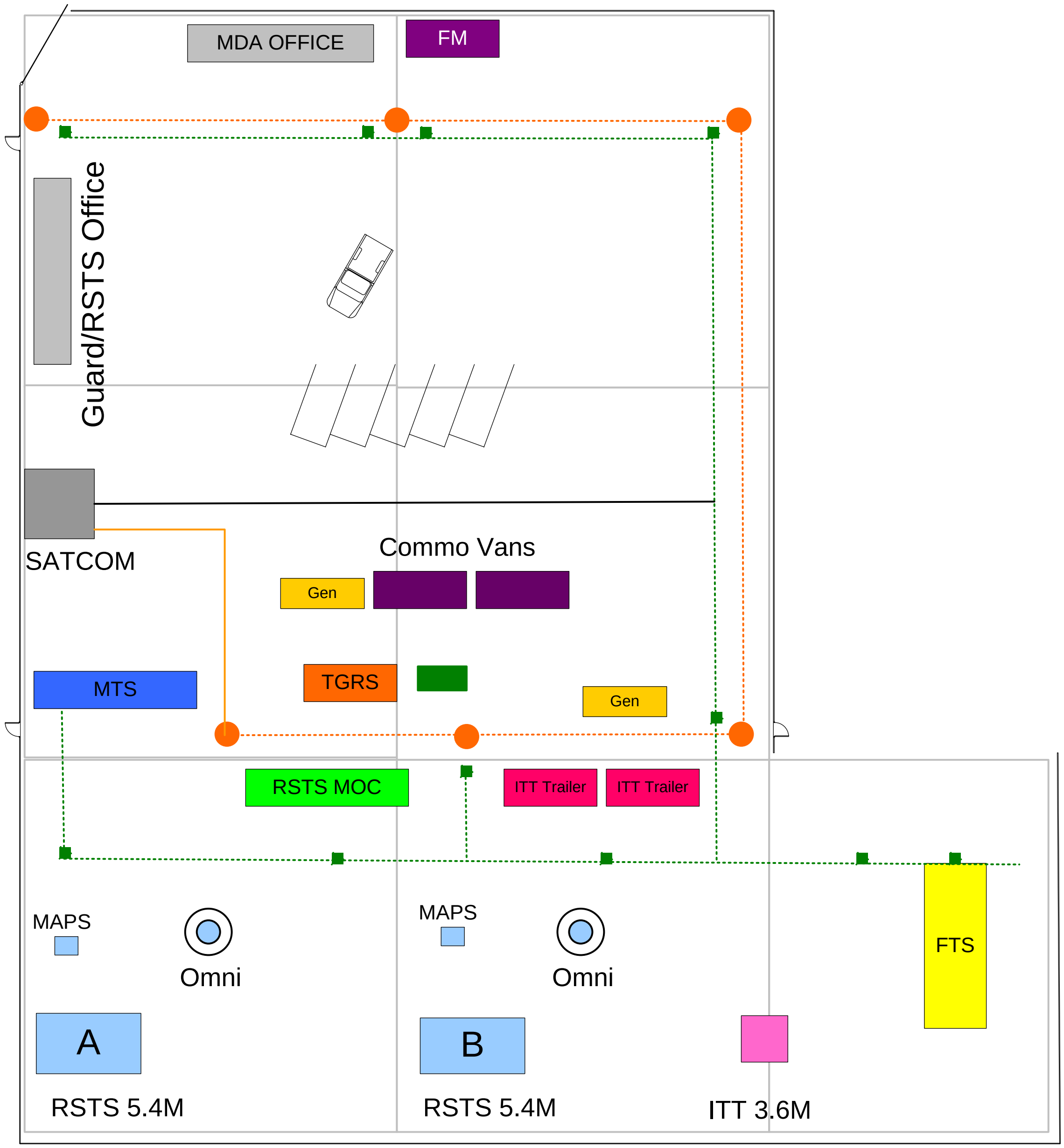
- Two RSTS Antennas (5.4 meters in diameter)
- Two UHF FTS antennas
- Two omni-directional UHF FTS antenna
- One ITT-2 antenna (3.6 meter diameter)

Other support equipment and facilities would include:

- Flight Safety control trailer,
- RSTS control trailer,
- MTS control trailer,
- Two ITT control trailers,
- FTS control trailer,
- FM-2 control trailer,
- TRACS control trailer,
- Communication vans,
- Concrete pad for satellite antenna,
- Above ground storage tanks, and
- Back-up diesel-powered generators (one 100 kilowatt and two 200 kilowatt generators).

The majority of the sensors and their associated control equipment and administrative support facilities (i.e., guard shack, sanitation facilities, and parking areas) would be constructed on the north side of the runway, east of the existing infrastructure (see Exhibit 2-20). The duration of the site preparation activities would be approximate 1 month. The 1.2-acre parcel would be cleared of vegetation and leveled; fill material would be brought in as necessary. The parcel would be fenced to control access.

Exhibit 2-20. Proposed Merle K. Smith Airport Site



Utilities, i.e., water, electric, and communication lines would be installed along the existing roads to the proposed facility.

The off-axis site would be operational for between 60 to 120 days in support of various test launch events. During operations, approximately 35 personnel would be working at the proposed facility. During the non-operational period, only security and maintenance personnel, up to eight individuals would be at the proposed facility on an intermittent basis (approximately once per week). The telemetry systems primarily would provide support for launches occurring from the KLC and as such, the primary direction of the various tracking systems would be southwest. During the 60 to 120 day operational period, the various tracking and communication systems would operate from zero to 18 hours each day.

During active operations and test events, AADC would set up an RSTS system north and adjacent to the Kodiak Launch Complex to assist in collecting telemetry data and provide a line of sight communication relay between Kodiak Launch Complex and the proposed off-axis facility at the Merle K. Smith Airport. AADC has consulted with the the owners of the Lodge and have established a land use agreement for the placement of such sensors. AADC would establish a 40 by 40 foot area in a grassy clearing, compact the soil, and level the area with gravel to provide a stable platform for the RSTS sensor. The system would include a 100 kW generator, a 50 kW generator, a high gain 5.4 meter dish antenna, an omni-directional antenna, and a directional antenna. Other than the ground preparations, no permanent structures would be required for the setup and operation of the RSTS.

2.3 Alternatives to the Proposed Action

Alternatives to the proposed action, including the no action alternative, have been identified and will be considered in this EA. These alternatives include

- **Alternative 1** – use of land-based mobile sensors but not airborne sensor systems, and
- **Alternative 2** – use of airborne sensor systems but not land-based mobile sensors.

2.4 No Action Alternative

Under the no action alternative, MDA would not transport or use mobile land-based sensors or airborne sensors to support MDA test events or to track targets of opportunity to test and calibrate the mobile land-based and airborne sensors. The sensors used for the test events would be the existing fixed land-based sensors as well as any sea-based sensor assets. For the purpose of this EA, MDA assumed that no mobile land-based or airborne sensors would be used during MDA testing events.

2.5 Alternatives Considered but Not Carried Forward

Under Alternative 1 for mobile land-based sensors, MDA considered other potential test support locations including: Cape Canaveral AFS, Florida; Patrick AFB, Florida; Eglin AFB, Florida; Argentia, Newfoundland; Antigua; and Ascension Island. However, the use of these locations as test support locations for mobile land-based sensors is not reasonably foreseeable and therefore was not analyzed as part of Alternative 1 in this document. If in the future these locations become designated as potential sensor sites for mobile land-based sensors, additional environmental analyses would be prepared as appropriate.

3 AFFECTED ENVIRONMENT

This section presents the general characteristics of the affected environment by resource area. When appropriate (i.e., when a resource may be impacted), MDA reviewed the site-specific conditions of the affected environment and completed a site-specific impact analysis. For example, air quality could be impacted by the proposed action; therefore, MDA reviewed the current attainment status of each proposed testing location and evaluated the impact of the emissions of the land-based and airborne mobile sensor on that particular site. The affected environment is described succinctly to provide a context for understanding potential impacts. The level of detail for each resource area is commensurate with the potential for impact to that resource area.

The Affected Environment provides a general description of the resources that may be impacted. When appropriate to adequately characterize the potential impacts, MDA included site-specific information on the specific locations in the U.S. and areas outside the U.S. where proposed activities are reasonably foreseeable (see Sections 1.4.1 and 1.4.2). As a result, applicable international treaties, foreign laws and regulations, and U.S. Federal, state, and local laws and regulations must be considered.

Exhibit 3-1 shows the global distribution of the various sites.

Thirteen resources areas were considered to provide a context for understanding the potential effects of the proposed action and to provide a basis for understanding the severity of potential impacts. The resource areas considered include: air quality, airspace, biological resources, cultural resources, geology and soils, hazardous materials and hazardous waste, health and safety, land use, noise, socioeconomics and environmental justice, transportation and infrastructures, visual resources, and water resources. These areas represent the resources that the proposed Mobile Sensors may impact and were identified based on review of previous environmental documentation for the MDA, and the other Department of Defense (DoD) organizations (Navy, Army, Air Force), see Appendix A.

Exhibit 3-1. Global Distribution of Sites

3.1 Definition and Description of Resource

The following sections define the resource, provide a description of the characteristics of the resource, and when appropriate present site-specific information.

3.1.1 Air Quality

Air quality in a given location is measured in terms of the concentration of various air pollutants in the atmosphere. The type and amount of pollutants emitted into the air, the size and topography of the air basin, and the meteorological conditions related to the prevailing climate determine pollutant concentrations. The pollutant concentrations are measured against Federal, state and local ambient air quality standards that protect public health and welfare. Existing ambient pollutant concentrations are determined by analyzing air monitoring data obtained from monitoring stations located in representative areas and maintained by appropriate state or local agencies.

The Environmental Protection Agency (EPA), in accordance with the Clean Air Act (CAA), has established National Ambient Air Quality Standards (NAAQS) for criteria pollutants. Criteria pollutants include sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (including volatile organic compounds [VOCs] and nitrogen oxides [NO_X] as precursors), particulate matter with a diameter of less than 10 microns (PM_{10}), particulate matter with a diameter of 2.5 microns or less ($PM_{2.5}$), and lead (Pb). There are primary and secondary NAAQS for these pollutants. The primary standards were established to protect public health with an adequate margin of safety; the secondary standards were intended to protect the public from any known or anticipated adverse effects of a pollutant. Exhibit 3-2 summarizes the primary and secondary NAAQS. State and local agencies may also establish ambient air quality standards. These standards must address the same pollutants as the NAAQS and must be equal to or more stringent than the NAAQS. Some state and local agencies have developed standards for additional criteria pollutants such as visibility and hydrogen sulfide.

The EPA has characterized local and regional air quality through attainment status. If the pollutant concentration in a region meets the NAAQS, it is considered to be an attainment area. If the pollutant concentration in a region exceeds the NAAQS, it is considered to be a nonattainment area. The determination of attainment status varies by pollutant. For example, an area is considered to be in nonattainment for ozone if its NAAQS has been exceeded more than three times in three years at a single monitoring station. However, an area is in nonattainment for any other pollutant if its NAAQS has been exceeded more than once per year. Some areas may be unclassified because insufficient data are available to characterize the area. Other areas are deemed maintenance areas if the area is in attainment but NAAQS were exceeded in the past and a revised State Implementation Plan (SIP) has provided for attainment status for the 10 years after redesdignation.

Exhibit 3-2. National Ambient Air Quality Standards

Pollutant	Averaging Time	National Standards[a] Concentration Primary[b,c]	National Standards[a] Concentration Secondary[b,d]
Ozone	1 hour	0.12 ppm[e] (235 μg/m^3)[f]	Same as primary
	8 hour	0.08 ppm (157 μg/m^3)	Same as primary
Carbon monoxide	8 hour	9.0 ppm (10 mg/m^3)	---
	1 hour	35 ppm (40 mg/m^3)	---
Nitrogen dioxide	Annual arithmetic mean	0.053 ppm (100 μg/m^3)	Same as primary
Sulfur dioxide	1 hour	---	---
	3 hours	---	0.5 ppm (1,300 μg/m^3)
	24 hour	0.14 ppm (365μg/m^3)	---
	Annual arithmetic mean	0.03 ppm (80 μg/m^3)	---
Particulate matter as PM_{10}	24 hour	150 μ/m^3	Same as primary
	Annual (arithmetic mean)	50 μg/m^3	Same as primary
Particulate matter as $PM_{2.5}$	24 hour	65 μg/m^3	Same as primary
	Annual arithmetic	15 μg/m^3	Same as primary
Lead	Quarterly average	1.5 μg/m^3	Same as primary
	30-day average	---	---

Source: USEPA, Air and Radiation Division, 2004

[a]These standards, other than for ozone, particulate matter, and those based on annual averages, must not be exceeded more than once per year. The eight-hour ozone standard is attained when the fourth highest eight-hour concentration in a year, averaged over three years, is equal to or less than the standard. For PM_{10}, the 24-hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above the standard is equal to or less than one. For $PM_{2.5}$, the 24-hour standard is attained when 98 percent of the daily concentrations, averaged over three years, are equal to or less than the standard.

[b] Concentration is expressed first in units in which it was adopted and is based on a reference temperature of 25°Celsius (°C) (77°F) and a reference pressure of 760 millimeters (1,013.2 millibars) of mercury. All measurements of air quality must be corrected to a reference temperature of 25°C (77°F) and a reference pressure of 760 millimeters (1,013.2 millibars) of mercury. Parts per million (ppm) in this exhibit refers to parts per million by volume or micromoles of pollutant per mole of gas.

[c] National primary standards are the levels of air quality necessary, with an adequate margin of safety, to protect the public health.

[d] National secondary standards are the levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant

[e] Parts per million by volume or micromoles per mole of gas

[f] Micrograms per cubic meter

The CAA requires the preparation of an SIP that describes how the state will meet or attain the NAAQS. The SIP contains emission limitations as well as record keeping and reporting requirements for affected sources. As a result of the CAA Amendments, the requirements and compliance dates for reaching attainment are based on the severity of the air quality standard violation. A Federal agency cannot support an action (e.g., fund, license) unless the activity will conform to the EPA-approved SIP for the region. A conformity determination or analysis is needed. A conformity analysis may involve performing air quality modeling and implementing measures to mitigate air quality impacts. Federal agencies are exempt from performing a conformity analysis if the following conditions are met.

- The ongoing activities do not produce emissions above the *de minimis* levels specified in the rule. Exhibit 3-3 shows the *de minimis*[1] threshold levels of various non-attainment areas.
- The Federal action is not considered a regionally significant action. A Federal action is considered regionally significant when the total emissions from the action equal or exceed 10 percent of the air quality control area's emissions inventory for any criteria pollutant.

Exhibit 3-3. Thresholds in Non-Attainment Areas

Area Designation		Pollutant	*De Minimis* Level (tons per year)
Ozone	Extreme Nonattainment	NO_X or VOC	10
	Severe Nonattainment	NO_X or VOC	25
	Serious Nonattainment	NO_X or VOC	50
	Other Nonattainment, within OTR	NO_X	100
	Other Nonattainment, within OTR	VOC	50
	Other Nonattainment, outside OTR	NO_X or VOC	100
	Maintenance	NO_X	100
	Maintenance, within OTR	VOC	50
	Maintenance, outside OTR	VOC	100
PM_{10}	Serious Nonattainment	PM_{10}	70
	Moderate Nonattainment	PM_{10}	100
	Maintenance	PM_{10}	100
CO	Nonattainment or Maintenance	CO	100
SO_2	Nonattainment or Maintenance	SO_2	100
NO_2	Nonattainment or Maintenance	NO_2	100
Pb	Nonattainment or Maintenance	Pb	25

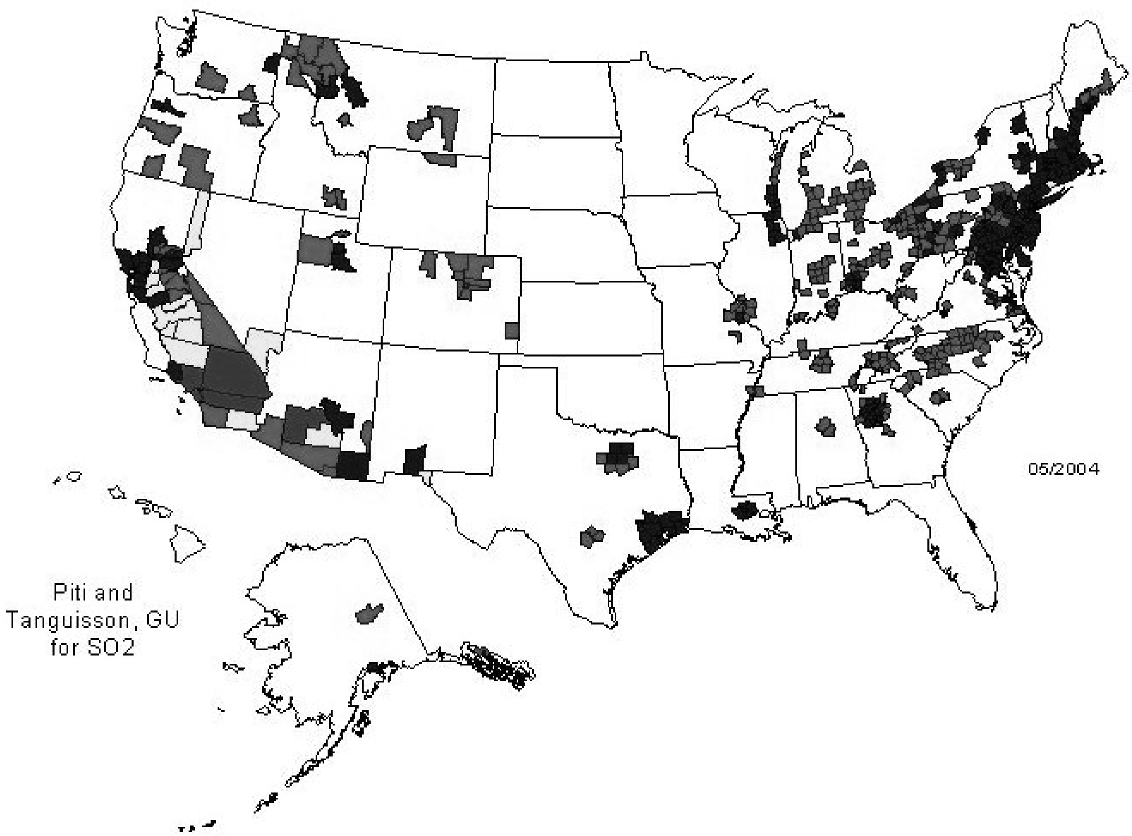
Source: EPA regulations 40 Code of Federal Regulations (CFR) 93.153(b)

[1] *De minimis* refers to the level of emissions below regulatory concern.

The EPA evaluates ambient air quality and calculates *de minimis* levels for emissions at or below 914 meters (3,000 feet). Air quality modeling is used to determine the effects of air emission sources on ambient air concentrations. The types and amounts of pollutants, the topography of the air basin, and the prevailing meteorological parameters that most often affect pollutant dispersion are wind speed and direction, atmospheric stability, mixing height, and temperature.

Exhibit 3-4, presents the locations of all the nonattainment and maintenance areas throughout the nation.

Exhibit 3-4. Location of Nonattainment Areas for Criteria Pollutants, January 2004



Note: Map is shaded by county to indicate the number of criteria pollutants for which the county is in non-attainment. However, the purpose of this exhibit is to generally illustrate the location of non-attainment areas in the U.S. Source: EPA, 2003b

Exhibit 3-5 lists the current attainment status of all the areas where the mobile land-based and airborne sensors would be used under the proposed action (see Appendix A).

Exhibit 3-5. Location of Sensor Activity and Attainment Status

Location	State	County	Non-attainment for Pollutant
Huntsville International Airport	Alabama	Madison	In attainment
Eareckson AFS	Alaska	Aleutians West	In attainment
Adak NAS	Alaska	Aleutians West	In attainment
Anchorage International Airport	Alaska	Anchorage	Anchorage Municipality, CO – Maintenance Anchorage Municipality, PM-10 – Moderate
Elmendorf AFB	Alaska	Anchorage	Anchorage Municipality, CO – Maintenance Anchorage Municipality, PM-10 – Moderate
King Salmon AS	Alaska	Bristol Bay	In attainment
Kodiak Airport	Alaska	Kodiak Island	In attainment
KLC	Alaska	Kodiak Island	In attainment
Merle K. Smith Airport	Alaska	Valdez Cordova	In attainment
Monterey Airport	California	Monterey	In attainment
Edwards AFB	California	Los Angeles	CO - Serious 1-hour ozone – Extreme to Severe 17 8-hour ozone – Moderate to Severe 17 NO_2 – Maintenance PM-10 – Serious PM 2.5 – Non-attainment
Vandenberg AFB	California	Santa Barbara and San Luis Obispo Counties	8-hour ozone – Maintenance
San Jose International Airport	California	Santa Clara	CO – Maintenance 1-hour ozone – Other 8-hour ozone – Marginal
Travis AFB	California	Solano	8-hour ozone - Sacramento Metro, CA - Serious 8-hour ozone - San

Location	State	County	Non-attainment for Pollutant
			Francisco Bay Area, CA - Marginal 1-hour ozone Sacramento Metro, CA - Severe-15 1-hour ozone - San Francisco Bay Area, CA - Other
Naval Base Ventura County Port Hueneme/San Nicolas Island/Point Mugu, California	California	Ventura	1-hour ozone – Severe 15 8-hour ozone – Moderate
Patrick AFB	Florida	Brevard	In attainment
Eglin AFB	Florida	Okaloosa	In attainment
Key West NAS	Florida	Monroe	In attainment
MacDill AFB	Florida	Hillsborough	In attainment
Melbourne International Airport	Florida	Brevard	In attainment
Palm Beach International Airport	Florida	Palm Beach	In attainment
Tyndall AFB	Florida	Bay	In attainment
Anderson AFB	Guam	Yigo	In attainment
Hickam AFB	Hawaii	Honolulu	In attainment
PMRF	Hawaii	Kauai	In attainment
Niihau	Hawaii	Kauai	In attainment
Lihue International Airport	Hawaii	Kauai	In attainment
Kaneohe Bay Marine Corp AS	Hawaii	Honolulu	In attainment
Andrews AFB	Maryland	Prince George's	1-hour ozone – Severe 15 8-hour ozone – Moderate PM-2.5 – Non-attainment
Keesler AFB	Mississippi	Harrison	In attainment
McCarran International Airport	Nevada	Clark	CO – Serious 8-hour ozone – Subpart 1 PM-10 – Serious
Nellis AFB	Nevada	Clark	CO – Serious 8-hour ozone – Subpart 1 PM-10 – Serious

Location	State	County	Non-attainment for Pollutant
Holloman AFB	New Mexico	Otero	In attainment
Kirtland AFB	New Mexico	Bernalillo	CO – Maintenance
WSMR	New Mexico	Dona Ana, Otero, Sierra, Socorro, Lincoln	WSMR is in attainment. Dona Ana County, Sunland Park area, 1-hour ozone – Marginal Anthony area, PM-10 – Moderate
Jones Riverside Airport	Oklahoma	Tulsa	In attainment
Tulsa International Airport	Oklahoma	Tulsa	In attainment
Majors Army Air Field	Texas	Hunt	In attainment
Harlingen Airport	Texas	Cameron	In attainment
Wallops Island	Virginia	Accomack	In attainment
NASWI	Washington	Island	In attainment
Sea-Tac International Airport	Washington	King	In attainment
USAKA	n/a	n/a	n/a
Midway Island	n/a	n/a	n/a
Wake Island	n/a	n/a	n/a
Johnston Atoll	n/a	n/a	n/a
Majuro Island, RMI	n/a	n/a	n/a

3.1.2 Airspace

Airspace is the space above a nation, which is under its jurisdiction. Airspace is defined vertically, laterally, and temporally for aviation purposes. The Federal Aviation Administration (FAA) determines the boundaries of airspace and governs its use under Public Law 85-725, Federal Aviation Act of 1958. The categories of airspace include controlled and uncontrolled airspace, special use airspace, and other airspace. These categories are determined based on the complexity or density of aircraft movements, the nature of operations within the airspace, the level of safety required and national and public interest in the airspace. The categories of airspace are defined in Exhibit 3-6.

Exhibit 3-6. Categories of Airspace

Category	Description	Example
Controlled Airspace	Requires air traffic control services for instrument flight rules (IFR) flights. Pilots are subject to specific pilot qualifications, operating rules, and equipment requirements. Controlled airspace classified as A, B, C, D, or E.	▪ Airport traffic areas ▪ Airport terminal control areas ▪ Jet routes ▪ Victor routes ▪ Altitudes above Flight Level (FL) 180 (5,500 meters [18,000 feet] above mean sea level [MSL])
Uncontrolled Airspace	For aircraft operating under visual flight rules (VFR); is not classified by FAA	Altitudes extending up to 4,420 meters (14,500 feet) above MSL
Special Use Airspace	Limitations are placed upon aircraft activities because of their nature and/or wherein limitations may be imposed upon aircraft operations that are not a part of those activities.	Alert Areas, Controlled Firing Areas, Military Operations Areas, Prohibited Areas, Restricted Areas, Warning Areas
Other Airspace	Airspace not included under controlled, uncontrolled, or special use airspace.	Military Training Routes

Airspace management and use in the U.S. are governed by the Federal Aviation Act of 1958 (Public Law 85-725) and its implementing regulations set forth by the FAA. FAA Order 7490, "*Policies and Procedures for Air Traffic Environmental Actions*," includes procedures and guidance for special use airspace environmental issues between FAA and DoD. FAA Order 7610.4H, "*Special Military Operations*," specifies procedures for air traffic control planning, coordination, and services during defense activities, and special military operations conducted in airspace controlled by or under the jurisdiction of the FAA.

The U.S. airspace is divided into 21 zones (centers), and each zone is divided into sectors. Also within each zone are portions of airspace, about 81 kilometers (50 miles) in diameter, called TRACON (Terminal Radar Approach CONtrol) airspaces. Multiple airports exist within each TRACON airspace, and each airport has its own airspace with an 8-kilometer (5-mile) radius.

3.1.3 Biological Resources

The biological resources include terrestrial and aquatic plants and animals and the various ecosystems that they inhabit. Plants include single-celled algae and plankton to more complex multicellular angiosperms (flowering plants) and gymnosperms (non-flowering seed plants). Animals include single-cell protozoa up through multicellular aquatic and terrestrial organisms.

Terrestrial Plants and Animals

Terrestrial plants are located throughout most of the world. Plants tend to be limited by temperature and will not grow at high latitudes or altitudes due to the cold climates. Terrestrial plants tend to have growing cycles in temperate climates, resting dormant in the winter and then flowering in the spring. Deciduous plants will loose their foliage in the fall. Conifers (evergreens) do not loose their foliage during the winter season, though they do not grow or flower in the winter. In tropical climates plants may grow all year round, though they tend to flower at specific times of the year. Currently, a total of 746 species of plants are listed as threatened or endangered by the U.S. Fish and Wildlife Service (USFWS) and are afforded protection under the Endangered Species Act (ESA) of 1973 (16 USC 1531 *et seq.*). (USFWS, 2004)

Terrestrial wildlife inhabits all the continents on Earth. Characteristics that are common to the more advanced animals (e.g., reptiles, mammals, birds) include migratory patterns, specific breeding areas and times, foraging areas and specific ranges of distribution. Such animals tend to establish home ranges and distribution patterns based on quality of the available habitat and its ability to support a particular population size. Scarce resources, low quality, or degraded/disturbed habitat tend to preclude wildlife habitation or cause existing wildlife to abandon such areas. However, a host of wildlife species typically referred to as “pests” are able to thrive in low quality or degraded habitats.

The migratory pattern generally refers to the north-south movement of birds as they travel to and from their breeding and wintering grounds. The individual paths that these birds travel are commonly known as migration routes. Migration routes crisscross over the entire North American continent, and no two species will follow exactly the same path from beginning to end. This being said, migration routes tend to concentrate along coastlines, major river valleys, and mountain ranges. These broad, heavily traveled corridors comprised of many individual routes are called migration flyways. The concept of a flyway does not imply that all species migrate along definite paths, or that all individuals within a species travel along the same route. Rather, flyways are a convenient generalization to help convey the idea that certain factors (geography, availability of food, etc.) guide the migration of birds along relatively regular paths (see Exhibit 3-7). (Lincoln et. al., 1998)

Exhibit 3-7. Common Migration Routes

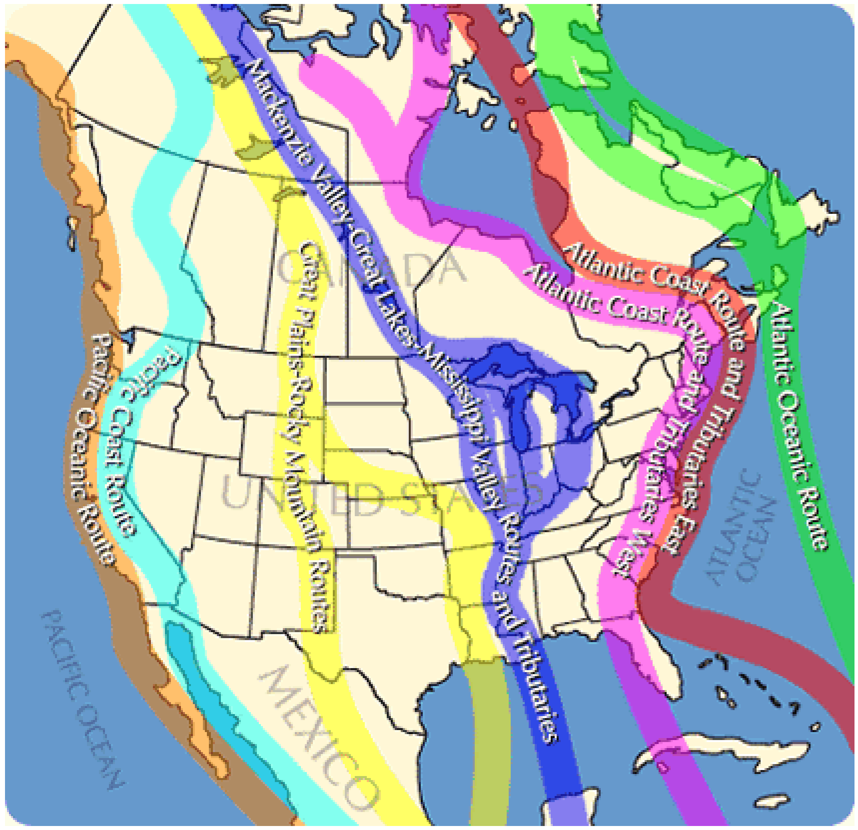


Exhibit 3-8, Location of Sensor Activity and Migratory Flyway or Population lists the proposed locations of the land-based and airborne sensor activities in relation to migratory flyways or migratory populations (see Appendix B).

Exhibit 3-8. Location of Sensor Activity and Migratory Flyway or Population

Location	State	County	Migratory Flyway or Population
Huntsville International Airport	Alabama	Madison	No
Eareckson AFS	Alaska	Aleutians West	Yes – Seabird Migration
Adak Naval Air Station	Alaska	Aleutians West	Yes – Seabird Migration
Anchorage International Airport	Alaska	Anchorage	Yes – Pacific Ocean Route
Elmendorf AFB	Alaska	Anchorage	Yes – Pacific Ocean Route
King Salmon AS	Alaska	Bristol Bay	Yes – Population
Kodiak Launch Complex	Alaska	Kodiak Island	Yes – Pacific Ocean Route
Kodiak Airport	Alaska	Kodiak Island	Yes – Pacific Ocean Route
Merle K. Smith Airport	Alaska	Valdez Cordova	Yes – Population
Monterey Airport	California	Monterey	Yes – Pacific Ocean Route
Edwards AFB	California	Los Angeles	No
Travis AFB	California	Solano	Yes – Pacific Coast Route
Vandenberg AFB	California	Santa Barbara and San Luis Obispo Counties	Yes – Pacific Ocean and Coast Route
San Jose International Airport	California	Santa Clara	Yes – Pacific Coast Route
Naval Base Ventura County Port Hueneme/San Nicolas Island/Point Mugu, California	California	Ventura	Yes – Pacific Ocean and Coast Route
Eglin AFB	Florida	Okaloosa	Yes – Atlantic Coast Route, West

Location	State	County	Migratory Flyway or Population
Key West NAS	Florida	Monroe	Yes – Atlantic Coast Route, West
MacDill AFB	Florida	Hillsborough	Yes – Atlantic Coast Route, West
Melbourne International Airport	Florida	Brevard	Yes – Atlantic Coast Route, East
Palm Beach International Airport	Florida	Palm Beach	Yes – Atlantic Coast Route, East
Patrick AFB	Florida	Brevard	Yes – Atlantic Coast Route, East
Tyndall AFB	Florida	Bay	Yes – Atlantic Coast Route, West
Anderson AFB	Guam	Yigo	No
Hickam AFB	Hawaii	Honolulu	Yes – Population
Pacific Missile Range Facility	Hawaii	Kauai	Yes – Population
Niihau	Hawaii	Kauai	Yes - Population
Lihue International Airport	Hawaii	Kauai	Yes – Population
Kaneohe Bay Marine Corps AS	Hawaii	Honolulu	Yes – Population
Andrews AFB	Maryland	Prince George’s	Yes – Atlantic Coast Route
Keesler AFB	Mississippi	Harrison	No
McCarran International Airport	Nevada	Clark	No
Nellis AFB	Nevada	Clark	No
Hollman AFB	New Mexico	Otero	No
Kirtland AFB	New Mexico	Bernalillo	No
WSMR	New Mexico	Dona Ana, Otero, Sierra, Socorro, Lincoln	No
Jones Riverside Airport	Oklahoma	Tulsa	No
Tulsa International Airport	Oklahoma	Tulsa	No

Location	State	County	Migratory Flyway or Population
Majors Army Air Field	Texas	Hunt	No
Harlingen Airport	Texas	Cameron	Yes – Mississippi Valley Route
Wallops Island	Virginia	Accomack	Atlantic Coast Route
McChord AFB	Washington	Pierce	Yes – Pacific Ocean Route
NASWI	Washington	Island	Yes – Pacific Ocean Route
Sea-Tac International Airport	Washington	King	Yes – Pacific Ocean Route
USAKA	n/a	n/a	Yes
Midway Island	n/a	n/a	Yes
Wake Island	n/a	n/a	Yes
Johnston Atoll	n/a	n/a	Yes
Majuro Island, RMI	n/a	n/a	Yes

Source: See Appendix B.

Aquatic Plants and Animals

Aquatic plants tend to be located close to shorelines and are limited in depth by light penetration (photic zone) and in range by water temperature. Located in the region between uplands and the open water are a host of terrestrial plants that have become tolerant to living in seasonally or permanently wet conditions. Cordgrasses and mangroves are examples of terrestrial plants that have adapted to have their bases and roots submerged in saltwater, while their leaves are always in the open air. These plants expel excess salt through special pores, which allows them to live in the salt water. The plants' root systems help to hold mud together, which would otherwise be washed away with the tides. The mud creates a habitat specific to wetland areas and is required for a number of species to live in during varying parts of their life cycle. Algae belong to the kingdom Protista and are eukaryotes, which carry out photosynthesis and may be unicellular or multicellular. Algae are found throughout the ocean within the photic zone (water depth to which light penetrates).

Aquatic wildlife includes fish, crustaceans (shrimp, lobsters, crabs), bivalves (clams) as well as various birds (gulls, pelicans, penguins, puffins), and marine mammals (whales, walruses, seals). Aquatic birds are differentiated from the terrestrial ones in that they tend to spend the majority of their time living and feeding in aquatic environments, though they still lay their eggs on the land. Aquatic birds are found all over the world.

Aquatic mammals include animals that spend part of their time on land and sea like seals, sea lions, walruses, and sea otters, and those that spend their entire life in the ocean like dolphins, whales, and manatees. Marine mammals are found all over the world's oceans. Marine reptiles are similar to their terrestrial counterparts except that they live primarily, and in some cases entirely, at sea. Examples would include sea turtles, sea snakes, and marine iguana. Marine reptiles are again limited in their range due to the inability to regulate their own body temperature. Fish are located throughout all aquatic ecosystems. Fish spend their entire lives at sea, and breathe oxygen through the use of gills that remove oxygen from water as it passes over the gills. As with the terrestrial animals, seasonal habits, migration patterns, and breeding times are species specific.

Regulatory Setting

The ESA is the primary law that addresses biological resources. The USFWS administers the ESA, which states that all Federal departments and agencies shall seek to conserve endangered species and threatened species. Included with the protection of the animals themselves is a concern for their critical habitat, which is defined as specific areas within the geographical area occupied by the species at the time it is listed and also areas that are essential to conservation of the species. Currently, a total of 519 species of plants are listed as threatened or endangered by the FWS and are afforded protection under the ESA. (USFWS, 2004) The Defense Department FY2004 Authorizations bill (Public Law 108-136, Section 318) amends the Endangered Species Act to allow the Secretary of the Interior to exempt DoD sites from critical habitat designations if an adequate natural resources management plan is in place at the sites. Individual States have State-listed threatened and endangered species that are afforded protection in accordance with State-specific regulations.

Other Federal regulations designed to protect the nation's biological resources include

- *The Fish and Wildlife Coordination Act* of 1958 (16 USC 661 *et seq.*), which promotes conservation of non-game fish and wildlife and their habitats to all Federal departments and agencies.

- *The Migratory Bird Treaty Act* of 1918, as amended (16 USC 703-712) protects migratory birds from actions such as hunting, capturing, or killing of the listed species or their nests and eggs.

- *The Bald and Golden Eagle Protection Act* (16 USC 668 *et seq.*) specifically protects the two species from unauthorized capture, purchase, transportation, etc. of the birds, or their nests, or their eggs. Any action that might disturb the eagles would require notification of the USFWS for appropriate mitigation measures.

- *The Marine Mammal Protection Act* of 1972 was most recently reauthorized in 1994. The purpose of the act is to protect marine mammals from human activities. The MMPA established a moratorium, with certain exceptions, on the taking of marine mammals in U.S. waters and by U.S. citizens on the high seas, and on the importing of marine mammals and marine mammal products into the U.S.

- *The Magnuson-Stevens Fishery Conservation and Management Act* of 1976 governs the conservation and management of ocean fishing. The Act establishes exclusive U.S. management authority over all fishing within the Exclusive Economic Zone (EEZ), all anadromous fish throughout their migratory range except when in a foreign nation's waters and all fish on the Continental Shelf. Each individual site may be subject to further State and local regulations.

3.1.4 Cultural and Historic Resources

Cultural resources include prehistoric and historic artifacts, archaeological sites (including underwater sites), historic buildings and structures, and traditional resources (such as Native American and Native Hawaiian religious sites). Paleontological resources are fossil remains of prehistoric plant and animal species and may include bones, shells, leaves, and pollen.

Cultural resources of particular concern include properties listed or eligible for inclusion in the National Register of Historic Places (National Register). Only those cultural resources determined to be potentially significant under 36 CFR 60.4 are subject to protection from adverse impacts resulting from an undertaking. To be considered significant, cultural resources must meet one or more of the criteria established by the National Park Service that would make that resource eligible for inclusion in the National Register. The term "eligible for inclusion in the National Register" includes all properties that meet the National Register listing criteria which are specified in Department of Interior regulations at 36 CFR 60.4. Therefore, sites not yet evaluated may be considered potentially eligible to the National Register and, as such, are afforded the same regulatory consideration as nominated properties.

The *National Historic Preservation Act* (16 USC 470f and 470h-2(a)) establishes a national policy to preserve, restore, and maintain cultural resources. The Act establishes the National Register of Historic Places as the mechanism to designate public or privately owned properties deserving protection. Federal agencies must take into account the effect of a project on any property included in or eligible for inclusion in the National Register.

Section 101(b)(4) of NEPA established a Federal policy for the conservation of historic and cultural, as well as the natural, aspects of the nation's heritage. Regulations implementing NEPA stipulate that Federal agencies must consider the consequences of their undertakings on cultural resources that are included or eligible for inclusion on the National Register. (40 CFR Part 1502.16[g]) The terminology…"eligible for inclusion in the National Register" includes all properties that meet the specifications set forth in Department of Interior (DOI) regulations at 36 CFR 60.4. These guidelines are promulgated under Section 106 of the National Historic Preservation Act (NHPA) 16 USC 470 *et seq*. Requirements of Section 106 include

- The identification of significant historic properties or sites of cultural significance that may be adversely impacted by a proposed action or undertaking,
- Consultation with the applicable State and/or Tribal Historic Preservation Officer, and as necessary, the Advisory Council on Historic Preservation, and
- The development of mitigation measures.

In addition to compliance with Section 106, a site-specific analysis should also consider EO 13287, Preserve America. EO 13287 provides government directives for the goals of the protection, enhancement, and contemporary use of federally owned historic properties by promoting intergovernmental cooperation and partnerships for the preservation and use of such resources. EO 13287 states… "Agencies shall maximize efforts to integrate the policies, procedures, and practices of the NHPA and this order into their program activities in order to efficiently and effectively advance historic preservation objectives in the pursuit of their missions."

A Traditional Cultural Property is defined by the National Park Service as a property or place that is eligible for inclusion on the National Register because of its association with cultural practices and beliefs that are (1) rooted in the history of a community, and (2) important to maintaining the continuity of that community's traditional beliefs and practices.

EO 13007 defines an Indian Sacred Site as "any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian tribe or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion; provided that the tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such a site." Under EO 13007, Federal agencies, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, must: (1) accommodate access to and ceremonial use of Indian Sacred Sites by Indian religious practitioners; and (2) avoid adversely affecting the physical integrity of such sacred sites.

3.1.5 Geology and Soils

Geology and soils are earth resources that could be adversely affected by the proposed action. They play a major role in the susceptibility of an area to erosion, depletion of mineral or energy resources, seismic risk or landslide, and soil and ground water contamination that could occur as a result of the proposed action.

Geology is the study of the composition and configuration of the Earth's surface and subsurface features. The general shape and arrangement of a land surface, including its height and the position of its natural and man-made features, is referred to as topography. The topography of the land surface can influence erosion rates and the general direction of surface water and ground water flow. Geologic conditions also influence the potential for naturally occurring or human-induced hazards, which could pose risk to life or property. Such hazards could include phenomena such as landslides, flooding, ground subsidence, volcanic activity, faulting, earthquakes, and tsunamis (tidal waves). The potential for geologic hazards is described relative to each environment type's geologic setting.

Soils are the unconsolidated materials overlying bedrock or other parent material. Soils typically are described in terms of their composition, slope, and physical characteristics. Differences among soil types in terms of their structure, elasticity, strength, shrink-swell potential, and erosion potential affect their abilities to support certain applications or uses. In appropriate cases, soil properties must be examined for their compatibility with particular construction activities or types of land use. In a limited number of cases, the presence, distribution, quantity, and quality of mineral resources might affect or be affected by a proposed action.

3.1.6 Hazardous Materials and Hazardous Waste Management

Hazardous materials and hazardous waste include substances that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, may present substantial danger to the public health, welfare, or the environment when released. The EPA, in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the Resource Conservation and Recovery Act (RCRA), and the Toxic Substance Control Act (TSCA), regulates hazardous materials and wastes. The Occupational Safety and Health Administration (OSHA) and the Department of Transportation (DOT) have regulatory control over some hazardous materials and wastes as well.

- *CERCLA*, also known as Superfund, (42 USC 9601) creates authority and procedures for conducting emergency responses, removal, and remediation actions at sites requiring a cleanup of releases of hazardous substances. The Act specifies standards of liability and provides procedures for determining compensation, reportable quantities of releases of hazardous substances, penalties, employee protection, claims procedures, and cleanup standards.

- *The Superfund Amendment and Reauthorization Act* (SARA) of 1986 revised and extended CERCLA in 1986. SARA Title III, the Emergency Planning and Community Right-To-Know Act, provides for emergency planning and preparedness, community right-to-know reporting, and toxic chemical release reporting. The Act requires information about hazardous materials be provided to state and local authorities, including material safety data sheets, emergency and hazardous chemical inventory forms, and toxic chemical release reports.

- *RCRA*, or *the Solid Waste Disposal Act*, (42 USC 6901) authorizes the EPA to regulate the generation, storage, and disposal of hazardous wastes. RCRA also covers underground storage tanks and establishes a "cradle-to-grave," or life cycle system, requirements for managing hazardous waste, from generation to eventual disposal.

- *The Pollution Prevention Act* of 1990 (42 USC 13101) defines pollution prevention as source reduction and other practices that reduce or eliminate the creation of pollutants. The Act requires the EPA to develop standards for measuring waste reduction, serve as an information clearinghouse, and provide matching grants to state agencies to promote pollution prevention. Facilities with more than ten employees that manufacture, import, process, or otherwise use any chemical listed in and meeting threshold requirements of the Emergency Planning and Community Right-To-Know Act must file an annual toxic chemical source reduction and recycling report to EPA and to the facility's state of residence.

3.1.7 Health and Safety

Health and safety includes consideration of any activities, occurrences, or operations that have the potential to affect the well-being, safety, or health of workers or members of the general public. Workers are those persons directly involved with the operation producing the effect or who are physically present at the operational site. Members of the general public are persons who are not physically present at the operational site, including workers at nearby locations not involved in the operation and the off-site population. Also included in this category are equipment, structures, flora, and fauna. The standards applicable to the evaluation of health and safety differ for workers and the general public; therefore the resource is described in terms of occupational health and safety (workers) and environmental health and safety (general public).

The primary physical reaction to electromagnetic radiation (EMR) exposure is cellular heating, with symptoms such as eye damage as an early consequence. EMR hazard zones provide a safety factor ten times greater than the Institute of Electrical and Electronics Engineers (IEEE) Maximum Permissible Exposure Limit (MPELs). Per IEEE Standard C95.1-1999, *Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields*, 3 kilohertz to 300 gigahertz, MPELs are capped at five milliwatts per square centimeter for frequencies greater than 1,500 megahertz.

General public exposure is typically limited to one-fifth of the occupational limits. These hazard zones are defined in Army guidance and regulations on microwave and radio frequency (RF) safety. For non-ionizing radiation, OSHA established a radiation protection guide (29 CFR 1910.97, Non-ionizing Radiation) for normal environmental conditions and for incident electromagnetic energy of frequencies from 10 megahertz to 100 megahertz. This radiation protection guide is 10 milliwatts per square centimeter, averaged over any possible one-hour period. DoD Instruction 6055.11, *Protection of DoD Personnel from Exposure to Radiofrequency Radiation*, established permissible exposure limits for controlled and uncontrolled environments and for High Power Microwave narrow-band and Electromagnetic Pulse broad-band simulator systems. Additional values that are protective of human health and safety are derived from the IEEE standards and applicable OSHA standards including the pamphlet, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields," OET Bulletin 65, dated August 1997. The values present two sets of criteria, one for the general population/uncontrolled exposure that allows up to 30 minutes of exposure of a power density of 0.29 mW/cm^2, and one for occupational/controlled exposure that allows up to 6 minutes of exposure of a power density of 1.47 mW/cm^2

3.1.8 Land Use

Land use is described as the human use of land resources for various purposes, including economic production, natural resource protection, or institutional uses. Land uses are frequently regulated by management plans, policies, ordinances, and regulations that determine the types of uses that are permissible or protect specially designated or environmentally sensitive uses. Planning departments at the local and municipal level typically designate land uses for specific areas, which describe the permitted development activities that are acceptable for the area, such as residential, commercial, and industrial uses.

Public land may be assigned specific designations for which land use and management guidelines are provided, such as controlled use, wilderness, limited use, low use, moderate use, and intensive use areas. Within these designations are various types of land uses including agriculture, livestock grazing and production, conservation and recreation sites, military installations, and research sites.

Combined state, county, local, and on-site plans may regulate land use within the boundaries of a particular installation. Facilities where proposed activities may occur may use a wide range of planning documents as their land use plans, including legal settlement agreements narrowly tailored to designating land uses; comprehensive site plans incorporating all planning information, including current and future land uses, budget projections, and institutional plans; and a hierarchy of multiple planning documents. On-site land use management plans may address the security of essential mission activities from encroachment and the protection of both human and natural environments.

- *The Coastal Zone Management Act* (16 USC 1451) seeks to preserve, protect, and restore coastal areas. Coastal areas include wetlands, floodplains, estuaries, beaches, dunes, barrier islands, coral reefs, and fish and wildlife and their habitat. All Federal agencies must assess whether their activities will affect a coastal zone and ensure, to the maximum extent possible, that the activities are consistent with approved state Coastal Zone Management Plans.

- *The Coastal Barrier Resources Act of 1983* (16 USC 3501) is designed to curtail Federal subsidization of development on fragile coastal barriers. The Act prohibits designated Federal expenditures and financial assistance, including flood insurance, for development within the coastal barrier system.

3.1.9 Noise

Noise is generally defined as unwanted sound that is typically associated with human activity. Three characteristics are used to measure noise: amplitude, frequency, and duration. Amplitude is the intensity of noise and is described in units called decibels (dB). Frequency measures the number of wavelengths that are received over a period of time. High frequency noises have a high number of wavelengths per time period (e.g., 1 second), and low frequency noises have fewer wavelengths per time period. Examples of high frequency noises are those from jet engines or train whistles. Low frequency noises can be sonic booms and blast noises. Duration is simply the length of time over which the noise continues.

A-weighted decibels (dBA). Most measures of noise for community planning purposes use dBA units, and are used to characterize noise as heard by the human ear. It accomplishes this by artificially lowering the sound at lower and higher frequencies, where the human ear is less sensitive to sound reception. The dBA is used to assess human reaction to single event noise and is averaged over a 24-hour period to predict community reaction.

Community noise equivalent level (CNEL). The CNEL describes the average sound level during a 24-hour day in dBA. For noises occurring between 7:00 p.m. and 10:00 p.m., five dBA are added to the measured noise level, and for noises occurring between 10:00 p.m. and 7:00 a.m., 10 dBA are added to the measured noise level.

Day/night average sound level (DNL). DNL is the average sound level during a 24-hour day. It is reported in dBA and is used to predict human annoyance and community reaction to unwanted sound (noise). Because humans are typically more sensitive to noise in the evening, the DNL places a ten dBA penalty on noise produced between the hours of 10:00 p.m. and 7:00 a.m.

Equivalent Noise Level (L_{eq}). Equivalent noise level is the energy mean A-weighted sound level during a stated measurement period. It is used to describe the time-varying character of environmental noise.

Examples of A-weighted noise levels for various common noise sources are shown in Exhibit 3-9.

Exhibit 3-9. Comparative A-Weighted Sound Levels

dBA	Overall Level	Outdoor Noise Level	Indoor Noise Level
120	Uncomfortably Loud	Military jet aircraft take off from aircraft carrier at 15 meters (50 feet)	Oxygen torch
110	Very Loud	Turbo fan aircraft at take off at 61 meters (200 feet)	Rock band
100		Boeing 707 or DC-8 aircraft at one nautical mile, Jet flyover at 305 meters (1,000 feet), Bell J-2A helicopter at 30 meters (100 feet)	-
90	Moderately Loud	Boeing 737 or DC-9 aircraft at 2 kilometers (one nautical mile), power lawnmower, Motorcycle at 8 meters (25 feet)	Newspaper press
80		Propeller plane flyover at 305 meters (1,000 feet), Diesel truck at 64 kilometers per hour (40 miles per hour) at 15 meters (50 feet)	Blender, Garbage disposal
70		High urban ambient sound, Passenger car 105 kilometers per hour (65 miles per hour) at 8 meters (25 feet)	Radio, TV, vacuum cleaner
60	Quiet	Air conditioning unit at 30 meters (100 feet)	Dishwasher at 3 meters (10 feet), Conversation

Exhibit 3-9. Comparative A-Weighted Sound Levels

dBA	Overall Level	Outdoor Noise Level	Indoor Noise Level
50		Large transformers at 30 meters (100 feet)	Dishwasher in next room
40	Just audible	Lowest levels of urban ambient sound	Small theater Large conference room
10		-	Broadcast and recording studio
0	Threshold of Hearing	-	-

Source: Modified from FAA, 2001

Noise from transportation sources, such as vehicles and aircraft, and from continuous sources, such as generators, would be assessed using the A-weighted DNL, which significantly reduces the measured pressure level for low-frequency sounds and some high-frequency sounds. Noise from small arms ranges is assessed using the A-weighted DNL. Impulse noise resulting from armor, artillery, and demolition activities is assessed in terms of the C-weighted DNL. The C-weighted DNL is often used to characterize high-energy blast noise and other low frequency sounds capable of inducing vibrations in buildings or other structures. The C-weighted scale does not significantly reduce the measured pressure level for low frequency components of a sound.

OSHA regulations (29 CFR 1910.95) establish a maximum noise level of 90 dBA for a continuous eight-hour exposure during a workday and higher sound levels for a shorter time of exposure in the workplace. When information indicates that an employee's exposure may equal or exceed an eight-hour time-weighted average of 85 dB, the employer shall develop and implement a monitoring program.

3.1.10 Socioeconomics and Environmental Justice

Socioeconomics encompasses the social, economic, and demographic variables associated with community growth and development. A community can be described as a dynamic socioeconomic system, where physical and human resources, technology, social and economic institutions, and natural resources interrelate to create new products, processes, and services to meet consumer demands. The measure of a community's ability to support these demands depends on its ability to respond to changing environmental, social, economic, and demographic conditions. Socioeconomic resources consist of several primary elements including population, employment, and income. Other socioeconomic aspects that are described often may include housing and employment characteristics, and an overview of the local economy.

Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (Executive Order 12898). Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, state, local, and tribal programs and policies. Meaningful involvement means that potentially affected residents have an appropriate opportunity to participate in decisions about a proposed activity that will affect their environment and/or health; the public's contribution can influence the agency's decision; the concerns of all participants involved are considered in the decision-making process; and the decision makers seek out and facilitate the involvement of those potentially affected.

3.1.11 Transportation and Infrastructure

The transportation section addresses ground, aviation, and ocean transport systems. According to the most recently available data, the U.S. has over four million miles of highways, railroads, and waterways that connect all parts of the country. It also has 19,000 public and private airports. This extensive transportation network supported about 4.9 trillion passenger-miles of travel in 2001 and 3.8 trillion ton-miles of commercial freight shipments in 2001. The U.S. transportation system, one of the world's largest, serves 284 million residents and seven million business establishments. (DOT BTS, 2003)

Metropolitan areas are characterized by urban transit, a complex mix of heavy, light, and commuter rail; buses and demand responsive vehicles; ferries; and other less prevalent types such as inclined planes, trolley buses, and automated guide ways. More than one-third of America's population lives outside of urbanized areas, which typically do not have extensive transit systems.

Regulations pertaining to transportation are implemented by the DOT and are located in Title 49 of the CFR. Title 49 includes regulations applicable to railroads (49 CFR 200-299), highways (49 CFR 300-399; 49 CFR 500-599), coastal transportation (49 CFR 400-499), transportation safety (49 CFR 800-899), and surface transportation generally (49 CFR 1000-1199). In addition, the DOT oversees air transportation, and the applicable regulations are located at Title 14 of the CFR.

Infrastructure includes utilities, which are a network of systems that provide public services required for the functioning of a county, region, or organization. These public services include the distribution of energy, the treatment and distribution of potable water, the handling and treatment of wastewater, and the disposal of solid waste.

Energy refers to the power that is produced by a central electrical power plant or, in some cases, by individual power generators.

Water refers to the system that produces water, the treatment system that purifies the water, and the network that distributes that water. This water system usually is controlled, managed, and distributed by an entity such as a utility purveyor. In the absence of a water system, individualized water wells or a series of wells meet the demand for water. The water system is identified by potable, or drinkable, freshwater and nonpotable water used for other activities such as construction, operations, and irrigation. In some cases the non-potable system is saltwater. The water system is composed of a source that produces the water and the treatment systems that cleanse and purify it, making it available for use.

Wastewater that is produced by a site is treated by different methods. The wastewater can be collected in a central system and then directed to a treatment plant where it can be treated and then discharged. In many instances, the wastewater is further treated and reclaimed for use as nonpotable water. In the absence of a central system, septic systems collect and treat water either individually (individual households) or collectively (within a community).

Solid waste disposal includes the collection, handling, and disposal of waste. Designated landfills within an area or region are the final destinations where solid waste and construction debris is transported for processing. Solid waste usually is processed to separate out recyclable products first. Solid waste disposal also includes practices such as open burning, septic disposal, and burial in open or excavated trenches.

3.1.12 Visual Resources

Visual resources are defined as the natural and man-made features that constitute the aesthetic qualities of an area. Landforms, surface water, vegetation, and man-made features are the fundamental characteristics of an area that define the visual environment and form the overall impression that an observer receives of an area. The importance of visual resources and any changes in the visual character of an area is influenced by social considerations, including the public value placed on the area, public awareness of the area, and community concern for the visual resources in the area.

The visual resources of an area and any proposed changes to these resources can be evaluated in terms of “visual dominance” and “visual sensitivity.” Visual dominance describes the level of noticeability that occurs as the result of a visual change in an area. The levels of visual dominance vary from “not noticeable” to a significant change that demands attention and cannot be disregarded. Visual sensitivity depends on the setting of an area. Areas such as coastlines, national parks, and recreation or wilderness areas usually are considered to have high visual sensitivity, whereas heavily industrialized urban areas tend to have the lowest visual sensitivity.

The significance of visual effects is very subjective and depends upon the degree of alteration, the scenic quality of the area disturbed, and the sensitivity of the viewers. The degrees of alteration refer to the height and depth of maximum cut and fill areas and the introduction of urban elements into an existing natural environment or a substantial increase of structural elements into an already urban environment, while acknowledging any unique topographical formation or natural landmark. Sensitive viewers are those who use the outdoor environment or value a scenic viewpoint to enhance their daily activity and are typically residents or recreational users. Changes in the existing landscape where there are no identified scenic values or sensitive viewers are considered less than significant. Also, it is possible to acknowledge a visual change as possibly adverse but not significant, because either viewers are not sensitive or the surrounding scenic quality is not high. Visual impacts also would occur if proposed development is inconsistent with existing goals and policies of jurisdictions in which the project is located.

3.1.13 Water Resources

Water resources include both freshwater and marine systems (the marine system includes the broad ocean area (BOA) that is not under the direct jurisdiction of any single nation), wetlands, floodplains, and ground water.

Freshwater Systems

Freshwater environments, also known as interior water systems, consist of rivers and streams (lotic systems) and lakes and ponds (lentic systems). Rivers and streams include natural and man-made bodies of moving water. Streams originate from lakes or from ground water seeps and join with other streams, or tributaries to form a main channel or river. Rivers empty into large water bodies such as oceans and lakes and are fed by tributaries. Depending upon their regularity of flow, streams are described as (1) ephemeral, which only exist for a short time during rain events, (2) intermittent, which flow seasonally depending on rainfall patterns and snowmelt, and (3) perennial, which maintain a constant flow.

The physical characteristics of a lotic system often determine the biological characteristics of the system. Slow moving systems often have higher biological productivity. Because of the slow water movement, more organic material is able to settle out the water column to be used by primary and secondary consumers. In fast moving systems, the organic material is washed downstream before it can be utilized. Slow moving systems often have more productive vegetative communities. Suspended solids in the water column settle out in low energy systems and allow for greater light penetration to promote higher photosynthesis rates. Fast moving, turbulent systems stir up sediment and suspended solids and restrict light penetration. In addition, slow moving systems allow vegetation to root along the shorelines. This vegetation can be a food source and a habitat for other organisms.

Lakes are large, deep freshwater bodies that can be large enough to have surface waves and tides. Lakes are often closely associated with rivers. Rivers often flow into and/or out of lakes. Lakes have a stratified temperature regime from surface to bottom. The temperature differences between the layers cause water column stability. This stability restricts oxygen movement to bottom layers and nutrient and food movement to upper layers. In the spring and fall, water column stability deteriorates and results in uniform mixing. This often referred to as lake turnover. (EPA, 2004) Ponds smaller versions of lakes and can support rooted plants in all areas of the pond. The water temperatures are relatively uniform from top to bottom and are based on the ambient air temperature. In cold climates, the entire pond can freeze solid.

Marine Systems

Including coasts along the Atlantic Ocean, Pacific Ocean, Gulf of Alaska, Bering Sea, Arctic Ocean, and Gulf of Mexico, the U.S. has more than 153,226 kilometers (95,000 miles) of coastline. Just as other countries with coastlines, the U.S. has an established EEZ that defines its coastal environments from an economic, political, and regulatory perspective. While the host country does not have complete sovereignty over their EEZ regarding maritime or air traffic, the host country does maintain sovereign rights over resources within the zone (e.g., fishing, mineral resources, and marine protection).

Created in 1983 by presidential proclamation, the U.S. EEZ extends out from the coast to a distance of 370 kilometers (200 nautical miles). Within the EEZ are two smaller zones, the territorial and the contiguous zone. The territorial zone extends 22 kilometers (12 nautical miles) from the coastline and is included in the sovereign territory of the host country. The contiguous zone extends an additional 22 kilometers (12 nautical miles) out from the territorial zone border. Within this zone, the host country has rights to control immigration, customs, sanitary, and pollution regulations. (Environmental Health Center, 1998) The areas within the U.S. EEZ are rich in natural resources such as seafood, oil and mineral deposits, and wilderness and recreational areas.

More than 26,000,000 acres of wetlands are located along the coasts of the Atlantic Ocean, Pacific Ocean, and Gulf of Mexico. This includes salt marshes and coastal freshwater wetlands. Estuaries dominate the coastal wetlands. Estuaries are defined as tidally influenced, brackish water wetlands. Estuaries provide protection to inland areas from the physical forces of coastal waves and wind, nursery and nesting areas for a variety of fish and waterfowl, and filtration of water for sediment, nutrients, and other pollutants. Over 75 percent of U.S. commercial fish and shellfish and 80 to 90 percent of

U.S. recreational fish are dependent on estuaries during mating, birthing, or maturation. (Environmental Health Center, 1998) According to EPA, coastal wetlands along the Gulf of Mexico alone provide habitat for 75 percent of the migrating waterfowl in the U.S.

The BOA is defined as the open water areas of the Pacific and Atlantic Oceans outside of the EEZ, located 322 kilometers (200 miles) offshore. The BOA is outside of the jurisdiction of any individual nation. The marine environment supports a wealth of diverse organisms and it is estimated that 80 percent of all life on the planet is located within its oceans. (Ocean98, 1999) Additionally, ocean waters have the capacity to produce carbon and absorb large amounts of CO_2 that result from fossil fuel burning activities. Ocean movement is primarily influenced by wind, though tides that are a result of the gravitational pull of the sun and moon and seismic activity are also factors. The majority of the Earth's geologic activity occurs within the ocean, particularly the Pacific Ocean. (Marine Biology, 2004) Volcanic eruptions and lava flows continually add to the ocean crust and large chains of undersea trenches and mountain ranges such as the Monterey Bay Submarine Canyon and the Mid-Ocean Ridge are present.

Oceans are constantly in motion as a result of both horizontal and vertical currents. Horizontal ocean currents are a result of wind-based currents that occur due to solar energy and uneven heating of the Earth's surface. Wind-based currents primarily affect surface waters; however, their impact can be measured down to 200 meters (656 feet) in depth. Frictional forces between the water molecules drag deeper waters along but at reduced energy levels. In addition, the Earth's rotation tends to deflect the water movements with increasing depth. Some surficial currents are seasonal in nature, while others move in patterns that are almost unchanged throughout the year. Because of the wind-influenced surficial ocean currents, ocean circulation and the general circulation patterns of the atmosphere are related. Currents that have the potential to affect the U.S. include the Gulf Stream, the California, and Labrador currents. (Naval Meteorology and Oceanography Command, 2004)

Wetlands

Generally, wetlands are lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface. (Cowardin, 1979) Wetlands vary widely because of regional and local differences in soils, topography, climate, hydrology, water chemistry, vegetation, and other factors, including human disturbance. Wetlands are found from the tundra to the tropics and on every continent except Antarctica. For regulatory purposes under the Clean Water Act, the term wetlands means "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas." (40 CFR 230.3(t))

The Cowardin classification system has five wetland systems, eight subsystems, and 11 classes of wetlands. The term "system" refers here to a complex of wetlands and deepwater habitats that share the influence of similar hydrologic, geomorphologic, chemical, or biological factors. Exhibit 3-10 presents a description of the wetland systems.

Exhibit 3-10. Wetlands Systems

System	Description
Marine	The Marine System consists of the open ocean overlying the continental shelf and its associated high-energy coastline. Marine habitats are exposed to the waves and currents of the open ocean and the water regimes are determined primarily by the ebb and flow of oceanic tides. Salinities exceed 30 percent, with little or no dilution except outside the mouths of estuaries. Shallow coastal indentations or bays without appreciable freshwater inflow, and coasts with exposed rocky islands that provide the mainland with little or no shelter from wind and waves are also considered part of the Marine System because they generally support typical marine biota.
Estuarine	The Estuarine System consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land. The salinity may be periodically increased above that of the open ocean by evaporation. Along some low-energy coastlines an appreciable dilution of sea water exists. Offshore areas with typical estuarine plants and animals, such as red mangroves (*Rhizophora mangle*) and eastern oysters (*Crassostrea virginica*), are also included in the Estuarine System.
Riverine	The Riverine System includes all wetlands and deepwater habitats contained within a channel, with two exceptions: (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) habitats with water containing ocean-derived salts in excess of 0.5 percent. A channel is "an open conduit either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of standing water."
Lacustrine	The Lacustrine System includes wetlands and deepwater habitats with all of the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30 percent areal coverage; and (3) total area exceeds 8 hectares (ha) (20 acres). Similar wetland and deepwater habitats totaling less than 8 ha

System	Description
	are also included in the Lacustrine System if an active wave-formed or bedrock shoreline feature makes up all or part of the boundary, or if the water depth in the deepest part of the basin exceeds 2 meters (6.6 feet) at low water. Lacustrine waters may be tidal or nontidal, but ocean-derived salinity is always less than 0.5 percent.
Palustrine	The Palustrine System includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 percent. It also includes wetlands lacking such vegetation, but with all of the following four characteristics: (1) area less than 8 ha (20 acres); (2) active wave-formed or bedrock shoreline features lacking; (3) water depth in the deepest part of basin less than 2 meters at low water; and (4) salinity due to ocean-derived salts less than 0.5 percent.

Wetlands are capable of a wide variety of ecological functions that provide significant biological, economic, and societal values. The functionality of a wetland depends upon its physical location (e.g., freshwater or coastal environs), the hydrological regime, surrounding topography, precipitation, climate, soils, and available nutrients. Some of the most important wetland functions include

- Critical habitats that provide food, shelter, nesting, and breeding/spawning grounds,
- Decomposition of organic material that incorporates nutrients back into the food web,
- Natural flood storage capabilities, and
- The improvement of water quality.

By providing a mix of terrestrial and aquatic environs, wetlands maintain a unique habitat on which numerous species including invertebrates and microorganisms are dependent. According to data from the Natural Resources Conservation Service, wetlands in the U.S. support about 5,000 plant species, 190 species of amphibians, and a third of all native bird species. Coastal wetlands are an integral part of the life cycle for many marine organisms; they are the nursery and spawning grounds for 60 to 90 percent of U.S. commercial fish catches. (U.S. Department of Agriculture, 2004)

Floodplains

Floodplains consist of the low-lying areas adjacent to rivers and streams that are subject to natural inundations typically associated with precipitation. The most common regulatory definition concerning such an area is the 100-year floodplain or Special Flood Hazard Area, which has been established for most U.S. rivers and streams by the Federal Emergency Management Agency (FEMA). By FEMA standards, a 100-year flood is a flood that has a one percent chance of being reached or exceeded in any given year. In some cases FEMA has also designated floodways. Floodways are areas likely to experience the deepest and fastest flowing floodwaters. The risk and severity of a flood depends on several factors that include the size of the watershed, surrounding topography, stream bank elevation, annual rainfall or snowfall, and the presence of upstream water bodies, dams, or other hydraulic modifications.

Floodplains serve a critical role in floodwater attenuation, water quality, and ground water recharge. Floodplains naturally slow storm water velocities and accommodate peak flows, allowing for organic waste and sediment removal. Natural vegetation present within the floodplain serves as a buffer for excessive nutrient loads, assists in stabilizing water temperatures, and as a filtration system for other contaminants, thus improving water quality. Floodplains also provide habitat for a wide diversity of plant and animal life whose presence is directly related to the health of a given ecosystem. Many fish, bird, and other wildlife species are dependent upon floodplains as spawning or nesting areas. Streams and their associated floodplains also provide sources of potable water derived from either surface water or ground water recharge. Additionally, floodplains characteristically maintain nutrient rich soils that support agricultural uses which in turn provide economic benefits. Lastly, floodplains provide a wealth of aesthetic and recreational opportunities that not only provide economic, but social value as well.

Ground Water

Ground water is defined as water, both fresh and saline, that is stored below the Earth's surface in pores, cracks, and crevices below the water table. Typical forms of ground water include aquifers and aquifer sources, such as springs and wells. The U.S. Geological Survey (USGS) defines an aquifer as "a formation, group of formations, or part of a formation that contains sufficient saturated, permeable material to yield significant quantities of water to wells and springs." (USGS, 2004) Surface water from precipitation or that resides in wetlands, ponds, lakes, or rivers may enter an aquifer through percolation through soils. Areas that provide source water to the aquifers are known as recharge zones. Water that moves into the ground first enters a belt of soil moisture that is known as the zone of aeration or the unsaturated zone. Once soils and plants have removed what water they need, surplus water can then move through an intermediate belt and into the ground water's zone of saturation. (Botkin, 1987)

The occurrence of ground water is dependent upon a given area's geology, soils, topography, and climatic regimes. Thus, the amount of ground water present throughout the U.S. is not evenly distributed and the depth to ground water can be close to the surface or lie several hundred feet below. (USGS, 1999)

Ground water is critical because aquifers serve as a major source of drinking water in the U.S., as well as sources of irrigation for agriculture, industrial, and mining activities. Accessed via drilled wells, artesian wells, and springs, ground water typically tends to be acceptable for human consumption. This is because ground water is less susceptible to contamination by pollutants associated with human activity than surface water. The soils and rocks associated with aquifers act as a filtration system for most biological contaminants, though high bacterial concentrations can exist in some cases, especially where the ground water table is shallow. (USGS, 1999) Additionally, minerals and organic constituents are present in ground water. These are harmless in most cases, but in rare cases can be harmful or even toxic. (USGS, 1999)

According to the USGS, factors such as population growth, technology that allows for more rapid ground water removal rate, and added industrial and agricultural demands have had an impact on ground water supplies. Human activity contributes to ground water degradation in the form of pesticide, herbicide, and fertilizer use, which can percolate through soils and into aquifers. Additional human stressors include leaking sewage and septic systems, petroleum product or chemical spills, and landfill leachates. (USGS, 1999) Because most ground water recharge occurs at a very slow rate, growing water demands and contamination can pose significant issues. Recharge rates may not be able to keep up with increasing water demands and diminishing ground water resources in some areas such as the Midwest, and the overuse of shallow coastal aquifers can result in saltwater intrusion that renders the ground water infeasible for future public uses. Another issue is that ground water contamination is extremely difficult to detect, and recognition of contamination may not occur until an aquifer's water quality has been compromised.

4 ENVIRONMENTAL CONSEQUENCES

This section describes the potential environmental consequences of the proposed action and the no action alternative, and discusses potential mitigation measures, as appropriate. Under the proposed action, the potential impacts associated with the land-based sensor systems are presented, followed by the potential impacts associated with the airborne sensor systems, and concludes with an analysis of the site-specific activities, as presented in Section 2.

Section 4.1, Impacts of Land-Based Sensors, presents a discussion of Alternative 1, as well as the description of the conditions of the land-based portion of the proposed action. Section 4.2, Impacts of Airborne Sensors, presents a discussion of Alternative 2, as well as the description of the conditions of the airborne portion of the proposed action. Section 4.3, Impacts of the Proposed Action, presents a summary of the impacts associated with the proposed action by combining the impacts discussed in Sections 4.1 and 4.2.

4.1 Impacts of Land-Based Sensors

The impacts analysis focuses on those resource areas that may be impacted by the use of land-based sensors based on the assumptions presented in Section 2.1.1. No impacts are associated with the setup of the land-based sensor systems (i.e., radars, telemetry, and optical) because the proposed placement of the sensor system would be in an area that had been previously disturbed and would require minimal if any additional grading or clearing activities. A site-specific analysis would be required for the placement of a sensor in an undisturbed area that would require grading, clearing, or other ground disturbing activities. The impact analysis presented in this EA is based on the transportation and the operation of the land-based sensors.

The transportation of the mobile land-based sensors to the test site, the use of portable generators during sensor operation, and the operation of the radars would potentially impact some resource areas. The transportation analysis discusses the impacts associated with transporting the mobile sensor equipment via land, air, and sea. The analysis of the operation of the generators during sensor operation discusses the air and noise emissions associated with diesel generators. The analysis of the radars focuses on the impacts associated with the emission of electromagnetic frequencies (microwaves). Exhibit 4-1 presents a brief summary of the potential for impact to various resource areas from the use of land-based sensors.

Exhibit 4-1. Summary of Potential Land-Based Sensor Impacts Associated with the Proposed Action on Resource Areas

Resource Area	Land-Based Sensors				
	Radar/ LIDAR	Telemetry	Transceiver Systems	Command and Control	Optical
Air Quality	Yes*	Yes*	Yes*	Yes*	Yes*
Airspace	Yes (EMF and laser)	No	Yes (EMF)	No	No
Biological Resources	Yes (microwave and laser)	No	Yes (EMF)	No	No
Cultural Resources	No	No	No	No	No
Geology and Soils	No	No	No	No	No
Hazardous Materials and Hazardous Waste	No	No	No	No	No
Health and Safety	Yes (microwave and laser)	No	Yes (EMF)	No	No
Land Use	No	No	No	No	No
Noise	Yes**	Yes**	Yes**	Yes**	Yes**
Socioeconomics and Environmental Justice	Yes	Yes	Yes	Yes	Yes
Transportation	Yes***	Yes***	Yes***	Yes***	Yes***
Visual Resources	Yes	Yes	Yes	Yes	Yes
Water Resources	No	No	No	No	No

Notes: *Transportation of the system and generator operation
**Generator operation
***Transportation of system
The resource areas that were determined not to be potentially impacted by land-based sensors are not analyzed further in this section of the EA.
EMF = Electromagnetic Frequency

The telemetry, command and control, and optical systems are passive systems, meaning that they only receive and record data and do not emit energy; therefore, with the exception of air quality, noise, transportation, visual resources, and socioeconomics, the operation of such equipment would not impact any resource areas. Radar and transceiver operations would emit radio waves, which would affect living organisms but would not impact non-living resources including cultural resources, geology and soils, land use, or water resources. The LIDAR systems emit a low power laser beam that may impact airspace use, biological resources, and health and safety. Because radars and the LIDAR system would be used to track flying objects from a fixed location on the ground, the microwaves emitted by the radar and the laser emitted from the LIDAR would not be directed at aquatic biological resources and would not impact such resources.

Hazardous materials associated with land-based sensors include diesel fuel, petroleum based lubricants, coolants, as well as various epoxies, resins, and materials that make up the physical sensor. The use and potential disposal of the hazardous materials consumed by the mobile sensors (fuel, lubricants, and coolants) would be in accordance with applicable regulations including Hazardous Waste Management plans; therefore, there would be no hazardous waste impact from their use. The hazardous materials that make up the physical sensor, would not be consumed or disposed of during a test event, and would not result in any hazardous waste impacts.

4.1.1 Air Quality

The following presents the impacts on air quality associated with the transportation and operation of the mobile land-based sensor systems. As presented under Section 2.1, Proposed Action, MDA assumed ten tests per year per sensor system the following conditions associated with the use of each land-based mobile sensor.

- Land-based sensors would be transported via tractor-trailer, C-5, or C-130 transport planes. (Note: other similar transport planes may be used; however, this analysis is based on the use of C-5 or C-130 aircraft, depending on the dimensions of the land-based sensors.)
- The sensor would be set up in a previously disturbed area that is not located on or adjacent to an environmentally sensitive resource (e.g., threatened or endangered species habitat, wetlands, cultural resource, national park, recreation area, refuge, monument, or a populated area).
- If a previously disturbed area cannot be found or is inappropriate to sensor needs, a site-specific analysis could be required for the placement of a sensor and would be completed in accordance with NEPA, as appropriate.
- Distances greater than 1,000 miles would be transported via transport plane.
- No previously undisturbed areas or environmentally sensitive resource area would be cleared to set up or operate the sensor.
- The sensor would require power from a portable generator.

- Each test event would last one week (seven days).
- The sensors and support equipment would operate for eight hours per day during the test event for a total of 56 hours per test event, or a total of 560 hours per year. Integration of sensors consists of the transmission or delivery of data to an integration facility. Activities occurring at integration facilities are outside the scope of the EA.

Exhibit 4-2 lists the generator power and transportation requirements of the land-based mobile sensors.

Exhibit 4-2. Mobile Land-Based Sensors

Type	Sensor System	Power Requirements	Transport Requirements
Radar	TPS-X	1.5 MW (Two 750 kW generators)	Three C-5s or Five Tractor Trailers
	FBX-T	1.5 MW (Two 750 kW generators)	Three C-5s or Five Tractor Trailers
	MK-74	250 KW	Two C-130s or Three Tractor Trailers
	MPS-36	500 KW	Two C-130s or Four Tractor Trailers
Telemetry	TTS	100 KW	Two C-130s or Four Tractor Trailers
	MRSS	200 KW	Two C-130s or Four Tractor Trailers
	RSTS	200 KW	Two C-130s or Four Tractor Trailers
Command and Control	TRACS	100 KW	One C-130 or One Tractor Trailer
Optical	SHOTS	50 KW	One C-130 or One Tractor Trailer
LIDAR	ISTEF	80 KW	One C-130 or One Tractor Trailer

The following subsections present the impacts on air quality during transportation and operation of the sensor systems.

Transportation Related Emissions

The on-road transportation of the various land based sensors would result in emission of VOCs, CO, NO_X, PM, including diesel particulates, and SO_2, while air transport would result in the emissions of hydrocarbons (HC), CO, NO_X, and SO_2. Because the location of the mobile land-based sensor in relation to the proposed testing location would vary by test event, MDA assumed as a conservative estimate that the one-way distance to a test event would equal 1,000 miles, for a total of 2,000 miles round trip. Of the 1,000 miles, MDA assumed that highways would make up 90 percent of the on-road travel and local road travel would make up 10 percent. Exhibit 4-3 presents the emissions per truck associated with the transport of the land-based mobile sensors.

Exhibit 4-3. On-Road Emissions

Roadway Type	Pollutant	Emissions in Grams per Mile*	Miles (round trip)	Grams per Event per Truck	Pounds per Event per Truck
Highway	VOC	0.374	1,800	893.2	1.97
Local		1.100	200		
Highway	CO	2.649	1,800	6,060.4	13.36
Local		6.461	200		
Highway	NO_X	33.136	1,800	62,731.6	138.30
Local		15.434	200		
Highway	PM_{10}	0.316	1,800	632	1.39
Local		0.316	200		
Highway	SO_2	0.346	1,800	692	1.52
Local		0.346	200		

* The emission factors were derived from the U.S. EPA mobile source emission factor model, MOBILE6.2, and assumed that the trucks involved in the transport would be no older than model year 2002.

Exhibit 4-4 presents the emission associated with up to five tractor trailers involved in transporting the mobile sensors.

Exhibit 4-4. Total Tractor Trailer Emissions per Event

Pollutant	1 Truck (pounds)	2 Trucks (pounds)	3 Trucks (pounds)	4 Trucks (pounds)	5 Trucks (pounds)
VOC	1.97	3.94	5.91	7.88	9.85
CO	13.36	26.72	40.08	53.44	66.8
NO_X	138.30	276.6	414.9	553.2	691.5
PM_{10}	1.39	2.78	4.17	5.56	6.95
SO_2	1.52	3.04	4.56	6.08	7.60

The potential range of emissions associated with the transport of land-based mobile sensors by tractor-trailer would be from zero emissions (a location where no annual testing would occur) to 98.5 pounds of VOCs, 668 pounds of CO, 6,915 pounds (3.46 tons) of NO_X, 69.5 pounds of PM_{10}, and 76 pounds of SO_2. This amount of emissions is based on 5 tractor trailers for 10 test events. The emissions associated with the on-road transport of the sensor equipment would be released along the entire transport route and even if the emissions would occur in a single non-attainment area, they would not exceed any *de minimis* thresholds for ambient air quality standards. The emissions associated with transport of mobile sensors would not result in a significant impact on ambient air quality.

In addition to analyzing on-road emissions of the transport of mobile land-based sensors, MDA reviewed the emissions associated with transportation via one C-130 or three C-5 transport plane(s). The C-5 was determined to be a conservative estimate of the emissions associated with the transport of the TPS-X or the FBX-T radars. The flight phase activities associated with the transport plane that would result in emissions include idling, take-off, climb out, and approach. Exhibit 4-5 presents the emissions per take-off/landing cycle for the C-130 and C-5 transport planes.

Exhibit 4-5. Aircraft Emissions for the C-130 and C-5

Mass	**C-130 Emissions (grams)**			
	HC	**CO**	**NO_X**	**SO_2**
C-130 Total Emissions per take-off/landing cycle				
Grams	7,935	8,868	5,195	380
Kilograms	7.94	8.87	5.20	0.38
Pounds	17.49	19.55	11.45	0.84
C-5 Total Emissions per take-off/landing cycle				
Grams	33,000	57,200	34,300	1,200
Kilograms	33	57.2	34.3	1.2
Pounds	72.75	126.1	75.62	2.65

Source: See Appendix D

The emissions presented in Exhibit 4-5 associated with the aerial transport of the sensor equipment would be released at the bed-down location and at the staging area associated with the proposed test site. For each test event, each transport plane would be involved in two approach and take-off cycles, once during delivery, and once during pick up. Exhibit 4-6 presents the total emissions per event.

Exhibit 4-6. Total C-130 and C-5 Emissions per Test Event

Pollutant	**1 C-130 Transport (pounds)**	**2 C-130 Transports (pounds)**	**3 C-5 Transports (pounds)**
HC	34.99	69.98	436.5
CO	39.10	78.20	756.60
NO_X	22.91	45.81	453.72
SO_2	1.67	3.35	15.9

The potential range of emissions would be from zero emissions (a location where no annual testing would occur) to up to 4,365 pounds (2.18 tons) of HC, 7,556 pounds (3.78 tons) of CO, 4,537.2 pounds (2.27 tons) of NO_X, and 159 pounds (0.08 tons) of SO_2 (a location where 10 test events would occur annually requiring one C-5 transport plane). The additional aircraft operations associated with the transport of mobile sensors would not exceed any *de minimis* thresholds for the criteria pollutants, as defined under the CAA for any of the locations listed in Exhibit 3-5. The emissions associated with three C-5 transport planes would not exceed even the most restrictive *de minimis* threshold levels.

Operations Related Emissions

The land-based mobile sensors would require a variety of generators, based on the power requirements of the mobile sensors (see Exhibit 4-2). To calculate the emissions associated with each type of generator, Exhibit 4-7, Generator Kilowatt Output to Horsepower, lists the horsepower of the generator required to produce a particular kilowatt output. Exhibit 4-8 estimates the average emissions from generators based on horsepower (HP) and the total amount of time the generators are used.

Exhibit 4-7. Generator Kilowatt Output to Horsepower

Mobile Land-Based Sensor	Engine HP	Kilowatt Output
SHOTS	100	50
TRACS, TTS, ISTEF	200	100
MK-74, MRSS, and RSTS	300	200
MPS-36	750	500 to 700
TPS-X and FBX-T	Two at 750 each	1,400

Exhibit 4-8. Average Generator Emission by Horsepower (HP)

HP	Pollutant	Grams per HP per Hour	Grams per Day	Pounds per Day	Pounds per Event	10 Event Total (tons)
100	TOC	1.10	880	1.94	13.58	0.07
	NO_X (BACT)	6.90	5,520	12.17	85.19	0.43
	NO_X (uncontrolled)	14.06	11,248	24.80	173.58	0.87
	SO_2	0.18	147.2	0.32	2.27	0.01
	CO	2.75	2,200	4.85	33.95	0.17
	CO_2	526.00	420,800	927.70	6,493.87	32.47
	PM_{10}	1.00	800	1.76	12.35	0.06

HP	Pollutant	Grams per HP per Hour	Grams per Day	Pounds per Day	Pounds per Event	10 Event Total (tons)
200	TOC	1.10	1,760	3.88	27.16	0.14
	NO_X (BACT)	6.90	11,040	24.34	170.37	0.85
	NO_X (uncontrolled)	14.06	22,496	49.59	347.16	1.74
	SO_2	0.18	294.4	0.65	4.54	0.02
	CO	2.75	4,400	9.70	67.90	0.34
	PM_{10}	1.00	1,600	3.53	24.69	0.12
	CO_2	526.00	841,600	1,855.39	12,987.74	64.94
300	TOC	1.10	2,640	5.82	40.74	0.20
	NO_X (BACT)	6.90	16,560	36.51	255.56	1.28
	NO_X (uncontrolled)	14.06	33,744	74.39	520.74	2.60
	SO_2	0.18	441.6	0.97	6.81	0.03
	CO	2.75	6,600	14.55	101.85	0.51
	PM_{10}	1.00	2,400	5.29	37.04	0.19
	CO_2	526.00	1,262,400	2,783.09	19,481.61	97.41
750	TOC	1.10	6,600	14.55	101.85	0.51
	NO_X (BACT)	6.90	41,400	91.27	638.89	3.19
	NO_X (uncontrolled)	14.06	84,360	185.98	1,301.86	6.51
	SO_2	0.18	1,104	2.43	17.04	0.09
	CO	2.75	16,500	36.38	254.63	1.27
	PM_{10}	1.00	6,000	13.23	92.59	0.46
	CO_2	526.00	3,156,000	6,957.72	48,704.02	243.52
1,235	TOC	1.10	10,868	23.96	167.72	0.84
	NO_X (BACT)	6.90	68,172	150.29	1,052.04	5.26
	NO_X (uncontrolled)	14.06	138,912.8	306.25	2,143.73	10.72
	SO_2	0.18	1,817.9	4.01	28.05	0.14
	CO	2.75	27,170	59.90	419.29	2.10
	PM_{10}	1.00	9,880	21.78	152.47	0.76
	CO_2	526.00	5,196,880	11,457	80,199.29	401.00

Source: USEPA 1996, and CARB 2003
Notes: TOC – Total Organic Carbon
Regular diesel fuel is about 87 percent carbon by weight, resulting in 10.33 kilograms of carbon dioxide produced per gallon of diesel fuel consumed.

The emissions associated with the use of the various mobile land-based sensors would vary based on the mode of transportation and the sensors that would be used and availability of existing shore power. As a possible example scenario, Exhibit 4-9 lists the emissions associated with the use of the FBX-T (two 750 HP generators), an RSTS (a 300 HP generator), the SHOTS (a 100 HP generator), and a TRACS (a 200 HP generator), as well as transporting the equipment to the test site via three C-5 aircraft.

Exhibit 4-9. Test Event Generator Emissions for Example Scenario

Pollutant	Tons per Event	Tons per 10 Events
TOC	0.36	3.6
NO_X (BACT)	1.12	11.2
NO_X (Uncontrolled)	2.05	20.5
SO_2	0.03	0.3
CO	0.73	7.3
PM_{10}	0.13	1.3

In potential test areas where all or some of the power requirements would be available, the emissions would be reduced. The emissions associated with the generators would impact local air quality; however, even if the 10 events of the hypothetical scenario shown in Exhibit 4-9 occurred within the most stringent nonattainment area associated with the land-based test sites (a severe nonattainment area for ozone), the emission values would not exceed the *de minimis* emission levels. In addition, because the location where the mobile land-based sensors and their associated generators would be used are within active test ranges, sensitive populations (children, elderly) or locations (schools, population centers) would not be located near such emission sources. In addition, MDA or the test proponent would be required to notify regulators, obtain all necessary permits, and in some cases complete Toxic Risk Screening Analyses. Exhibit 4-10, lists the potential locations where the land-based mobile sensors would be used and their current attainment status under the Clean Air Act.

Exhibit 4-10. Location of Land-Based Sensor Activity and Nonattainment Status

Location	State	County	Nonattainment for Pollutant
King Salmon AS	Alaska	Bristol Bay	In attainment
Eareckson AS	Alaska	Aleutians West	In attainment
KLC	Alaska	Kodiak Island	In attainment
Merle K. Smith Airport	Alaska	Valdez Cordova	In attainment
Vandenberg AFB	California	Santa Barbara and San Luis Obispo Counties	8-hour ozone – Maintenance

Location	State	County	Nonattainment for Pollutant
Naval Base Ventura County Port Hueneme/San Nicolas Island/Point Mugu, California	California	Ventura	1-hour ozone – Severe 15 8-hour ozone - Moderate
PMRF	Hawaii	Kauai	In attainment
WSMR	New Mexico	Dona Ana, Otero, Sierra, Socorro, Lincoln	WSMR is in attainment Dona Ana County – Sunland Park, 1-hour zone; and Anthony, PM-10
Wallops Island	Virginia	Accomack	In attainment
NASWI	Washington	Island	In attainment
USAKA	n/a	n/a	n/a
Midway Island	n/a	n/a	n/a
Wake Island	n/a	n/a	n/a

Source: EPA Greenbook

Exhibit 4-11 lists the state specific regulatory criteria (permits and risk assessments) that may apply for non-road mobile source emissions (generators).

Exhibit 4-11. State Specific Emission Standards

State	Threshold	Regulation	Contact
California	NO_X emissions >10 pounds/highest day triggers best available control technology (BACT); diesel particulates (PM_{10}) 0.64 pounds/year requires Toxic Risk Screening Analysis	Regulation 2-2-30; http://www.arb.ca.gov/bluebook/bluebook.htm	California Air Resources Board
Virginia	An exemption applies if engines do not exceed 500 hours of operation per year at a single stationary source as follows: diesel engines powering electrical generators having an aggregate rated power output of less than 1,125 kW. However, it is	9-VAC-5-80-1320, Item (B)(2)(b) available at: http://www.deq.virginia.gov/air/pdf/airregs/806.pdf Form 7 available at: ftp://ftp.deq.virginia.gov/pub/air/permitting/form7.doc	Virginia Department of Environmental Quality Air Program Coordination (http://www.deq.state.va.us/air/homepage.html)

Exhibit 4-11. State Specific Emission Standards

State	Threshold	Regulation	Contact
	necessary to fill out a Form 7 for a proposed unit.		
New Mexico	No requirements if emissions are <10 Tons/year and <10 pounds/hour. If emissions are >10 Tons/year, a notice of intent is required. If emissions are >25 Tons/year or >10 pounds/hour, a permit is required.	20.2.73 part 200; 20.2.72 part 200 http://www.nmenv.state.nm.us/aqb/regs/index.html	New Mexico Environment Department, Air Quality Bureau (http://www.nmenv.state.nm.us/aqb/contact.html)
Washington	If input is greater than or equal to 1,000,000 BTUs/hour, then a permit is required. All generators operating less than 500 hours/year are being waitlisted, where operations may proceed without a permit.	Northwest Clean Air Agency Regulation 300.4 (c)(4) http://www.ecy.wa.gov/laws-rules/ecywac.html	Northwest Clean Air Agency[2]
Hawaii	No permit is needed if emissions are <1 Ton/year for all criteria pollutants and <0.1 Tons/year for hazardous air pollutants. If exempt, not required to consult with agency.	Non-covered sources, Ch. 4, 11-60.1-62 (d)(1) http://www.hawaii.gov/health/about/rules/11-60-1.pdf	Hawaii State Department of Health Clean Air Branch
Alaska	All diesel generators are approved on a case-by-case basis, by filling out an application for a pre-approved emission limit.	18 Alaska Administrative Code 50.230(c)	Alaska Department of Environmental Conservation, Division of Air Quality

For installations in California, Vandenberg AFB and the Naval Base Ventura County Port Hueneme, San Nicolas Island, Point Mugu, the use of the portable generators would have to meet the standards developed by the California Air Resources Board (CARB) as well as the local air quality control district. Under such conditions, generators that would emit NO_X in excess of 10 pounds per day would require a permit, and generators that emit

[2] This is one of seven local air agencies in the state of Washington, and it covers Skagit, Island and Whatcom Counties. This area is where Whidbey Island is located.

diesel particulates (a toxic pollutant) in excess of 0.6 pounds per year, would need to pass a toxic risk screening level of less than ten in a million.

Under the permit conditions, the generators would be required to meet the best achievable control technologies (BACT). Such conditions may include a turbocharger, aftercooler, direct fuel injection, and specific engine tuning (10 degrees before top dead center for injection timing) to reduce NO_X emissions, a diesel oxidation catalyst and/or low-sulfur diesel fuel to reduce PM emissions, positive crankcase ventilation to reduce POC emissions, low-sulfur diesel fuel (0.05% by wt.) to reduce SO_2 emissions. The risk screening would assume a constant exposure of ultra sensitive populations (e.g. young people, schools, the elderly, and the infirm) at 24 hours for a 70 years life. The location of the emissions in relation to the residential and industrial receptors as well as the hours of operation would be factored into the analysis. MDA or the test proponent would be required to obtain the necessary permits and complete the necessary toxic risk screening analysis prior to using the portable generators. Because such measures would be implemented the operation of the land-based sensors would not result in a significant impact on air quality.

4.1.2 Airspace

The activities associated with the proposed action would result in electromagnetic radiation (EMR) emissions from the radar and transceiver systems as well as laser light emissions that may impact airspace. The emission of high energy EMR would affect navigation and communication systems of aircraft operating near the location of the mobile land-based sensors. The laser light emissions may affect the pilot of the aircraft.

The FAA and DoD have standards for EMR interference with aircraft. DoD uses MIL-STD-464, which indicates that to operate in the area, military aircraft would have to be protected from EMR levels up to 3,500 volts per meter (peak power) and 1,270 volts per meter (average power). Commercial aircraft must be protected from EMR levels up to 3,000 volts per meter (peak power) and 300 volts per meter (average power) as mandated by the FAA by Notice 8110.71, Guidelines for the Certification of Aircraft Flying through High Intensity Radiated Field Environments.

The following provides a brief discussion of each type of system and its potential impacts on airspace.

Radars

The radars associated with the proposed action would emit EMR and may require a high-energy radiation notice. The operation of the radar and its programming may affect the size and duration of such notices. The following are the approximate sizes of the potential high-energy radiation notice associated with the radar systems associated with the proposed action.

- TPS-X - 514 meters
- FBX-T – 514 meters
- MK-74 – 1,128 meters
- MPS-36 - 114 meters

A high-energy radiation area notice would be published on the appropriate aeronautical charts, notifying aircraft of a radio frequency radiation area. The boundaries of the radar high-energy radiation area would be configured to minimize impacts to aircraft operations and other potentially affected systems. Radar operations would be coordinated with FAA and range officials, and the operations would be scheduled to occur during hours of minimal aircraft operations if possible. In addition, radars would be programmed to limit radio frequency emissions in the direction of airways that pass within the potential interference distance. In addition, because the radar beam would be in constant motion, it would be unlikely that the radars would illuminate an aircraft long enough to interfere with onboard electronics.

Transceiver Systems

The transceiver systems associated with the proposed action would emit EMR and may require a high-energy radiation notice. The operation of the transceiver systems and its programming may affect the size and duration of such notices. The following are the approximate sizes of the potential high-energy radiation notice associated with the transceiver systems associated with the proposed action.

- MRSS – None
- RSTS – None

The high-energy radiation area notice would follow the same procedures as those presented for the radars.

LIDAR

The laser light emissions associated with the LIDAR would not impact airspace. The laser light emissions would use a filter, which results in laser light that would be eye-safe; therefore it would not affect pilots and would not impact airspace.

Telemetry, Optical, and Command and Control

The use of the telemetry, optical, and command and control systems associated with the proposed action would not result in the emission of high-energy EMR and would not impact airspace.

Notifications

NOTAMs and NOTMARs would be sent in accordance with the conditions of the directive specified in Army Regulation 95-10, Operations. The U.S. NOTAM System, Sections 3-2n(1)(a) and (b) deal with operations/exercises over the high seas, host nation territory, international airspace, and bare-base locations, and specifies the International NOTAM office coordination requirements and procedures (Army Regulation 95-10, 1990). To satisfy airspace safety requirements in accordance with the service-specific regulations or directives of the Army, Air Force, or Navy, specifically Army Regulation 385-62, MDA or the test proponent would obtain approval from the Administrator, FAA, through the appropriate Army airspace representative as required by Army Regulation 95-50. Provision would be made for surveillance of the affected airspace in accordance with Army Regulation 385-62 (1983).

For each specific radar and transceiver system, the FAA would be requested to establish a navigation warning advising aircraft to remain at safe distances from the source of such equipment. MDA or the test event sponsors would be responsible for coordinating airspace use and notifying the FAA to establish the navigation warnings. Such warnings may include issuing NOTAMs and NOTMARs to notify people in the affected area that a test event is planned. Additionally, additional aircraft may be used to ensure that the test area is clear of non-participating aircraft and marine vessels.

Airspace restrictions would be short-term events and would not pose a significant impact on available airspace surrounding the proposed testing locations. Sufficient notice of restricted areas and appropriate Altitude Reservations would be provided to allow pilots to select alternate flight paths to avoid the restricted areas. Potential safety consequences associated with radar interference with electronic and emitter units (e.g., flight navigation systems, tracking radars) would also be examined before startup.

4.1.3 Biological Resources

The operation of the mobile land-based sensors would impact surrounding vegetation and wildlife. The impacts to vegetation would include the potential removal of pioneering vegetation on previously disturbed locations and limited pruning or removal of vegetation downrange of a radar or transceiver. Such impacts would not be considered significant impacts, because as presented in Section 2, such activities would occur in previously disturbed areas that would not be located within or adjacent to an environmentally sensitive resource.

The impacts on wildlife would result from the noise emitted from the generator as well as any cooling fans associated with the sensors (see Section 4.1.5, Noise, for a description of the noise), and from potential night-time artificial lighting. The noise may startle and preclude wildlife from using areas in the vicinity of the sources; however, because the sensors would be set-up in previously disturbed areas that would not be located within or adjacent to an environmentally sensitive resource, the impacts would not be significant. The artificial lighting may preclude certain wildlife species from or attract certain wildlife species to the location of the mobile land-based sensors. However, because the sensors would be located in a previously disturbed area that is not located within or adjacent to an environmentally sensitive resource, the impacts would not be significant. In addition to the noise and light, the EMR emitted from the radars and transceivers may impact wildlife. The power densities emitted from the radars associated with the mobile land-based sensors would be unlikely to cause any biological effects in land dwelling animals or on aquatic or marine animals. The radars would not radiate lower than five degrees above horizontal, which would preclude EMR impacts on land dwelling animals or on aquatic or marine animals outside of the uncontrolled hazard area (see Exhibit 2-12).

The potential for main-beam (airborne) exposure thermal effects to birds exists. The radar beam would normally be in motion, making it extremely unlikely that a bird would remain within the most intense area of the beam for any considerable length of time. The size of the beam is relatively small, which further reduces the probability of bird species remaining within this limited region of space, even if the beam were still. (Ballistic Missile Defense Organization, 2000) In addition, the laser light emissions associated with the LIDAR, a solid-state 1.5 µm eye safe laser radar, would result in laser light that would be eye-safe and would not affect biological resources.

The MDA has considered the impacts to birds from the operation of radars as part of earlier environmental analyses. Specifically, the 1993 Ground-Based Radar Family of Radars Environmental Assessment (EA) analyzed potential impacts on wildlife from EMR, in particular migrating birds that might fly through the radar beams. That analysis concluded that because the main beam would normally be in motion, it would be extremely unlikely that a bird would remain within the most intense area of the beam for any considerable length of time. That analysis also noted that the size of the beam is "relatively small," further reducing the probability of birds remaining within this limited region of space, even if the beam remained still. (U.S. Army Space and Missile Defense Command, 2003) The MDA has also undertaken additional analyses on the potential impacts to wildlife, particularly migratory birds and resident bird populations from EMR, the results of which are presented in Appendix C. The extent of exposure of migrating birds and resident populations to radar beams depends both on the behavior of the birds and the motion and output of the radars (see Appendix B for additional information).

The following summarizes the results of the analysis presented in Appendix C on the impacts associated with the peak power, the average power, single pulse, and surveillance mode of radars.

As presented in Appendix C, Exhibit C-13, no birds would be exposed to ERM that exceeds the IEEE Std c95.1-1999 peak power density limit of 2,652 W/cm^2. For the average power, the X-band radar the reference value, 10 mW/cm^2 was exceeded at altitudes of less than 150 meters above the radar (Exhibit C-11). The far field equation, which significantly overestimates power densities close to a radar, was used to determine these values, thus, the actual power density may not exceed the 10 mW/cm^2 threshold.

As presented in Appendix C for single pulse exposures, (Exhibit C-15) shows values less than the reference value of 10 mW/cm^2 and indicates a negligible risk of impacting a bird encountering the beam. For radars in surveillance mode (Exhibit C-16), birds within 500 meters of the radars might be exposed to EMR above the threshold of 10 mW/cm^2 average over six minutes. Because the peak power was estimated using the far field equation and the distance is well within the near field, the actual exposures may be less.

In summary, the analysis indicates that only the X-band mobile radars may present a small risk in spring and fall to some migrating birds during periods of inclement weather, when birds migrate at lower altitudes than usual, as well as to resident bird populations. Therefore, there is likely to be no or a very small risk to migrating birds from flying over areas where mobile X-band radars are operating. The analysis further shows that, under both tracking and surveillance modes that there is very low probability of an impact on migrating birds and on resident bird populations.

Threatened and Endangered Wildlife Species

The potential for impacts on threatened and endangered seabirds would be the same as that discussed above for wildlife. The radars would not be expected to radiate lower than 5 degrees above horizontal and would not impact land dwelling animals or aquatic or marine animals outside of the uncontrolled hazard area.

In addition RF radiation does not penetrate the surface of water to any great degree. The power density level just below the surface of the ocean would not exceed the permissible exposure level for uncontrolled environments. (U.S. Department of the Navy, 2002a) No adverse impacts would occur to whales, other marine mammals, or sea turtles at least 1.3 centimeters (0.5 inch) below the surface. It is also highly unlikely that an individual would be on or substantially above the surface of the water for a significant amount of time within the main beam or side lobe areas when radar would be operating. No impacts to marine mammals would be expected as a result of proposed radar operation. For these reasons, no effects are anticipated on marine mammals, or on sea turtles. Therefore, no further action regarding whales is required pursuant to the Endangered Species Act and the Marine Mammal Protection Act.

4.1.4 Health and Safety

For each proposed location and for each land-based mobile radar or transceiver that would be used at that particular location, an EMR/electromagnetic interference survey would be conducted that considers Hazards of Electromagnetic Radiation to Personnel (HERP), Hazards of Electromagnetic Radiation to Fuels (HERF), and Hazards of Electromagnetic Radiation to Ordnance (HERO), as appropriate (i.e., where sensors and ordnance co-exist). The analysis would provide recommendations for sector blanking and safety systems to minimize exposures. The values collected for the radio frequency ground hazard area would be derived from the IEEE standards and applicable OSHA standards including the pamphlet, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields," OET Bulletin 65, dated August 1997. The analysis would present two sets of criteria, on for the general population/uncontrolled exposure that allows up to 30 minutes of exposure of a power density of 0.29 mW/cm^2, and one for Occupational/Control Exposure that allows up to 6 minutes of exposure of a power density of 1.47 mW/cm^2.

The proposed systems (radars and transceivers) would have appropriate safety exclusion zones established before operation, and warning lights to inform personnel when the system is in operation and emitting EMR. EMR hazard zones would be established within the beam's tracking space and near emitter equipment. A visual survey of the area would be conducted to verify that all personnel are outside the hazard zone prior to startup. Marking the hazard zone would preclude personnel from entering such areas while the radar is in operation. Typical EMR hazard zones are listed in Exhibit 2-12.

The accepted levels for high power effects are 1 megawatt per square centimeter for military equipment and 0.1 megawatt per square centimeter for civilian equipment. Under the proposed sensor operating conditions, full power operation would involve tracking a moving object through the atmosphere with the beam pointed up and constantly moving. The beam would not remain stationary for any appreciable period of time; thus, the stationary equipment would not be exposed to long periods of high power EMR.

Implementation of Range operational safety procedures, including establishment of controlled areas and limitations in the areas subject to illumination by the radar and transceiver units, would preclude any potential safety hazard to either the public or workforce from exposure to EMR. Radar and transceiver operations at the test locations would be coordinated with the FAA, U.S. Coast Guard, and other groups or agencies as appropriate.

Potential health and safety hazards associated with the operation of x-band radars were analyzed in two previous documents: *Ground-Based Radar Family of Radars EA* (U.S. Army Program Executive Office, 1993),, *EA for Theater Missile Defense Ground-Based Radar Testing Program at Fort Devens, Massachusetts* (U.S. Army Space and Strategic Defense Command, 1994a), and the GMD ETR Final EIS. (U.S. Army Space and Strategic Defense Command, 2003) The analyses in the EAs concluded that the required implementation of operational safety procedures, including establishment of controlled areas and limitations in the areas subject to illumination by the radar units, would preclude any potential safety hazard to either the public or workforce from exposure to EMR. Appendix C contains additional information on health and safety impacts and analyses.

Radio frequency emissions associated with communications equipment would be low power so that there is no EMR exposure hazard. In the event of an emergency scenario, telemetry systems would be used to activate the FTS on a missile. A command-destruct onboard transmitter would be located with the telemetry equipment and have both directional and omni-directional antennas. It would operate on ultra high frequency bandwidth at approximately 420 megahertz. The transmitter would be activated manually when the flight path of the missile deviates from established parameters. Upon activation, the transmitter would send arm and destruct tones to the missile to trigger an explosive sequence or thrust termination to terminate flight. Transmission of the arm and destruct signals would be active and would be similar to operation of radars. The discussion of the health and safety impacts of radars would also apply to the use of telemetry systems. The probability that the FTS would be activated is low, and impacts to health and safety because of activation of the command-destruct transmitter would not be anticipated.

Optical Systems

Measurements made by the mobile optical systems would be accomplished non-intrusively with no impacts on health and safety. The mobile optical systems, including telescopes and detectors ranging in wavelength from ultraviolet to the mid-band infrared, which includes the visible light spectrum would be used for “watching” targets like a camera is used. As a result, operation of the mobile optical systems would not impact health and safety.

LIDAR

The laser light emissions associated with the LIDAR would not result in a health and safety impact. The laser light emissions would use a filter, which results in laser light that would be eye-safe and would not affect human health and safety.

4.1.5 Noise

Under the proposed action the primary sources of noise would be from the generator power units and cooling fans associated with various sensor equipment. Exhibit 4-12 presents the noise levels (in dBA) estimated for the operation of generators ranging from 100 to 200 kilowatts. As generators increase in size, the noise associated with their operation does not appreciably increase, and such generators typically would be mounted within an enclosed trailer that would reduce the dBA level emitted from the generator.

Exhibit 4-12. Generator Noise in dBA

Generator Kilowatts and HP	50 ft (15 meters)		23 ft (7 meters)		3 ft (1 meter)	
	No Load	Full Load	No Load	Full Load	No Load	Full Load
114 kilowatts - 216 hp	70	73	76	79	79	83
200 kilowatts - 325 hp	68	71	76	77	83	84
200 kilowatts - 300 hp	67	70	74	77	80	84

Sound in dBA – sound measurement weighted for human hearing.

The operation of the cooling fans would result in similar dBA noise levels as the generators. Because the generators and cooling fans would be located in a previously disturbed area that is not located in or adjacent to any environmentally sensitive resources, and would only be operated for up to 8 hours per day, no significant noise impacts would result from their operation. No sensitive noise receptors would be located near the equipment and all personnel operating such equipment would have the appropriate hearing protection (e.g., ear plugs or ear muffs) in accordance with Federal standards developed by the Occupational Safety and Health Administration to protect worker health and safety. In addition, the EPA recommended value of 65 dBA (decibels that are A-weighted to emphasize frequencies within human sensitivity) is an average over a 24-hour period that would not be exceeded.

4.1.6 Socioeconomics and Environmental Justice

Implementation of the proposed action would not impact socioeconomic conditions or environmental justice concerns. The testing locations have been designed to support temporary project staff to support testing activities, and the additional testing staff would not exceed the capacity of the existing infrastructure at the various facilities. No environmental justice concerns would be impacted because no residential populations that fall under the protection of Environmental Justice are located on the test sites. Should any potential impacts occur outside of the boundary of a test site (EMR hazard areas); such areas would be reviewed for Environmental Justice concerns.

4.1.7 Transportation

Under the proposed action, the approximate maximum number of vehicle miles traveled (VMT) by tractor trailers would be 480,000. This assumes that there would be 10 events per year would involve six land-based mobile sensors in which 4 trucks would be required to transport each sensor system. Should all the mobile land-based sensors be transported via C-130 aircraft, assuming all 10 events would require three C-130 aircraft, a total of 60 round-trip flights (30 deliveries and 30 pick-ups) would occur.

Current statistics (2002) published by the Federal Motor Carrier Safety Administration indicated that 214,530,000,000 VMT were recorded in 2002 with an injury rate of 60.5 per 100,000,000 VMT. Based on the VMT, the 480,000 VMT associated with the proposed action represents less than 0.001 percent of the total tractor trailer VMT, would result in an injury rate of less than 0.3, which are not considered to be a significant impact on transportation. In addition, when in transit, the C-130 or C-5 aircraft would operate as any other plane in the National Airspace System. As such, these planes would follow all applicable procedures as directed by airspace management authorities and would not impact air transportation.

4.1.8 Visual Resources

Under the proposed action, the temporary setup of various antennas, radars, and signal collection dishes may impact the aesthetic setting of an area. Because the sensors would only be set up for short-term (7-day) test events and the locations where the sensors would be set-up would be in previously disturbed areas, no significant impacts on visual resources are associated with the proposed action.

4.2 Airborne Sensor Systems

The impacts analysis associated with airborne sensors focuses on those resource areas that have the potential to the impacted by the use of airborne sensors based on the assumptions presented in Section 2.1.3. Exhibit 4-13 presents a brief summary of the potential for impact on various resource areas from the use of airborne sensors. Those resource areas that were determined to have no potential to be impacted by airborne sensors are not analyzed further in this section EA.

Exhibit 4-13. Summary of Potential Airborne Sensor Impacts Associated with the Proposed Action on Resource Areas

Resource Area	Potential for Impact	Rationale for Impact Determination
Air Quality	Yes	See Section 4.2.1
Airspace	Yes	See Section 4.2.2
Biological Resources	No	Infrared and optical sensors are passive systems that would not impact biological resources. A plausible airborne sensor, the LIDAR system, emits an eye-safe laser and would not impact biological resources.
Cultural Resources	No	Current airborne sensors are passive systems and would not remove, alter, or physically impinge on cultural resources and adverse impacts are not anticipated. A plausible airborne sensor, the LIDAR system, emits an eye-safe laser and would not impact cultural resources.
Geology and Soils	No	Airborne sensors are passive systems that would not alter soils or impact geology.
Hazardous Materials and Hazardous Waste	No	Hazardous materials associated with airborne sensors include JP-5, Skydrol (hydraulic fluid used in airplanes), and liquid nitrogen (HALO-I). These substances would be used and disposed of in accordance with applicable regulations including Hazardous Waste Management plans and there would be no impact from their use or disposal.
Health and Safety	No	Current airborne sensors are passive systems and would not impact human health and safety. A plausible airborne sensor, the LIDAR system, emits an eye-safe laser and would not impact health and safety.
Land Use	No	Airborne sensors would operate from existing airports or military bases and their use would be consistent with the existing land use; therefore, land use would not be impacted.

Resource Area	Potential for Impact	Rationale for Impact Determination
Noise	No	The planes carrying the airborne sensors would produce noise during the takeoff, flight, and landing; however, the noise produced during takeoff and landing would be consistent with noise produced at the airports where these activities occur. Under the proposed action, the planes carrying the airborne sensors would climb to an altitude between 20,000 and 45,000 feet and would not be audible from the ground. The operation of the planes and use of the airborne sensors would not impact noise sensitive areas or populations.
Socioeconomics and Environmental Justice	Yes	See 4.2.3
Transportation	No	The relatively infrequent flights (30 test events per year) of the Gulfstream IIB and DC-10 planes would result in a negligible increase in air traffic; therefore, transportation would not be impacted.
Visual Resources	No	The planes carrying the airborne sensors would takeoff and land from existing facilities, which would be consistent with current visual setting at the airports where these activities occur.
Water Resources	No	Current airborne sensors are passive systems and would not impact on water resources. A plausible airborne sensor, the LIDAR system, emits an eye-safe laser and would not impact water resources.

4.2.1 Air Quality

The activation of the LIDAR or the infrared and optical sensors that would be carried by the HALO-I, HALO-II, or WASP would have no impact on air quality. Such sensors are passive systems that would not impact air quality. The emissions of the aircraft that carry the airborne sensors, the HALO-I, HALO-II, or WASP, would impact air quality. Therefore, this analysis focuses on the potential impacts from the use of the Gulfstream IIB (HALO-I and HALO-II) and the DC-10 aircraft (WASP). As discussed in Section 2.1.4, for the purposes of this analysis MDA made several bounding assumptions regarding the number of flights and flight time needed to support a test using the airborne sensors. Using these assumptions it was determined that a maximum of 10 tests would be conducted per year using the HALO-I, 10 using the HALO-II, and 10 using the WASP sensor system platforms. Each test event would use only one type of airborne sensor system platform (i.e., HALO-I, HALO-II, or WASP) at one staging location. This would require up to 14 takeoff/landing cycles (two per day) of the Gulfstream IIB or DC-10 aircraft and the testing would take place over a period of seven days. The analysis for impacts on air quality is based upon the emissions produced during the 14 takeoff/landing cycles of the Gulfstream IIB and DC-10 for up to 20 total test events for the Gulfstream IIB, and up to 10 total test events for the DC-10 per year.

For purposes of this analysis each takeoff/landing cycle consists of the following activities idle out, takeoff, climb out, approach, and idle in. These activities were included in the analysis because they represent activities that occur below 914 meters (3,000 feet) above ground surface. Federal standards recognize 914 meters (3,000 feet) as the level above which emissions would not reach the ground. During each of these takeoff/landing cycle activities the aircraft produces emissions. To perform this analysis, MDA defined the time that each aircraft spends in each of the above listed activities, and determined the amount of fuel consumed during each activity specific to the engine used on the aircraft. Appendix D shows the calculations and assumptions used to support this analysis. A summary of the emissions for each aircraft is presented in the subsections below.

Gulfstream IIB Aircraft

Exhibit 4-14 presents the emissions from a single takeoff/landing cycle of the two Rolls Royce Spey MK511-8 engines on the Gulfstream IIB aircraft.

Exhibit 4-14. Gulfstream IIB Emissions

Flight Phase	Emissions			
	HC [1] (grams)	CO (grams)	NO_X (grams)	SO_2 (grams)
Takeoff	4	6	970	24
Climb out	6	28	754	24
Approach	10	142	384	28
Idle	732	6,294	714	106
Total				
Grams	752	6,470	2,822	182
Kilograms	0.7	6.5	2.8	0.2
Pounds	1.5	14.3	6.2	0.4

[1] HC are total hydrocarbons including unburned hydrocarbons and organic pyrolysis products. For this study HC will conservatively be considered VOCs and particulate matter so as to compare with VOC and particulate matter regulatory limits.

Assuming that fourteen takeoff/landing cycles would be required to support a test event, Exhibit 4-15 presents the total emissions from the Gulfstream IIB per test event.

Exhibit 4-15. Gulfstream IIB Emissions per Test Event (includes emissions from 14 takeoff/landing cycles)

Mass	HC	CO	NO_X	SO_2
Kilograms	9.8	91	39.2	2.8
Pounds	21	200.2	86.8	5.6

With up to 10 test events occurring per year (from the HALO-I or HALO-II) at any one facility, the total annual emissions from the Gulfstream IIB associated with the use of airborne sensors would be as presented in Exhibit 4-16.

Exhibit 4-16. Maximum Annual Gulfstream IIB Emissions

Mass	HC	CO	NO_X	SO_2
Kilograms	98	910	392	28
Pounds	210	2,002	868	56
Tons	0.1	1.0	0.4	0.03

DC-10 Aircraft

The emissions from a single takeoff/landing cycle of the three Pratt and Whitney JT9D-59A engines on the DC-10 aircraft are presented in Exhibit 4-17.

Exhibit 4-17. DC-10 Emissions

Flight Phase	Emissions (grams)			
	HC [1]	CO	NO_X	SO_2
Takeoff	63	63	9,723	165
Climb out	159	159	20,271	429
Approach	147	834	3,822	264
Idle	13,311	58,785	3,327	600
Total				
Grams	13,680	59,841	37,143	1,458
Kilograms	13.7	59.8	37.1	1.5
Pounds	30.2	131.8	81.8	3.3

[1] HC are total hydrocarbons including unburned hydrocarbons and organic pyrolysis products. For this study HC will conservatively be considered VOCs and particulate matter so as to compare with VOC and particulate matter regulatory limits.

Assuming that 14 takeoff/landing cycles would be required to support a test event (two per day), the total emissions from the DC-10 would be as presented in Exhibit 4-18.

Exhibit 4-18. DC-10 Emissions Per Test Event (includes emissions from 14 takeoff/landing cycles)

Mass	HC	CO	NO_X	SO_2
Kilograms	191.8	837.2	519.4	21
Pounds	422.8	1,845.2	1,145.2	46.2

With up to 10 test events occurring per year at any one facility, the total annual emissions from the DC-10 associated with the use of airborne sensors would be as presented in Exhibit 4-19.

Exhibit 4-19. Maximum Annual DC-10 IIB Emissions

Mass	HC	CO	NO_X	SO_2
Kilograms	1,918	8,372	5,194	210
Pounds	4,228	18,452	11,452	462
Tons	2.1	9.2	5.7	0.2

Gulfstream IIB and DC-10 Aircraft

Because all 30 tests (20 tests involving the HALO-Ior HALO-II (Gulfstream IIB aircraft) and 10 tests involving the WASP (DC-10 aircraft)) may occur in the same location, MDA calculated the sum total emissions of all 20 test events. Exhibit 4-20 presents the sum of the emissions from 20 annual test events.

Exhibit 4-20. Sum of Airborne Sensor Emissions

Airborne Sensor (Aircraft)	HC	CO	NO_X	SO_2
HALO-I/II (Gulfstream IIB) (tons)	0.2	2.0	0.8	0.06
WASP (DC-10) (tons)	2.1	9.2	5.7	0.2
Total (tons)	**2.3**	**11.2**	**6.5**	**0.26**

Because all 30 tests (20 tests involving the HALO-I or HALO-II (Gulfstream IIB aircraft) and 10 tests involving the WASP (DC-10 aircraft)) may occur in the same location, MDA reviewed the sum total emissions against the ambient air quality *de minimis* standards. Exhibit 4-21 shows a comparison of the total emissions (20 test events) against the ambient air quality *de minimis* regulatory thresholds.

Exhibit 4-21. *De Minimis* Thresholds and Total Airborne Sensor Emissions

Area Designation	Pollutant	Classification	Tons Per Year*	Total Annual Emissions (tons)
Maintenance	CO	All Areas	100	11.2
Maintenance	NO_2	All Areas	100	6.5
Maintenance	NO_X	All Areas	100	6.5
Maintenance	PM_{10}	All Areas	100	2.3
Maintenance	SO_X	All Areas	100	0.26
Maintenance	VOC	All Areas Except OTR	100	2.3
Maintenance	VOC	OTR	50	2.3
Nonattainment	CO	All	100	11.2
Nonattainment	NO_2	All	100	6.5
Nonattainment	NO_X	Extreme	10	6.5
Nonattainment	NO_X	Severe	25	6.5
Nonattainment	NO_X	Serious	50	6.5
Nonattainment	NO_X	OTR	100	6.5
Nonattainment	NO_X	Other	100	6.5
Nonattainment	PM_{10}	Serious	70	2.3
Nonattainment	PM_{10}	Moderate	100	2.3
Nonattainment	SO_X	All	100	0.26
Nonattainment	VOC	Extreme	10	2.3
Nonattainment	VOC	Severe	25	2.3
Nonattainment	VOC	Serious	50	2.3
Nonattainment	VOC	OTR	50	2.3
Nonattainment	VOC	Other	100	2.3

Notes:
OTR = Ozone Transport Region
Ozone Maintenance and Nonattainment areas relate to emissions of VOCs and NO_X
HC are total hydrocarbons including unburned hydrocarbons and organic pyrolysis products. For this study HC will conservatively be considered VOCs and particulate matter so as to compare with VOC and particulate matter regulatory limits
* Represents the *di minimis* thresholds for various pollutants.

The area designation of each location that would be used as a bed down location and as a staging area is presented in Exhibit 3-5. As shown in Exhibit 4-21, none of the ambient air quality *de minimis* regulatory thresholds would be exceeded; therefore, ambient air quality would not be significantly impacted.

4.2.2 Airspace

When in transit, the Gulfstream IIB or DC-10 would operate as any other plane in the National Airspace System. As such, these planes would follow all applicable procedures as directed by airspace management authorities.

When supporting testing operations, the HALO-I or HALO-II (Gulfstream IIB aircraft) and the WASP (DC-10 aircraft) would fly between 20,000 and 45,000. At these altitudes, the airborne sensors could be flying through commercial airspace. The MDA would coordinate all testing activities with the appropriate airspace management authorities. Each military service has designated persons within the FAA Headquarters and Regional offices to facilitate coordination on air traffic and airspace issues. The representatives provide guidance and coordination services to their assigned military units to coordinate creation of and changes to airspace. In addition, many military facilities and ranges have airspace managers who are responsible for working with the FAA and other agencies to identify, coordinate, procure, and manage airspace. Where conflicts or potential conflicts exist, airspace agreements provide a tool to define protocols that address coordination of activities, time, and responses. These airspace agreements identify each agency's specific responsibilities and document the resolution of these conflicts or potential conflicts.

Although MDA testing activities may result in the closure of some airspace to commercial and general aviation activities and would, therefore, impact the amount of available airspace, the use of airborne sensors would not in itself require the closure of airspace. For such testing activities, MDA would perform an environmental review in accordance with NEPA that would analyze the impacts on airspace. The use of airborne sensors would take place in airspace appropriately designated for this type of activity including Special Use Airspace and would conform with applicable requirements including airspace agreements (e.g., Letters of Agreement, Memoranda of Understanding, and Interagency Agreements). Therefore, no significant impacts on airspace would result from the use of airborne sensors.

4.2.3 Socioeconomics and Environmental Justice

Airborne sensors would require small support crews (up to 15 people) who would be deployed temporarily at the staging location near the test area for approximately two weeks. Because the proposed action would include the addition of temporary workers there is a potential for impact on socioeconomics. However, the staging areas are designed and operated to accommodate such temporary influxes of personnel; therefore, the local socioeconomic setting would not be impacted. In addition, because all airborne sensor activities would occur at established airfields or at an altitude above 20,000 feet, no environmental justice populations would be disproportionately affected.

4.3 Impacts of the Proposed Action

Under the proposed action, MDA would use both mobile land-based (Section 4.1) and airborne (Section 4.2) sensors. Of the location that mobile land-based sensors would be used and the bed down, staging areas, and test areas of the airborne sensors, only seven areas would involve the use of both mobile land-based and airborne sensors. Exhibit 4-22 lists the seven locations and their current ambient air quality attainment status.

Exhibit 4-22. Locations of Land-Based and Airborne Mobile Sensors

Location	County	State	Attainment Status
Kodiak Airport and KLC	Kodiak Island	Alaska	In Attainment
Naval Base Ventura County Port Hueneme/San Nicolas Island/Point Mugu	Santa Barbara and San Luis Obispo Counties	California	1-hour ozone – Severe 15 8-hour ozone – Moderate
PMRF	Kauai	Hawaii	In Attainment
NASA Wallops Island	Accomack	Virginia	In Attainment
WSMR	Dona Ana, Otero, Sierra, Socorro, Lincoln	New Mexico	WSMR is in attainment. Dona Ana County, Sunland Park area, 1-hour ozone – Marginal Anthony area, PM-10 – Moderate
USAKA/RTS, Majuro Island, RMI	N/A	OCONUS	N/A
Midway Island	N/A	OCONUS	N/A

Exhibit 4-23 presents a brief summary of the potential for impact on various resource areas from the proposed action at the locations listed in Exhibit 4-22. Those resource areas that were determined to have no potential to be impacted or would not be further impacted by the combination of using both mobile land-based and airborne sensors at the same location are not analyzed further in this section EA.

Exhibit 4-23. Summary of Potential Impacts Associated with the Proposed Action on Resource Areas

Resource Area	Potential for Impact	Rationale for Impact Determination
Air Quality	Yes	See Section 4.3.1
Airspace	No	The same consultations and notices would be developed as presented in Section 4.1.2, and 4.2.2
Biological Resources	No	The combination of both mobile land-based and airborne sensors would not result in additional impacts on biological resources.
Cultural Resources	No	The combination of both mobile land-based and airborne sensors would not result in additional impacts on cultural resources
Geology and Soils	No	The combination of both mobile land-based and airborne sensors would not result in additional impacts on geology and soils.
Hazardous Materials and Hazardous Waste	No	The combination of both mobile land-based and airborne sensors would not result in additional impacts associated with hazardous materials and hazardous waste.
Health and Safety	No	The combination of both mobile land-based and airborne sensors would not result in additional impacts associated with health and safety.
Land Use	No	The combination of both mobile land-based and airborne sensors would not result in additional impacts on land use.
Noise	No	The combination of both mobile land-based and airborne sensors would not result in additional impacts associated with noise.
Socioeconomics and Environmental Justice	Yes	See 4.3.2
Transportation	No	The combination of both mobile land-based and airborne sensors would not result in additional impacts associated with transportation.
Visual Resources	No	The combination of both mobile land-based and airborne sensors would not result in additional impacts associated with visual resources.

Resource Area	Potential for Impact	Rationale for Impact Determination
Water Resources	No	The combination of both mobile land-based and airborne sensors would not result in additional impacts on water resources

4.3.1 Air Quality

Under the proposed action, both mobile land-based and airborne sensors would be used at

- Kodiak Airport and KLC, Alaska;
- Naval Base Ventura County Port Hueneme/San Nicolas Island/Point Mugu, California;
- PMRF, Hawaii;
- NASA Wallops Island, Viginia;
- USAKA/RTS, Majuro Island, RMI;
- Midway Island; and
- WSMR.

All the annual emissions associated with the mobile land-based sensors and airborne sensors may be emitted at those locations. Exhibit 4-24 presents the sum emissions that may occur at a single location, which assumes that 10 land-based test events as presented in Exhibit 4-9 and 30 airborne test events as presented in Exhibit 4-20 would be conducted at a single location.

Exhibit 4-24. Total Emissions (in tons) from Land-based and Airborne Mobile Sensors

Sensor System	VOC	CO	NO_X (BACT)	NO_X (Non BACT)	SO_2	PM_{10}
Airborne	2.3	11.2	6.5	6.5	0.26	2.3
Land-based	3.6	7.3	11.2	20.5	0.3	1.3
Total (tons)	**5.9**	**18.5**	**17.7**	**27**	**0.56**	**3.6**

Note: As a conservative calculation the HC emissions in Exhibit 4-20 were assumed to equal the PM_{10} aircraft emissions concentration.

Of the potential locations, Naval Base Ventura County Port Hueneme/San Nicolas Island/Point Mugu, California, has the most stringent ambient air quality standards. The Naval Base Ventura County Port Hueneme/San Nicolas Island/Point Mugu is listed as a moderate nonattainment area under the 8-hour ozone standard and a severe nonattainment area under the 1-hour oxone standard, which have *de minimis* emission levels of 100 tons and 25 tons, respectively. As shown in Exhibit 4-24, the NO_X (Non BACT) emissions would exceed the de minimis emission level in a severe ozone nonattainment area. The only proposed test location that has that status is located in California, which requires BACT for generator emissions; therefore, such emissions associated with the proposed action would not occur at the Naval Base Ventura County Port Hueneme/San Nicolas Island/Point Mugu. The conditions relating to the land-based permitting activities presented in Section 4.1.1, also would apply. The other emission levels presented in Exhibit 4-24 are below the most stringent *de minimis* levels for ambient air quality criteria.

4.3.2 Socioeconomics and Environmental Justice

Implementation of the Proposed Action would not impact socioeconomic conditions or environmental justice concerns. The bed down, staging, and testing locations have been designed to support temporary project staff to support testing activities, and the additional staff would not exceed the capacity of the existing infrastructure at the seven facilities where the potential exists for both mobile land-based and airborne sensors to be used. No environmental justice concerns would be impacted because no residential populations that fall under the protection of environmental justice are located on the test sites. Should any potential impacts occur outside of the boundary of a test site (EMR hazard areas); such areas would be reviewed for environmental justice concerns.

4.4 No Action Alternative

Under the no action alternative, MDA would not transport or use mobile land-based sensors or airborne sensors on targets of opportunity or to support specific MDA tests. Under such conditions, MDA would be limited to using the existing fixed based sensor systems to track and collect data on targets of opportunity and to support specific MDA tests. This would limit the amount and value of the data collected and could result in additional test events over the long-term. Under the no action only existing sensor systems would be used, all of which would be used under each alternative (Alternative 1, 2, and the proposed action), and as such no impacts on any resource area are associated with the proposed action.

4.5 Site Specific Activities - Placement and Use of Land-based Sensors at Cordova, Alaska

4.5.1 Air Quality

The Merle K. Smith Airport and the proposed off-axis site are located in a class II attainment area. The development of the off-axis site and the operation of the equipment as described under the proposed action would result in emissions of air pollutants regulated under the Clean Air Act. During development, the construction equipment would emit VOCs, CO, NO_X, PM, including diesel particulates, and SO_2. Because the of the small size of the proposed site, 1.2 acres, and the limited amount of time necessary to develop the proposed site, such emissions would not result in a significant impact.

The operation of the onsite generators (a 100 kW and two 200 kW) would result in emissions of VOCs, CO, NO_X, PM, including diesel particulate, and SO_2. Because the backup generators would only be used when shore power has been disrupted, MDA conservatively estimated that the generators would not operate more than 10 percent of the time. A 100 kW generator requires a 200 horsepower engine and a 200 kW generator requires a 300 horsepower engine. Given that the proposed facility would operate up to 120 days per year for a maximum of 18 hours per day, the generators would operate for up to 216 hours per year. Exhibit 4-25 presents the annual total emissions associated with the generators.

Exhibit 4-25. Proposed Off-Axis Site Generator Emissions

Hours	Horsepower	Pollutant	Grams per Brake HP per Hour	Total Grams	Total Pounds	Total Tons
216	200	TOC	1.1	47,520	104.76	0.05
216	200	NO_X (BACT)	6.9	298,080	657.15	0.33
216	200	NO_X (uncontrolled)	14.06	607,392	1,339.06	0.67
216	200	SO_2	0.18	7,776	17.14	0.01
216	200	CO	2.75	118,800	261.91	0.13
216	200	PM_{10}	1	43,200	95.24	0.05
216	200	CO_2	526	22,723,200	50,095.57	25.05
432	300	TOC	1.1	142,560	314.28	0.16
432	300	NO_X (BACT)	6.9	894,240	1,971.44	0.98
432	300	NO_X (uncontrolled)	14.06	1,822,176	4,017.16	2.00
432	300	SO_2	0.18	23,328	51.42	0.02
432	300	CO	2.75	356,400	785.72	0.40
432	300	PM_{10}	1	129,600	285.72	0.14
432	300	CO_2	526	68,169,600	150,286.70	75.14

At the proposed Lodge site, located adjacent to the KLC launch complex, the operation of the RSTS system for up to 120 days would result in the emissions as shown in Exhibit 4-26.

Exhibit 4-26. RSTS Emissions at Lodge Site

Pollutant	Emissions (pounds per day)	Days of Operation	Total Pounds	Total Tons
TOC	5.8	120.0	698.4	0.3
NO_X (BACT)	36.5	120.0	4,381.2	2.2
NO_X (uncontrolled)	74.4	120.0	8,926.8	4.5
SO_2	1.0	120.0	116.4	0.1
CO	14.6	120.0	1,746.0	0.9
PM_{10}	931.2	120.0	111,747.6	55.9
CO_2	1,857.2	120.0	222,858.0	111.4

The generators designated for use at the proposed off-axis site and the Lodge site would have to be approved by the Alaska Department of Environmental Conservation, Division of Air Quality. MDA or the test proponent would complete the required forms and consult with the Alaska Department of Environmental Conservation, Division of Air Quality. Approval by the Alaskan authorities and the fact that the emissions would not exceed any *de minimis* thresholds, preclude any significant impacts on ambient air quality.

4.5.2 Airspace

The development of the proposed off-axis site and the operation of the proposed suite of sensors presented under the proposed action would not impact airspace. The sensors are passive sensors and the transmitters would not affect the communications of aircraft.

4.5.3 Biological Resources

The development of the proposed off-axis site would result in the loss of up to 0.2 acres of pioneering and buffer vegetative habitat that is adjacent to the activeMerle K, Smith Airport in Cordova. Although the airport lies within the boundaries of the Copper River Delta, an estuary classified as a Critical Habitat by the State of Alaska, the loss of 0.2 acres would not represent a regionally substantial loss of pioneering and buffer vegetation (Alaska DOT, 2005).

The Copper River Critical Habitat is also an important stop for migratory birds and a vital summer nesting habitat for many waterfowl species. The loss of the limited area of pioneering and buffer vegetative habitats at the Merle K. Smith Airport would not displace any bird populations or other wildlife in the area, such as moose, bear, dear, lynx and smaller mammals (Alaska DOT, 2005).

MDA consulted with the U.S. Fish and Wildlife Service and the Alaska Department of Fish and Game and found that the proposed action would not be likely to adversely affect any federal or state-listed threatened, endangered, or candidate species or any designated Critical Habitat. (Alaska DOT, 2005)

The development of the Lodge site would result in the loss of up to 0.5 acre of grazed grassland habitat. The loss of such habitat would not represent a regionally substantial loss and would not displace large numbers of wildlife populations; thereby resulting in negligible impacts.

4.5.4 Essential Fish Habitat

Tributaries of the Elsner and Glacier Rivers flow along the borders of several Merle K. Smith Airport taxiways, aprons and buildings. A number of these tributaries have been shown to contain one or more species of anadromous fish, thereby qualifying them as essential fish habitat (EFH). (Alaska DOT, 2005) During the construction and development phase of the proposed project increased turbidity and soil runoff could cause fish mortality rates to rise and result in deleterious impacts on eggs, alevins, migration, rearing and spawning. However, due to the small size of the off-axis site, its location in relation to the EFH, and the best management practices that would be implemented during site preparation and development (e.g., hay bales, silt fencing, stormwater management), there would be limited short-term impacts and no long-term impact on the EFH.

4.5.5 Cultural and Historic Resources

The area of the proposed off-axis site has been previously disturbed and is not likely to contain any cultural resources that would be eligible for listing in the National Register. MDA consulted with the Alaska SHPO and concluded that the proposed action would not impact cultural resources. (Alaska DOT, 2005)

MDA or AADC would ensure that any construction contract would stipulate that work will halt and the SHPO will be contacted immediately if cultural or paleontological resources are discovered during site preparation and construction activities.

4.5.6 Geology and Soils

The development of the proposed off-axis site would require clearing, grading, the potential placement of fill material, and compaction. Such activities would alter the characteristics of the surface soil from the operation of heavy equipment compacting the soil, grading activities mixing the soil horizons, to the potential placement of fill material. Such activities would not result in significant adverse impacts on the soil at the proposed off-axis site because the area has been previously disturbed.

4.5.7 Hazardous Materials and Hazardous Waste Management

The development of the proposed off-axis site may result in incidental spills of fuel or lubricants associated with the construction vehicles. Such spills would be cleaned up in accordance with appropriate and relevant federal and state regulations.

The operation of the proposed off-axis site, would include the placement of a fuel tank that would meet current standards (double walled or secondary containment system), if necessary, a spill prevention, control and countermeasure plan would be prepared for any onsite storage tanks. In addition, any incidental spills of fuel or lubricants associated with the generators may occur, and would be cleaned up in accordance with appropriate and relevant federal and state regulations. As such, implementation of the proposed action would not result in a significant impact associated with hazardous materials and hazardous waste management.

4.5.8 Health and Safety

The development of the proposed off-axis site would not result in a significant impact on health and safety. Construction workers would practice safe operating procedures and would be trained in the use of heavy equipment.

Prior to operating any radar at the proposed off-axis site, MDA or AADC would complete an EMR/electromagnetic interference survey that considers Hazards of Electromagnetic Radiation to Personnel (HERP), Hazards of Electromagnetic Radiation to Fuels (HERF), and Hazards of Electromagnetic Radiation to Ordnance (HERO), as appropriate. The analysis would provide recommendations for sector blanking and safety systems to minimize exposures. The values collected for the radio frequency ground hazard area would be derived from the IEEE standards and applicable OSHA standards including the pamphlet, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields," OET Bulletin 65, August 1997.

For the telemetry system, hazard control areas could extend out to 17 meters; whereas, for the RSTS and satellite antenna the hazard control areas could extend out to 76 meters. The proposed action would not result in a significant impact on health and safety because physical controls would be established to keep operational personnel and the general public outside of hazard control areas.

The development of the Lodge RSTS site would be located greater than 100 meters from the existing structures, and physical controls (fencing/flagging) would be used to keep personnel outside of the 76 meter uncontrolled hazard area. As such, the there would be no significant impacts on health and safety.

4.5.9 Land Use

The location of the proposed action is entirely contained within the Merle K. Smith Airport. Other than aircraft operations, other portions of the airport are leased by the Alaska Department of Transportation and contain an active wastewater treatment plant. Because the site of the proposed action would be located on an area that was previously disturbed and the proposed development and operation of the off-axis site would not preclude or adversely affect any of the existing land uses, the proposed site would not impact land use.

The establishment of the Lodge RSTS site would change the land use of approximately 4,536 square meters (1.1 acres), which includes the uncontrolled hazard area, of grazing land to developed land. Such a change would not represent a regionally significant change in land use.

4.5.10 Noise

The location of the proposed off-axis site is adjacent to an active runway and day-time construction would not result in a substantial new source of ambient noise. During operation of the proposed off-axis site, the generators would be housed in a shelter and would have sound attenuating equipment (muffler) to reduce the potential noise impacts associated with night-time use. Furthermore, there are no residential areas in the vicinity of the proposed site that would be affected by changes in noise level. Therefore, the development and operation of the proposed off-axis site would not result in a significant impact on ambient noise.

The operation of the generators at the proposed Lodge RSTS site would not result in a substantial change in the ambient noise levels. The propose generators would be housed in an enclosed trailer and would have noise attenuation equipment (mufflers).

4.5.11 Socioeconomics and Environmental Justice

The development and operation of the proposed off-axis site at the Merle K., Smith Airport would not result in a significant impact on socioeconomics. The proposed construction period of one month would provide short-term employment for the local population and during operation up to 35 personnel would be onsite. The temporary influx of 35 personnel to the region would not represent a substantial change in the population or require additional infrastructure.

Although proposed in a community under control of Eyak, a federally recognized tribal government, the project would not necessitate relocation of residential homes, businesses or transportation systems. The surrounding communities would not be disrupted by the proposed action and no Eyak land acquisition would be required.

4.5.12 Transportation and Infrastructure

The equipment associated with the proposed off-axis site in Cordova would be transported from King Salmon Alaska via barge or aircraft. No roads exist between King Salmon and Cordova so tractor trailers could not be used. Barges would be required to transfer all the equipment. The use of such transport equipment would not result in a significant impact on transportation.

The proposed off-axis site at Cordova would tie into the exiting infrastructure at the airport, including power, water, communication, and wastewater connections. The temporary influx of 35 personnel per year and the operational period of up to 120 days per year would not result in a significant impact on the existing infrastructure and no new infrastructure would need to be developed.

4.5.13 Visual Resources

The development of the proposed off-axis site and its operation would alter the visual setting of the area. However, because the facility is an active airport and contains various towers and antennas, the placement of additional antennas and support equipment in the same location would not result in a significant impact on visual resources.

Because the operation of the RSTS at the lodge site would be temporay, and only on RSTS system would be set up, the impacts on visual resources would not be significant.

4.5.14 Water Resources

The development and operation of the proposed off-axis facility would result in minor impacts on water resources. The site preparation and construction activities would result in increased stormwater runoff that would enter the onsite streams, resulting in short-term impacts. The operation of the proposed off-axis site would not impact water resources. The area surrounding the Merle K. Smith Airport has not been flood hazard mapped by FEMA. Although the proposed site is located between drainages from the Glacier River in the east, and the Scott River in the west, the width of these channel systems suggests large flood discharge and its associated flood elevation would not encroach on the Merle K. Smith Airport. Because the area of the development of the temporary off-axis site would be only 1.2 acres and is on a previously disturbed area, such development would not affect the local or regional flood elevations.

The proposed off-axis facility would tie into existing water supply and wastewater infrastructure and would not require a new water source or a discharge permit.

4.5.15 Wetlands

The Copper River Delta, which surrounds the Merle K. Smith Airport and the proposed off-axis site, is the largest contiguous wetland on the Pacific Coast of North America. The airport is surrounded on its western, southern, and eastern boundaries by a combination of both palustrine and riverine wetlands. While these wetland areas serve vital ecological functions such as flood storage, fish and wildlife habitat, and nutrient transport, they are not uncommon in the area around the Merle K. Smith Airport. Furthermore, the proposed off-axis site is located in an area which has been previously disrupted and the project would not impact the hydrological properties of the wetland system or alter its current function or value. (Alaska DOT, 2005)

4.5.16 Cumulative Impacts - Cordova

To review the potential cumulative impacts, MDA reviewed the potential impacts associated with the proposed off-axis site with other Federal and non-federal actions, specifically the impacts associated with the airport improvements. Because the proposed location for the off-axis site at Cordova would be a temporary site that will be renovated under the airport improvement plan, MDA concluded that there would be no cumulative site preparation and construction impacts.

MDA reviewed the operations of the proposed sensors at the off-axis site, and found that the operation of the sensors, the ongoing airport operations, and the improvement projects would not result in significant cumulative impacts.

4.6 Cumulative Impacts

Under the cumulative impact analysis, MDA reviewed the impacts of using the various mobile land-based and airborne sensor systems at different locations at the same time, as well as the impacts associated with using a mobile sensor with the existing fixed based sensors in conjunction with a specific MDA test event. Because the specifics of the unique test events are unknown, and such tests would be a "major Federal action" as defined under NEPA requiring an environmental review in accordance with NEPA, the cumulative impacts of using mobile sensors during a specific test event would be addressed in subsequent test specific documentation.

The cumulative impacts of using various land-based and airborne mobile sensor systems at different locations supporting different test events, and potentially at different times would not result in cumulative impacts. The potential locations would be far enough apart that the local emissions, EMR hazard areas, or cleared air space would not overlap and result in cumulative impacts. MDA acknowledges that the use of the land-based and airborne mobile sensor systems along with the local activities and impacts of a specific test may result in cumulative impacts. However, at this time, the details of specific test events are unknown; therefore, the potential cumulative impacts cannot be determined. MDA or the test proponent would use this document to aid in defining the cumulative impacts in the environmental reviews prepared in accordance with NEPA for the specific test events.

4.7 Adverse Environmental Effects that Cannot be Avoided

Adverse environmental effects that cannot be avoided include adverse minor long-term impacts on air quality resulting from combustion emissions, and negligible short-term impacts on biological resources resulting from the noise and EMF emissions associated with operating the sensors.

4.8 Irreversible and Irretrievable Commitment of Resources

The amount of raw materials required for the activities considered in this EA would be small. Some irreversible or irretrievable commitment of resources would occur, such as dedication of raw materials (fuel, fill material) and labor required for the set up of an area for placement of land-based mobile sensors. The intent would be to use existing infrastructure (cleared areas, data/communication and power lines) to avoid unnecessary commitment of resources. The activities considered in this EA would not commit natural resources in substantial quantities.

4.9 Mitigation Measures

The following mitigation measures are associated with the implementation of the Proposed Action and the alternatives. These mitigation measures represent a potential range of measures that may be implemented at a specific test location.

- For any vegetation removed for the placement of mobile land-based sensors, adhere to site-specific revegation plans or implementation of a two to one vegetation replacement plan for any removed trees.
- Only revegetate with native vegetation.
- Attempt to perform tests during daylight hours to avoid the need for nighttime illumination. Should nighttime illumination be required, focus the light on desired areas and only use during active testing.
- Where possible, use shore power or run temporary power lines along existing roads to provide shore power to remote locations.
- Use low-sulfur diesel fuel in any generators.
- Use generators that meet or exceed the best available control technology (BACT)
- Install noise attenuation devices or systems (mufflers or enclosures) on generators and cooling systems associated with mobile land-based sensors.

5 REFERENCES

Alaska Department of Transportation and Public Facilities (Alaska DOT). 2005. Environmental Assessment for Merle K. (Mudhole) Smith Airport Improvements Project. May.

Alaska Department of Fish and Game (DFG), 2004a. "State of Alaska Endangered Species List," http://www.wildlife.alaska.gov/aawildlife/endangered/es_list.cfm, accessed September 20, 2004.

Alaska Department of Fish and Game (DFG), 2004b. "State of Alaska Species of Special Concern," http://www.wildlife.alaska.gov/aawildlife/endangered/es_ssc.cfm, accessed September 20, 2004.

Alaska Department of Fish and Game (DFG), 2003. Division of Wildlife Conservation, "Eskimo Curlew," September 30. http://www.wildlife.alaska.gov/aawildlife/endangered/curlew.cfm, accessed September 13, 2004.

Alaska Department of Transportation and Public Facilities, 2004. *Naknek Crossing Intermodal Economic Impact and Airport Use Study, Appendix D – Initial Environmental Evaluation, Physical and Biological Environment Study, Bristol Bay Borough*, May. http://www.dot.state.ak.us/stwdplng/projectinfo/naknekcrossing/naknekdraft_pop.html, accessed September 21, 2004.

Alaska Land of the Midnight Sun, 2003. "King Salmon Alaska," http://www.alaskans.com/kingsalmon_alaska.html, accessed August 17, 2004.

BeringSea.com, 2004. "Communities: King Salmon," http://www.beringsea.com/communities/index.php?community=185, accessed August 23, 2004.

Bristol Bay Borough, 2004. "Bristol Bay Area," http://www.theborough.com/area.html, accessed September 21, 2004.

California Department of Fish and Game (DFG), 1997. *California Steelhead Report-Restoration Card: A Report to the Legislature*, February. http://www.dfg.ca.gov/nafwb/pubs/1997/1997_Steelhead_Report_www.pdf, accessed September 14, 2004.

California Department of Fish and Game (DFG), 2004. California's Threatened and Endangered Species, "Southern Sea Otter," http://www.dfg.ca.gov/te_species/index/classification/mammalslist/otter.html, accessed August 17, 2004.

California Department of Fish and Game (DFG), Habitat Conservation Division, 2004. Wildlife and Habitat Data Analysis Branch, California Natural Diversity Database, *State and Federally Listed Endangered and Threatened Animals of California*, http://www.dfg.ca.gov/whdab/pdfs/TEAnimals.pdf, accessed August 24, 2004.

California Department of Fish and Game (DFG), Habitat Conservation Planning Branch, 2004a. "California's Plants and Animals," http://www.dfg.ca.gov/hcpb/species/t_e_spp/tespp.shtml, accessed August 17, 2004.

California Department of Fish and Game (DFG), Habitat Conservation Planning Branch, 2004b. "Beach Layia," http://www.dfg.ca.gov/hcpb/cgi-bin/more_info.asp?idKey=ssc_tespp&specy=plants&query=Layia%20carnosa, accessed September 14, 2004.

California Department of Fish and Game (DFG), Habitat Conservation Planning Branch, 2004c. "Beach Spectacle Pod," http://www.dfg.ca.gov/hcpb/cgi-bin/read_one.asp?specy=plants&idNum=88, accessed September 13, 2004.

California Department of Fish and Game (DFG), Habitat Conservation Planning Branch, 2004d. "Gambel's Watercress," http://www.dfg.ca.gov/hcpb/cgi-bin/more_info.asp?idKey=ssc_tespp&specy=plants&query=Rorippa%20gambellii, accessed September 14, 2004.

California Department of Fish and Game (DFG), Habitat Conservation Planning Branch, 2004e. "Lompoc Yerba Santa," http://www.dfg.ca.gov/hcpb/cgi-bin/more_info.asp?idKey=ssc_tespp&specy=plants&query=Eriodictyon%20capitatum, accessed September 14, 2004.

California Department of Fish and Game (DFG), Habitat Conservation Planning Branch, 2004f. "San Nicolas Island buckwheat," http://www.dfg.ca.gov/hcpb/cgi-bin/read_one.asp?specy=plants&idNum=107, accessed September 14, 2004.

California Department of Fish and Game (DFG), Habitat Conservation Planning Branch, 2004g. "Surf Thistle," http://www.dfg.ca.gov/hcpb/cgi-bin/more_info.asp?idKey=ssc_tespp&specy=plants&query=Cirsium%20rhothophilum, accessed September 14, 2004.

California Department of Fish and Game (DFG), Habitat Conservation Planning Branch, 2004h. "American Peregrine Falcon," http://www.dfg.ca.gov/hcpb/cgi-bin/more_info.asp?idKey=ssc_tespp&specy=birds&query=Falco%20peregrinus%20anatum, accessed September 14, 2004.

California Department of Fish and Game (DFG), Habitat Conservation Planning Branch, 2004i. "Arroyo Toad," http://www.dfg.ca.gov/hcpb/cgi-bin/more_info.asp?idKey=ssc_tespp&specy=amphibians&query=Bufo%20microscaphus%20californicus, accessed September 14, 2004.

California Department of Fish and Game (DFG), Habitat Conservation Planning Branch, 2004j. "Bald Eagle," http://www.dfg.ca.gov/hcpb/cgi-bin/more_info.asp?idKey=ssc_tespp&specy=birds&query=Haliaeetus%20leucocephalus, accessed September 14, 2004.

California Department of Fish and Game (DFG), Habitat Conservation Planning Branch, 2004k. "Belding's Savannah Sparrow," http://www.dfg.ca.gov/hcpb/cgi-bin/more_info.asp?idKey=ssc_tespp&specy=birds&query=Passerculus%20sandwichensis%20beldingi, accessed September 14, 2004.

California Department of Fish and Game (DFG), Habitat Conservation Planning Branch, 2004l. "California Brown Pelican," http://www.dfg.ca.gov/hcpb/cgi-bin/more_info.asp?idKey=ssc_tespp&specy=birds&query=Pelecanus%20occidentalis%20californicus, accessed September 14, 2004.

California Department of Fish and Game (DFG), Habitat Conservation Planning Branch, 2004m. "California Least Tern," http://www.dfg.ca.gov/hcpb/cgi-bin/more_info.asp?idKey=ssc_tespp&specy=birds&query=Sterna%20antillarum%20browni, accessed September 14, 2004.

California Department of Fish and Game (DFG), Habitat Conservation Planning Branch, 2004n. "Coho Salmon," http://www.dfg.ca.gov/hcpb/cgi-bin/read_one.asp?specy=fish&idNum=56, accessed September 14, 2004.

California Department of Fish and Game (DFG), Habitat Conservation Planning Branch, 2004o. "Least Bell's Vireo," http://www.dfg.ca.gov/hcpb/cgi-bin/more_info.asp?idKey=ssc_tespp&specy=birds&query=Vireo%20bellii%20pusillus, accessed September 14, 2004.

California Department of Fish and Game (DFG), Habitat Conservation Planning Branch, 2004p. "Tidewater Goby," http://www.dfg.ca.gov/hcpb/cgi-bin/more_info.asp?idKey=ssc_tespp&specy=fish&query=Eucyclogobius%20newberryi, accessed September 14, 2004.

California Department of Fish and Game (DFG), Habitat Conservation Planning Branch, 2004q. "Unarmored Threespined Stickleback," http://www.dfg.ca.gov/hcpb/cgi-bin/more_info.asp?idKey=ssc_tespp&specy=fish&query=Gasterosteus%20aculeatus%20williamsoni, accessed September 14, 2004.

California Department of Fish and Game (DFG), Habitat Conservation Planning Branch, 2004r. "Gaviota tarplant," http://www.dfg.ca.gov/hcpb/cgi-bin/read_one.asp?specy=plants&idNum=131, accessed September 16, 2004.

California Department of Fish and Game (DFG), Habitat Conservation Planning Branch, 2004s. "California Red-legged Frog," http://www.dfg.ca.gov/hcpb/cgi-bin/read_one.asp?specy=amphibians&idNum=66, accessed September 16, 2004.

California Air Resources Board (CARB). 2005. BACT Clearinghouse Database. I.C. Engines – Compression Ignition, Non-Emergency => 228 hp; I.C. Engines – Compression Ignition, Non-Emergency < 228 hp; I.C. Engines – Compression Ignition, Emergency; and I.C. Engines – Compression Ignition, Portable. http://www.arb.ca.gov/bact/bact.htm

Caterpillar Diesel Generator Set (1,000 kW). 2002. Specifications Sheet. April 4.

Central Intelligence Agency (CIA), 2004a. "The World Factbook, Midway Island," http://www.cia.gov/cia/publications/factbook/geos/mq.html, accessed October 1, 2004.

Central Intelligence Agency (CIA), 2004b. "The World Factbook, Wake Island," http://www.cia.gov/cia/publications/factbook/geos/wq.html, accessed September 10, 2004.

Clark, Delores, 2004. "Working Together to Save Lives: Manager Conducts Remote Weather Observation Station Training." *National Weather Service Focus*, May 3. http://www.nws.noaa.gov/com/nwsfocus/fs050304.htm, accessed September 10, 2004.

Department of Defense (DoD), 2002. "FY02 Pollution Prevention Award, Naval Air Station, Whidbey Island, Oak Harbor, Washington," https://www.denix.osd.mil/denix/Public/News/OSD/SecDef02/P2NonIndustrial/navy-naswhidbeyisland.doc, accessed August 17, 2004.

EMC, Range Support Specialist. 2005. Electronic mail correspondence between T. Stribley (MDA) and C. Mangham, RE: MPS 36 radar. June 8.

Enchanted Learning, 2004a. "Right Whale," http://www.enchantedlearning.com/subjects/whales/species/Rightwhale.shtml, accessed September 15, 2004.

Enchanted Learning, 2004b. "Sperm Whale," http://www.enchantedlearning.com/subjects/whales/species/Spermwhale.shtml, accessed September 16, 2004.

Expedia.com, 2004. Maps, King Salmon, Alaska, United States, http://www.expedia.com/pub/agent.dll, accessed September 21, 2004.
Federal Aviation Administration (FAA), 2003. "Chapter 13: Airspace," Pilot's Handbook of Aeronautical Knowledge, FAA-H-8083-25, October 24. http://av-info.faa.gov/data/traininghandbook/faa-h-8083-25-4of4.pdf, accessed October 5, 2004.

Federal Aviation Administration (FAA), 2004a. Alaskan Division, "Alaska Flight Service Operations," http://www.alaska.faa.gov/at/, accessed September 21, 2004.

Federal Aviation Administration (FAA), 2004b. "King Salmon Alaska, Revision of Class E Airspace," Posted September 1, 2004. http://www.alaska.faa.gov/at/Finalrules/kingsalmon.htm, accessed September 21, 2004.

Great Barrier Reef Marine Park Authority (GBRMPA), 2004. Australian Government, "Facts About Dugongs," http://www.gbrmpa.gov.au/corp_site/info_services/publications/dugong/, accessed September 21, 2004.

Hawaii Biological Resources, 2003. "Hawaii's Endangered and Threatened Species Web Site," http://hbs.bishopmuseum.org/endangered/, accessed September 10, 2004.

Hunting, Kevin, 2000. California Partners in Flight, California Department of Fish and Game, *Grassland Bird Conservation Plan, Mountain Plover*. http://www.prbo.org/calpif/htmldocs/species/grassland/moplacct.html, accessed September 14, 2004.

Klein, David R., David F. Murray, Robert H. Armstrong, and Betty A. Anderson, 2004. "Alaska." U.S. Geological Survey, http://biology.usgs.gov/s+t/SNT/noframe/ak177.htm, accessed July 9, 2004.

Legal Information Institute, 2004. "US Code Collection." Title 42, Chapter 82, Subchapter I, §6903. Definitions. http://assembler.law.cornell.edu/uscode/html/uscode42/usc_sec_42_00006903----000-.html, accessed October 6, 2004.

Lipkin, R. and D.F. Murray. 1997. *Alaska Rare Plant Field Guide*. Alaska Rare Plant List, "Aleutian Shield Fern." U.S. Fish and Wildlife Service, National Park Service, Bureau of Land Management, Alaska Natural Heritage Program, and U.S. Forest Service. http://enri.uaa.alaska.edu/rareguide/, accessed on September 13, 2004.

Maps.com, 2004. http://www.maps.com/cgi-bin/maps/aerochart.pl, accessed August 17, 2004.

Marine Biology, 2004. "Fin Whale," http://www.marinebio.com/species.asp?id=40, accessed September 15, 2004.

Midway Islands History, 2004. http://www.janeresture.com/midway/, accessed October 1, 2004.

Missile Defense Agency (MDA), 2003. *Airborne Laser (ABL) Program Final Supplementary Environmental Impact Statement*, July. http://www.smdcen.us/dcsenev/SMDCEnvDocs/Pages/EIS.asp; http://www.afcee.brooks.af.mil/ec/eiap/eis/abl/ABL_F-SEIS_Apr_03.pdf, accessed August 24, 2004.

Missile Defense Agency (MDA), 2004. *Ballistic Missile Defense System (BMDS) Draft Programmatic Environmental Impact Statement*, March 28. http://www.acq.osd.mil/mda/mdalink/html/enviro.html, accessed October 6, 2004.

National Oceanic and Atmospheric Administration (NOAA) Fisheries, 2004a. National Marine Fisheries Service, Office of Protected Resources, "Chinook Salmon (*Oncorhynchus tshawytscha*)," http://www.nmfs.noaa.gov/prot_res/species/fish/Chinook_salmon.html, accessed September 13, 2004.

National Oceanic and Atmospheric Administration (NOAA) Fisheries, 2004b. National Marine Fisheries Service, Office of Protected Resources, "Coho Salmon (*Oncorhynchus kisutch*)," http://www.nmfs.noaa.gov/prot_res/species/fish/coho_salmon.html, accessed September 13, 2004.

National Oceanic and Atmospheric Administration (NOAA) Fisheries, 2004c. National Marine Fisheries Service, Office of Protected Resources, "Guadalupe Fur Seal," http://www.nmfs.noaa.gov/prot_res/species/Pinnipeds/guadalupefurseal.html, accessed September 13, 2004.

National Oceanic and Atmospheric Administration (NOAA) Fisheries, 2004d. National Marine Fisheries Service, Office of Protected Resources, "Leatherback sea turtle (*Dermochelys coriacea*)," http://www.nmfs.noaa.gov/prot_res/species/turtles/leatherback.html, accessed September 13, 2004.

National Oceanic and Atmospheric Administration (NOAA) Fisheries, 2004e. National Marine Fisheries Service, Office of Protected Resources, "Loggerhead sea turtle (*Caretta caretta*)," http://www.nmfs.noaa.gov/prot_res/species/turtles/loggerhead.html, accessed September 13, 2004.

National Oceanic and Atmospheric Administration (NOAA) Fisheries, 2004f. National Marine Fisheries Service, Office of Protected Resources, "Olive Ridley sea turtle (*Lapidochelys olivacea*)," http://www.nmfs.noaa.gov/prot_res/species/turtles/olive.html, accessed September 14, 2004.

National Oceanic and Atmospheric Administration (NOAA) Fisheries, 2004g. National Marine Fisheries Service, Office of Protected Resources, "Steelhead Trout (*Oncorhynchus mykiss*)," http://www.nmfs.noaa.gov/prot_res/species/fish/steelhead_trout.html, accessed September 14, 2004.

National Oceanic and Atmospheric Administration (NOAA) Fisheries, 2004h. National Marine Mammal Laboratory, Alaska Fisheries Science Center. "Stellar Sea Lion Biology," http://nmml.afsc.noaa.gov/AlaskaEcosystems/sslhome/StellerDescription.html, accessed September 14, 2004.

National Oceanic and Atmospheric Administration (NOAA) Fisheries, 2004i. Alaska Fisheries Science Center. "Stellar Sea Lion Research: Hypotheses for Population Decline," http://www.afsc.noaa.gov/Stellers/hypotheses.htm, accessed September 14, 2004.

National Oceanic and Atmospheric Administration (NOAA), Channel Islands National Marine Sanctuary, 2004. "Management Plan Review," http://www.cinms.nos.noaa.gov/manplan/overview.html, accessed October 1, 2004.

National Oceanic and Atmospheric Administration (NOAA), National Marine Sanctuaries, 2004. "The Humpback Whale," http://hawaiihumpbackwhale.noaa.gov/about/humpback.html, accessed September 15, 2004.

National Park Service (NPS), Bering Land Bridge National Preserve, 2004. "Bowhead Whales," http://www.nps.gov/bela/html/bowhead.htm, accessed September 15, 2004.

National Park Service (NPS), Katmai National Park & Preserve, 2004a. "Nature & Science, Animals," http://www.nps.gov/katm/pphtml/animals.html, accessed August 23, 2004.

National Park Service (NPS), Katmai National Park & Preserve, 2004b. "Nature & Science, Geologic Activity," http://www.nps.gov/katm/pphtml/subenvironmentalfactors13.html, accessed August 23, 2004.

National Park Service (NPS), Katmai National Park & Preserve, 2004c. "Nature & Science, Natural Features and Ecosystems," http://www.nps.gov/katm/pphtml/naturalfeatures.html, accessed August 23, 2004.

National Park Service (NPS), Katmai National Park & Preserve, 2004d. "Nature & Science, Volcanoes/Lava Flows," http://www.nps.gov/katm/pphtml/subnaturalfeatures39.html, accessed August 23, 2004.

National Park Service (NPS), Katmai National Park & Preserve, 2004e. "Home," http://www.nps.gov/katm/, accessed September 20, 2004.

National Park Service (NPS), National Register Information System (NRIS), 2004. http://www.nr.nps.gov/, accessed August 17, 2004.

National Parks Conservation Association (NPCA), 2004. "Blue Whale," http://www.npca.org/marine_and_coastal/marine_wildlife/bluewhale.asp, accessed September 15, 2004.

Naval Air Station Whidbey Island (NASWI), 2003. *P-162 Consolidated Fuel Facility Environmental Assessment*, January.

Naval Surface Warfare Center (NSWC), Port Hueneme Division, 2000. *Virtual Test Capability (VTC), Surface Warfare Engineering Facility (SWEF) Environmental Assessment*, May.

New York State Department of Environmental Conservation (NYDEC), 2003. "Sei Whale Fact Sheet," Last updated March 1, 2003. http://www.dec.state.ny.us/website/dfwmr/wildlife/endspec/sewhfs.html, accessed September 16, 2004.

Office of Naval Research, 2001. *Final Environmental Impact Statement for the North Pacific Acoustic Laboratory*, Volume I, Chapter 3, Affected Environment, May. http://npal.ucsd.edu/FEIS/download.html, accessed October 1, 2004.

Republic of the Marshall Islands (RMI), 2004a. "Area and Location of Atolls in the Marshall Islands," http://www.rmiembassyus.org/statistics/pdf/Geography/geography1.pdf, accessed October 1, 2004.

Republic of the Marshall Islands (RMI), 2004b. "Population by Atolls/Islands, 1958-1999," http://www.rmiembassyus.org/statistics/pdf/Demographics/PopbyAtollVarYrs.pdf, accessed October 1, 2004.

SN/Raytheon. 2005. FBX-T Radiation Hazard White Paper (Draft), July.

State of Alaska Department of Environmental Conservation (Alaska DEC), Air and Water Data and Monitoring Section, 2001. "Alaska's SLAMS/NAMS Monitoring Network Assessment 2001 Annual Report," http://www.state.ak.us/dec/air/am/AK_Network_01.pdf, accessed August 23, 2004.

State of Alaska Department of Environmental Conservation (Alaska DEC), Contaminated Sites Program, 2004. Division of Spill Prevention and Response, "King Salmon AFB," http://www.state.ak.us/dec/spar/csp/sites/kingsalmon.htm, accessed August 17, 2004.

The Marine Mammal Center, 2004. "Blue Whale," http://www.tmmc.org/learning/education/whales/blue.asp, accessed September 15, 2004.

U.S. Army Space and Strategic Defense Command. 1993. *Final Ground-Based Radar Family of Radars Environmental Assessment*, June.

U.S. Army Space and Missile Defense Command, 1999. *Wake Island Launch Center (WILC) Supplemental Environmental Assessment*, October. http://www.smdcen.us/dcsenev/SMDCEnvDocs/Pages/EA.asp, accessed August 24, 2004.

U.S. Army Space and Missile Defense Command, 2000. *National Missile Defense (NMD) Deployment Final Environmental Impact Statement*, July. http://www.acq.osd.mil/mda/mdalink/html/eis.html; http://www.smdcen.us/dcsenev/SMDCEnvDocs/default.asp, accessed August 24, 2004.

U.S. Army Space and Missile Defense Command, 2001. *Final Historic Preservation Plan, United States Army Kwajalein Atoll*, August. http://www.smdcen.us/PDFSearch/usaka/usaka_hpp_maintext_aug2001.pdf, accessed October 6, 2004.

U.S. Army Space and Missile Defense Command, 2002a. *Theater High Altitude Area Defense (THAAD) Pacific Flight Tests Environmental Assessment*, December. http://www.smdcen.us/dcsenev/SMDCEnvDocs/Pages/EA.asp, accessed August 24, 2004.

U.S. Army Space and Missile Defense Command, 2002b. *White Sands Missile Range (WSMR), New Mexico Liquid Propellant Targets (LPT) Environmental Assessment*, May. http://www.smdcen.us/dcsenev/SMDCEnvDocs/Pages/EA.asp, accessed August 24, 2004.

U.S. Army Space and Missile Defense Command, 2003a. *Ground-Based Midcourse Defense (GMD) Extended Test Range (ETR) Final Environmental Impact Statement,* July. http://www.smdcen.us/dcsenev/SMDCEnvDocs/Pages/EIS.asp; http://www.acq.osd.mil/mda/mdalink/html/enviro.html, accessed August 24, 2004.

U.S. Army Space and Missile Defense Command, 2003b. *Environmental Standards and Procedures for U.S. Army Kwajalein Atoll (USAKA) Activities in the Republic of the Marshall Islands (RMI) (8th Edition)*, April. http://www.smdcen.us/pubdocs/files/ues2003.pdf accessed September 17, 2004.

U.S. Army Space and Missile Defense Command, 2004. *Use of Tributyl Phosphate (TBP) in the Intercept Debris Measurement Program (IDMP) at White Sands Missile Range (WSMR) Environmental Assessment*, April 27.

U.S. Army Space and Missile Defense Command, Reagan Test Site, 2004a. *Ronald Reagan Ballistic Missile Defense Test Site (RTS), Kwajalein Atoll,* http://www.smdc.army.mil/rts.html, accessed October 1, 2004.

U.S. Army Space and Missile Defense Command, Reagan Test Site, 2004b. *Strategic Location of Reagan Test Site*, http://www.smdc.army.mil/kwaj/KMR_LOCN.HTM, accessed October 1, 2004.

U.S. Army Space and Missile Defense Command, Reagan Test Site, 2004c. *U.S. Army Kwajalein Atoll (USAKA) Base Operations,* http://www.smdc.army.mil/kwaj/BaseOps.html, accessed September 7, 2004.

U.S. Army Space and Strategic Defense Command, 1993. *Supplemental Environmental Impact Statement, Proposed Actions at U.S. Army Kwajalein Atoll (USAKA)*, December. http://www.smdcen.us/dcsenev/SMDCEnvDocs/Pages/EIS.asp; http://www.smdcen.us/pubdocs/Pages/USAKASupp_EIS.htm; http://ax.losangeles.af.mil/axf/eaapgs/eis.htm, accessed August 24, 2004.

U.S. Army Space and Strategic Defense Command, 1994. *Wake Island Environmental Assessment*, January. http://www.smdcen.us/dcsenev/SMDCEnvDocs/Pages/EA.asp, accessed August 24, 2004.

U.S. Army Space and Strategic Defense Command, 1995. *U.S. Army Kwajalein Atoll (USAKA) Temporary Extended Test Range (ETR) Environmental Assessment*, October 19. http://www.smdcen.us/dcsenev/SMDCEnvDocs/Pages/EA.asp, accessed August 24, 2004.

U.S. Census Bureau, 2004a. "California QuickFacts, Ventura County, California," http://quickfacts.census.gov/qfd/states/06/06111.html, accessed August 26, 2004.

U.S. Census Bureau, 2004b. "New Mexico QuickFacts, New Mexico," http://quickfacts.census.gov/qfd/, accessed August 17, 2004.

U.S. Census Bureau, 2004c. "Washington QuickFacts, Island County, Washington," http://quickfacts.census.gov/qfd/states/53/53029.html, accessed August 17, 2004.

U.S. Census Bureau, 2004d. "Alaska QuickFacts," http://quickfacts.census.gov/qfd/states/02/02060.html, accessed September 29, 2004.

U.S. Census Bureau, International Database, 2004. "Summary Demographic Data for Marshall Islands," Last updated September 30, 2004, http://www.census.gov/cgi-bin/ipc/idbsum?cty=RM accessed October 1, 2004

U.S. Department of the Air Force, 1997. *Program Definition and Risk Reduction (PDRR) Phase of the Airborne Laser (ABL) Program Final Environmental Impact Statement*, April. http://www.smdcen.us/dcsenev/SMDCEnvDocs/Pages/EIS.asp, accessed August 24, 2004.

U.S. Department of the Air Force, Space and Missile Systems Center, 2001. *Final Environmental Assessment for the U.S. Air Force Quick Reaction Launch Vehicle (QRLV) Program*, January 22. http://ax.losangeles.af.mil/axf/eaapgs/docs/QrlvEaF.pdf, accessed August 27, 2004.

U.S. Department of the Navy, Naval Air Warfare Center, Weapons Division, 2002. *Final Environmental Impact Statement/Overseas Environmental Impact Statement, Point Mugu Sea Range*, March. http://www.smdcen.us/pubdocs/files/Final-EIS.pdf; http://ax.losangeles.af.mil/axf/eaapgs/eis.htm, accessed August 24, 2004.

U.S. Department of the Navy, Naval Air Station Whidbey Island (NASWI), 2004a. "Hazardous Waste and Hazardous Materials," http://www.naswi.navy.mil/env/hazwaste.htm, accessed August 17, 2004.

U.S. Department of the Navy, Naval Air Station Whidbey Island (NASWI), 2004b. "Water Quality Report, January 1 – December 31, 2002," http://www.naswi.navy.mil/env/2002%20water_quality_report.htm, accessed August 17, 2004.

U.S. Department of the Navy, Naval Air Station Whidbey Island (NASWI), 2004c. "Mission." http://www.naswi.navy.mil/pao/mission.htm, accessed September 7, 2004.

U.S. Department of the Navy, Pacific Missile Range Facility (PMRF), Barking Sands, 1998. *Pacific Missile Range Facility Enhanced Capability Final Environment Impact Statement*, December. http://www.smdcen.us/dcsenev/SMDCEnvDocs/Pages/EIS.asp; http://www.smdcen.us/pubdocs/Pages/PMRF.htm, accessed August 24, 2004.

U.S. DOT, 2002. *Environmental Assessment for the Site, Launch, Reentry, and Recovery Operations at the Kistler Launch Facility, Nevada Test Site*, April.

U.S. DOT, Bureau of Transportation Statisitics (BTS), 2003. "National Transportation Statistics." http://www.bts.gov/publications/national_transportation_statistics/, accessed November 2004.

U.S. Environmental Protection Agency (USEPA), 2004. "Environmental Justice," http://www.epa.gov/compliance/environmentaljustice/index.html, accessed October 5, 2004.

U.S. Environmental Protection Agency (USEPA), Air and Radiation Division, 2004. "National Ambient Air Quality Standards (NAAQS)," http://www.epa.gov/air/criteria.html, accessed October 5, 2004.

U.S. Environmental Protection Agency (USEPA), AirData, 2004. "Monitor Values Report," http://www.epa.gov/air/data/monvals.html, accessed September 7, 2004.

U.S. Environmental Protection Agency (USEPA), Office of Air Quality and Planning Standards (OAQPS), 2004. "Green Book," http://www.epa.gov/air/oaqps/greenbk/, accessed September 7, 2004.

U.S. Environmental Protection Agency (USEPA), Region 10, 2001. "Naval Air Station, Whidbey Island (Ault)," http://yosemite.epa.gov/r10/nplpad.nsf/88d393e4946e3c478825631200672c95/89c39e6b0b0f96408525659f004ba002?OpenDocument, accessed August 17, 2004.

U.S. Environmental Protection Agency (USEPA). AP 42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources, Sections 3.3 Gasoline and Diesel Industrial Engines, October 1996, and Large Stationary Diesel and All Stationary Dual-fuel Engines, October 1996.

U.S. Environmental Protection Agency (USEPA), Office of Transportation and Air Quality (OTAQ). 2005. ICAO Aircraft Engine Emissions Databank. http://www.epa.gov/otaq/aviation.htm

U.S. Fish and Wildlife Service (USFWS), 1999. Federal Register Notice of Availability, Midway Atoll National Wildlife Refuge Historic Preservation Plan, July 16. Volume 64, Number 136. http://policy.fws.gov/library/99fr38466.html, accessed October 4, 2004.

U.S. Fish and Wildlife Service (USFWS), 2001a. Fact Sheet, "Spectacled Eider (*Somateria fischeri*)," http://alaska.fws.gov/media/SpecEider.htm, accessed September 14, 2004.

U.S. Fish and Wildlife Service (USFWS), 2001b. Fact Sheet, "Steller's Eider (*Polysticta stelleri*)," http://alaska.fws.gov/media/StellEider.htm, accessed September 14, 2004.

U.S. Fish and Wildlife Service (USFWS), 2004a. "Endangered Species Glossary," September. http://endangered.fws.gov/glossary.pdf, accessed October 6, 2004.

U.S. Fish and Wildlife Service (USFWS), 2004b. Endangered Species Program, http://endangered.fws.gov/, accessed September 10, 2004.

U.S. Fish and Wildlife Service (USFWS), 2004c. Life History, "Least Bell's vireo," http://ecos.fws.gov/docs/life_histories/B067.html, accessed September 16, 2004.

U.S. Fish and Wildlife Service (USFWS), Midway Atoll National Wildlife Refuge (NWR), 2000. "Short-tailed Albatross," June 28. http://midway.fws.gov/intro/locate.html, accessed September 14, 2004.

U.S. Fish and Wildlife Service (USFWS), Midway Atoll National Wildlife Refuge (NWR), 2002. http://midway.fws.gov/intro/locate.html, accessed August 17, 2004.

U.S. Fish and Wildlife Service (USFWS), Pacific Islands, 2004. "Threatened and Endangered Animals in the Hawaiian and Pacific Islands," http://pacificislands.fws.gov/wesa/hawanimalsindex.html#Hawaiian, accessed August 17, 2004.

U.S. Fish and Wildlife Service (USFWS), Sacramento Fish and Wildlife Office, 2004. "Species Account: Western Snowy Plover (*Charadrius alexandrinus nivosus*)," http://sacramento.fws.gov/es/animal_spp_acct/western_snowy_plover.htm, accessed September 14, 2004.

U.S. Fish and Wildlife Service (USFWS), Threatened and Endangered Species System (TESS), 2004. http://ecos.fws.gov/tess_public/TESSWebpage, accessed September 10, 2004.

U.S. Geological Survey (USGS), 1999. *Ground Water Atlas of the United States, Alaska, Hawaii, Puerto Rico, and the US Virgin Islands*, HA 730-N. http://capp.water.usgs.gov/gwa/ch_n/N-HItext1.html, accessed August 17, 2004.

U.S. Geological Survey (USGS), 2004a. "Mountain Plover *Charadrius montanas*," http://www.mbr-pwrc.usgs.gov/id/framlst/i2810id.html, accessed September 14, 2004.

U.S. Geological Survey (USGS), 2004b. Southwest Biological Science Center, Colorado Plateau Research Station, "Southwestern Willow Flycatcher Site," http://www.usgs.nau.edu/swwf/, accessed August 17, 2004.

U.S. Geological Survey (USGS), 2004c. "Land Use," http://biology.usgs.gov/s+t/SNT/noframe/lu106.htm, accessed October 6, 2004.

Virginia Tech, 1996. Endangered Species Information System: Fish and Wildlife Information Exchange, Plants, "Fern, Shield, Aleutian (*Polystichum aleuticum*): Draft Taxonomy," March 13. http://fwie.fw.vt.edu/WWW/esis/, accessed September 14, 2004.

Western Pacific Regional Fishery Management Council, 2001. *Final Fishery Management Plan for Coral Reef Ecosystems of the Western Pacific Region*, October. http://www.wpcouncil.org/coralreef.htm, accessed August 8, 2004.

Wikipedia.org, 2004. "Kwajalein," http://en.wikipedia.org/wiki/Kwajalein, accessed March 2004.

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7 DISTRIBUTION LIST

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Department of Environmental Quality 629 East Main Street Post Office Box 10009 Richmond VA 23240	Ethel Eaton Manager, Office of Review and Compliance Department of Historic Resources, Central Office 2801 Kensington Avenue Richmond, VA 23221
Department of Game and Inland Fisheries 4010 West Broad Street Richmond VA 23230	
STATE AGENCIES - Washington	
Washington State Conservation Commission P.O. Box 47721 Olympia, WA 98504-7721	Washington Department of Natural Resources P.O. Box 47001 Olympia, WA 98504-7001
Washington Department of Fish and Wildlife 600 Capitol Way N. Olympia, WA USA 98501-1091	Allyson Brooks, State Historic Preservation Officer Office of Archaeology & Historic Preservation Suite 106 1063 South Capitol Way Olympia WA 98501
OCONUS	
Ms. Carmen Bigler Secretary of Interior Affairs and Historic Preservation Officer P.O. Box 1454 Majuro, Marshall Islands 96960	Tim Bodeen Refuge Manager Midway Atoll National Wildlife Refuge PO Box 29460 Honolulu, HI 96820-1860

STATE OF ALASKA

FRANK H. MURKOWSKI, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF PARKS AND OUTDOOR RECREATION
OFFICE OF HISTORY AND ARCHAEOLOGY

550 W. 7TH AVENUE, SUITE 1310
ANCHORAGE, ALASKA 99501-3565
PHONE: (907) 269-8721
FAX: (907) 269-8908

September 28, 2005

File No.: 3130-1R DOD

SUBJECT: Proposed Missile Defense Agency Activities, Cordova

Post-it® Fax Note 7671	Date 9/28/05	# of pages ▶ 2
To Trevor McCroskey	From Margie	
Co./Dept. MDA	Co. OHA	
Phone # 703-697-5108	Phone # 907 269 8722	
Fax # 703-695-5760	Fax # 907 269 8908	

Trevor McCroskey
Missile Defense Agency
Department of Defense
1601 Kirby Road
McLean, VA 22101

Dear Mr. McCroskey,

Our office has received the scope-of-work and project area maps (via email 9/23/05 and 9/28/05) regarding the proposed gravel pad in association with the temporary placement of mobile telemetry equipment at the Cordova Municipal Airport. In addition you have also provided the archaeological report written by Daniel Thompson and Rolfe Buzzell (6/2004) entitled, *Cultural Resource Reconnaissance of the Merle K (Mudhole) Smith Airport, Cordova and Material Site MS 851-067-5: ADOT&PF Project Number 61403.* According to this archaeological report, the maps which you provided of the proposed project area and material site have been previously surveyed and were found not to contain archaeological or historic resources. Therefore, the State Historic Preservation Office concurs with your finding of No Historic Properties Affected for this project.

Please note that this concurrence is for the scope-of-work which we received on 9/23/05 and 9/28/05 only. If there is a change in the scope, a new review by our office must occur in order for the Missile Defense Agency to remain in compliance under Section 106 of the National Historic Preservation Act. As was mentioned in our letter of 9/23/05 regarding the *Missile Defense Agency Mobile Sensors Environmental Assessment* (9/1/05), any activities occurring at Cordova Municipal Airport or the Kodiak Launch Facility must be submitted to our office for review prior to project implementation. As you and Mr. Crate Spears discussed (9/27/05) with Margie Goatley of our staff, there are no proposed projects planned for the Kodiak Launch Facility at this time.

While we understand MDA did not anticipate the need for Section 106 review by the State Historic Preservation Office, we ask that our 30 day review period (and possible recommendation of an archaeological survey and ensuing report) is scheduled for accordingly regarding future projects. Our office appreciates your cooperation throughout this process and looks forward to working with the Missile Defense Agency in future Section 106 projects.

Please contact Margie Goatley at (907) 269-8722 if you have any questions or if we can be of further assistance.

Sincerely,

Joan M Antonson

Judith E. Bittner
Deputy State Historic Preservation Officer

JEB:mmg

Cc: Don Klima, Director of Eastern Office, Advisory Council of Historic Preservation, 1100 Pennsylvania Ave., NW, Ste. 803, Washington DC 20004
Maureen Koetz, Principal Deputy Assistant Secretary, SAF/IE, Room 4E998, 1665 Air Force Pentagon, Washington DC 20330-1665
Douglas Burkett, Natural & Cultural Resources Program Manager, 1260 Air Force Pentagon, Washington DC 20330-1260

McCroskey, Trevor CTR MDA/TERC

From: Spears, Crate CIV MDA/TERC
Sent: Friday, September 23, 2005 6:53 PM
To: Finkel, Howard S CTR MDA/TER; McCroskey, Trevor CTR MDA/TERC; Stribley, Todd CTR MDA/TER; Wheeler, George CTR MDA/TER
Subject: FWS comments on MSEA

-----Original Message-----
From: Ann_Rappoport@fws.gov [mailto:Ann_Rappoport@fws.gov]
Sent: Friday, September 23, 2005 6:55 PM
To: Spears, Crate CIV MDA/TERC
Subject: Mobile Sensors - Missile Defense Agency

Hi Crate -

We have looked at your September 1, 2005, Environmental Assessment, "Missile Defense Agency, Mobile Sensors." The proposal in this EA to place mobile sensors on an existing gravel pad at the Mudhole Smith Airport in Cordova will not involve new wetlands fill, nor will it present a likely bird strike hazard. At this time, there are no listed threatened or endangered species in the vicinity of Cordova, Alaska; nor are there any candidate species in that area. Consequently we have no objections to the project as proposed.

Sincerely,

Ann G. Rappoport, Field Supervisor
Anchorage Fish and Wildlife Field Office
U.S. Fish and Wildlife Field Office
605 W. 4th, Room G-61
Anchorage, AK 99501
(907)271-2787

STATE OF ALASKA

DEPT. OF ENVIRONMENTAL CONSERVATION
DIVISION OF AIR QUALITY
AIR NON-POINT & MOBILE SOURCES

FRANK H. MURKOWSKI, GOVERNOR
410 Willoughby Ave., Suite 303
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http://www.dec.state.ak.us

September 22, 2005

File: 41.05

Mr. Crate Spears
Environmental Manager
Department of Defense (DOD)
Missile Defense Agency
7100 Defense Pentagon
Washington DC 20301-7100

Dear Mr. Spears:

This letter is in regards to the *Missile Defense Agency Mobile Sensors* Environmental Assessment Report posted to the Missile Defense Agency website [http://www.mda.mil/mdalink/html/mdalink.html] September 8, 2005. Cordova, Alaska is not currently in a maintenance or nonattainment area for air quality control under the Clean Air Act. Therefore, Cordova projects receiving federal funds or approvals do not require an applicability analysis under General Conformity regulations.

Thank you for contacting us about your project. If you have further questions or concerns about air quality issues in Cordova or elsewhere in Alaska, you may contact Barbara Shepherd at (907) 465-5176 or by e-mail at *barbara_shepherd@dec.state.ak.us*.

Sincerely

Ronald G. King

Ronald G. King
Program Manager

O:\AQ\[illegible]\Rural general conformity correspondence\DODMD[illegible]EA2005.doc

APPENDIX A

Description of Site-Specific Information for Proposed Land-Based and Airborne Mobile Sensor Systems

APPENDIX A

Description of Site-Specific Information for Proposed Land-Based Mobile Sensor Systems

The following presents general site-specific information on the proposed locations where land-based mobile sensors would be used and where potential impacts could occur. For each location, MDA reviewed other documents prepared in accordance with NEPA and incorporated by reference the information presented for most resource areas. For resource areas not incorporated by reference, a concise description is provided in this appendix in order to facilitate tiering in subsequent NEPA documents. This appendix is meant to provide baseline information for future studies and analyses.

Site-specific information on the proposed bed down locations of airborne mobile sensors is not included in this appendix due to the fact that the proposed activities at these locations are routine, do not include ground-disturbing activities, and are not likely to alter the normal operations of these facilities.

A.1 Vandenberg Air Force Base

Vandenberg AFB comprises more than 39,660 hectares (98,000 acres) within Santa Barbara County, California and is located approximately 89 kilometers (55 miles) north of the city of Santa Barbara near Lompoc, and 225 kilometers (140 miles) northwest of Los Angeles. The host unit at Vandenberg AFB is the 30th Space Wing, which is responsible for launching satellites into orbit. Vandenberg AFB also provides launch facilities for testing intercontinental ballistic missiles and conducts military, NASA, and commercial space launches. (USAF, 1995 as referenced in MDA, 2003)

Some of the resources at Vandenberg AFB are incorporated by reference from the Booster Verification Tests Environmental Assessment (USAF, 1999), Ground-Based Midcourse Defense Extended Test Range Environmental Impact Statement [GMD ETR EIS, (SMDC, 2003)] and the Airborne Laser Program Supplemental Environmental Impact Statement [ABL SEIS, (MDA, 2003)]. Exhibit A-1 shows where the discussion for each resource area can be found.

Exhibit A-1. Resource Area Specific Description of Affected Environment for Vandenberg AFB

Resource Area	Incorporated by Reference	Location of Description of Affected Environment
Air Quality	No	A.1.1
Airspace	Yes	ABL SEIS
Biological Resources	No	A.1.2

Resource Area	Incorporated by Reference	Location of Description of Affected Environment
Cultural Resources	Yes	GMD ETR EIS
Geology and Soils	Yes	GMD ETR EIS
Hazardous Materials and Hazardous Waste Management	Yes	GMD ETR EIS
Health and Safety	Yes	GMD ETR EIS
Land Use	Yes	GMD ETR EIS
Noise	Yes	GMD ETR EIS
Socioeconomics and Environmental Justice	Yes	GMD ETR EIS
Transportation and Infrastructure	Yes	GMD ETR EIS
Visual Resources	Yes	Booster Verification Tests EA
Water Resources	Yes	GMD ETR EIS

A.1.1 Air Quality – Vandenberg AFB

Climate

The climate at Vandenberg AFB is dry and subtropical. The Pacific Ocean is a moderating influence on temperatures and moisture content of the air. The weather is warm and dry from May to November and wet and cool from December to April. The average annual temperature is 13ºC (55ºF), with a high of 23ºC (74ºF) in September and a low of 3ºC (38ºF) in January. Average annual rainfall is approximately 33 centimeters (13 inches). The wettest month is February, and the driest is July. The widely varying topography causes a great variation in local wind direction and speed. In general, winds are stronger on the higher ridgelines and along the beaches. The annual surface wind speed is approximately 11 kilometers (7 miles) per hour, usually from the west-northwest. Coastal fog, which occurs primarily during July through September, is usually confined to late evenings and early mornings.

Air Quality

Vandenberg AFB is part of the South Central Coast Air Basin and is located in the Santa Barbara County Air Pollution Control District. Santa Barbara County is considered to be in attainment for all AAQS except for California's state AAQS for ozone and PM_{10}, as determined by the California Air Resources Board. Santa Barbara County has recently been redesignated by the EPA as being in attainment for both the 1-hour and 8-hour ozone standards. (USEPA, 2005)

Existing Emissions

The Santa Barbara County Air Pollution Control District administers regulations for nonvehicular air pollution sources, and is required to monitor air pollution levels to ensure Federal and state AAQS are met or develop a plan to meet them. (Air Force Center for Environmental Excellence, 1999 as referenced in GMD ETR EIS) The air monitoring station at Vandenberg AFB is located in the south portion of the base. Under Federal standards, Santa Barbara County is a moderate ozone non-attainment region, as demonstrated by the maximum ozone daily 1-hour maximum concentrations shown in Exhibit A-2. Santa Barbara County is in attainment for CO. Although a single exceedance of the PM_{10} NAAQS limit has occurred, the county, under present rules, remains in attainment for PM_{10}.

Exhibit A-2. Summary of Maximum Criteria Pollutant Concentrations in Santa Barbara County

Year	CO (8-hour) ppm	PM_{10} (24-hour) µg/m^3	Ozone (1-hour) ppb
1996	4.9	78	134
1997	4.1	122	137
1998	4.6	73	130
1999	4.2	99	135
2000	3.1	53	128
2001	n/a	66	117
2002	n/a	50	113
2003	n/a	58	107

µg/m^3 = micrograms per cubic meter
PM_{10} = particulate matter equal to or less than 10 microns in diameter
ppb = parts per billion
ppm = parts per million
n/a = information not available
Source: MDA, 2003 and USEPA AirData, 2004

A.1.2 Biological Resources – Vandenberg AFB

Vandenberg AFB is subject to both Federal and California laws regarding biological resources. The official California listing of threatened and endangered plants is contained in CCR Title 14 Section 670.2. The official California listing of threatened and endangered animals is contained in CCR Title 14 Section 670.5.

Vegetation

Vandenberg AFB occupies a transition zone between the cool, moist conditions of northern California and the semi-desert conditions of southern California. Many plant species and plant communities reach their southern or northern limits in this area.

Natural vegetation types include southern foredunes; southern coastal, central dune, central coastal, and Ventura coastal sage scrub; chaparral, including central maritime chaparral; coast live oak woodland and savanna; grassland; tanbark oak and southern bishop pine forest; and wetland communities including saltmarsh and freshwater marsh, riparian forests, scrub, and vernal pools. (U.S. Air Force, 1998a as referenced in MDA, 2003)

Plant communities include central coastal sage scrub, chaparral, grassland, wetlands, eucalyptus (non-native woodland), and ruderal areas. Ruderal vegetation is characterized by disturbance-tolerant, mostly non-native species, primarily introduced grasses. (U.S. Air Force, 1998a as referenced in MDA, 2003)

Coastal strand occurs along Vandenberg AFB's beaches. Native beach plants include beach saltbush, sea rocket, sand verbena, beach morning glory, and beach burr. European beachgrass and ice plant, non-native species, are pervasive and spreading on most Vandenberg AFB beaches. (U.S. Air Force, 1998a as referenced in MDA, 2003)

Wildlife

Vandenberg AFB contains a number of habitat types that support a rich diversity of wildlife. The coastline, near shore waters, and Channel Islands also support a wide variety of aquatic life, including marine mammals, birds, and fish.

Small carnivores include raccoons, long-tailed weasels and striped skunks. Feral pigs forage in riparian zones, and mule deer are found in several habitat types. Other carnivores include the bobcat, black bear, gray fox, and coyote. Amphibians such as ensatina, blackbelly slender salamander, and pacific treefrogs may occur in coastal sage and chaparral communities, and are also found along with western toads in riparian woodland areas. Reptiles such as the western skink, western fence lizard, southern alligator lizard, and gopher snakes are common on Vandenberg AFB. (U.S. Air Force, 1998a as referenced in MDA, 2003) Other smaller wildlife species include the garter snake, pocket gopher, California ground squirrel, deer mouse, brush rabbit, and the badger.

Birds such as the ring billed, Heerman's, and glaucous-winged gulls; western wood-pewee; rhinoceros auklet; red-winged blackbird; red-tailed hawk; great horned owl; and golden eagle have also been spotted. (U.S. Department of the Air Force, 1997b; Vandenberg AFB, 2000 as referenced in SMDC, 2003) Because Vandenberg AFB is near the southern limit of the breeding ranges for many seabird species, a long-term program was begun in 1999 to annually monitor population dynamics and breeding biology of seabirds breeding on Vandenberg AFB. An estimated total of 1,200 seabirds were identified that year. (Point Reyes Bird Observatory, 1999 as referenced in SMDC, 2003)

An abundance and diversity of marine birds are found along the offshore waters and Channel Islands. As many as 30 species of seabirds are known to occur in the open ocean off the continental shelf. The Channel Islands are inhabited by breeding colonies of marine birds including Leach's and ashy storm-petrels; Brandt's, double-crested, and pelagic cormorants; pigeon guillemots; and Cassin's auklets. (U.S. Air Force, 1998a as referenced in MDA, 2003)

Northern fur seals and northern elephant seals use the northern Channel Islands as haul-out (nesting), mating, and pupping areas. Purisima Point and Rocky Point are the primary haul-out sites on Vandenberg AFB. (U.S. Air Force, 1998a as referenced in MDA, 2003)

The Pacific harbor seal is a resident species of Lion's Head and Point Sal. Counts of harbor seals performed at nine main haul-out sites along the coast of Vandenberg AFB average 327 seals. Harbor seals haul-out at a total of 19 sites between Point Sal and Jalama Beach. Lion's Head has been documented as a haul-out area and recently as a pupping area for a small number of Pacific harbor seals. The largest numbers of harbor seals are found at Lion's Head between September and January. Most harbor seal pupping occurs in March with a 4 to 6 week weaning period. (U.S. Department of the Air Force, 1999 as referenced in SMDC, 2003)

The California sea lion does not breed on Vandenberg AFB but is found along the coastline during the summer. (U.S. Department of the Air Force, 1999 as referenced in SMDC, 2003) Point Sal, which is north of the AFB boundary, is the closest area used as a haul-out by the California sea lion. Other pinnipeds such as the elephant seal and northern fur seal are observed periodically on the base and can be found in nearby haul-out/rookery areas, preferring undisturbed sections of mainland coast and offshore islands or rocks. One such area is just south of Minuteman Beach.

Bottlenose, common, and Pacific white-sided dolphins, and small-toothed and killer whales are common near Vandenberg AFB and the Channel Islands. The gray whale (a former federally listed endangered species, now designated as recovered) is found close to shore, off south Vandenberg AFB, during migration between November and May. Minke whales have been reported within a few miles of the leeward side of the Channel Islands. (U.S. Air Force, 1998a, as referenced in MDA, 2003) In addition, National Oceanic and Atmospheric Administration (NOAA) Fisheries indicates that the following marine mammal species may also be found in the region: beaked whales, fin whales, striped dolphins, Risso's dolphin, northern right whale dolphins, and Dall's porpoise.

Threatened and Endangered Species

Federally and state-listed species of threatened or endangered plants and animals that may be present in the vicinity of Vandenberg AFB are listed in Exhibit A-3. Six of the mammals include federally endangered whales that are found only in low densities in waters off Vandenberg AFB.

Exhibit A-3. Threatened and Endangered Species Known or Expected to Occur at Vandenberg AFB

Common Name	Scientific Name	State Status	Federal Status
Plant Species			
Beach Layia	*Layia carnosa*	E	E
Gambel's watercress	*Rorippa gambellii*	T	E
Gaviota tarplant	*Hemizonia increscens* ssp. *Villosa*	E	E
Lompoc yerba santa	*Eriodictyon capitatum*	R	E
Surf thistle	*Cirsium rhothophilum*	T	-
Animal Species			
American peregrine falcon	*Falco peregrinus anatum*	E/FP	D
Arroyo toad	*Bufo microscaphus californicus*	CSC	E
Bald eagle	*Haliaeetus leucocephalus*	E/FP	T/PD
Belding's Savannah sparrow	*Passerculus sanwichensis*	E	-
California brown pelican	*Pelecanus occidentalis californicus*	E/FP	E
California least tern	*Sterna antillarum browni*	E/FP	E
California red-legged frog	*Rana aurora draytonii*	CSC	T
Coho salmon	*Oncorhynchus kisutch*	E	T
Least Bell's vireo	*Bireo bellii pusillus*	E	E
Mountain plover	*Charadrius montanas*	CSC	PT
Southern sea otter	*Enhydra lutris nereis*	FP	T
Southwestern willow flycatcher	*Empidonax trailli extimus*	E	E
Steelhead trout	*Oncorhynchus mykiss*	-	T
Tidewater goby	*Eucyclogobius newberry*	CSC	E/PD
Unarmored three-spined stickleback	*Gasterosteus aculeatus williamsoni*	E/FP	E
Western snowy plover	*Charadrius alexandrinus nivosus*	CSC	T

Exhibit A-3. Threatened and Endangered Species Known or Expected to Occur at Vandenberg AFB

Common Name	Scientific Name	State Status	Federal Status
Whale, Blue	*Balaenoptea musculus*	-	E
Whale, Finback	*Balaenoptera physalus*	-	E
Whale, Humpback	*Megaptera novaengliae*	-	E
Whale, Right	*Balaena glacialis*	-	E
Whale, Sei	*Balaenoptera borealis*	-	E
Whale, Sperm	*Physeter macrocephalus*	-	E

E = Endangered
R = Rare
T = Threatened
P = Proposed
D = Delisted
FP = Fully Protected
CSC = California Species of Concern, a native species or subspecies that have become vulnerable to extinction because of declining population levels, limited ranges, or rarity. The goal is to prevent these from being endangered by addressing the issues or concern early enough to secure long-term viability. (as defined in ABV Verification Tests EA)
Sources: SMDC, 2003; MDA, 2003; California DFG, Habitat Conservation Planning Branch, 2004a

Sensitive Habitats

Environmentally sensitive habitats on Vandenberg AFB include butterfly trees, marine mammal haul outs, seabird nesting and roosting areas, white-tailed kite habitat, and wetlands. The Monarch butterfly is a regionally rare and declining insect known to overwinter in the eucalyptus and cypress groves on Vandenberg AFB. White-tailed kite foraging habitat includes grassland and open coastal sage scrub, primarily during the fall and winter. (U.S. Air Force, 1998a as referenced in MDA, 2003)

Marine Ecological Reserve

There are five kilometers (three miles) of coastline designated as a marine ecological reserve; this includes a beach area south of Rocky Point used by harbor seals as haul-out and pupping areas. Vandenberg AFB and the California Department of Fish and Game have a memorandum of agreement to limit access to this area to scientific research and military operations. (U.S. Air Force, 1998a as referenced in MDA, 2003)

Dune Systems

The installation envelops one of the major southern California coastal dune systems, with areas still resembling their original condition, and occupies one of the state’s six remaining coastal dune systems. Extensive central foredunes and coastal dune scrub are located on the North Vandenberg coast. (U.S. Department of the Air Force, 1991 as referenced in SMDC, 2003)

Wetlands and Waterways

Along with a network of swales, several wetlands (including two man-made) occur near Building 1819; the closest is approximately 1.6 kilometers (1 mile) to the northwest. These wetlands, ranging between 0.8 and 2.8 hectares (2 and 7 acres) in size, support such typical species as arroyo willow, wide-leaf cattail, California bulrush, water smartweed, and bog rush. (SMDC, 2003)

The Santa Ynez River watershed drains approximately 2,330 square kilometers (900 square miles) of land; approximately 117 square kilometers (45 square miles) occur on Vandenberg AFB. The Santa Ynez River supports many sensitive species, and becomes intermittent during the summer as water levels drop. (U.S. Air Force, 1998a as referenced in MDA, 2003)

Channel Islands National Marine Sanctuary

In 1980, a 4,294-square kilometer (1,252-square nautical mile) portion of the Santa Barbara Channel was designated as the Channel Islands National Marine Sanctuary. The sanctuary is an area of national significance that encompasses the waters that surround Anacapa, Santa Cruz, Santa Rosa, San Miguel and Santa Barbara Islands and extends from mean high tide to 11 kilometers (6 nautical miles) offshore around each of the five islands. Seabird nesting and roosting areas are situated on the Channel Islands and on Vandenberg AFB. The sanctuary's primary goal is the protection of natural and cultural resources contained within its boundaries. NOAA has proposed to expand the Channel Islands National Marine Sanctuary off the coast of Vandenberg AFB. The study area for this expansion includes an area off the coast of California from south of Point Mugu to north of Point Sal. (National Oceanic and Atmospheric Administration, Channel Islands National Marine Sanctuary, 2002 as referenced in SMDC, 2003)

Critical Habitat

The USFWS recently designated approximately 2,590 hectares (6,401 acres) and 3,929 hectares (9,709 acres) of critical habitat for the Lompoc yerba santa and the Gaviota tarplant, respectively. These endangered plants are only found in coastal areas of Santa Barbara County. Approximately 2,126 hectares (5,253 acres) of critical habitat for these two plants at Vandenberg AFB was excluded. The decision was based on the commitment of Vandenberg AFB to develop and implement protective measures agreed to in its Integrated Natural Resources Management Plan. These measures include establishing Sensitive Resource Protection Areas for the plants in the areas proposed for critical habitat designation and monitoring, survey, enhancement, and restoration activities. (U.S. Fish and Wildlife Service, 2002c as referenced in SMDC, 2003)

The USFWS has also designated critical habitat for snowy plovers nesting along the beaches of Vandenberg AFB. Vandenberg AFB is developing a management plan in coordination with USFWS for beach closures during the snowy plover nesting season (1 March through 30 September).

Essential Fish Habitat

Essential Fish Habitat includes those waters and substrate (sediment, hard bottom) necessary to the complete life cycle of fish, from spawning to maturity. The east-west boundary for coastal pelagic species (Pacific sardine and mackerel, northern anchovy, jack mackerel, and squid), groundfish (including species of rockfish, shark, and cod), and highly migratory fish (tunas, marlin, and swordfish) includes all marine and estuary waters from the coast of California to the limits of the Exclusive Economic Zone (the 322-kilometer [200-mile] limit) where the United States has exclusive authority over management of fisheries. Fishing regulations are enforced by Vandenberg AFB security police game wardens. (SMDC, 2003)

A.2 Port Hueneme/San Nicolas Island

Port Hueneme

The Naval Base Ventura County Port Hueneme is located 97 kilometers (60 miles) northwest of Los Angeles and 80 kilometers (50 miles) south of Santa Barbara. The base itself covers more than 647 hectares (1,600 acres). (SMDC, 2003) The Naval Base Ventura Colunty serves as the U.S. Port of Entry for California's Central Coast region and serves international businesses and ocean carriers from both the Pacific Rim and Europe. It is also the primary support facility for offshore industry in the Central Coast area. Also located at the port is the Naval Construction Battalion Center, which provides support for Navy combat and weapon system programs from the time the systems are first built until they are no longer used. (U.S. Department of the Navy, 1999)

San Nicolas Island

Located approximately 105 kilometers (65 miles) southwest of the Naval Air Station Point Mugu, San Nicolas Island is owned and operated by the U.S. Navy as a major element of the Point Mugu Sea Range. The island is 14 kilometers (9 miles) long by 5.8 kilometers (3.6 miles) wide, and encompasses 5,411 hectares (13,370 acres). An airfield is located on San Nicolas near the southeastern edge of the island's central mesa. The landing area consists of one 3,050-meter (10,000-foot) concrete and asphalt runway. The airfield can accommodate aircraft up to the size and weight of C-5 aircraft. The island is extensively instrumented with tracking radar, electro-optical devices, telemetry, and communications equipment necessary to support long-range and over-the-horizon weapons testing and fleet training. It houses facilities that support all aspects of range operations, such as missile and target launches and missile impacts and scoring. (U.S. Department of the Navy, 2002)

Some of the resources at Port Hueneme and San Nicolas Island are incorporated by reference from the GMD ETR EIS (SMDC, 2003), the Virtual Test Capability Surface Warfare Engineering Facility Environmental Assessment [VTC EA, (U.S. Department of the Navy, 1999)], and the Point Mugu Sea Range EIS/Overseas EIS [OEIS, (U.S. Department of the Navy, 2002)]. Exhibits A-4 and A-5 indicate where the discussion for each resource area can be found.

Exhibit A-4. Resource Area Specific Description of Affected Environment for Port Hueneme

Resource Area	Incorporated by Reference	Location of Description of Affected Environment
Air Quality	Yes	GMD ETR EIS, VTC EA
Airspace	Yes	GMD ETR EIS, VTC EA
Biological Resources	No	A.2.1
Cultural Resources	Yes	VTC EA
Geology and Soils	Yes	Point Mugu EIS/OEIS
Hazardous Materials and Hazardous Waste Management	Yes	Point Mugu EIS/OEIS
Health and Safety	Yes	GMD ETR EIS, VTC EA
Land Use	Yes	VTC EA
Noise	Yes	VTC EA
Socioeconomics and Environmental Justice	No	A.2.2
Transportation and Infrastructure	No	GMD ETR EIS, VTC EA
Visual Resources	Yes	VTC EA
Water Resources	Yes	GMD ETR EIS

Exhibit A-5. Resource Area Specific Description of Affected Environment for San Nicolas Island

Resource Area	Incorporated by Reference	Location of Description of Affected Environment
Air Quality	Yes	GMD ETR EIS, VTC EA
Airspace	Yes	GMD ETR EIS
Biological Resources	No	A.2.1
Cultural Resources	Yes	Point Mugu EIS/OEIS

Resource Area	Incorporated by Reference	Location of Description of Affected Environment
Air Quality	Yes	GMD ETR EIS, VTC EA
Airspace	Yes	GMD ETR EIS, VTC EA
Biological Resources	No	A.2.1
Cultural Resources	Yes	VTC EA
Geology and Soils	Yes	Point Mugu EIS/OEIS
Hazardous Materials and Hazardous Waste Management	Yes	Point Mugu EIS/OEIS
Health and Safety	Yes	GMD ETR EIS, VTC EA
Land Use	Yes	VTC EA
Noise	Yes	VTC EA
Socioeconomics and Environmental Justice	No	A.2.2
Transportation and Infrastructure	No	GMD ETR EIS, VTC EA
Visual Resources	Yes	VTC EA
Water Resources	Yes	GMD ETR EIS

Exhibit A-5. Resource Area Specific Description of Affected Environment for San Nicolas Island

Resource Area	Incorporated by Reference	Location of Description of Affected Environment
Geology and Soils	Yes	Point Mugu EIS/OEIS
Hazardous Materials and Hazardous Waste Management	Yes	Point Mugu EIS/OEIS
Health and Safety	Yes	Point Mugu EIS/OEIS, GMD ETR EIS
Land Use	Yes	Point Mugu EIS/OEIS
Noise	Yes	Point Mugu EIS/OEIS
Socioeconomics and Environmental Justice	No	A.2.2
Transportation and Infrastructure	No	Point Mugu EIS/OEIS
Visual Resources	Yes	Point Mugu EIS/OEIS
Water Resources	Yes	Point Mugu EIS/OEIS

A.2.1 Biological Resources – Port Hueneme/San Nicolas Island

Vegetation – Port Hueneme

Port Hueneme lies within the northern end of the area known as the Southern California Bight (SCB), which extends from Point Conception to a point just south of the

U.S./Mexico border. The SCB is considered one of the most productive and diverse marine ecosystems in the world. The marine ecosystems within Port Hueneme include rocky intertidal and tidal pools, sandy beaches, rocky and sandy shore (benthic), kelp forests, and open ocean (pelagic). (U.S. Department of the Navy, 1999)

Offshore, but within the harbor jetties, are two small kelp beds, whose primary species is giant kelp. Kelp beds are also present in near shore waters along the coast and around offshore islands. This ecosystem supports several other small species of kelp, as well as numerous algae and invertebrates. (U.S. Department of the Navy, 1999)

Vegetation – San Nicolas Island

Twelve vegetation communities have been identified on San Nicolas Island. (Halverson et al., 1996, as referenced in U.S. Department of the Navy, 2002) This includes five scrub communities (caliche, isocoma, baccharis, lupinus, and coreopsis scrub) which comprise 7,349 acres (2,974 hectares) of habitat. Freshwater aquatic vegetation communities include vernal pools and riparian habitats. Coastal and inland dunes are found along the coastline of San Nicolas Island, and coastal marsh is found in three small areas. Annual iceplant, native and nonnative grasslands, and disturbed and developed habitats also occur. Barren areas that support no vegetation comprise 3,468 acres (1,476 hectares) of habitat. (U.S. Department of the Navy, 2002) San Nicolas Island is almost completely surrounded by marine flora, including giant kelp and numerous species of red, green, and brown algae. (U.S. Department of the Navy, 2002)

Wildlife – Port Hueneme

The Port Hueneme Harbor and associated jetties provide habitat and foraging areas for numerous fish species, both resident and seasonal visitors. These may include sharks, rays, flatfish, perch, croakers, smelt, herring, bass, anchovy, mackerel, bonito, goby, sculpin, mullet, and others. Between the jetties, just off the jetties, and in nearshore waters, California grunion, jacksmelt, topsmelt, barred and walleye surfperch, California corbina, spotfin croaker, senorita, sheephead, rockfish, flatfish, and the deepbody and slough anchovy are commonly found. Offshore pelagc waters support a variety of sharks, rockfish, anchovy, sardine, white seabass, salmon, and deep-sea fishes. (U.S. Department of the Navy, 1999)

Thirty-four species of cetaceans (whales, dolphins, porpoises) and six species of pinnipeds (seals and sea lions) can be found in the waters off the Ventura County coast near Port Hueneme, and many inhabit or migrate through nearshore waters. Some are year-round residents, and others are seasonal visitors or migratory. As many as 300,000 individual animals reside in or pass through the area each year, however, Port Hueneme is not used for feeding or breeding grounds at this time. The marine mammals within the region of influence are protected by the Marine Mammal Protection Act. Gray whales, whose numbers are now estimated at over 24,000 individuals, are often sighted off the Port Hueneme jetties during their annual migrations to and from breeding lagoons in Mexico and feeding grounds in the North Pacific (usually December through April). (SMDC, 2003) They are the first species of whale to have sufficiently recovered from commercial whaling to be removed from the endangered species list. Other cetacean species routinely found in these waters are the common dolphin, Pacific white-sided dolphin, Pacific bottlenose dolphin, pilot whale, blue whale, and finback whale. On occasion individual animals have been sighted inside Port Hueneme Harbor. (U.S. Department of the Navy, 1999)

Wildlife – San Nicolas Island

Marine inhabitants common to the rocky intertidal waters off San Nicolas Island include the wooly sculpin, reef finspot, rockpool blenny, spotted kelpfish, California clingfish, juvenile opaleye, and juvenile dwarf surfperch. (Cross and Allen 1993, as referenced in U.S. Department of the Navy, 2002) Nearshore inhabitants include a variety of fish, including the senorita, blacksmith, striped surfperch, painted greenling, and the yellowfin fringehead. (U.S. Department of the Navy, 2002) It is possible that a small number of sea turtles might occur in near shore waters off San Nicolas Island, especially during the summer. The kelp beds off western San Nicolas Island might attract some leatherback and green/black sea turtles. However, there are no known sea turtle nesting beaches at San Nicolas Island. (Stinson 1984, as referenced in U.S. Department of the Navy, 2002)

San Nicolas Island and the adjacent waters are important for northern elephant seals, California sea lions, and harbor seals, with principal breeding grounds at the southern and western shorelines of San Nicolas Island. Southern sea otters were moved to San Nicolas Island in an attempt to establish a population separate from that in central California. (U.S. Department of the Navy, 2002)

Dall's porpoise was recorded in waters 5.6 kilometers (3 nautical miles) from San Nicolas Island. Two Cuvier's beaked whales were stranded on San Nicolas Island, but probably drifted there after it died at sea. (Leatherwood et al. 1987 and NAWS Point Mugu 1998f, as referenced in U.S. Department of the Navy, 2002) Gray whales have been recorded within 5.6 kilometers (3 nautical miles) of San Nicolas Island, and minke whales were recorded further away. (Leatherwood et al. 1984, as referenced in U.S. Department of the Navy, 2002)

San Nicolas Island provides breeding habitat for several seabirds, including the western gull, Brandt's cormorant, and black oystercatcher. (NAWS Point Mugu, 1997, as referenced in U.S. Department of the Navy, 2002) Most common southern California seabirds and shorebirds nest or are seasonally present on San Nicolas Island and include the double-crested cormorant, western sandpiper, Pacific golden plover, and sooty shearwater. Resident and migratory terrestrial species include the American kestrel, horned lark, rock wren, and house finch. (U.S. Army Space and Strategic Defense Command, 1994 as referenced in SMDC, 2003)

Threatened and Endangered Species – Port Hueneme

Federally and state-listed species of threatened or endangered plants and animals that may be present in the vicinity of Port Hueneme are listed in Exhibit A-6. Six of the mammals include federally endangered whales that are likely found only in low densities in waters off Port Hueneme.

Exhibit A-6. Threatened and Endangered Species Known or Expected to Occur at Port Hueneme

Common Name	Scientific Name	State Status	Federal Status
American peregrine falcon	*Falco peregrinus anatum*	E/FP	D
California brown pelican	*Pelecanus occidentalis californicus*	E/FP	E
California least tern	*Sterna antillarum browni*	E/FP	E
Southern sea otter	*Enhydra lutris nereis*	-	T
Western snowy plover	*Charadrius alexandrinus nivosus*	CSC	T
Whale, Blue	*Balaenoptea musculus*	-	E
Whale, Finback	*Balaenoptera physalus*	-	E
Whale, Humpback	*Megaptera novaengliae*	-	E
Whale, Right	*Balaena glacialis*	-	E
Whale, Sei	*Balaenoptera borealis*	-	E
Whale, Sperm	*Physeter macrocephalus*	-	E

E = Endangered
T = Threatened
D = Delisted
FP = Fully Protected
CSC = California Species of Concern, a native species or subspecies that have become vulnerable to extinction because of declining population levels, limited ranges, or rarity. The goal is to prevent these from being endangered by addressing the issues or concern early enough to secure long-term viability. (as defined in ABV Verification Tests EA)
Sources: U.S. Department of the Navy, 1999; SMDC, 2003; California DFG, Habitat Conservation Division, 2004

Threatened and Endangered Species – San Nicolas Island

Federally and state-listed species of threatened or endangered plants and animals that may be present in the vicinity of San Nicolas Island are listed in Exhibit A-7. Four of the animals include federally endangered whales that are likely found only in low densities in waters off San Nicolas Island. Appendix B provides detailed descriptions of all of the species.

Exhibit A-7. Threatened and Endangered Species Known or Expected to Occur at San Nicolas Island

Common Name	Scientific Name	State Status	Federal Status
Plant Species			
Beach spectacle pod	*Dithyrea maritime*	T	-
San Nicolas Island buckwheat	*Eriogonum grande timorum*	E	-
Trask's milkvetch	*Astragalus traskiae*	R	-
Animal Species			
American peregrine falcon	*Falco peregrinus anatum*	E/FP	D
California brown pelican	*Pelecanus occidentalis californicus*	E/FP	E
Guadalupe fur seals	*Arctocephalus townsendi*	T	T
San Nicolas Island fox	*Urocyon littoralis dickeyi*	T	-
Western snowy plover	*Charadrius alexandrinus nivosus*	CSC	T
Whale, Blue	*Balaenoptea musculus*	-	E
Whale, Finback	*Balaenoptera physalus*	-	E
Whale, Humpback	*Megaptera novaengliae*	-	E
Whale, Right	*Balaena glacialis*	-	E

E = Endangered
R = Rare
T = Threatened
D = Delisted
FP = Fully Protected
CSC = California Species of Concern, a native species or subspecies that have become vulnerable to extinction because of declining population levels, limited ranges, or rarity. The goal is to prevent these from being endangered by addressing the issues or concern early enough to secure long-term viability. (as defined in ABV Verification Tests EA)
Sources: U.S. Department of the Navy, 2002; SMDC, 2003; California DFG, Habitat Conservation Division, 2004

A.2.2 Socioeconomics and Environmental Justice – Port Hueneme/San Nicolas Island

Socioeconomics

Port Hueneme and San Nicolas Island are both located in Ventura County, which exhibits the mixed residential and commercial/industrial character typical of many Southern California communities. Unlike many nearby areas, however, it also retains a significant agricultural sector. The southern half of the county, which is nearest the coast, is highly developed (Port Hueneme is located in this region, just south of Oxnard). Most of the county's residents live in this area, which also includes considerable commercial activity in addition to agriculture. (U.S. Department of the Navy, 1999)

According to the *Ventura County Workforce Investment Board 2002 State of the Workforce Report*, the 2001 economic recession only slowed the growth rate of Ventura County jobs. The reasons for the strong economy can be attributed to the overall strength of the California economy, the unprecedented returns from the financial market, and the steady growth of the agriculture sector. According to 2004 data, approximately 303,500 people are employed in Ventura County. In 2004, the unemployment rate was at 4.9 percent, down from 5.2 the year before. (RE/MAX® Gold Coast Realtors, 2004) Overall, the service sector has the highest employment rates, followed by wholesale and retail trade, and government and manufacturing. Despite the strength of the county's economy, there remains a significant gap between high-income and middle to low-income families.

The value of Ventura County's agricultural production was approximately $1.05 billion in 2001, the highest income crop being strawberries at $230.7 million. (Ventura County Farm Bureau, 2001)

Port Hueneme is the only deep-water commercial shipping harbor between Los Angeles and the San Francisco Bay area. Although Port Hueneme is the smallest port in California, it is one of the top ten ports in the nation servicing automobile imports, and it is now the third largest banana importer in the United States. Total cargo tonnage serviced by the Port has been rising, mainly due to increases in citrus exports to domestic and international markets. (Schniepp, 1998 as referenced in U.S. Department of the Navy, 1999)

The Federal government, and specifically the naval installations at Port Hueneme and Point Mugu, is the single largest employer in Ventura County. The Construction Battalion Center alone employed 9,104 people in 1998. The Naval Surface Warfare Center, Port Hueneme, is the tenth largest employer, employing 2,108 civilian workers, 122 military personnel, and a Naval Reserve detachment. Most of the workforce consists of scientists and engineers, although logisticians, analysts, computer specialists, technicians, and administrative personnel are also employed. (U.S. Navy, PHD NSWC, 1999 as referenced in U.S. Department of the Navy, 1999) The annual payroll is about $147 million. PHD NSWC also uses Navy contractors from the surrounding community. Both large and small companies from the local area provide a variety of technical and administrative services. (U.S. Navy, PHD NSWC, 1999 as referenced in U.S. Department of the Navy, 1999) Point Mugu is the third largest employer in Ventura County, employing 6,536 people. Total personnel at the Point Mugu and Port Hueneme Navy facilities, including all military, civilian and contractors, was 15,640 as of January 1998. The Federal civilian employees are paid some of the highest salaries in the county with an average salary in 1997 of $49,990. The overall county average salary for 1997 was $29,953. (Schniepp 1998 as referenced in VTC EA) The total economic impact locally from Naval Base Ventura County is $1.7 billion. (Ventura County Star, 2002)

Environmental Justice

Port Hueneme and San Nicolas Island are both located in Ventura County, where the 2003 population was estimated to be 791,130. According to the 2000 Census, the racial breakdown of the county is approximately 70 percent white, 5.5 percent Asian and 2 percent black. The rest is made up of other minority groups. Whites comprised 57 percent of the city of Port Hueneme and 42 percent of the city of Oxnard. (U.S. Census Bureau, 2004a)

The median household income in Ventura County was estimated to be $57,164 in 2000. At the time of the Census, the percentage of persons living below poverty level in Ventura County was 9.2 percent. In Port Hueneme it is 12.2 percent and 15.1 percent in Oxnard. Therefore, these areas are not considered to be predominantly low income. (U.S. Census Bureau, 2004a)

A.3 Pacific Missile Range Facility

The main base portion of the Pacific Missile Range Facility (PMRF) is located on the western side of Kauai, approximately 222 kilometers (120 nautical miles) from Pearl Harbor. The majority of PMRF's facilities and equipment are at the main base, which occupies a land area of 779 hectares (1,925 acres) and lies south of and adjacent to Polihale State Park. PMRF/Main Base is generally flat and approximately 0.8 kilometers (0.5 miles) wide and 10.5 kilometers (6.5 miles) long with a nominal elevation of 4.6 meters (15 feet) above MSL, except for the target launch pad areas. (U.S. Department of the Navy, 1998)

In addition to the PMRF/Main Base, PMRF holds a restrictive easement on 854 hectares (2,110 acres) of land adjacent to the facility for safety purposes. PMRF support facilities on Kauai include Makaha Ridge (99.2 hectares [245 acres]), Kokee (9.3 hectares [22.9 acres]), Kamokala Magazines (30.2 hectares [74.5 acres]), and Port Allen (0.28 hectares

[0.69 acres]). The nearest community, Kekaha, is about 13 kilometers (8 miles) south of PMRF. (U.S. Department of the Navy, 1998)

Some of the resources at PMRF are incorporated by reference from the GMD ETR EIS (SMDC, 2003), the Theater High Altitude Area Defense Pacific Flight Tests EA [THAAD Pacific Flight Tests EA (SMDC, 2002a)], and PMRF Enhanced Capability EIS (U.S. Department of the Navy, 1998). Exhibit A-8 shows where the discussion for each resource area can be found.

Exhibit A-8. Resource Area Specific Description of Affected Environment for PMRF

Resource Area	Incorporated by Reference	Location of Description of Affected Environment
Air Quality	Yes	PMRF Enhanced Capability EIS
Airspace	Yes	PMRF Enhanced Capability EIS
Biological Resources	Yes	GMD ETR EIS
Cultural Resources	Yes	THAAD Pacific Flight Tests EA
Geology and Soils	Yes	THAAD Pacific Flight Tests EA
Hazardous Materials and Hazardous Waste Management	Yes	GMD ETR EIS
Health and Safety – Radiation Safety	Yes	THAAD Pacific Flight Tests EA
Health and Safety – Range Safety	Yes	GMD ETR EIS
Land Use	Yes	Pacific Flight Tests EA
Noise	Yes	PMRF Enhanced Capability EIS
Socioeconomics and Environmental Justice	Yes	GMD ETR EIS
Transportation and Infrastructure	Yes	THAAD Pacific Flight Tests EA
Visual Resources	Yes	PMRF Enhanced Capability EIS
Water Resources	Yes	THAAD Pacific Flight Tests EA

A.4 U.S. Army Kwajalein Atoll – Ronald Reagan Ballistic Missile Defense Test Site (USAKA/RTS)

USAKA/RTS is located in the Republic of the Marshall Islands (RMI), approximately 3,889 kilometers (2,100 nautical miles) southwest of Honolulu, Hawaii. Kwajalein Atoll is a crescent-shaped coral reef, dotted with a string of approximately 100 islands, and encloses the world's largest lagoon (2,849 square kilometers [1,100 square miles]). Although Kwajalein is the world's largest coral atoll, the combined land area of the islands totals only 14.5 square kilometers (5.6 square miles). Lagoon depths are typically 37 to 55 meters (120 to 180 feet), although numerous coral heads approach or break the surface. Ocean depths outside the lagoon descend rapidly to as much as 3,962 meters (13,000 feet) within 8 kilometers (5 miles) of the atoll. (SSDC, 1993)

Some of the resources at USAKA are incorporated by reference from the Proposed Actions at USAKA Supplemental EIS [USAKA SEIS, (SSDC, 1993)], the U.S. Army Kwajalein Atoll Temporary Extended Test Range Environmental Assessment [USAKA EA, (SSDC, 1995)], and the THAAD Pacific Flight Tests EA, (SMDC, 2002a), and the GMD ETR EIS (SMDC, 2003). Exhibit A-9 shows where the discussion for each resource area can be found.

Exhibit A-9. Resource Area Specific Description of Affected Environment for USAKA/RTS

Resource Area	Incorporated by Reference	Location of Description of Affected Environment
Air Quality	Yes	THAAD Pacific Flight Tests EA, USAKA SEIS, and GMD ETR EIS
Airspace	Yes	GMD ETR EIS
Biological Resources	No	A.4.1
Cultural Resources	Yes	USAKA EA
Geology and Soils	Yes	USAKA EA
Hazardous Materials and Hazardous Waste Management	Yes	GMD ETR EIS
Health and Safety	Yes	GMD ETR EIS
Land Use	Yes	USAKA EA
Noise	Yes	USAKA SEIS
Socioeconomics and Environmental Justice	No	A.4.2
Transportation and Infrastructure	No	A.4.3
Visual Resources	Yes	USAKA SEIS
Water Resources	Yes	USAKA EA

A.4.1 Biological Resources – USAKA/RTS

Regulations governing endangered species and wildlife resources at USAKA/RTS are specified in U.S. Army Kwajalein Atoll Environmental Standards and Procedures (UES) Section 3-4. Water quality and reef protection standards at USAKA/RTS are in UES Section 3-2. (U.S. Army Space and Missile Defense Command, 2001a, as referenced in SMDC, 2003)

Vegetation

The types of vegetation currently found on USAKA/RTS consist of managed vegetation, herbaceous (green, leaf-like) strand, littoral (relating to the shore) shrubland, littoral forest, and coconut plantation. (SMDC, 2003) Natural vegetation on all the islands has been disturbed by some combination of coconut plantations, Japanese occupation, fighting and bombing during World War II, and USAKA operations. (SSDC, 1995) Managed vegetation is disturbed vegetation dominated by alien weeds and is usually maintained by mowing. Herbaceous strand is a narrow zone of vegetation on upper sandy or rocky beaches dominated by grasses, sedges, and vines. Littoral shrubland consists of vegetation in coastal areas dominated by wide spread shrubs. Littoral forest is usually the most common type of vegetation on tropical islands dominated often by a single tree species. Coconut plantations are dominated by planted coconut palms. (Oak Ridge Institute for Science and Education and U.S. Army Environmental Center, 1999, as referenced in SMDC, 2003)

A 1988 study of the flora of several USAKA/RTS islands found a low species diversity common to coral atolls. (Herbst, 1988, as referenced in SSDC, 1995) Only seventeen percent of the species found are considered native to the Marshall Islands, and none are endemic. The GMD ETR EIS (2003) contains information on vegetation specific to Kwajalein, Meck, and Roi-Namur islands, and the USAKA EA (1995) provides island-specific information for Gellinam, Illeginni, Kwajalein, Legan, Meck, Omelek, and Roi-Namur islands.

Wildlife

The U.S. Fish and Wildlife Service conducted a baseline wildlife survey of all the islands of Kwajalein Atoll, with the exception of Ennugarret Island, in 1988. (Clapp, 1988, as referenced in SSDC, 1995) Particular emphasis was placed on avian resources and protected sea turtle species.

The birds common to Kwajalein Atoll can be grouped together as either migratory shorebirds that winter on the Pacific islands and nest in the Arctic or resident seabirds that nest on the ground or in island vegetation. Greater vulnerability of chicks and eggs to disturbances from USAKA/RTS activities makes the nesting seabirds the more critical of the two categories. Clearing of native vegetation on many of the islands has resulted in a decline in the population of resident seabirds. Conversely, the clearing and maintenance of open areas may have benefited migratory shorebirds by increasing forage and roost habitat. (Clapp, 1988; U.S. Army Strategic Defense Command, 1989; U.S. Army Space and Strategic Defense Command, 1993a, as referenced in SSDC, 1995)

Terrestrial fauna on the islands of Kwajalein Atoll are fairly limited and consist primarily of coconut crabs and assorted lizards, rodents, and domestic animals. (Clapp, 1988; U.S. Army Strategic Defense Command, 1989; U.S. Army Space and Strategic Defense Command, 1993a, as referenced in SSDC, 1995)

A study was conducted of the marine biology in areas potentially affected by USAKA/RTS activities (Titgen, 1988, as referenced in USAKA EA) at all USAKA island shoreline, reef, and marine quarry sites except those of Ennugarret Island. The marine environment surrounding the USAKA/RTS facilities was determined to be of good quality. Of particular interest was the well-developed coral assemblage in the lagoon off Gellinam Island. (Titgen, 1988 as referenced in USAKA EA; U.S. Army Strategic Defense Command, 1989; U.S. Army Space and Strategic Defense Command, 1993a, as referenced in SSDC, 1995)

Threatened and Endangered Animal Species

No rare, threatened, endangered, or candidate plant species have been identified in USAKA/RTS. (USAKA EA, 1995 and U.S. Army Space and Missile Defense Command, 2001a, as referenced in SMDC, 2003)

No rare, threatened, endangered, or candidate avian or terrestrial species were identified on any of the islands of Kwajalein Atoll. (Clapp, 1988; U.S. Army Strategic Defense Command, 1989; and U.S. Army Space and Strategic Defense Command, 1993a, as referenced in SSDC, 1995)

Exhibit A-10 below presents the wildlife that might be found in and near the waters of the Kwajalein Atoll, and that are considered threatened and endangered by the United States. The RMI may or may not extend protected status to these species. Specifically, the green sea and hawksbill turtles are not protected by RMI, and are a traditional food source for the Marshallese population. (Clapp, 1988; U.S. Army Strategic Defense Command, 1989; and U.S. Army Space and Strategic Defense Command, 1993a, as referenced in SSDC, 1995) Appendix B provides descriptions of each species.

Five species of giant clam are found at Kwajalein Atoll along the surrounding reef on the lagoon side, ocean side, and between several of the islands. The largest species (*Tridacna gigas*) has been significantly reduced in number, and is listed in Appendix II of the Convention on International Trade in Endangered Species (CITES), which means that international trade can be carried out only under permit. (CITES, 2004; Titgen, 1988 as referenced in USAKA EA; U.S. Army Strategic Defense Command, 1989; and U.S. Army Space and Strategic Defense Command, 1993a, as referenced in SSDC, 1995)

Exhibit A-10. Threatened or Endangered Species Known or Expected to Occur at USAKA

Common Name	Scientific Name	U.S. Status
Green sea turtle	*Chelonia mydas*	T
Hawksbill turtle	*Eretmochelys imbricate*	E
Leatherback sea turtle	*Dermochelys coriacea*	E
Loggerhead sea turtle	*Caretta caretta*	T
Olive ridley sea turtle	*Lapidochelys olivacea*	T
Whale, blue	*Balaenoptera musculus*	E
Whale, finback	*Balaenoptera physalus*	E
Whale, humpback	*Megaptera novaeangliae*	E
Whale, sperm	*Physeter coaptation*	E

E = Endangered
T = Threatened
Source: U.S. Army Strategic Defense Command, 1989, as referenced in USAKA EA; U.S. Army Space and Strategic Defense Command, 1993a, as referenced in USAKA EA; and USFWS, 2004

A.4.2 Socioeconomics and Environmental Justice

Population and Employment

USAKA is part of the RMI, which has a population of about 57,738 people over 100 islands. (Census International Database, 2004) USAKA strictly regulates access to Kwajalein Island, thereby controlling its resident population. The nonindigenous population of Kwajalein Island fluctuates depending on program activity, but is approximately 2,500. (RTS, 2004; Wikipedia, 2004; and SSDC, 1995) This number consists of military, civil service, and contractor personnel and their dependents.

Income

Precise data concerning the total income earned by USAKA nonindigenous personnel are not available. However, an estimate of the total income of USAKA nonindigenous contract employees can be derived from data on the five percent income tax paid to the RMI government by all contract employees. In 1991, income tax receipts amounted to $2,357,491, corresponding to a total income of approximately $47 million. (U.S. Army Space and Strategic Defense Command, 1993a, as referenced in SSDC, 1995)

Housing

Housing for USAKA's personnel is located on Kwajalein and Roi-Namur islands and consists of family housing, unaccompanied personnel housing (UPH), and transient housing. On Roi-Namur, 231 personnel are housed in 231 rooms in eight buildings. There are also 10 two-bedroom trailers than can house a total of 20 personnel, bringing the total for unaccompanied personnel housing to 251. A dispensary is staffed by one medical technician. (SMDC, 2002a) Construction workers are usually housed in temporary trailers (Mann Camps) provided by the construction contractor. (U.S. Army Space and Strategic Defense Command, 1993a, as referenced in SSDC, 1995; SMDC, 2002a) There are a total of 482 beds for transient lodging on Kwajalein Island. (U.S. Army Space and Strategic Defense Command, 1994a, as referenced in SSDC, 1995)

A.4.3 Transportation and Infrastructure – USAKA/RTS

Kwajalein Island

There are approximately 21 kilometers (13 miles) of paved roads and 11 kilometers (6.5 miles) of unpaved roads on Kwajalein Island. Bicycles are the principal means of transportation and travel on the same paths used by pedestrians, as well as on roads used by motor vehicles. (U.S. Army Space and Strategic Defense Command, 1993a, as referenced in SSDC, 1995) Island shuttle buses provide vehicular transportation to and from work and school. (SSDC, 1995)

Marine transport facilities are concentrated at Kwajalein Island, which serves as a base for receiving cargo and fuel to USAKA/RTS. Passenger fleets, consisting of two catamaran ferries, a Landing Craft Mechanized that can carry up to 190 passengers, and a personnel boat that can carry up to 73 passengers, are also located at Kwajalein. (U.S. Army Space and Strategic Defense Command, 1993a, as referenced in SSDC, 1995)

Kwajalein Island also has air transportation capabilities and houses the Bucholz AAF, which serves as a refueling point for a wide variety of military and civilian aircraft. Aircraft ranging from Learjets to military C-5 transports use Kwajalein as an en route stop (U.S. Army Strategic Defense Command, 1989, as referenced in SSDC, 1995).

Utilities found on Kwajalein include permanent facilities for water supply; wastewater collection, treatment, and disposal; solid and hazardous waste disposal; and power generation. (U.S. Army Strategic Defense Command, 1989, as referenced in SSDC, 1995) Kwajalein has one electrical power plant using engine generator sets that burn diesel fuel; underground feeders distribute the electricity. In 1993, there were three power plants, which had combined capacity of 26,790 kilowatts. Historical peak loads totaled 13,500 kilowatts over different periods, or 50 percent of capacity. (U.S. Army Space and Strategic Defense Command, 1993a, as referenced in SMDC, 2003) Two of the power plants have been decommissioned, as Power Plants 1A and 1B suffice to meet the demand. (SMDC, 2003)

Power distribution is conventional, with underground high-voltage transmission lines and aboveground "user voltage" (110-220 volt alternating current) distribution lines. Generating capacities have not changed in several years. Currently, there are seven generators operating with a total output of 29,200 kilowatts. (U.S. Army Space and Missile Defense Command, 2002b, as referenced in SMDC, 2003)

Kwajalein has a conventional package filter drinking water system for potable water production. Under normal conditions, Kwajalein's potable water system can provide an adequate supply of fresh water. In 1993, the daily supply of 1.6 million liters (430,000 gallons) per day from rainwater treatments and groundwater was more than sufficient to meet the average demand of 1.1 million liters (300,000 gallons) per day. A desalination facility was decommissioned in 2002. (SMDC, 2003)

The capacity of the system is 1,703,435 liters (450,000 gallons) per day. Upgrades are in progress to improve this system's ability to meet USAKA/RTS environmental standards. These upgrades include the addition of reverse osmosis to units for control of total trihalomethanes and haloacetic acids. Drinking water quality is produced to meet the standards of the UES. Drinking water standards are essentially the same as EPA standards for public systems that serve a population of 10,000 people. (U.S. Army Space and Missile Defense Command, 2001a, as referenced in SMDC, 2003)

Raw water is provided primarily by a rainwater catchment system along the runway. During dry seasons, additional water is provided by pumping the freshwater lens that forms an unconfined surficial aquifer beneath the island surface. Portable reverse osmosis water-purifying units are employed to remove organic contaminants from the lens well water. (U.S. Army Space and Missile Defense Command, 2002b, as referenced in SMDC, 2003)

Kwajalein has twelve 3.8 million-liter (1 million-gallon) reinforced concrete tanks for storage of rainwater collected from the catchments and lens wells. Rainwater is pumped from storage to treatment in the package water treatment plant. The treated water receives pH adjustment and chlorination before being stored in one of two covered concrete tanks. Nine of the 14 existing raw water storage tanks are covered. (SMDC, 2003)

The wastewater system for Kwajalein consists of a force main and gravity collection system, nine pump stations, a secondary wastewater treatment plant, and an outfall extending into the lagoon. The wastewater treatment plant is now approximately 20 years old. Plant flow for the period September 1992 through August 1993 averaged 1.4 million liters (382,000 gallons) for this period at approximately 560 liters (148 gallons) per capita per day. Wastewater is reclaimed by conventional secondary treatment followed by chemical (chlorine) disinfection. Reclaimed water is used for non-potable uses, including sanitation and irrigation. Excess water is discharged in accordance with the UES. Wastewater sludge is treated and composted per the UES for use as soil amendment for lawns, landscaping, and gardens. (U.S. Army Space and Missile Defense Command, 2002b, as referenced in SMDC, 2003)

Kwajalein Island generates approximately 20.3 to 30.5 metric tons (20 to 30 tons) of municipal solid waste per day. Green waste is collected and taken to a composting area. Food wastes are no longer disposed of in the ocean off Kwajalein. The compost mulch is used for landscaping and in a nursery. Municipal solid waste is incinerated at the incinerator facility. Ash and inert waste solids are buried at an adjacent landfill. Metals are shipped to Honolulu to be recycled. (U.S. Army Space and Missile Defense Command, 2002b, as referenced in SMDC, 2003) Waste batteries are shipped off-island intact. Used oil is collected in 208.2-liter (55-gallon) drums and used for energy reclamation. Glass, concrete rubble, and similar materials are processed for reuse as construction (including shoreline protection) and fill material at USAKA. (SMDC, 2003)

Roi-Namur Island

Roi-Namur Island has approximately 10 kilometers (8 miles) of paved roads and 2 kilometers (1 mile) of unpaved roads. Island shuttle buses provide vehicular transportation to and from work; bikes are used by many of the residents. (U.S. Army Space and Strategic Defense Command, 1993a, as referenced in USAKA EA)
Roi-Namur has a cargo pier, cargo/fuel pier, and marine ramp. Roi-Namur also has air transportation capabilities and is home to the Dyess AAF, which provides service to a variety of aircraft and helicopters. (U.S. Army Strategic Defense Command, 1989, as referenced in SSDC, 1995)

Utilities found on Roi-Namur include permanent facilities for water supply; wastewater collection, treatment, and disposal; solid and hazardous waste disposal; and power generation. (U.S. Army Strategic Defense Command, 1989, as referenced in SSDC, 1995)

Meck Island

Meck Island has about 2 kilometers (1 mile) of paved road. (U.S. Army Space and Strategic Defense Command, 1993a, as referenced in SSDC, 1995) Meck Island has a concrete pier that accepts both personnel and cargo. Meck Island has a runway that no longer accepts fixed-wing aircraft but is capable of accepting helicopters. (U.S. Army Strategic Defense Command, 1989, as referenced in SSDC, 1995)

The source of potable water on Meck Island is a rainwater catchment. Two tanks store raw freshwater that is filtered and chlorinated before being pumped to the system. No treated water storage is provided. Wastewater is treated through the use of one of three septic tank/leach field systems. Island power is provided by five 565-kilowatt diesel-powered engine generators. (U.S. Army Strategic Defense Command, 1989, as referenced in SSDC, 1995)

Other Islands

Gellinam, Legan, and Omelek Islands do not have any paved roads nor do they house any motor vehicles. Illeginni Island has approximately 0.8 kilometer (0.5 mile) of paved roads and other unpaved roads that are utilized by island personnel. The harbors of all four islands are periodically dredged and are therefore capable of accepting marine transport. All four islands also have a 900-square meter (10,000-square foot) helipad and are serviced by UH-1H helicopters. (U.S. Army Strategic Defense Command, 1989, as referenced in SSDC, 1995)

Gellinam, Illeginni, Legan, and Omelek Islands are without active, developed potable water systems, making it necessary for personnel working on the islands to carry water for consumption and other uses. A network of communication lines and underground electrical lines is found on Omelek Island. Generator buildings are located on Gellinam and Legan Islands that are capable of producing 210 kilovolts and 180 kilovolts of power, respectively. A power plant capable of producing 1,200 kilovolts of power is located on Illeginni Island. (U.S. Army Strategic Defense Command, 1989; U.S. Army Space and Strategic Defense Command, 1994d, as referenced in SSDC, 1995)

A.5 Midway Island (Midway Atoll National Wildlife Refuge)

Midway is an atoll comprised of three islands known as Sand, Eastern, and Spit. (USFWS, Midway Atoll NWR, 2002) The Midway Atoll is located near the northwestern end of the Hawaiian Islands archipelago, and lies about 4,510 kilometers (2,800 miles) west of San Francisco and 3,540 kilometers (2,200 miles) east of Japan. It is less than 241 kilometers (150 miles) east of the International Dateline, and is considered a true mid-point around the world from the Greenwich meridian. The entire Midway Atoll area is comprised of 6.2 square kilometers (2.4 square miles) of land with 15 kilometers (9 miles) of coastline, and is located at the geographic coordinates 28 13 N, 177 22 W. (Geography.about.com, 2005)

The first legal residents of Midway were U.S. Marines sent to stop the commercial exploitation of bird life. In the early 1900s, the employees of the Commercial Pacific Cable Company made a home on Sand Island, and in the mid 1930s Pan Am employees were sent to build a prefab hotel. The late 1930s brought soldiers preparing for war, and the commission of Naval Air Station, Midway Island occurred on August 1, 1941. A significant World War II battle occurred at Midway in June of 1942. (USFWS, Midway Atoll NWR, 2002)

In 1988 Midway became a National Wildlife Refuge, and in 1993 the Navy closed the Naval Air Facility after more than 50 years of continuous operation. On May 26, 1996 the custody and accountability for Midway Atoll was transferred from the Department of the Navy to the Department of the Interior; on October 31, 1996 President Clinton signed Executive Order 13022, officially reinforcing the transfer.

The final U.S. Navy personnel stationed at Midway departed on June 30, 1997. On March 10, 1998, a new code of regulations governing activities at Midway Atoll National Wildlife Refuge was published in the Federal Register. (USFWS, Midway Atoll NWR, 2002) Since January 2002, Midway has been closed to visitors due to the loss of a cooperating transportation contractor; however, in some instances visitors who can provide their own transportation may visit the Refuge. (USFWS, Midway Atoll NWR, 2002)

Some of the resources at Midway are incorporated by reference from the Ground-Based Midcourse Defense Extended Test Range Environmental Impact Statement (SMDC, 2003). Exhibit A-11 shows where the discussion for each resource area can be found.

Exhibit A-11. Resource Area Specific Description of Affected Environment for Midway

Resource Area	Incorporated by Reference	Location of Description of Affected Environment
Air Quality	Yes	GMD ETR EIS
Airspace	No	A.5.1
Biological Resources	No	A.5.2
Cultural Resources	No	A.5.3
Geology and Soils	No	A.5.4
Hazardous Materials and Hazardous Waste Management	Yes	GMD ETR EIS
Health and Safety	No	A.5.5
Land Use	No	A.5.6
Noise	No	A.5.7
Socioeconomics and Environmental Justice	No	A.5.8
Transportation and Infrastructure	No	A.5.9
Visual Resources	No	A.5.10
Water Resources	No	A.5.11

A.5.1 Airspace – Midway

Sand Island has one useable runway and taxiway, and Eastern Island has one emergency and two unusable runways. (USFWS, Midway Atoll NWR, 2002)

A.5.2 Biological Resources – Midway

Slow growing, sun-loving plants thrive in the harsh, salty environment at Midway. Because Midway lies near the most northern limit of coral growth, coral diversity is less than in more tropical climates; however, some species (e.g. *Pocillopora*, *Porites*) are abundant. Deep chasms, caves, and corridors in the reef create habitat for a wide variety of fish, several of which are unique to Midway. (USFWS, Midway Atoll NWR, 2002)

Vegetation

Over 200 plant species have been introduced to Midway's islands since the arrival of permanent residents in 1902. The most common of these include ironwood, golden crown-beard, wild poinsettia, Haole koa, sweet alyssum, buffalo grass, peppergrass, and Bermuda grass. Ironwood trees can grow as much as 12 meters (40 feet) in 18 months unless aggressively managed. Efforts have been undertaken to prevent further colonization, especially in beach areas, to preserve the remaining beach strand vegetation (Pacific Division, Naval Facilities Engineering Command, 1994 as referenced in the SMDC, 2003). Additionally, golden crown-beard grows so quickly that it can exclude birds from otherwise desirable nesting habitat. (U.S. Fish and Wildlife Service, Midway Atoll National Refuge, 2002a as referenced in SMDC, 2003)

Plants indigenous or naturalized to Midway Atoll include beach naupaka, tree heliotrope, beach morning glory, lovegrass, sickle grass, ihi, alena, puncture vine (nohu), and 'ena'ena. Ihi occurs commonly on Eastern and Spit Islands but is much less common on Sand Island. (U.S. Fish and Wildlife Service, 2002a as referenced in the SMDC, 2003)

Beach naupaka and tree heliotrope are examples of beach strand vegetation, which are dune-binding species. Although once abundant over much of the coastal areas of Sand Island, these plants have been reduced in extent due to grazing by rats and shading by ironwood trees. Frigate Point on Sand Island contains the only large strand of beach naupaka. (Pacific Division, Naval Facilities Engineering Command, 1994 as referenced in SMDC, 2003)

Wildlife

A large variety of wildlife occurs at the Midway Atoll, including an abundance of migratory seabirds. Over 100 species of birds have been identified. About 15 species of birds nest on Midway Atoll with a total population of almost two million. Midway has the world's largest colony of Laysan albatross, nearly 400,000 nesting pairs, and the largest colonies of red-tailed tropicbirds, black noddies, and white terns. Additional bird species include short-tailed and black-footed albatross; shearwaters; brown, masked, and red-footed booby; brown noddy; and terns. Birds native or indigenous to Midway include a small variety of arctic nesting shorebirds, such as the bristle-thighed curlew and ruddy turnstone, and vagrant species observed in small numbers. (U.S. Fish and Wildlife Service, Midway Atoll National Wildlife Refuge, 2002a as referenced in SMDC, 2003)

An introduced species that has had a profound adverse affect on Midway's wildlife is the black rat. Due to a very aggressive rat control program, rats have been eliminated from Eastern and Spit islands and are probably also absent from Sand Island. (U.S. Fish and Wildlife Service, Midway Atoll National Wildlife Refuge, 2002a as referenced in the SMDC, 2003)

About 250 spinner dolphins inhabit the lagoon during the day and generally leave it each night to feed in deeper waters. The lagoon also supports over 130 species of fish and a variety of marine invertebrates. (U.S. Department of the Interior, Fish and Wildlife Service, 1996 as referenced in SMDC, 2003)

Threatened and Endangered Species

Exhibit A-12 presents a list of the endangered animal species known to inhabit the Midway Atoll. Appendix B provides a description of each species.

Exhibit A-12. Threatened and Endangered Animal Species Located on Midway Atoll

Common Name	Species	State Status	Federal Status
Green sea turtle	*Chelonia mydas*	E	E
Hawaiian monk seal	*Monachus schauinslandi*	E	E
Hawksbill sea turtle	*Eretmochelys imbricate*	E	E
Short-tailed albatross	*Phoebastria albatrus*	SC	E

E= Endangered
SC = Species of Concern
Source: USFWS, 2004; U.S. Fish and Wildlife Service, 2002a as referenced in the SMDC, 2003; Hawaii Biological Resources, 2003

Critical Habitat and Wetlands

All of Midway Atoll, except for Sand Island and its harbor, has been designated as critical habitat for the Hawaiian monk seal. Additionally, a small (less than 0.2 hectare [0.5 acre]), emergent wetland area has been identified on Sand Island. It is located west of Decatur Avenue, north of the cemetery, and south of Halsey Drive. (Pacific Division, Naval Facilities Engineering Command, 1994 as referenced in SMDC, 2003)

Marine Protected Areas

The *Coral Reef Ecosystem Fishery Management Plan* for the western Pacific established Marine Protected Areas. No-take Marine Protected Areas are at 0 to 10 fathom (0 to 18 meter [60-feet]) depths for all the chain. No-take Marine Protected Areas are also located from 10 to 50 fathoms (18 to 91 meters [300 feet]) at French Frigate Shoals, Laysan, and the northern half of Midway. The southern half of Midway is for recreational catch and release only. (Birkeland, 2002 as referenced in SMDC, 2003)

A.5.3 Cultural and Historic Resources – Midway

There are 63 historically significant buildings, facilities, sites, and structures such as runways, bunkers, ammunition huts, gun emplacements, and pillboxes. (USFWS, Midway Atoll NWR, 2002)

A.5.4 Geology and Soils – Midway

The Hawaiian Islands are the exposed part of the Hawaiian Ridge, which is a large volcanic mountain range on the sea floor. Hawaii consists of 132 islands, reefs, and shoals that extend for more than 2,410 kilometers (1,500 miles) from southeast to northwest across the central Pacific Ocean between about 155 and 179 degrees west longitude and about 19 to 28 degrees north latitude. The volcanoes are youngest in the southeast and become progressively older to the northwest. The volcanoes of the Hawaiian Ridge have formed as a plate of the Earth's crust beneath the Pacific Ocean that moves northward and westward relative to an area of anomalously high temperature, called a hot spot, in the Earth's mantle. As a volcano moves northwestward away from the hot spot, eruptions become less frequent, and a new volcano begins to form above the hot spot. Many of the younger volcanoes have grown above sea level, forming islands. As islands age they erode and subside, eventually becoming atolls and then seamounts. (USGS, 1999)

Midway began as a volcanic island nearly 30 million years ago, created over a hot spot in the earth's crust that now supplies the Island of Hawaii with its lava. As the Pacific plate shifted northwest, the wind, water, and changing sea level eroded the island until it disappeared beneath the ocean surface. A fringing reef, made largely of calcareous skeletons of coral and coralline algae, formed around the island's edge, creating an atoll. As the island disappeared, the reef continued to grow. The movement of coral and sand within the atoll over time created the three islands. Wind and water erosion continue to change the shape and size of the islands. (USFWS, Midway Atoll NWR, 2002)

A.5.5 Health and Safety – Midway

All actions at Midway will be conducted in accordance with USFWS and DoD health and safety regulations.

A.5.6 Land Use – Midway

The entire area is considered a National Wildlife Refuge. None of the land is used for agriculture, and only 30 people use the existing infrastructure to reside and work at the Refuge. (Geography.about.com, 2005)

A.5.7 Noise – Midway

No sensitive receptors would be disturbed by the proposed intermittent and short-term activity, and noise levels are expected to be below OSHA workplace standards. (SMDC, 2003)

A.5.8 Socioeconomics and Environmental Justice – Midway

At one point, the infrastructure at Midway supported more than 5,000 people; the current resident population is less than 30. (USFWS, Midway Atoll NWR, 2002) The economy is based on providing support services for the National Wildlife Refuge activities that take place on the islands. All food and manufactured goods must be imported. (Geography.about.com, 2005)

A.5.9 Transportation and Infrastructure – Midway

Ten miles of paved roads and two miles of gravel roads exist. Nearly 5,490 meters (18,000 feet) of sheet piling seawall and breakwater also exist. Nearly 20 buildings exist, including cable company buildings from 1904, maintenance shops, hangars, warehouses, barracks, residences, cold storage, etc. Most were built between 1941 and 1960.
For telephone use, there is a satellite system and over nine miles of line supporting an on-island system. For electricity, there are two 1,800 kilowatt-hour generators from the 1970s and a new 1998 Caterpillar 1,800 kilowatt-hour generator. There are nearly 36,600 meters (120,000 feet) of above ground electrical line and 6,100 meters (20,000 feet) of street light line.

Recreational facilities include tennis courts, a bowling alley, a gymnasium, a weight room, racquetball courts, a theatre, and satellite TV broadcasting one station. (USFWS, Midway Atoll NWR, 2002)

A.5.10 Visual Resources – Midway

Because the entire Midway area is a National Wildlife Refuge, most of Midway has remained unaltered during the past 10 years or longer and is considered to have high visual sensitivity.

A.5.11 Water Resources – Midway

Midway's water resources include a 51-hectare (126-acre) catchment basin, three 15.9 million-liter (4.2 million-gallon) storage tanks, two treatment reservoirs, one 49-meter (161-foot) water tower, and 12,500 meters (41,000 feet) of underground water line. Additionally, 6,180 meters (20,280 feet) of underground sewage line, lift stations, and offshore outfall, and a septic/leach field system were added in October 1997. (USFWS, Midway Atoll NWR, 2002)

A.6 Wake Island

Wake Atoll is a typical Pacific coral atoll consisting of three islands, Wake, Wilkes, and Peale. The v-shaped atoll is approximately 14.5 kilometers (9 miles) long from the tip of Wilkes Island around to the tip of Peak Island and 3 kilometers (2 miles) wide from approximately Heel Point to the south portion of Wake Island. Total landmass is approximately 739 hectares (1,826 acres). (SSDC, 1994)

Wake Island is in the possession of the U.S., and under the control of the U.S. Air Force. It was a U.S. Army launch support facility operated under a caretaker permit from the U.S. Air Force until October 2002 when the U.S. Air Force resumed administration. The MDA continues to operate the Wake Island Launch Center (WILC) as a tenant organization. RTS maintains and operates the launch facilities and also provides instrumentation, communications, flight and ground safety, security, and other support. (U.S. Army Space and Missile Defense Command, 2000d, as referenced in SMDC, 2002a) The island has a population of roughly 100 people and supports a 3,000-meter (9,850 feet) long and 46-meter (150 feet) wide runway, as well as two missile launch pads. (SMDC, 2002a) Wake Island was designated a National Historic Landmark in 1985 in order to preserve both the battlefield where important World War II events occurred and Japanese and American structures from that period. (Wikipedia, 2005)

Some of the resources for Wake Island are incorporated by reference from the Wake Island Environmental Assessment (SSDC, 1994), the Wake Island Launch Center Supplemental Environmental Assessment [WILC Supplemental EA, (SMDC, 1999)], and the THAAD Pacific Test Flights Environmental Assessment (SMDC, 2002a). Exhibit A-13 shows where the discussion for each resource area can be found.

Exhibit A-13. Resource Area Specific Description of Affected Environment for Wake Island

Resource Area	Incorporated by Reference	Location of Description of Affected Environment
Air Quality	Yes	THAAD Pacific Flight Tests EA, WILC Supplemental EA
Airspace	Yes	THAAD Pacific Flight Tests EA, WILC Supplemental EA
Biological Resources	No	Section A.6.1
Cultural Resources	Yes	Wake Island EA
Geology and Soils	Yes	WILC Supplemental EA
Hazardous Materials and Hazardous Waste Management	Yes	THAAD Pacific Flight Tests EA, WILC Supplemental EA
Health and Safety	Yes	THAAD Pacific Flight Tests EA, WILC Supplemental EA
Land Use	Yes	THAAD Pacific Flight Tests EA
Noise	Yes	WILC Supplemental EA
Socioeconomics and Environmental Justice	Yes	THAAD Pacific Flight Tests EA
Transportation and Infrastructure	Yes	THAAD Pacific Flight Tests EA, WILC Supplemental EA
Visual Resources	No	A.6.2
Water Resources	Yes	WILC Supplemental EA

A.6.1 Biological Resources – Wake Island

Vegetation

Vegetation near the Peacock Point area of Wake Island consists of areas of scrub tree heliotrope, ironwood, and kou trees interspersed with dense stands of naupaka and cotton. (SMDC, 2002a) The vegetation on the east side of Peacock Point is mainly scattered, shrubby tree heliotrope growing in coral rubble. On the west side of Peacock Point, the tree heliotrope is interspersed with dense stands of naupaka and ironwood trees which become dominant at the west end of the site and in the near vicinity of the Wake Island control tower. Just seaward of the tower, dense stands of kou trees, 6 to 8 meters (20 to

26 feet) in height, can be found. (SMDC, 1999) A single specimen of the Pisonia grandis tree, one of the few trees native to Wake Atoll, is found on Wake Island. (SSDC, 1994)

Weedy plant species such as Tridex, Jamaica vervain, ‘Uhaloa, and Nohu are present on Wake Island. In addition, 19 species of marine macroalgae (multi-celled) were recorded at Wake Atoll. (SMDC, 1999)

Wildlife

Up to 32 species of birds have been observed on Wake Island. (SMDC, 1999) Most of the birds found on Wake Island are indigenous shore and seabirds, such as the Laysan Albatross, Black-footed Albatross, White-tailed Tropicbird, Red-tailed Tropicbird, Masked Booby, Brown Booby, Red-footed Booby, Great Frigatebird, Pacific Golden-plover, Wandering Tattler, Siberian Tattler, Ruddy Turnstone, Gray-backed (Spectacled) Tern, Sooty Tern, Brown Noddy, Black Noddy, White Tern, Short-eared Owl, and Rock Dove (Feral Pigeon). (SSDC, 1994) No breeding land birds are found on the island. (SMDC, 2002a)

Other than birds, the native terrestrial fauna at Wake Atoll is relatively limited and includes insects and several species of land crabs. The following insects have been recently reported at Wake Atoll: *Lepidoptera* (butterflies and moths), *Hymenoptera* (wasps, bees, and ants), *Diptera* (houseflies, gnats, and mosquitos), *Odonata* (dragonflies and damselflies), *Isoptera* (termites), and *Coleoptera* (beetles). (WILC Supplemental EA, 1999)

The main predators on the island include feral cats and rats. Skinks and geckos (introduced lizard species) can be found on all three islands. The brown tree snake, a species known to clandestinely immigrate throughout the Pacific in military and civilian cargo, has been reported at Wake Atoll. (SMDC, 1999)

The reefs surrounding the atoll support a variety of sea life. Approximately 122 species of reef fish, 41 species of corals, and 39 species of other macroinvertebrates (animals without a backbone large enough to be seen without a microscope) have been identified. The most common species of reef fish include surgeonfish, parrotfish, butterfly fish, wrass, and fairy basslet. Antler coral and star coral were two of the most common coral species observed during the survey. Giant clams and sea urchins were the most abundant macroinvertebrates observed. (U.S. Fish and Wildlife Service and National Marine Fisheries Service, 1999, as referenced in SMDC, 2002a)

Threatened and Endangered Species

No exclusively terrestrial plants and animals Federally listed as threatened or endangered are currently known or reported from Wake Atoll. (SMDC, 2002a) There are no threatened or endangered bird species on Wake Island. (SMDC, 1999)

Threatened and endangered marine mammals may occur in the open ocean area surrounding Wake Atoll and between Wake and Kwajalein Atolls and are listed in Exhibit A-14. (SMDC, 1999)

Exhibit A-14. Federally Threatened and Endangered Marine Species at Wake Island

Common Name	Scientific Name	Federal Status
Green sea turtle	*Chelonia mydas*	T
Hawaiian monk seal	*Monachus schauinslandi*	E
Hawksbill sea turtle	*Eretmochelys imbricate*	E
Whale, blue	*Balaenoptera musculus*	E
Whale, finback	*Balaenoptera physalus*	E
Whale, humpback	*Megaptera novaeangliae*	E
Whale, sperm	*Physeter macrocephalus*	E

Source: SMDC, 1999 and USFWS, TESS, 2004

The Wake rail (*Rallus wakensis*), a flightless species endemic to Wake Atoll, has not been observed since WWII and is now considered extinct. Japanese soldiers occupying the atoll during WWII are reported to have hunted and eaten these small birds to avoid starvation during a sustained American blockade of Japanese supply shipments to the atoll. Predation by feral cats has also been suggested as a possible factor in the extinction of this species. (SMDC, 1999)

Migratory Bird Treaty Act

Federally protected terrestrial biota at Wake Atoll is limited to the migratory seabirds, shorebirds, and occasional vagrant waterbirds. These birds are identified as "migratory" and are protected under the Migratory Bird Treaty Act of 1916 (MBTA) (16 U.S.C. 703-712). Birds known to occur at Wake Atoll and protected under the MBTA include the black-footed albatross (*Diomedea nigripes*), Laysan albatross (*Diomedea immutabilis)*, brown booby (*Sula leucogaster*), masked booby (*Sula dactylatra*), red-footed booby (*Sula sula*), bristle-thighed curlew (*Numenius tahitiensis*), great frigatebird (*Fregata minor*), lesser golden-plover (*Pluvialis dominica*), black noddy (*Anous minutus*), brown noddy (*Anous stolidus*), sharp-tailed sandpiper (*Calidris acuminate*), Christmas shearwater (*Puffinus nativitatis*), wedge-tailed sheawater (*Puffinus pacificus*), northern shoveler (*Anas clypeata*), wandering tattler (*Tringa incana*), gray-tailed tattler (*Heterosceles brevipes*), sooty tern (*Sterna fuscata*), gray backed tern (*Sterna lunata*), white tern (*Gygis alba*), red-tailed tropicbird (*Phaethon rubricauda)*, white-tailed tropicbird (*Phaethon lepturus)*, and the ruddy turnstone (*Arenaria interpres*). (SMDC, 1999)

Environmentally Sensitive Habitat

The Coral Reef Essential Fish Habitat on Wake Island ranges from the shoreline to the extent of the Exclusive Economic Zone, which is the 322-kilometer (200-mile) boundary around the island. In addition, Essential Fish Habitat ranges from the sea surface within this zone to a depth of 200 meters (656 feet). (SMDC, 2002a)

Since commercial fisheries are excluded and spear fishing is not allowed at Wake Atoll, the island has one of the few reef systems with abundant schools at natural population densities of large fish, such as bumphead parrotfish, jacks, and Napoleon wrasses (truck fish), otherwise overfished throughout most of their range in the Pacific Islands. Truck fish in particular are extremely abundant at the atoll, where the military presence also discourages poaching. (SMDC, 2002a)

A Coral Reef Ecosystem Fishery Management Plan, suggesting Wake Atoll as one of a number of Marine Protected Areas (areas of special value for the protection, conservation and management of significant coral reef areas), has been drafted and is currently available for public comment. If enacted, a special permit would be required to fish at Wake Atoll in depths of less than 92 meters (302 feet). (U.S. Army Space and Missile Defense Command, 2002, as referenced in the SMDC, 2002a and Western Pacific Regional Fishery Management Council, 2001)

A.6.2 Visual Resources – Wake Island

The objects that dominate the visual landscape are the buildings on the island and any support structures for the airfield and launch pads. Since the island is designated as a National Historic Landmark, it is considered to have high visual sensitivity.

A.7 White Sands Missile Range

White Sands Missile Range (WSMR) is a DoD major range and test facility with headquarters located approximately 40 kilometers (25 miles) east of Las Cruces, New Mexico in Dona Ana County. WSMR covers approximately 8,288 square kilometers (3,200 square miles) in south-central New Mexico and is the largest, all-overland test range in the western hemisphere. The range itself, together with adjacent call-up areas, has diverse environmental attributes and resources. The primary mission of WSMR is the operation of a National Range in accordance with direction from the Army Test and

Evaluation Command and DoD Directive 3200.11, *Major Range and Test Facility Base*. This mission includes range instrumentation research and development; developmental testing of U.S. Army, U.S. Navy, and U.S. Air Force air-to-air/surface, surface-to-air, and surface-to-surface weapons systems; dispense and bomb drop programs; gun system testing; target systems; meteorological and upper atmospheric probes; equipment, component, and subsystem programs; high-energy laser programs; and special tasks. WSMR also performs testing for commercial industry and foreign countries. (SMDC, 2002)

Portions of the description of the affected environment at WSMR are incorporated by reference from the White Sands Missile Range Range-Wide Environmental Impact Statement [WSMR EIS, (WSMR, 1998)], the White Sands Missile Range New Mexico Liquid Propellant Targets Environmental Assessment [WSMR EA, (SMDC, 2002b)], the ABL SEIS (MDA, 2003), and the Use of Tributyl Phosphate in the Intercept Debris Measurement Program at WSMR EA [TBP IDMP EA, (SMDC, 2004)]. Exhibit A-15 shows where the discussion for each resource area can be found.

Exhibit A-15. Resource Area Specific Description of Affected Environment for WSMR

Resource Area	Incorporated by Reference	Location of Description of Affected Environment
Air Quality	Yes	WSMR EA, ABL SEIS, TBP IDMP EA
Airspace	Yes	WSMR EA, ABL SEIS, TBP IDMP EA
Biological Resources	No	A.7.1
Cultural Resources	Yes	WSMR EA, ABL SEIS
Geology and Soils	Yes	WSMR EA
Hazardous Materials and Hazardous Waste Management	Yes	WSMR EA, ABL SEIS, TBP IDMP EA
Health and Safety	Yes	WSMR EA, ABL SEIS, TBP IDMP EA
Land Use	Yes	WSMR EA
Noise	Yes	WSMR EA, ABL SEIS
Socioeconomics and Environmental Justice	Yes	WSMR EA, ABL SEIS, TBP IDMP EA
Transportation and Infrastructure	Yes	WSMR EA
Visual Resources	Yes	WSMR EIS
Water Resources	Yes	WSMR EA, TBP IDMP EA

A.7.1 Biological Resources – WSMR

Vegetation

WSMR is located in the northern Chihuahuan Desert and supports a diverse and complex mosaic of grasslands, shrublands, and woodlands. WSMR is characterized by several major physiographic features such as the Jornada del Muerto, the Rio Grande drainage, the San Andres and Organ mountains, and the Tularosa Basin. (U.S. Army Space and Missile Defense Command, 1994, as referenced in SMDC, 2002b)

The eastern and western edges of the San Andres Mountains feature a series of belt-like soil/vegetation zones associated with increasing elevation. Along the western edge of the Tularosa Basin and the eastern edge of the Jornada Basin are scattered grasslands associated with clay loam soils that receive runoff from the mountain slopes. Higher in elevation, piedmont slopes feature a distinctive vegetation zone consisting almost entirely of creosote bush on coarse sand and gravel soils. Within the mountains, the highest elevations are composed of exposed rock cliffs with thin, stony soils in crevices and alluvial slopes. Scattered pinyon pine and alligator juniper are present, with ground cover of a variety of grama grasses. Oak thickets and many species of small shrubs also occur on some high mountain slopes. Associated with the canyon springs are dense growths of vegetation, including oak, cottonwood, and velvet ash, as well as the introduced salt cedar. On the lower slopes within the mountains, the thin, stony soil supports scattered grasses and a variety of shrubs and cacti. (U.S. Army Space and Missile Defense Command, 1994, as referenced in SMDC, 2002b)

The Chihuahuan Desert areas of WSMR are divided into five very general vegetative groups based on topography and vegetational characteristics. These include mesquite (sand dunes), creosote bush (alluvial fans), yucca grassland (foothills and draws), grassland (mesa), pinyon-juniper (mountains and canyons). (U.S. Army Space and Missile Defense Command, 1994, as referenced in SMDC, 2002b)

Wildlife

More than 200 species of birds have been observed at WSMR, although less than half of the species are known as regular residents. Many species of migratory waterfowl and shorebirds are winter occupants of wastewater ponds, ephemeral playas, and spring-fed streams in the Tularosa Basin. A variety of raptors are common in mountain and basin areas, including Swainson’s hawk, red-tailed hawk, northern harrier, American kestrel, prairie falcon, golden eagle, great horned owl, burrowing owl, Mexican spotted owl, and peregrine falcon. Mourning dove, Gambel’s quail, scaled quail, and white-necked raven are the most abundant game birds present at WSMR. Other common species include the roadrunner, lesser nighthawk, Scott’s oriole, cactus wren, crissal thrasher, black-throated sparrow, horned lark, western meadowlark, and turkey vulture. The spring migration of birds through the southwestern United States occurs during March through May. (U.S. Army Space and Missile Defense Command, 1994, as referenced in SMDC, 2002b)

Recent field surveys and literature reviews in association with the U.S. Army Corps of Engineers Construction Engineering Research Laboratory (CERL) Land Condition Trend Analysis program have documented the presence of over 140 species of native mammals in New Mexico of which 79 mammalian species can be found at WSMR. The primary native large mammals present within the Tularosa Basin are mule deer, pronghorn antelope, and a remnant population of desert bighorn sheep. Introduced African oryx and barbary sheep occur throughout WSMR. Common predatory mammals of the area include coyote, mountain lion, bobcat, gray fox, striped skunk, and badger. The mountain lion population of the San Andres Mountains is the subject of an ongoing, long-term study funded by the New Mexico Department of Game and Fish. (U.S. Army Space and Missile Defense Command, 1994, as referenced in SMDC, 2002b)
Non-game mammals, mostly small rodents, comprise a large basis of the food supply for the larger carnivorous mammals. Common insectivorous mammals include California bat, hoary bat, Brazilian free-tailed bat, pallid bat, and Townsend's big-eared bat. Reptiles are the most abundant and diverse group of vertebrate animals in the Chihuahuan Desert areas.

Threatened and Endangered Species

Exhibit A-16 lists the threatened and endangered species known to occur in the counties where WSMR is located. WSMR includes portions of Dona Ana, Lincoln, Otero, Sierra, and Socorro Counties, New Mexico, and El Paso County, Texas. The presence of each species has only been verified in the general vicinity of WSMR, and is not certain to be present at WSMR unless otherwise noted in the species descriptions provided in Appendix B. (NMDFG, 2004) Information on threatened and endangered plant species was determined using a current inventory of plants occurring in the aforementioned counties. (New Mexico Rare Plant Technical Council, 2002)

Exhibit A-16. Threatened and Endangered Species Located in the Vicinity of WSMR

Common Name	Scientific Name	State Status	Federal Status
Plant Species			
Arizona coralfoot	*Hexalectris spicata* var. *arizonica*	E	-
Dune pricklypear	*Opuntia arenaria*	E	SC
Mescalero milkwort	*Polygala rimulicola mescalerum*	E	-
Night-blooming cereus	*Peniocereus greggii* var. *greggii*	E	SC
Organ Mountains pincushion cactus	*Escobaria organensis*	E	-
Sneed's pincushion cactus	*Escobaria sneedii* var. *sneedii*	E	E
Villard pincushion cactus	*Escobaria villardii*	E	SC

Exhibit A-16. Threatened and Endangered Species Located in the Vicinity of WSMR

Common Name	Scientific Name	State Status	Federal Status
Animal Species			
American Peregrine falcon	*Falco peregrinus*	T	D
Aplomado falcon	*Falco fermeralis*	E	E
Baird's sparrow	*Ammodramus bairdii*	T	SC
Bald eagle	*Haliaeetus leucocephalus*	T	D
Bell's vireo	*Vireo belli*	T	-[3]
Gray vireo	*Vireo vicinior*	T	SC
Loggerhead shrikes	*Lanius ludovicianus*	-	E
Southwestern willow flycatcher	*Epidonax frailii extimus*	E	E
Varied bunting	*Passerind versicolor*	T	-
Western snowy plovers	*Charadrius alexandrinus nivosus*	-	T
White Sands pupfish	*Cyprinodon Tularosa*	T	-

SC = Species of concern[4]
E = Endangered
T = Threatened
D = Delisted
Source: New Mexico Rare Plant Technical Council, 2002; NMDGF, 2004; modified from U.S. Army Space and Missile Defense Command, 1994 as referenced in EASMDC, 2002b; and USFWS, 2004

A.8 Eareckson Air Force Station

Eareckson Air Force Station (AFS) is located on Shemya Island, part of the Near Island Group, near the tip of the Aleutian Archipelago of Alaska. The 1,425-hectare (3,520-acre) island is part of the Alaska Maritime National Wildlife Refuge administered by the USFWS. Shemya Island is about 2,414 kilometers (1,500 miles) from Anchorage, Alaska, has been occupied by the military since May 28, 1943, and continues to operate as an early warning radar site with the purpose of monitoring space and missile activities. The base is under the control of the Eareckson Air Station Program Management Office, part of the 611th Air Support Group at Elmendorf Air Force Base. (SMDC, 2000)

Some of the resources at Eareckson AFS are incorporated by reference from the National Missile Defense Deployment Final Environmental Impact Statement [NMD EIS, (SMDC, 2000)]. Exhibit A-17 shows where the discussion for each resource area can be found.

[3] Listed as endangered for California sub-species only.
[4] For USFWS, this designates a taxon for which further biological research and field study are needed to resolve their conservation status OR are considered sensitive, rare, or declining on lists maintained by Natural Heritage Programs, State wildlife agencies, other Federal agencies, or professional/academic scientific societies.

Exhibit A-17. Resource Area Specific Description of Affected Environment for Eareckson AFS

Resource Area	Incorporated by Reference	Location of Description of Affected Environment
Air Quality	Yes	NMD EIS
Airspace	Yes	NMD EIS
Biological Resources	Yes	NMD EIS
Cultural Resources	Yes	NMD EIS
Geology and Soils	Yes	NMD EIS
Hazardous Materials and Hazardous Waste Management	Yes	NMD EIS
Health and Safety	Yes	NMD EIS
Land Use	Yes	NMD EIS
Noise	Yes	NMD EIS
Socioeconomics and Environmental Justice	Yes	NMD EIS
Transportation and Infrastructure	Yes	NMD EIS
Visual Resources	Yes	NMD EIS
Water Resources	Yes	NMD EIS

A.9 King Salmon Air Station

The King Salmon Air Station (AS) is situated on the Alaska Peninsula adjacent to Bristol Bay and Katmai National Park and Preserve, approximately 457 kilometers (284 miles) southwest of Anchorage, and is adjacent to the community of King Salmon. The communities of Naknek and South Naknek are approximately 21 kilometers (13 miles) west-northwest of King Salmon, which is situated in Bristol Bay County at about 58°N Latitude and -156°W Longitude. (Alaska DEC, Contaminated Sites Program, 2004 and BeringSea.com, 2004)

King Salmon AS was built at the beginning of WWII as a military fuel and support base for the Aleutian Islands. The base became an operational ground controlled intercept site in 1951 and was converted to a North American Aerospace Defense Command (NORAD) Control Center in 1953. The State of Alaska acquired the airfield in 1959, and it now serves as a commercial airport. In 1994, the air station was placed in caretaker status, with day-to-day facility maintenance and operations provided by a contractor. The Bristol Bay Borough and the State of Alaska use several buildings on the base, and the Air Force continues to be a major tenant at the airport. The airfield and base could easily be reactivated to a military status during times of national security needs.

King Salmon AS is classified as a contaminated site under the Alaska DEC's Division of Spill Prevention and Response Contaminated Sites Program and under the Federal

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The Air Force is the party responsible for cleaning up these sites to Federal CERCLA standards, and DEC oversees the cleanup to assure it meets the State of Alaska's standards. (Alaska DEC, Contaminated Sites Program, 2004)

The base covers approximately 294 hectares (727 acres) adjacent to the commercial airport and north of the commercial area of King Salmon. King Salmon's location on the Alaska Peninsula is shown in Exhibit A-18 below.

Exhibit A-18. Resource Area Specific Description of Affected Environment for King Salmon AS

Resource Area	Incorporated by Reference	Location of Description of Affected Environment
Air Quality	No	A.9.1
Airspace	No	A.9.2
Biological Resources	No	A.9.3
Cultural Resources	No	A.9.4
Geology and Soils	No	A.9.5
Hazardous Materials and Hazardous Waste Management	No	A.9.6
Health and Safety	No	A.9.7
Land Use	No	A.9.8
Noise	No	A.9.9
Socioeconomics and Environmental Justice	No	A.9.10
Transportation and Infrastructure	No	A.9.11
Visual Resources	No	A.9.12
Water Resources	No	A.9.13

A.9.1 Air Quality

Climate

The climate in King Salmon is maritime, which is characterized by cool, humid, and windy weather. The annual mean temperature is 1°C (34°F), with average summer temperatures ranging from 5° to 7°C (42° to 63°F) and winter temperatures ranging from -2° to 7°C (29° to 44°F). Annual precipitation at King Salmon reaches about 50 centimeters (20 inches), with annual snowfall of approximately 117 centimeters (45 inches). Annual wind speed averages 16.9 kilometers (10.5 miles) per hour, and fog is common during the summer months. (City-data.com, 2004 and BeringSea.com, 2004)

Regional Air Quality

Air quality in and around King Salmon AS is considered good. Because of Alaska's large size and low population density, it is impossible for all areas of the state to be monitored for air quality. Only three population centers have more than 10,000 people – Anchorage, Fairbanks, and Juneau – and are the main sites for air quality monitoring stations. The closest of these three places to King Salmon AS is Anchorage, which is 386 kilometers (240 miles) away. (Alaska DEC, Air and Water Data and Monitoring Section, 2001)

Low mixing heights adversely affect regional air quality by creating atmospheric inversions which trap contaminants. Mixing heights vary depending on atmospheric conditions and are generally highest during afternoon hours and lowest during the evening and early morning. Temperature inversions, which occur most often in the winter, may cause extended periods of low mixing heights, causing exceedances of NAAQS or regional standards.

King Salmon Air Station is located in the maritime tundra region of Alaska. This region absorbs more carbon dioxide than it releases. Typically plants absorb carbon dioxide through photosynthesis and release it through decomposition. However, due to the short, cool summer and freezing winter temperatures, plants cannot decompose. Thousand-year-old plant remains have been found in the tundra permafrost. In this way, the tundra traps the carbon dioxide and removes it from the atmosphere. However, the tundra is losing its capacity to trap carbon dioxide since several feet of tundra are lost annually due to rising global temperatures. As the tundra melts the plant mass decomposes and returns the carbon dioxide to the atmosphere.

Existing Emission Sources

Existing emission sources on King Salmon AS include boilers, engines, gas stations, fuel handling, generators, storage tanks, and other miscellaneous equipment needed to run a commercial airport. Regional volcanic activity also contributes to air quality.

A.9.2 Airspace

King Salmon AS airspace type is Control Zone. The airspace class is considered Class D, but reverts to Class E when the control tower is closed. (Maps.com, 2004)

Much of the aviation activity in Alaska takes place within existing Memoranda of Agreement (MOAs) through a shared-use agreement, with information provided by the Special Use Airspace Information Service, a system operated by the U.S. The Air Force is under agreement with the FAA Alaskan Region to assist pilots with flight planning and situational awareness while operating in or around MOAs or Restricted Areas in Alaska.

A.9.3 Biological Resources

Vegetation

The vegetation in and around King Salmon AS is a combination of coastal rain forest, boreal forest, alpine tundra, northern coastal tundra and Aleutian tundra. The two principal vegetation formations are tundra and boreal forest. The boreal forest formation that occupies most of the lower elevations of the adjacent Katmai National Park and Preserve have soils that are deeper and richer, higher summer temperatures, no permanent snowfields, and lower wind intensity. Habitats include white spruce, birch and balsam poplar forests, alder and willow thickets and grasslands dominated by blue joint grass and blue grass. The coastal forest is similar to the boreal forest, except that the dominant coniferous tree is Sitka spruce. (NPS, Katmai National Park & Preserve, 2004d)

Wildlife

The mammals in and around King Salmon AS include boreal forest animals, such as the muskrat, northern red-backed vole, tundra vole, and red fox, as well as arctic tundra animals, such as the Greenland collared lemming, arctic ground squirrel, and arctic fox. The number of arctic foxes fluctuates widely in response to prey abundance. (Klein et. al., 2004)

King Salmon AS is adjacent to Katmai National Park and Preserve, where both brown bears and salmon are very active. The brown bear population has grown to more than 2,000 in this area. During the sockeye salmon run each July and the return of the "spawned out" salmon to Bristol Bay in September, bears congregate along the area's river and lake shorelines.

Besides the brown bear, Katmai provides a protected home to moose, caribou, red fox, wolf, lynx, wolverine, river otter, mink, marten, weasel, porcupine, snowshoe hare, red squirrel, and beaver. Marine mammals in the area include sea lions, sea otters, and hair seals. Beluga, killer, and gray whales can also be seen along the coast. The lakes and marshes in the area serve as nesting sites for tundra swans, ducks, loons, grebes, and the arctic tern. Sea birds abound along the coast, grouse and ptarmigan inhabit the uplands, and approximately 40 songbird species summer here. Seacoast rock pinnacles and treetops along lakeshores provide nesting sites for bald eagles, hawks, falcons, and owls. (NPS, Katmai National Park & Preserve, 2004a)

Runs of sockeye salmon into the Bristol Bay area are the single most valuable stocks of salmon in Alaska. In 1994 the catch of sockeye salmon in Bristol Bay was valued at more than $136 million, or about 30 percent of the entire value of the harvested salmon in Alaska in that year (Klein et al., 2004). Sockeye salmon contribute significantly to the biological diversity in this area; the species is indirectly responsible for the famous wild rainbow trout stocks that also occur here because young rainbow trout feed heavily on sockeye salmon eggs, which likely improves the growth rate of the rainbow trout. The rainbow trout support an annual multimillion-dollar recreational industry. (Klein et al., 2004)

Threatened and Endangered Species

Exhibit A-19 provides a list of all the threatened and endangered species in Alaska. None of the species have been confirmed to be on the King Salmon AS.

Exhibit A-19. Threatened and Endangered Species Located in Alaska

Common Name	Scientific Name	State Status	Federal Status
Plant Species			
Aleutian shield fern	*Polystichum aleuticum*	E	E
Animal Species			
Eskimo curlew	*Numenius borealis*	E	E
Leatherback sea turtle	*Dermochelys coriacea*	E	E
Short-tailed albatross	*Phoebastria (=Diomedea) albatrus*	E	E
Spectacled eider	*Somateria fischeri*	T	T
Steller's eider	*Polysticta stelleri*	T	T
Steller's sea lion	*Eumetopias jubatus*	E	E
Whale, bowhead	*Balaena mysticetus*	E	E
Whale, finback	*Balaenoptera physalus*	E	E
Whale, humpback	*Megaptera novaeangliae*	E	E

E = Endangered
T = Threatened
Source: USFWS, TESS, 2004

A.9.4 Cultural and Historic Resources

There are no sites listed on the National Register of Historic Places located at King Salmon AS. The only site in the entire county of Bristol Bay on the National Register is Fure's Cabin in neighboring Katmai National Park and Preserve. (NPS, NRIS, 2004)

A.9.5 Geology and Soils

Geology

The King Salmon AS area contains portions of two physiographic provinces, the Aleutian Range and Nushagak-Bristol Bay Lowlands. The Bruin Bay Fault separates the two geologically distinct areas. (NPS, Katmai National Park & Preserve, 2004c)

The Aleutian Range province is characterized by three landforms: the Shelikof Strait Seacoast, the Aleutian Range and the lake region centered on Naknek Lake. The Shelikof Strait seacoast is a rugged, diversified area of narrow-to-wide bays and long and narrow-to-wide beaches. Steep cliffs rising from the bays are common along the coastline. (NPS, Katmai National Park & Preserve, 2004c)

The Aleutian Range is the backbone of the Alaska Peninsula. The higher peaks of this range were formed predominately by volcanic action and rise steeply from the Shelikof Strait coastline to altitudes greater than 2,130 meters (7,000 feet). The slopes and upper valleys surrounding these peaks contain glaciers on both sides of the Aleutian divide. A few of these glaciers descend on the east almost to sea level. (NPS, Katmai National Park & Preserve, 2004c)

King Salmon AS sits near the north-central and northwestern portion of Katmai National Park and Preserve, an area commonly termed “the lake region.” Naknek Lake is the principal part of a hydrologic system of lakes, ponds, rivers, streams, and marshes formed in valleys dammed by glacial deposits. Lakes in the eastern portion of this region are bordered by mountains that rise to 914 meters (3,000 feet) above the water. The western part of this area is open terrain and grades into the Bristol Bay coastal plain. (NPS, Katmai National Park & Preserve, 2004c)

In the Bristol Bay lowlands, modified moraines (accumulations of boulders, stones, or other debris carried and deposited by glaciers) extend along parts of the coast and higher lowlands, and slightly modified prominent moraines generally extend over the highest plains and into the upland valleys. Predominantly nonglacial deposits are associated with the coastlines, rivers, and highlands. Alluvial fan deposits occupy sites near the base of larger volcanoes. (NPS, Katmai National Park & Preserve, 2004b)

Soils

Soils vary in composition between the Aleutian Range and the Nushagak-Bristol Bay Lowland physiographic provinces. At high elevations within the Aleutian Range province, the unconsolidated materials are coarse rubble deposits or bare rock. In the mid-to-lower elevations and hilly areas, soils are silty and sandy volcanic ash over gravelly material, stony loam, cinders, or bedrock. Deep depressions in the foothill slopes contain fibrous peat soils with lenses of volcanic ash. Soils in valley bottoms and in depressions in moraine hills along the coast are deep fibrous or partially decomposed peat. There is no permafrost in this province. (NPS, Katmai National Park & Preserve, 2004b)

Deep, poorly drained loamy soils with thick overlying peat mat and permafrost occupy lowlands in the Nushagak-Bristol Bay Lowlands province. Poorly drained, sandy-to-gravelly soils occupy outwash plains and foot slopes from the Naknek Lake area to the

Ugashik Lakes. Well-drained, dark, loamy soils from fine ash occupy sites on rolling hills and outwash plains in the Bristol Bay lowlands and the western slopes of the Aleutian Range. Organic peat soils occupy depressions throughout the lowlands of the King Salmon-Naknek areas. (NPS, Katmai National Park & Preserve, 2004b)

The soil on the grounds of King Salmon AS is contaminated by petroleum and trichloroethene from a former tank farm, two former dry wells, and various individual sites. The Alaska DEC installed six bioventing systems within the former tank areas to remediate the soil. Additional remediation actions are scheduled through 2005 and 2006. (Alaska DEC, Contaminated Sites Program, 2004)

Geological Hazards

Volcanism is one of the principal geologic processes in the area surround King Salmon AS. The high peaks in the area were formed by volcanic activity, and many are still active enough to occasionally emit steam, smoke, ash, or lava.

Active volcanoes within Katmai National Park and Preserve include Katmai, Novarupta, Trident, Mageik, and Martin. Mount Trident discharged steam, ash, or lava in each of the years 1957 through 1965 and in 1968. Mounts Martin and Mageik produce steam constantly, and the plumes may often be seen from King Salmon, 97 kilometers (60 miles) away. Other peaks in the area have also had periods of volcanic activity. Although a major eruption may occur at any time, the Alaska Volcano Observatory operates 19 monitoring stations within Katmai. (NPS, Katmai National Park & Preserve, 2004b and NPS, Katmai National Park & Preserve, 2004e)

In June 1912, Mount Katmai and Novarupta Volcano erupted with tremendous force and ejected enormous amounts of ash and pumice. Within minutes, more than 104 square kilometers (40 square miles) of this valley were buried by volcanic deposits as much as 91 meters (300 feet) thick. (NPS, Katmai National Park & Preserve, 2004b)

A.9.6 Hazardous Materials and Hazardous Waste Management

Hazardous Materials

Hazardous and potentially hazardous substances used and stored at King Salmon AS include diesel fuel and gasoline, oil, antifreeze, solvents for servicing and cleaning equipment, pesticides, and electrical transformers containing polychlorinated biphenyls (PCBs). (Alaska DEC, Contaminated Sites Program, 2004)

Hazardous Wastes

King Salmon AS is classified as a Contaminated Site under the Alaska DEC, Division of Spill Prevention and Response Contaminated Sites Program. The program oversees and conducts assessment and cleanup of contaminated sites in Alaska based upon risk to public health and the environment. (Alaska DEC, Contaminated Sites Program, 2004)

The facility has been divided into seven zones based on similarities in groundwater movement, contaminants of concern, geology, and location; these zones include the five areas within the King Salmon vicinity and two recreational areas east of King Salmon. Forty Installation Restoration Program (IRP) sites and 15 areas of concerns have been identified and are at various stages of investigation, cleanup, monitoring, or closure.

Additional hazardous waste is stored and managed in accordance with applicable laws and regulations.

A.9.7 Health and Safety

All activities associated with the proposed action would comply with Federal, state, and local laws and regulations applicable to worker and environmental health and safety. Sites would establish safety plans for various operations and safety scenarios. Potential hazards from explosive devices, physical impact, electromagnetic hazards, chemical contamination, ionizing and non-ionizing radiation are considered in the safety plans. These safety plans are coordinated with the appropriate local governments.

A.9.8 Land Use

King Salmon AS is mainly used as a commercial airport but contractor operations also support daily military activities, including Air Force, Army, and Marine training missions, NORAD missions, and U.S. Coast Guard law enforcement and search and rescue missions.

A.9.9 Socioeconomics and Environmental Justice

Population

Although employees of King Salmon AS could live in a number of surrounding communities, the community in closest proximity to the base is the town of King Salmon. As of 2000, the town of King Salmon had a population of 442, with 55 percent males and 45 percent females and an average age of 37.8 years. The following is the demographic breakdown of the population. (City-data.com, 2004)

- White Non-hispanic – 66.1 percent
- American Indian – 30.1 percent

- Two or more races – 3.2 percent
- Black – 1.1 percent

There are three tribes in the area surrounding King Salmon AS: King Salmon Village Council, Naknek Native Village Council, and South Naknek Village Council. Present-day tribal members are descendents of a group that was forced to relocate to King Salmon due to the eruption of Mount Katmai, on the east coast of the Alaska Peninsula. (Alaska DEC, Contaminated Sites Program, 2004)

Employment

The primary means of employment in the area surround King Salmon AS are (City-data.com, 2004)

- Transportation, warehousing, and utilities – 21.9 percent
- Public administration – 19.0 percent
- Education, health, and social services – 17.4 percent
- Contruction – 10.9 percent

Air services employ a large portion of the community, as King Salmon is a major shipping point for Bristol Bay salmon. The Bristol Bay red salmon fishery is the largest in the world, and the area is also a departure point for the Katmai National Park and Preserve. Tourism is also an important economic factor for the area, with over 30,000 visitors passing through the King Salmon airport each summer for wilderness and fishing adventures in the area. (Alaskans.com, 2003)
In 2000, the median household income for King Salmon was $54,375, and the median house value was $160,000. (City-data.com, 2004)

A.9.10 Transportation and Infrastructure

King Salmon is a transportation hub for the Bristol Bay area. King Salmon Airport offers a 2,590-meter (8,500-foot) paved and lighted runway, a 1,220-meter (4,000-foot) asphalt/gravel crosswind runway, and an FAA air traffic control tower. There are scheduled jet flights and charter services to and from Anchorage. A 1,220-meter (4,000-foot) stretch of the Naknek River is designated for float planes. A seaplane base is also located at Lake Brooks, within the Katmai National Park to the east. Four docks are available on the Naknek River, which are owned by the U.S. Park Service, U.S. Fish & Wildlife Service, Alaska State Troopers, and the Bristol Bay Borough. Cargo goods are delivered to Naknek by barge and trucked upriver to King Salmon via a 24-kilometer (15-mile) connecting road. During winter, an ice road provides access to South Naknek. Vehicles are the primary means of local transportation; skiffs are used during summer. (Alaskans.com, 2003)

A.9.11 Visual Resources

The existing visual resources conditions at King Salmon AS would be characterized as low visual sensitivity because the site is currently an industrialized area. The existing operations at the site consist of uses that have been in place since 1951.

A.9.12 Water Resources

On King Salmon AS, ground water has been contaminated by petroleum and trichloroethene from a former tank farm, two former dry wells, and various individual sites, as well as from releases and spills from former underground storage tanks. The contaminated ground water has migrated to various creeks and rivers in and around the site. The Alaska DEC has employed a variety of remediation measures on the site, such as installing bioventing curtains and ground water treatment systems, passive remediation, and monitoring natural attenuation. No private or public drinking water wells have been adversely impacted by these contaminated sites. (Alaska DEC, Contaminated Sites Program, 2004)
At this time, Records of Decision documenting the choice of cleanup methods have been completed for five of the seven ground water zones, and the remaining two are in the preparation stage. Ten remediation systems will continue to operate until state and Federal cleanup levels are met. Investigative studies to delineate the extent of contamination and to investigate sites not yet explored are scheduled for 2005 and 2006. Monitored natural attenuation and long-term monitoring at several sites will continue to be evaluated to demonstrate sustained reduction in contaminant levels. (Alaska DEC, Contaminated Sites Program, 2004)

A.10 Kodiak Launch Complex

The KLC is a commercial launch complex operated by the AADC licensed by the FAA. It is located on the eastern side of Kodiak Island, on a peninsula called Narrow Cape. It is approximately 40 miles from the nearest population center (Kodiak City and the U.S. Coast Guard Station, Kodiak). The KLC occupies 17.4 hectares (43 acres) within a 1,250-hectare (3,100-acre) parcel of state-owned property and consists of a Launch Control and Management Center, Payload Processing Facility, Integration and Processing Facility, Spacecraft Assemblies Transfer Facility, Launch Pad and Service Structure. Support facilities at KLC include access roads, water, power, communications and sewage disposal. Also located at the facility is a U.S. Coast Guard Loran "C" Station. (USAF, 2001)

All of the resources at KLC are incorporated by reference from the GMD ETR EIS (SMDC, 2003). Exhibit A-20 shows where the discussion for each resource area can be found.

Exhibit A-20. Resource Area Specific Description of Affected Environment for KLC

Resource Area	Incorporated by Reference	Location of Description of Affected Environment
Air Quality	Yes	GMD ETR EIS
Airspace	Yes	GMD ETR EIS
Biological Resources	Yes	GMD ETR EIS
Cultural Resources	Yes	GMD ETR EIS
Geology and Soils	Yes	GMD ETR EIS
Hazardous Materials and Hazardous Waste Management	Yes	GMD ETR EIS
Health and Safety	Yes	GMD ETR EIS
Land Use	Yes	GMD ETR EIS
Noise	Yes	GMD ETR EIS
Socioeconomics and Environmental Justice	Yes	GMD ETR EIS
Transportation and Infrastructure	Yes	GMD ETR EIS
Visual Resources	Yes	GMD ETR EIS
Water Resources	Yes	GMD ETR EIS

A.11 Whidbey Island

Whidbey Island is located northeast of Seattle, Washington in Puget Sound. U.S. Naval Air Station (AS) Whidbey Island (NASWI) was commissioned on September 21, 1942, and its current mission is to provide facilities, services, and products to the naval aviation community and all organizations using the Naval AS on Whidbey Island. (U.S. Department of the Navy, NASWI, 2004b, c) Exhibit A-21 shows where the discussion for each resource area can be found.

Exhibit A-21. Resource Area Specific Description of Affected Environment for NAS Whidbey Island

Resource Area	Incorporated by Reference	Location of Description of Affected Environment
Air Quality	No	A.11.1
Airspace	No	A.11.2
Biological Resources	No	A.11.3
Cultural Resources	No	A.11.4
Geology and Soils	No	A.11.5
Hazardous Materials and Hazardous Waste Management	No	A.11.6
Health and Safety	No	A.11.7
Land Use	No	A.11.8

Resource Area	Incorporated by Reference	Location of Description of Affected Environment
Noise	No	A.11.9
Socioeconomics and Environmental Justice	No	A.11.10
Transportation and Infrastructure	No	A.11.11
Visual Resources	No	A.11.12
Water Resources	No	A.11.13

A.11.1 Air Quality

Climate

Whidbey Island has a uniform marine climate with temperature extremes modified by prevailing westerly winds from the Pacific Ocean. The marine influence is responsible for the relatively mild but distinct wet and dry seasons associated with the area. The mean annual temperature is 8°C (47°F). Spring and summer are characterized by clear, sunny days, with average daily maximum temperatures of 14°C (58°F) and light and variable winds. Whidbey Island is on the leeward side of the Olympic Mountains from the prevailing southeast winds. Therefore, the average annual precipitation is relatively low at approximately 50 centimeters (20 inches). Snowfall is rare, and snow usually melts within a day or two if it falls.

The majority of the precipitation falls in the winter due to a stationary low-pressure region in the Aleutian Islands in Alaska. This low-pressure region sends storms through Puget Sound and is responsible for overcast, rainy winters with occasional fog. The average daily minimum temperature is 5°C (41°F). The strongest winds occur from the south or southeast during intense Pacific winter storms. Winds may exceed 89 kilometers per hour (55 miles per hour) once every two years and 129 kilometers per hour (80 miles per hour) once every 50 years.

Regional Air Quality

The Whidbey Island air basin is an air quality attainment area and is regulated by the U.S. Environmental Protection Agency (EPA), Washington Department of Ecology (WDOE), and the Northwest Air Pollution Authority (NWAPA). NWAPA is the local air pollution control agency serving Island, Skagit, and Whatcom counties. The EPA has established NAAQS to protect the health and welfare of the public. WDOE and NWAPA have established standards that for the most part parallel the NAAQS, except for more stringent sulfur dioxide ambient air quality standards (Exhibit A-22).

Exhibit A-22. National and State of Washington Ambient Air Quality Standards

Pollutant	National		Washington State	NWAPA
	Primary	Secondary		
Carbon Monoxide (CO)				
8-Hour Average	9 ppm	None	9 ppm	9 ppm
1-Hour Average	35 ppm	None	35 ppm	35 ppm
Particulate Matter (PM_{10})				
Annual Arithmetic Average	50 µg/m^3	50 µg/m^3	50 µg/m^3	50 µg/m^3
24-Hour Average	150 µg/m^3	150 µg/m^3	150 µg/m^3	150 µg/m^3
Particulate Matter ($PM_{2.5}$)				
Annual Arithmetic	15 µg/m^3	15 µg/m^3	--	--
Average 24-Hour Average	65 µg/m^3	65 µg/m^3	--	--
Ozone (O_3)				
1-Hour Average	0.12 ppm	0.12 ppm	0.12 ppm	0.12 ppm
8-Hour Average	0.08 ppm	0.12 ppm	--	--
Sulfur Dioxide (SO_2)				
Annual Average	0.03 ppm		0.02 ppm	0.02 ppm
24-Hour Average	0.14 ppm		0.10 ppm	0.10 ppm[a]
3-Hour Average		0.50 ppm		
1-Hour Average[b]			0.25 ppm	0.25 ppm
1 Hour Average			0.40 ppm	0.40 ppm
5-Minute Average				0.80 ppm
Lead (Pb) Calendar Quarter Average	1.5 µg/m^3	1.5 µg/m^3	1.5 µg/m^3	1.5 µg/m^3
Nitrogen Dioxide (NO_2) Annual Average	0.05 ppm	0.05 ppm	0.05 ppm	0.05 ppm

ppm = parts per million (volumetric)
µg/m^3 = micrograms per cubic meter
a Sulfur dioxide short-term standard never to be exceeded
b Not to be exceeded more than twice in 7 days
c Not to be exceeded more than once in 8 hours
Source: 40 CFR 50 (Federal); WAC 173-475 (State); NWAPA Regulations, Section 400 (local)

Monitoring of ambient air quality on Whidbey Island is limited because of the history of good air quality. NWAPA operated a total suspended particulates (TSP) monitoring station in the City of Oak Harbor, but it was discontinued after documenting several years of low TSP levels. The other NWAPA air quality monitoring network is associated with an industrial complex near Anacortes. Carbon monoxide (CO), oxides of nitrogen (NO_x), and ozone (O_3) are not measured on Whidbey Island. However, due to the low levels of pollutants emitted locally, emissions of these criteria pollutants are generally not considered to be a problem in the Oak Harbor area, and future changes in the air quality attainment status of the Whidbey Island air basin are not anticipated (Department of the Navy, 1999).

Emission Sources

NASWI is the only major source of emissions in the Oak Harbor area. In 2001, NASWI emissions included the following levels of criteria pollutants:

- 40 tons (36,297 kilograms) of VOCs,
- 24 tons (21,778 kilograms) of PM_{10},
- 26 tons (23,593 kilograms) of NO_X,
- 8 tons (7,258 kilograms) of SO_X, and
- 24 tons (21,778 kilograms) of CO.

A.11.2 Airspace

Controlled and Uncontrolled Airspace

Controlled airspace at Whidbey Island consists of Class C airspace from the surface to 1,220 meters (4,000 feet) above MSL within an 8-kilometer (4.8-nautical mile) radius. Surrounding that is Class E airspace from 213 meters (700 feet) AGL to 5,488 meters (17,999 feet) MSL. Seattle ARTCC is the air traffic control agency for the area.

Special Use Airspace

Special use airspace in the area consists of restricted airspace in Chinook A and B MOAs and Admiralty Inlet Restricted airspace 6701 (R-6701). Two alert airspace areas are in the vicinity of Whidbey Island, the Coupeville OLF Alert airspace (A-680) and Canadian airspace Black Rock, BC Alert airspace (CTA102(M)).

Other Airspace

Four en route airways are present in the Whidbey Island area, V23, V165, V287, and V495. Airports and airfields in the area include Skagit Regional, Frontier Airpark, Coupeville OLF, Camano Island, Lupien, Anacortes, and Blakely.

A.11.3 Biological Resources

Vegetation

Of the 14 vegetation cover types that occur at Ault Field on Whidbey Island, the predominant cover type is grassland (46 percent), which includes the pastures and cultivated fields in the agricultural outleases. The next most prominent vegetation types include mixed forest (quaking aspen and willow), landscaped area, and scrub-shrub, each comprising 8 to 9 percent of the installation. Common grasses found in the grassland areas include timothy, ryegrass, bentgrass, bluegreass, western fescue, orchardgrass, alfalfa, red clover, clover, tall fescue, Canada thistle, cole crops, annual weeds, velvetgrass, quackgrass, and vetch. In addition, 26 percent of the Seaplane Base is made up of grassland vegetation.

Beach habitat, along with eroding bluffs, dominates most of the Crescent Harbor shoreline. Subtidal marine habitat occurs throughout Crescent Harbor.

Wildlife

Over 140 species of water, shore, and land-based birds can be found on Whidbey Island. Terrestrial mammals such as coyotes, deer, raccoons, rabbits, foxes, and squirrels are among the 17 species found on Whidbey Island. In addition, five reptile, nine amphibian, and 125 marine fish species potentially occur in and around NASWI.

Of the habitats present on the Seaplane Base, the marine subtidal area provides habitat for 207 wildlife species, the greatest number of species for any habitat. This is followed by beach habitats that support between 78 and 112 species. Scrub-shrub habitat potentially supports 58 species of animals, while grasslands potentially support 100 species. The beach and marine subtidal habitat bordering Crescent Harbor are important for marine waterbirds and mammals. In particular, the zone within a few hundred feet of Forbes Point receives substantial use by resting waterfowl and seabirds. This zone is also relatively shallow and provides foraging habitat for numerous birds and pinnipeds (e.g., harbor seals).

Mammal species that commonly occur in the waters along Crescent Harbor include: the harbor seal, river otter, and California sea lion. Seals regularly haul out on rocks just off shore (30 to 61 meters [100-200 feet]) to the south of Forbes Point. Other marine mammal species occur in the waters of Puget Sound as well, such as the gray whale, humpback whale, killer whale, short-finned pilot whale, minke whale, Dall’s porpoise, harbor porpoise, Pacific white-sided dolphin, Steller sea lion, and northern elephant seal.

Threatened and Endangered Species

Exhibit A-23 presents the threatened and endangered vegetative and wildlife species on Whidbey Island.

Exhibit A-23. Threatened and Endangered Vegetative and Wildlife Species on Whidbey Island

Common Name	Scientific Name	State Status	Federal Status
Plant Species			
Golden paintbrush	*Castilleja levisecta*	T	T
Animal Species			
Bald eagle	*Haliaeetus leucocephalus*	T	T
Chinook salmon	*Onchorynchus tshawytscha*	T	T
Leatherback sea turtle	*Dermochelys coriacea*	E	E
Marbled murrelet	*Brachyramphus marmoratus*	T	T
Steller's sea lion	*Eumetopias jubatus*	T	T
Whale, humpback	*Megaptera novaeangliae*	E	E

T = Threatened
E = Endangered
Source: USFWS, 2004

A.11.4 Cultural and Historic Resources

Several cultural resources are located at the Naval Air Station on Whidbey Island (NASWI). These sites are related to buildings and activities from the WWII period and are listed on the National Register of Historic Places (NRHP) or are eligible for listing. The sites are located primarily at Ault Field and on the Seaplane Base. Four historic sites at Ault Field, all individual buildings, are recommended eligible for the NRHP. On the Seaplane Base, five historic sites and six archaeological sites have been identified as eligible for listing on the NRHP.

Historic sites located at Ault field include individual buildings 112, 118 (Base Theater), 180, and 220 (Base Security). Building 112 is the only remaining example of four airplane hangars built in 1942. (U.S. Department of the Navy, Historic and Archeological Resources Protection Program, 2004) Buildings 118, 180, and 220 were built in the early 1940's as an entertainment center and two planetariums, respectively. Their unique design and role in the lives of Navy personnel during World War II make them eligible for listing under the National Register. NASWI Security currently occupies the buildings.

The Seaplane Base historic resources include three individual buildings and two historic districts eligible for listing in the NRHP. The historic districts include: (1) the proposed

Seaplane Base Historic District (including 16 contributing buildings and structures), and (2) the Victory Homes Historic District (including 86 contributing buildings).

The Seaplane Base archaeological resources include three previously recorded sites, one newly discovered site, and isolated finds. The three previously recorded sites and one newly discovered site are potentially eligible for listing in the NRHP, pending formal test excavations. The archeological resources assessment also identified areas with a high probability to contain archeological resources, such as current and former shoreline areas. In fact, the slope on which it lies is a former shoreline area that may contain additional archeological resources. This area was cut off from the water when wetland areas were filled to construct the Seaplane Base in the early 1940's.

A.11.5 Geology and Soils

Geology

NASWI is located in the Puget Lowland physiographic province. The surface geology of Whidbey Island is the result of glacial activity from the Fraser Glaciation. The Cordilleran ice sheet of the Fraser Glaciation moved down from British Columbia to just south of Olympia, covering the entire Puget Lowland with glacial ice. The geological deposits from this glaciation in the Quaternary age occurred about 20,000 years ago. (Washington State DNR, 2001)

The Puget Lowland has a high frequency of earthquakes, and is classified as a. Seismic Risk Zone 3. Over 1,000 earthquakes occur annually in this area. However, only 1 percent of these are felt by the public. The last two major earthquakes occurred under Olympia (1949) and Seattle-Tacoma (1965) with Richter magnitudes 7.1 and 6.5, respectively. These major earthquakes are attributed to subduction of the oceanic Juan de Fuca plate under western Washington. (Washington State DNR, 2001)

Soils

The soils on Whidbey Island were formed from weathering of glacial materials. Twenty-three soil-mapping units, comprising 14 soil series, occur at the Seaplane Base. One of the dominant soil types present on Whidbey Island has been classified as a glacial upland soil type designated the Whidbey gravelly sandy loam, with 5 to 15 percent slopes. Soils in this series have been developed from a cemented gravelly till derived largely from granite, quartzite, schist, basalt, slate, and sandstone. The texture of the surface soil layer and subsoil varies from fine- to coarse-grained. Natural drainage is typically good for the soil; however, the underlying cemented gravel till (hardpan) can be poorly drained. During the rainy season, portions of the subsoil directly above the hardpan can remain saturated for long periods as moisture penetrates the hardpan very slowly. The Whidbey gravelly sandy loam typically ranges in natural thickness from 0.51 to 1.2 meters (20 to

48 inches). Other soils on the island are typical of depressions in uplands and terraces, and contain Carbondale Muck, Rifle Peat, and Tanwax Peat. Soils of Glacial Uplands can have a mixture of any of the seven following soils: Bozarth Fine Sandy Loam, Casey Fine Sandy Loam, Hoypus Coarse Sandy Loam, Hoypus Gravelly Loamy Sand, Keystone Loamy Sand, Swantown Gravelly Sandy Loam, and Whidbey Gravelly Sandy Loam.

A.11.6 Hazardous Materials and Hazardous Waste

Each organization that is subject to environmental regulations operating on NASWI and is required to assign at least one Hazardous Waste Manager (HWM) and one Hazardous Material Control Coordinator (HMCC). The HWM and HMCC are responsible for training personnel in proper hazardous materials and hazardous waste management procedures, Best Management Practices, communicating with regulatory agencies and superior officers regarding environmental concerns or emergencies related to hazardous materials and wastes, pollution prevention, waste identification and processing, and records management. (U.S. Department of the Navy, NASWI, 2004a)

NASWI has a pollution prevention program and is a mercury-free facility. In 2002, NASWI recycled 5,630 metric tons (6,211 tons) of waste, or 65 percent of the total solid waste stream. NASWI has reduced hazardous material use by replacing hazardous solvents and coolants with non-hazardous substances. In addition, NASWI has implemented a Consolidated Hazardous Material Reutilization and Inventory Management Program. This program has enabled the facility to reduce the hazardous materials inventory, lower procurement and hazardous waste disposal costs, and comply with Aerospace National Emission Standards for Hazardous Air Pollutants. (DoD, 2002)

Hazardous wastes are collected through a sequence of collection points, the first point being a satellite accumulation point (SAP). SAPs are hazardous waste collection points that are located at or near hazardous waste generation sites. The SAPs have at least one 208-liter (55-gallon) drum for the collection and temporary storage of generated hazardous wastes. Wastes from these SAPs are regularly collected and transported to a less-than-90-day storage area. The hazardous waste is collected from less-than-90-day storage areas on a regular basis (e.g., weekly, monthly) and transported to a hazardous waste treatment, storage, and disposal facility. All personnel involved in the collection and transport of hazardous materials and wastes are properly trained. All hazardous materials and wastes are collected, transported and disposed of according to all applicable Federal, state, and local regulations. (U.S. Department of the Navy, NASWI, 2004a)

Ault field and the Seaplane Base are designated as Superfund sites due to past use of hazardous materials and improper treatment and disposal of hazardous wastes. Ault Field is broken down into four separate operational units, 1, 2, 3, and 5. The Seaplane Base is addressed as operational unit 4 and was delisted in 1995. (U.S. EPA, Region 10, 2001)

The Ault Field operational units consist of four landfills, a waste storage area, a pesticide rinsate disposal area, a jet engine test facility, a fire training area, a former fire training area, and the runway ditch complex. The main health threat in these areas is groundwater contamination from volatile organic compounds, trichloroethylene, and trichlorethane. Ingestion or direct contact with groundwater contaminated by these compounds could be a health hazard. In addition, several areas throughout Ault Field have contaminated soil and sediment. The main pollutants are polychlorinated biphenyls, heavy metals, pesticides, polyaromatic hydrocarbons, and dioxins. (U.S. EPA Region 10, 2001)

Ault Field is considered a "construction complete" site, which means that all clean-up remedies have been implemented. These remedies include connection of local residents with private groundwater wells to public drinking water supplies, offsite disposal of 8,410 cubic meters (11,000 cubic yards) of contaminated soil, and oil skimming and bioventing of contaminated ground water. (U.S. EPA Region 10, 2001)

Four fuel farms are present at NASWI. Between these four fuel farms, NASWI has the capacity to store over 17 million liters (4.5 million gallons) of fuel (e.g., JP-5, No. 2 fuel oil) in underground storage tanks. Various spills have occurred in the past and continue to occur at these fuel farm locations. Spill volumes have ranged from 3 to 303,000 liters (1 to 80,000 gallons).

A.11.7 Health and Safety

Personnel who work for the Fuels Storage and Distribution Contractor are trained to operate in a safe manner around jet fuel. All operations will be conducted in accordance with Navy/DoD health and safety regulations.

A.11.8 Land Use

NASWI is located in Island County, Washington and consists of Ault Field and Seaplane Base. These land parcels are governed by a Navy document called the Regional Shore Infrastructure Plan, which is a regional planning effort being conducted by the Navy that is intended to identify appropriate land uses at each installation on a region-wide basis. The RSIP takes precedence over related sub-tiered planning documents with respect to Land Use. With the exception of shoreline authority as authorized by the State of Washington Shoreline Management Act (WAC 173-27-060), the City of Oak Harbor does not have land use authority over Federal property.

Ault Field is a 1,756-hectare (4,339-acre) area bordered by Puget Sound to the west and farming and residential communities to the north, east, and south, and has a total of 7.1 kilometers (4.4 miles) of shoreline bordering the Straight of San Juan de Fuca. Ault Field contains two runways, taxiways, hangar and operations support facilities, family housing, an elementary school, small arms ranges, headquarters facilities, a golf course, and other recreational facilities. Other facilities at Ault Field include ready magazines, an active landfill, water and sewage treatment facilities, a theater, a library, hobby shops, medical and dental facilities, maintenance shops, a fire station, storage yards, fuel farms, and related facilities.

Seaplane Base is a 1,088-hectare (2,688-acre) area and is 2.4 kilometers (1.5 miles) south of Ault Field at the eastern edge of the city of Oak Harbor. Approximately 708 hectares (1,750 acres) are undeveloped, including forest or land leased for agriculture. The Base's 16.3 kilometers (10.1 miles) of shoreline extend from the east side of Polnell Point along the entire length of Crescent Harbor to Oak Harbor. Seaplane Base includes support facilities, the Commissary and Exchange, maintenance shops, family housing units, two schools, a child development center, a park, playgrounds, and the Seaplane wastewater treatment plant on Seaplane Base.

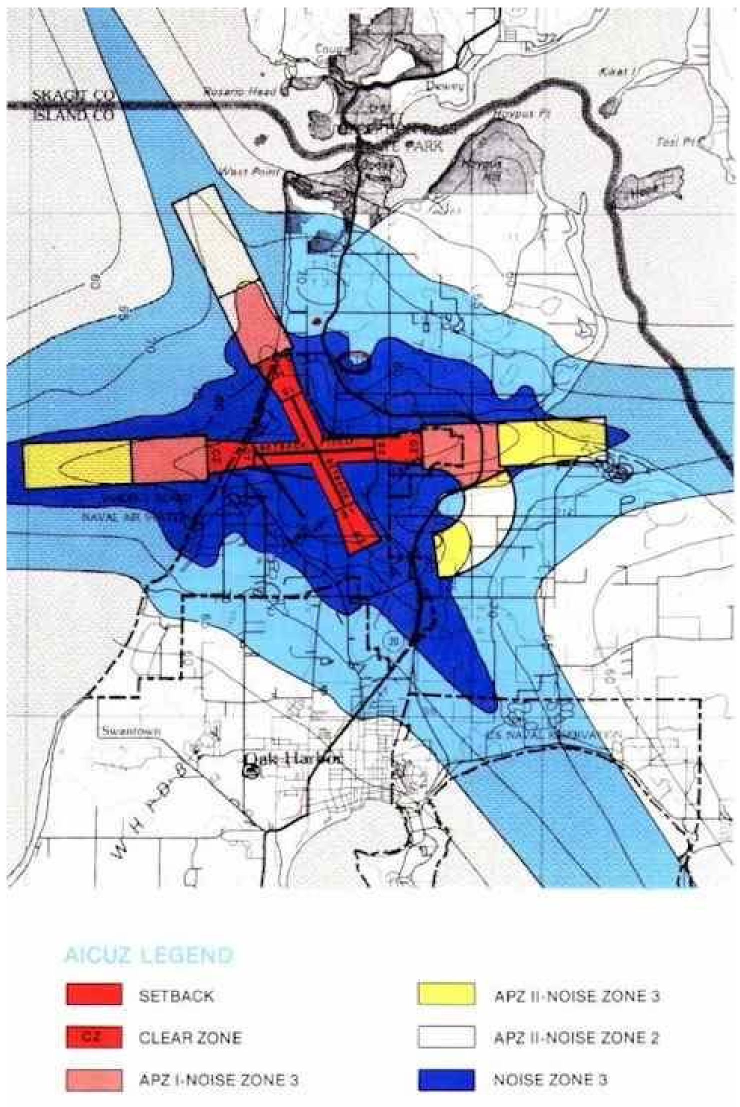
Land zoned as "General Mission Support" is used to support air operations, community services, housing functions, and other administrative functions. This land needs to be within a reasonable distance to support operational facilities, but there is no need for immediate adjacency. The allowable and conditional land uses include: Land Vehicle Fueling, Operating Fuel Storage, Training (Air-Focused), Maintenance-Ships and Floating Equipment, Maintenance-Tanks, and Automotive, Ammo/Explosive Maintenance, Public Works, RDT&E facilities, Contaminated Fuel Storage, General Supply & Storage, Open Storage, Communications Center, Photo Building, Inert Storage, and a Police Station. (ATSDR, 1993)

A.11.9 Noise

The Washington State Department of Ecology (WDOE) has established environmental noise limits defined in terms of an Environmental Designation for Noise Abatement, which considers the use of the property and adjacent lands when determining applicable noise standards. WDOE regulates motor vehicle noise through the implementation of WAC, Chapter 173-62, which limits the noise generated by motor vehicles at specified distances. WDOE exempts noise generated due to temporary construction activity between the hours of 7 a.m. and 10 p.m. The City of Oak Harbor Title 6.56 Oak Harbor Municipal Code exempts construction noise between the hours of 7:00 a.m. and 9:00 p.m., but prohibits loud construction noise after 9:00 p.m. and on weekends. According to the Island County Health Department, the Navy is exempt from noise regulations. Navy/DoD maintains Air Installation Compatible Use Zones (AICUZ), and based on the intensity of noise, land areas are zoned for compatible land use. Zone 1 is compatible for all land use; Zone 2 is recommended for commercial use; Zone 3 is not recommended for residential or commercial use. To reduce ambient interior noise levels, homeowners can implement noise reduction techniques like installing double-glazed windows, solid core doors, additional insulation, and additional wallboards. (ATSDR, 1993)

Exhibit A-24 presents the noise contours and AICUZs for the NASWI. The dark blue, red, pink, and yellow areas on the map are designated Zone 3 and are located within L_{dn} noise contours of 75 dBA or greater. The 65-dBA L_{dn} contour outlines the light blue areas on the map that are designated as Zone 2 areas. Areas outside of the 65-dBA contour are designated as Zone 1 areas and are compatible with all land uses. (Whidbeyrelocation.com, 2005)

Exhibit A-24. AICU Zones for NASWI



Source: Whidbeyrelocation.com, 2005

A.11.10 Socioeconomics and Environmental Justice – Whidbey Island

NASWI is Island County's largest employer with 7,600 military personnel assigned to NASWI and an additional 1,300 civilian employees. According to the 1990 Census, there were 3,876 persons living in the census tract that contains Ault Field. Over 83 percent are male, which is typical of military installations. Nearly all of the population is between the ages of 21 and 34, which is also normal for a military installation. The percentages of children under 10 and persons over 65 were well below the county averages. Very few housing units were owner occupied, which reflects the transient nature of military populations. Over 74 percent of persons in this tract lived in group quarters (e.g., barracks). (ATSDR, 1993)

The census tract containing the Seaplane Base had a population of 4,861 in 1990. The population density is over 1,000 persons per square mile. Family housing for the base is in this tract, which largely explains the extremely high percentage of children under age 10 and high number of persons per household. As with Ault Field, there are very few owner occupied housing units in the tract. (ATSDR, 1993) The socioeconomic data for Island County and for the State of Washington are presented below in Exhibit A-25.

Exhibit A-25. Socioeconomic Data for Island County and the State of Washington

Parameter	Island County	Washington State
Population[1]	71,558	5,894,121
% Population Change 1990-2000	18.9 (increase)	21.1 (increase)
% Population >65 years[1]	14.3	11.2
% Population 18-65 years[1]	60.2	63.1
Home Ownership Rate %[1]	70.1	64.6
Median Household Income[2]	$45,513	$45,776
Per Capita Income[2]	$21,472	$22,973
Poverty %[1]	7.0	10.3
Unemployment %[1]	3.0	4.1

Source: U.S. Census Bureau, 2004b
[1] – Data from 2000
[2] – Data from 1999

A.11.11 Transportation and Infrastructure

Ground Transport

Automobile and truck traffic access Whidbey Island by two highways. Highway 20 accesses the north end of the island, and Highway 525 accesses the south end of the island from Mukilteo. Major interstates and highways in the area include Interstate 5, Interstate 405, Highway 9, Highway 529, and Highway 536. There are no railroad facilities in Island County.

Air Transport

The nearest major airport to NASWI is the Seattle-Tacoma International Airport. Other public and private airports and air fields in the vicinity of NASWI include Oak Harbor

Airport, Whidbey Air Park, Skagit Regional, Frontier Airpark, Coupeville OLF, Camano Island Air Park, Anacortes, and Blakely.

Marine Transport

The Port Townsend-Keystone ferry route (north Whidbey Island) and the Mukilteo-Clinton ferry route (south Whidbey Island) operate regularly scheduled ferry service to Whidbey Island. Though Island County has several marinas, there are no facilities large enough to accommodate large ship transportation. As for barge service, the U.S. Navy (North Whidbey) has one slip that handles aviation fuel. Puget Sound is a major shipping area. Numerous shipping lanes crisscross the sound to and from harbors and ports, such as the Port of Seattle.

Water Sources

NASWI supplies potable water to 13,000 residents, employees, and visitors each year. The NASWI potable water supply comes from the Skagit River. The City of Anacortes purifies the water and then transports it to NASWI via the City of Oak Harbor's transmission pipeline. NASWI further treats the water to maintain chlorine levels and supplement it with fluoride. During 2002, no violations of Federal or state drinking water health standards occurred. (U.S. Department of the Navy, NASWI, 2004b)

NASWI has two wells (Wells No. 4 and 5) that are used as backup supplies. The Navy stopped using the wells because of high naturally occurring iron content. (ATSDR, 1993)

Wastewater Treatment

The NASWI Navy Owned Treatment Works (NOTW), the wastewater treatment plant at Ault Field, treats about 1,650,000 liters (435,000 gallons) of wastewater per day. (ATSDR, 1993) The NOTW has an influent wastewater flow permit limit of 322,000 liters (0.85 million gallons) per day. This is based on a maximum monthly average flow design. The Ault Field wastewater treatment plant is a sequencing batch reactor. (U.S. EPA Region 10, 2001) Wastewater from Seaplane Base is routed to the City of Oak Harbor wastewater treatment plant. (Commerce Business Daily, 2001) The City of Oak Harbor wastewater treatment plant is permitted to treat 322,000 liters (0.85 million gallons) of wastewater flow per day.

Solid Waste Handling

NASWI has a recycling and solid waste management program. Solid waste generated on NASWI is currently long-hauled to a landfill site approximately 500 miles away. To reduce handling and hauling costs, NASWI has implemented a recycling program with a goal of recycling up to 75 percent of the waste stream. NASWI also has an in-vessel composting facility that composts organic materials such as cardboard boxes, food scraps, chipped tree clippings, yard debris, mixed paper, and waste treatment plant biosolids. (NASWI, 2000)

A.11.12 Visual Resources

NASWI has several cultural resources, including historic districts, historic buildings, and archaeological sites. These cultural resources also have visual and aesthetic value, especially the historic districts Seaplane Base Historic District and Victory Homes Historic District. These districts contain buildings and architecture from the WWII era and hold a special significance based on their purpose and function in aviation training. Maintaining their visual integrity is very important. In addition, the natural coastline of Whidbey Island around NASWI has significant visual value.

A.11.13 Water Resources

Surface Water

Many of the streams and creeks in Island County are intermittent or ephemeral. Major surface water bodies on Whidbey Island include Crocket Lake, Cranberry Lake, Lake Hancock, Silver Lake, Hastie Lake, Deer Lake, Goss Lake, Lone Lake, Maxwelton Creek, and Dugualla Creek. (Office of the Interagency Committee, 2002)

The primary source of water for NASWI is the Skagit River. Water from the river is treated at the City of Anacortes water treatment plant and then transferred to NASWI via the City of Oak Harbors transmission pipeline

Ground Water

Ground water is the primary source of drinking water on Whidbey Island outside of NASWI. EPA has classified the ground water of Whidbey Island as a sole source aquifer (47 FR 66, 1987). WDOE has designated Island County as a ground water management area under WAC 173-100, ranking second in priority within the state. Island County has prepared a Ground Water Management Program to guide education, conservation, monitoring, regulation, and coordination efforts. Recharge to the ground water system of Whidbey Island occurs through infiltrating precipitation. Recharge is highest during the winter and spring, when the region receives the majority of its precipitation. Natural discharge from the aquifer occurs year-round as a result of ground water outflow to the surrounding marine waters. Whidbey Island ground water yields range between 189 to 1,320 liters (50 and 350 gallons) per minute, with most wells yielding less than 379 liters (100 gallons) per minute. Water tables generally follow the topography, although perched water tables exist in some locations. NASWI maintains two ground water wells for supplemental supplies in case of drought conditions.

Surface and Ground Water Quality

Northern Whidbey Island was identified in the Island County Watershed Ranking Report as the top priority regional watershed in the county. This rank is based on existing or potential contributions of nonpoint source pollution to Puget Sound and the sensitivity of the areas receiving discharges (e.g., shellfish beds). The three watersheds with the highest rankings are Oak Harbor/Crescent Harbor, Dugualla Creek, and Penn Cove. Potential pollutants to these watersheds are pathogens, sediment, and hazardous materials (e.g., VOCs, heavy metals, etc.).

A.12 Niihau, Hawaii

The Island of Niihau is located about 32 km (17 mi) southwest of Kauai. It is about 13 km (8 mi) wide by 29 km (18 mi) long and comprises approximately 186.5 km^2 (72 mi^2). PMRF leases 473.5 hectares (1,170 acres) of land in the northeastern corner of the island. PMRF operates radar units, optics, and electronic warfare sites on Niihau. The island was purchased in 1864 by James M. Sinclair and Francis Sinclair. It has been in the possession of their descendants to the present.

All of the resources at Niihau are incorporated by reference from the Pacific Missile Range Facility Enhanced Capability EIS (U.S. Department of the Navy, 1998). Exhibit A-26 shows where the discussion for each resource area can be found.

Exhibit A-26. Resource Area Specific Description of Affected Environment for Niihau

Resource Area	Incorporated by Reference	Location of Description of Affected Environment
Air Quality	Yes	PMRF Enhanced Capability EIS
Airspace	Yes	PMRF Enhanced Capability EIS
Biological Resources	Yes	PMRF Enhanced Capability EIS
Cultural Resources	Yes	PMRF Enhanced Capability EIS
Geology and Soils	Yes	PMRF Enhanced Capability EIS
Hazardous Materials and Hazardous Waste Management	Yes	PMRF Enhanced Capability EIS

Resource Area	Incorporated by Reference	Location of Description of Affected Environment
Health and Safety	Yes	PMRF Enhanced Capability EIS
Land Use	Yes	PMRF Enhanced Capability EIS
Noise	Yes	PMRF Enhanced Capability EIS
Socioeconomics and Environmental Justice	Yes	PMRF Enhanced Capability EIS
Transportation and Infrastructure	Yes	PMRF Enhanced Capability EIS
Visual Resources	Yes	PMRF Enhanced Capability EIS
Water Resources	Yes	PMRF Enhanced Capability EIS

A.13 Wallops Island, Virginia

NASA Goddard Space Flight Center`s Wallops Flight Facility was established in 1945 by the National Advisory Committee for Aeronautics as a center for aeronautic research. Wallops is NASA`s principal facility for management and implementation of suborbital research programs and employs approximately 900 full-time personnel. For over 40 years, Wallops Flight Facility has been used as the primary site for various launch and tracking facilities associated with the NASA Sounding Rockets Program. Approximately 2,500 launches have been conducted at Wallops. (NASA, 2005)

The Wallops Flight Facility is located in Accomack County on the Eastern Shore of Virginia, 5 miles south of the Maryland state line, and is part of the Delmarva Peninsula (Delaware, Maryland, Virginia). The facility is approximately 90 miles north of Norfolk, Virginia, and 160 miles southeast of Washington, DC. Wallops maintains three runways, an active launch range, communications and radar tracking systems, and 556 buildings or structures on approximately 26.3 square kilometers (6,500 acres) of land. The facility itself is divided into three separate land areas—Wallops Island, the Main Base, and Wallops Mainland. (NASA, 2003)

Some of the resources at Wallops Island are incorporated by reference from the Environmental Assessment for Range Operations Expansion at the National Aeronautics and Space Administration Goddard Space Flight Center Wallops Flight Facility [Range Ops Expansion EA, (NASA, 1997)] and the Final Environmental Assessment for AQM-37 Operations at the National Aeronautics and Space Administration Goddard Space

Flight Center Wallops Flight Facility [AQM-37 Ops EA, (NASA, 2003)]. Exhibit A-27 shows where the discussion for each resource area can be found.

Exhibit A-27. Resource Area Specific Description of Affected Environment for Wallops

Resource Area	Incorporated by Reference	Location of Description of Affected Environment
Air Quality	Yes	Range Ops Expansion EA, AQM-37 Ops EA
Airspace	Yes	AQM-37 Ops EA
Biological Resources	Yes	Range Ops Expansion EA, AQM-37 Ops EA
Cultural Resources	Yes	AQM-37 Ops EA
Geology and Soils	Yes	AQM-37 Ops EA
Hazardous Materials and Hazardous Waste Management	Yes	AQM-37 Ops EA
Health and Safety	Yes	Range Ops Expansion EA, AQM-37 Ops EA
Land Use	Yes	Range Ops Expansion EA, AQM-37 Ops EA
Noise	Yes	Range Ops Expansion EA, AQM-37 Ops EA
Socioeconomics and Environmental Justice	Yes	Range Ops Expansion EA, AQM-37 Ops EA
Transportation and Infrastructure	Yes	Range Ops Expansion EA, AQM-37 Ops EA
Visual Resources	No	Section A.13.1
Water Resources	Yes	Range Ops Expansion EA, AQM-37 Ops EA

Visual Resources

Wallops Island is a barrier island typical of those found on the East and Gulf Coasts of the United States and so has a predominately coastal visual landscape. In addition, the permanent structures and launch facilities of the Wallops Flight Facility have existed on the island since 1945 and can be considered part of the visual landscape. Other important visual resources on the island include the salt marsh and woodlands of the Wallops Island National Wildlife Refuge.

A. 14 References

Alaska Department of Environmental Conservation (Alaska DEC), Air and Water Data and Monitoring Section, 2001. "Alaska's SLAMS/NAMS Monitoring Network Assessment 2001 Annual Report," http://www.state.ak.us/dec/air/am/AK_Network_01.pdf, accessed July 27, 2005.

Alaska Department of Environmental Conservation (Alaska DEC), Contaminated Sites Program, 2004. Division of Spill Prevention and Response, "King Salmon AFB," http://www.state.ak.us/dec/spar/csp/sites/kingsalmon.htm, accessed July 27, 2005.

Alaskans.com, 2003. "King Salmon, Alaska." http://www.alaskans.com/kingsalmon_alaska.html, accessed July 27, 2005.
Agency for Toxic Substances and Disease Registry (ATSDR), 1993. *Public Health Assessment: Naval Air Station Whidbey Island (Ault Field and Seaplane Base) Oak Harbor, Island County, Washington,* September. http://www.atsdr.cdc.gov/HAC/PHA/whidbey/whi_toc.html, accessed July 27, 2005.

BeringSea.com, 2004. "Communities: King Salmon," http://www.beringsea.com/communities/index.php?community=185, accessed July 27, 2005.

California Department of Fish and Game (DFG), Habitat Conservation Planning Branch, 2004a. "California's Plants and Animals," http://www.dfg.ca.gov/hcpb/species/t_e_spp/tespp.shtml, accessed July 27, 2005.

City-data.com, 2004. "King Salmon, Alaska." http://www.city-data.com/city/King-Salmon-Alaska.html, accessed July 27, 2005.

Department of Defense (DoD), 2002. "FY02 Pollution Prevention Award, Naval Air Station, Whidbey Island, Oak Harbor, Washington," https://www.denix.osd.mil/denix/Public/News/OSD/SecDef02/P2NonIndustrial/navy-naswhidbeyisland.doc, accessed July 27, 2005.

Geography.about.com, 2005. http://geography.about.com/library/cia/blcmidway.htm, accessed July 27, 2005.

Klein, David R., David F. Murray, Robert H. Armstrong, and Betty A. Anderson, 2004. "Alaska." U.S. Geological Survey, http://biology.usgs.gov/s+t/SNT/noframe/ak177.htm, accessed July 27, 2005.

Missile Defense Agency (MDA), 2003. *Airborne Laser Program Supplemental Environmental Impact Statement*, June. http://www.smdcen.us/pubdocs/pages/ablfseis.htm, accessed July 26, 2005.

National Aeronautics and Space Administration (NASA), 1997. Environmental Assessment for Range Operations Expansion at the National Aeronautics and Space Administration Goddard Space Flight Center Wallops Flight Facility, October. http://www.wff.nasa.gov/~code250/Documents/documents.htm, accessed July 27, 2005.

National Aeronautics and Space Administration (NASA), 2003. *Final Environmental Assessment for AQM-37 Operations at the National Aeronautics and Space Administration Goddard Space Flight Center Wallops Flight Facility*, June. http://ax.losangeles.af.mil/axf/eaapgs/docs/wffaqm37ea.pdf, accessed July 26, 2005.

National Aeronautics and Space Administration (NASA), 2005. "Wallops Flight Facility." http://www.wff.nasa.gov/, accessed July 27, 2005.
National Park Service (NPS), Katmai National Park & Preserve, 2004a. "Nature & Science, Animals," http://www.nps.gov/katm/pphtml/animals.html, accessed August 23, 2004.

National Park Service (NPS), Katmai National Park & Preserve, 2004b. "Nature & Science, Geologic Activity," http://www.nps.gov/katm/pphtml/subenvironmentalfactors13.html, accessed August 23, 2004.

National Park Service (NPS), Katmai National Park & Preserve, 2004c. "Nature & Science, Natural Features and Ecosystems," http://www.nps.gov/katm/pphtml/naturalfeatures.html, accessed August 23, 2004.

National Park Service (NPS), Katmai National Park & Preserve, 2004d. "Nature & Science, Volcanoes/Lava Flows," http://www.nps.gov/katm/pphtml/subnaturalfeatures39.html, accessed August 23, 2004.

National Park Service (NPS), Katmai National Park & Preserve, 2004e. "Home," http://www.nps.gov/katm/, accessed September 20, 2004.

National Park Service (NPS), National Register Information System (NRIS), 2004. http://www.nr.nps.gov/, accessed August 17, 2004.

Naval Air Station Whidbey Island (NASWI), 2000. http://www.naswi.navy.mil/env/fy00_pollution_prev.htm, accessed July 27, 2005.

New Mexico Rare Plant Technical Council, 2002. http://nmrareplants.unm.edu/index.html, accessed July 27, 2005.

Office of the Interagency Committee, 2002. http://www.iac.wa.gov/default.asp

U.S. Air Force (USAF), 1999. *Booster Verification Tests Environmental Assessment*, March. http://www.smdcen.us/dcsenev/SMDCEnvDocs/Pages/EA.asp, accessed July 27, 2005.

U.S. Air Force (USAF), 2001. *Quick Reaction Launch Vehicle Environmental Assessment*, January. http://ax.losangeles.af.mil/axf/eaapgs/docs/QrlvEaF.pdf, accessed July 27, 2005.

U.S. Army Kwajalein Atoll, 2004. *Environmental Standards and Procedures for United States Army Kwajalein Atoll (USAKA) Activities in the Republic of the Marshall Islands*, April. http://www.smdcen.us/pubdocs/files/usaka_esp9e_apr04.pdf, accessed July 26, 2005.

U.S. Army Space and Missile Defense Command (SMDC), 1999. *Wake Island Launch Center Supplemental Environmental Assessment*, October. http://www.smdcen.us/dcsenev/SMDCEnvDocs/Pages/EA.asp, accessed July 27, 2005.

U.S. Army Space and Missile Defense Command (SMDC), 2000. *National Missile Defense Deployment Final Environmental Impact Statement*, July. http://www.smdcen.us/dcsenev/SMDCEnvDocs/default.asp, accessed July 27, 2005.

U.S. Army Space and Missile Defense Command (SMDC), 2002a. *Theater High Altitude Area Defense Pacific Flight Tests Environmental Assessment*, December. http://www.smdcen.us/dcsenev/SMDCEnvDocs/Pages/EA.asp, accessed July 27, 2005.

U.S. Army Space and Missile Defense Command (SMDC), 2002b. *White Sands Missile Range*, *New Mexico Liquid Propellant Targets*, May. http://www.smdcen.us/dcsenev/SMDCEnvDocs/Pages/EA.asp, accessed July 27, 2005.

U.S. Army Space and Missile Defense Command (SMDC), 2003. *Ground-Based Midcourse Defense Extended Test Range Environmental Impact Statement*, July. http://ax.losangeles.af.mil/axf/eaapgs/eisother.htm, accessed July 26, 2005.

U.S. Army Space and Missile Defense Command (SMDC), 2004. *Use of Tributyl Phosphate in the Intercept Debris Measurement Program at WSMR Environmental Assessment*, April. http://www.smdcen.us/dcsenev/SMDCEnvDocs/Pages/EA.asp, accessed July 27, 2005.

U.S. Army Space and Strategic Defense Command (SSDC), 1993. *Proposed Actions at the USAKA Final Supplemental Environmental Impact Statement*, December. http://www.smdcen.us/dcsenev/SMDCEnvDocs/default.asp, accessed July 27, 2005.

U.S. Army Space and Strategic Defense Command (SSDC), 1994. *Wake Island Environmental Assessment*, January. http://www.smdcen.us/dcsenev/SMDCEnvDocs/Pages/EA.asp, accessed July 27, 2005.

U.S. Army Space and Strategic Defense Command (SSDC), 1995. *U.S. Army Kwajalein Atoll Temporary Extended Test Range Environmental Assessment*, October. http://www.smdcen.us/dcsenev/SMDCEnvDocs/default.asp, accessed July 27, 2005.

U.S. Army White Sands Missile Range (WSMR), 1998. *White Sands Missile Range Range-Wide Environmental Impact Statement*, January. http://www.mda.mil/mdalink/pdf/too068.pdf, accessed July 27, 2005.

U.S. Census Bureau, 2004a. "California QuickFacts, Ventura County, California," http://quickfacts.census.gov/qfd/states/06/06111.html, accessed August 26, 2004.

U.S. Census Bureau, 2004b. "Washington QuickFacts, Island County, Washington," http://quickfacts.census.gov/qfd/states/53/53029.html, accessed August 17, 2004.

U.S. Census Bureau, International Database, 2004. "Summary Demographic Data for Marshall Islands," Last updated September 30, 2004, http://www.census.gov/cgi-bin/ipc/idbsum?cty=RM accessed October 1, 2004

U.S. Department of the Navy, 1998. *Pacific Missile Range Facility Enhanced Capability Environmental Impact Statement*, December. http://www.smdcen.us/pubdocs/Pages/PMRF.htm, accessed July 27, 2005.

U.S. Department of the Navy, 1999. *Virtual Test Capability Surface Warfare Engineering Facility Environmental Assessment.*

U.S. Department of the Navy, 2002. *Point Mugu Sea Range EIS/Overseas Final Environmental Impact Statement*, March. http://www.smdcen.us/pubdocs/files/Final-EIS.pdf, accessed July 27, 2005.

U.S. Department of the Navy, Naval Air Station Whidbey Island (NASWI), 2004a. "Hazardous Waste and Hazardous Materials," http://www.naswi.navy.mil/env/hazwaste.htm, accessed August 17, 2004.

U.S. Department of the Navy, Naval Air Station Whidbey Island (NASWI), 2004b. "Water Quality Report, January 1 – December 31, 2002," http://www.naswi.navy.mil/env/2002%20water_quality_report.htm, accessed August 17, 2004.

U.S. Department of the Navy, Naval Air Station Whidbey Island (NASWI), 2004c. "Mission." http://www.naswi.navy.mil/pao/mission.htm, accessed July 27, 2005.
U.S. Department of the Navy, Historic and Archeological Resources Protection Program, 2004

U.S. Environmental Protection Agency (USEPA), Region 10, 2001. "Naval Air Station, Whidbey Island (Ault)," http://yosemite.epa.gov/r10/nplpad.nsf/88d393e4946e3c478825631200672c95/89c39e6b0b0f96408525659f004ba002?OpenDocument, accessed July 27, 2005.

U.S. Environmental Protection Agency (USEPA), AirData, 2004. "Monitor Values Report," http://www.epa.gov/air/data/monvals.html, accessed July 27, 2005.

U.S. Environmental Protection Agency (USEPA), Office of Air Quality and Planning Standards (OAQPS), 2005. "Green Book," http://www.epa.gov/air/oaqps/greenbk/, accessed July 27, 2005.

U.S. Fish and Wildlife Serivce (USFWS), 2002. "Midway Atoll National Wildlife Refuge." http://www.fws.gov/pacific/midway/intro/default.htm, accessed July 27, 2005.

U.S. Fish and Wildlife Service (USFWS), Threatened and Endangered Species System (TESS), 2004. http://ecos.fws.gov/tess_public/TESSWebpage, accessed September 10, 2004.

U.S. Geological Survey (USGS), 1999. *Ground Water Atlas of the United States, Alaska, Hawaii, Puerto Rico, and the US Virgin Islands*, HA 730-N. http://capp.water.usgs.gov/gwa/ch_n/N-HItext1.html, accessed July 27, 2005.

Ventura County Farm Bureau, 2001. http://members.aol.com/vcfb1/, accessed July 27, 2005.

Washington State Department of Natural Resources (DNR), 2001. "The Geology of Washington: Puget Lowland." http://www.dnr.wa.gov/geology/lowland.htm, accessed July 27, 2005.

Western Pacific Regional Fishery Management Council, 2001. *Final Fishery Management Plan for Coral Reef Ecosystems of the Western Pacific Region*, October. http://www.wpcouncil.org/coralreef.htm, accessed August 8, 2004.

Whidbeyrelocation.com, 2005. "Whidbey Island Noise Zones."
http://www.whidbeyrelocation.com/noise_zones.htm, accessed July 27, 2005.

Wikipedia, 2005. National Historic Landmarks.
http://en.wikipedia.org/wiki/National_Historic_Landmark, accessed July 27, 2005

APPENDIX B

Migratory Birds – Flyways and Characteristics

APPENDIX B

Migratory Birds – Flyways and Characteristics

The following subsections present a discussion of the migratory flyways and the general characteristics of the migratory bird species.

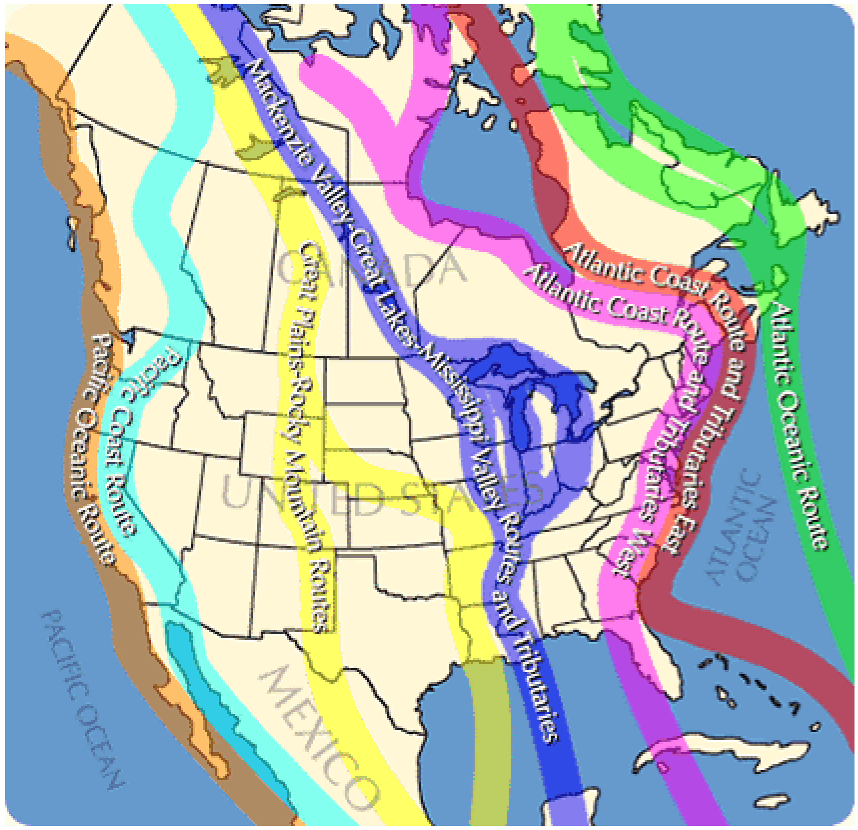
B.1 Migration Flyways

Migration patterns of birds are incredibly varied; however, the migratory movements of most concern are the longer distance flights between North and Central and South America, particularly including neotropical songbirds which have been experiencing population declines in both the northern and southern hemispheres over the past several decades. The physiological strain of long-distance migration makes these birds particularly vulnerable to adverse events. Bird migration generally refers to the movement of birds as they travel to and from their breeding and wintering grounds. The individual paths that these birds travel are commonly known as migration routes. Migration routes crisscross over the entire North American continent, and no two species will follow exactly the same path from beginning to end. This being said, migration routes tend to concentrate along coastlines, major river valleys, and mountain ranges. These broad, heavily traveled corridors comprised of many individual routes are called migration flyways. The concept of a flyway does not imply that all species migrate along definite paths, or that all individuals within a species travel along the same route. Rather, flyways are a convenient generalization to help convey the idea that certain factors (geography, availability of food, etc.) guide the migration of birds along relatively regular paths. (Lincoln et. al., 1998)

Most bird species can navigate using more than one type of cue depending on availability. Cues used by birds to navigate include visual cues (e.g., landmarks, polarization of light, location of setting sun, stars), sound (e.g., ocean waves on coastlines, other sources of infrasound), and 18 species of birds have been demonstrated to have a magnetic "compass" that is recalibrated periodically using other cues. (Wiltschko and Wiltschko, 1996; Hagstrum, 2000; Mouristen and Larsen, 2002; Cochran et al., 2004)

Migration flyways can be broken down into seven generalized routes for birds migrating from the United States to wintering grounds in the West Indies, Central America, and South America. The same flyways are generally followed during spring migration, although many species return north over a different route than they used during fall migration. (Lincoln et. al., 1998)

Exhibit B-1. Principal Migration Routes from North America to Wintering Grounds



(Lincoln et. al., 1998)

Exhibit B-2 describes the general characteristics of the major migration flyways.

Exhibit B-2. Description of Migration Flyways

Route Name	General Characteristics
Atlantic Ocean	The Atlantic Ocean route passes over the Atlantic Ocean from northeastern Canada to mainland South America, with a stopover on the Lesser Antilles islands. This primarily oceanic route is used by shorebirds and seabirds, such as plovers, auks, and petrels.
Atlantic Coast	The Atlantic Coast route follows the Atlantic coast southward, passing over Florida, various Caribbean islands, and finally ending in South America. It is used by both land and sea birds. The western Atlantic Coast Route is a more direct coastal path to South America, but involves much longer flights. It is used primarily by land birds.
Mississippi Valley	The Mississippi Valley route is the longest migration route in the Western Hemisphere. It begins at the mouth of the Mackenzie River in Canada's

Route Name	General Characteristics
	Northwest Territories, passes over the Mississippi delta and across the Gulf of Mexico, and eventually ends in Argentina. The Mississippi Valley route is the preferred route for most migratory bird species.
Great Plains-Rocky Mountains	The Great Plains-Rocky Mountains route also originates in the Mackenzie River delta and passes south through Alberta to western Montana. At this point, some birds move west to the Columbia River valley and then south to California. Other birds travel southeast across Wyoming or Colorado and then merge with Mississippi Valley route. Cranes, geese, pintails, and wigeons are the species most commonly found on the Great Plains-Rocky Mountain Routes.
Pacific Coast	The Pacific Coast Routes are the least heavily traveled migration paths, beginning in western Alaska and continuing over the Gulf of Alaska to British Columbia. They then follow the coastline south, swing inland, and finally end in western Mexico. These routes are used primarily by geese, ducks, and arctic-breeding shorebirds.

Source: Lincoln et. al., 1998

B.2 Timing of Migration

Birds generally travel during two peak migratory seasons, fall and spring. Fall migration beings around late August and lasts until about early December. Spring migration generally occurs from March to May. (Birdnature.com, 2001)

In addition to these annual seasons of migration, some birds time their migration to travel exclusively at night. The majority of nocturnal migrants are songbirds and other small birds. Radar observations have shown that nocturnal migration begins about an hour after sundown, reaches a maximum shortly before midnight, and then gradually declines until daybreak. (Lincoln et. al., 1998)

The day migrants include larger birds like ducks, geese, loons, cranes, gulls, pelicans, hawks, swallows, and swifts. Soaring birds such as hawks, storks, and vultures can only migrate during the day because they depend on updrafts created either by thermal convection or the deflection of wind by topographic features like hills and mountain ridges. Birds that are able to feed at all hours, such as most water birds, migrate either by day or night. (Lincoln et. al., 1998)

B.3 Altitude of and Characteristics of Migratory Birds

The altitude of migration is extremely variable and depends on factors such as species, location, geography, season, time of day, and weather. Nevertheless, some general conclusions about migration altitude can be drawn based on radar observations of birds.

Approximately 95 percent of birds migrate at altitudes under 10,000 feet. (Lincoln et al., 1998) According to the Clemson University Radar Ornithology Laboratory and the U.S. Fish and Wildlife Service, the vast majority of birds migrate at altitudes between 500 and 4,500 ft, with the highest density of birds found at approximately 1,500 ft. (CUROL, 2005; Lincoln et. al., 1998) The majority of smaller birds favor migration altitudes between 500 and 1,000 feet. A few species sometimes migrate a few hundred feet or less above the ground. (Lincoln et al., 1998) During inclement or foggy weather, some birds will migrate closer to the ground, sometimes as low as 150 to 250 feet above the ground.

Birds on long-distance flights fly at higher altitudes than short-distance migrants. Some shorebirds have been known travel at 15,000 to 20,000 feet over the ocean. Nocturnal migrants also fly slightly higher than diurnal migrants, but their altitude depends on the time of night. Birds generally gain maximum altitude shortly after sundown and maintain this peak until around midnight. Nocturnal migrants then gradually descend until daylight. (Lincoln et. al., 1998)

In general, migratory birds travel at air speeds of 20 to 50 miles per hour, with ducks and geese flying at 40 to 50 miles per hour, herons and hawks at speeds of 22 to 28 miles per hour, and flycatchers and smaller birds flying at 10 to 17 miles per hour. (Lincoln et al., 1998) In general, the northward spring flights are more direct and slightly faster than the southerly migrations in late summer and early fall.

A majority of bird species migrate in flocks numbering in the hundreds to hundreds of thousands. In general, many species breed over relatively large areas, but during migration, the population can be funneled through a more narrow area. For example, the eastern kingbirds summer breeding range extends 2,800 miles from Newfoundland to British Columbia; however, the width of the migratory path narrows to 400 miles from east-west at the latitude of the Yukatan. (Lincoln et al., 1998)

Several studies of bird migrations using NEXRAD (weather radar) have allowed researchers to estimate the density of migrating birds. (CUROL, 2005) Estimates of 120 to 230 birds per cubic kilometer have been recorded for birds flying across the Gulf of Mexico in the spring. Densities of 230 to 490 birds per cubic kilometer have been recorded over the Great Plains in the spring and fall. Densities as high as 500 birds per cubic kilometer have been recorded over Houston, Texas. (CUROL, 2005) Dr. Sidney Gauthreau, the nation's leading expert on bird migration patterns using NEXRAD studies, indicated that the highest recorded density of migrating birds observed is approximately 2,000 per cubic kilometer. This observation was made one evening during the first week of October above Clemson University in South Carolina after a cold front had passed through the area. (Dr. Gaurthreau, 2005) Similarly high densities can be reached when flocks are initially taking off from a dense roosting site.

B.4 Migratory Bird Stopover Sites

Stopover sites are habitats or natural communities that consistently provide migrants with the necessary resources to refuel and rest during their journey. (NJAS, 2004) The following habitats typically provide the best resources and are therefore the most popular stopover sites for migrants.

Mountain Ridges

The forests along the slopes of mountain ridges typically provide important food resources like insects and fruit. (NJAS, 2004) Higher elevation sites along the slopes or tops of ridges are especially important in the fall, when the insect population peaks. (Deinlein, 2005)

Riparian Areas

Major rivers typically support extensive wetlands and woodlands. The vegetation in these riparian areas provides concentrated food sources and sheltered resting areas for migrants. (NJAS, 2004) In the fall, foothill riparian areas provide important fruiting plants for birds such as tanagers and grosbeaks. (Deinlein, 2005) Throughout much of the arid western United States, riparian forests are oases that offer the only trees to the landscape, and birds rely heavily on them for shelter. (Sterling, 2005)

Barrier Islands and Coastal Marshes

For many migrants, coastal woodlands and barrier islands represent the first opportunity to refuel after a long journey across a large body of water. For this reason, the northern Gulf coast contains many key stopover sites and hosts large numbers of migratory birds during the spring migration. (Deinlein, 2005)

Other key stopover sites, especially for shorebirds, are as follows: the Copper River Delta in southern Alaska; Gray's Harbor in Washington; the Bay of Fundy in Nova Scotia and New Brunswick; the Cheyenne Bottoms in Kansas; the Delaware Bayshore of New Jersey and Delaware; and the prairie pothole region of the northern U.S. and southern Canada. (Deinlein, 2005)

B.5 References

Birdnature.com. 2001. "Migration Timetable." http://www.birdnature.com/timetable.html Accessed 4/26/05.

Clemson University Radar Ornithology Laboratory (CUROL). 2005. "Migrating Birds." http://virtual.clemson.edu/groups/birdrad/comment.htm

Cochran, W.W., H. Mouritsen, and M. Wilelski. 2004. Migrating songbirds recalibrate their magnetic compass daily from twilight cues. *Science* 304: 405-408.

Deinlein, Mary. 2005. "Fact Sheet: Stopover Sites in Decline." Migratory Bird Center, Smithsonian National Zoological Park. http://nationalzoo.si.edu/ConservationAndScience/MigratoryBirds/Fact_Sheets/default.cfm?fxsht=6 Accessed 4/26/05.

Hagstrum, J, 2000. Infrasound and the avian navigational map. J. Exp. Biology 203:1103-1111.

Lincoln, Frederick C., Steven R. Peterson, and John L. Zimmerman. 1998. "Migration of birds." U.S. Department of the Interior, U.S. Fish and Wildlife Service, Washington, D.C. Circular 16. Jamestown, ND: Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/othrdata/migratio/migratio.htm ,(Version 02 APR 2002).

Mouritsen, H., and O.N. Larsen. 2002. Migrating songbirds tested in computer-controlled Emlen funnels use stellar cues for a time-independent compass. *J. Exp. Biol.* 204: 3855-3865.

New Jersey Audubon Society (NJAS). 2004. "Stopover Sites." http://www.njaudubon.org/Education/Oases/Stopover.html Accessed 4/26/05.

Sterling, John. 2005. "Fact Sheet: Western Riparian Systems: Magnets for Migrants." Migratory Bird Center, Smithsonian National Zoological Park. http://nationalzoo.si.edu/ConservationAndScience/MigratoryBirds/Fact_Sheets/default.cfm?fxsht=5 Accessed 4/26/05.

Wiltschko, W., and R. Wiltschko. 1996. Magnetic orientation in birds. J. Exp. Biology 199: 29-38.

APPENDIX C

Electromagnetic Radiation, Radars, and Impacts on Human Health and Wildlife

APPENDIX C

Electromagnetic Radiation, Radars, and Impacts on Human Health and Wildlife

C.1 Introduction and Radars Basics

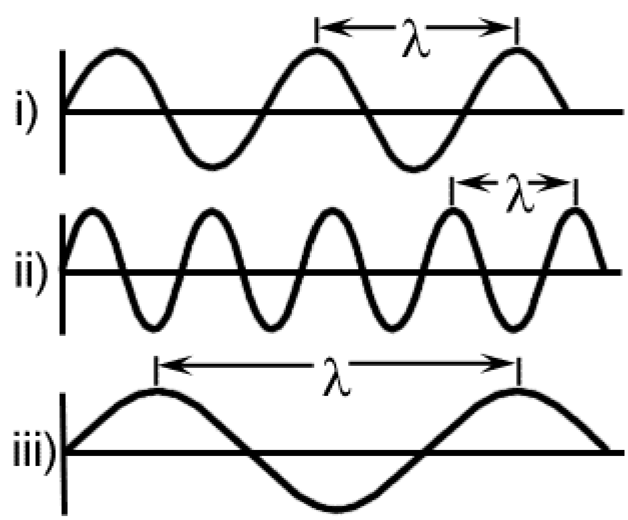
C.1.1 Introduction

This appendix presents a general discussion of radars, defines electromagnetic radiation (EMR) and discusses its characteristics, and presents health concerns and the safety procedures that are protective of human health. The appendix goes on to analyze the effects of EMR on wildlife, specifically on migratory birds and resident bird populations.

C.1.2 Radar Basics

Radar is an acronym for "radio detection and ranging" and is a system used to detect and map objects such as aircrafts and weather by transmitting and receiving electromagnetic radiation in the form of micro or radio waves. These waves are measured in terms of their frequency, which refers to the number of waves formed per given unit of time (measured in Hertz), and their wavelength, which refers to the distance the wave travels during one cycle. The relationship between wavelength and frequency is such that waves with a long wavelength have a low frequency and vice versa (see Exhibit C-1).

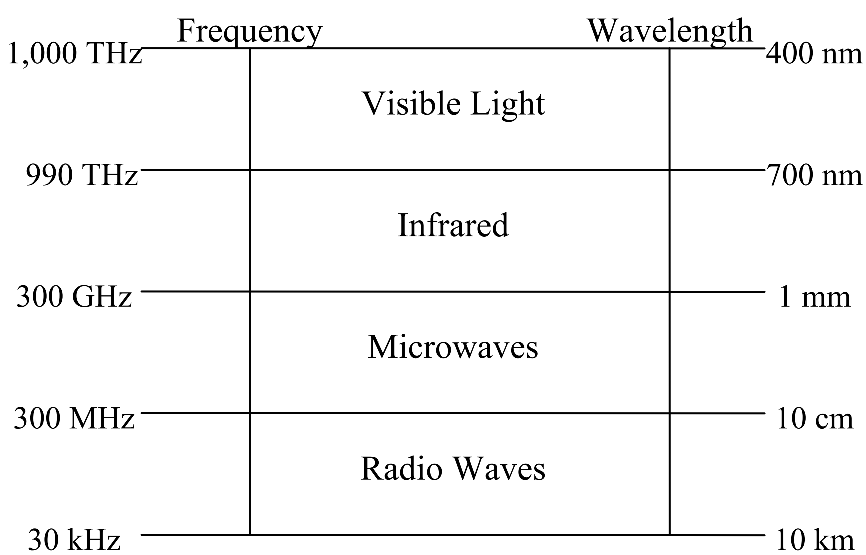
Exhibit C-1. Relationship between Wavelength and Frequency



Wave i - depicts the wave with the middle frequency and wavelength.
Wave ii - depict the wave with high frequency and short wavelength.
Wave iii - depicts the wave with low frequency and long wavelength.

There are a number of different types of radars that utilize various parts of the electromagnetic spectrum and technologies to track objects. Typically, radars operate by emitting radio waves with wavelengths ranging from several meters to just a few tenths of a meter and frequencies of between 10,000 hertz and 300 gigahertz. Radars can also operate by emitting microwaves, which have wavelengths of around 1/100 of a meter and frequencies of between 300 megahertz and 300 gigahertz (see Exhibit C-2). Just as the energy associated with different radars varies as a result of different operating frequencies, the associated power of radars varies as well.

Exhibit C-2. Electromagnetic Spectrum

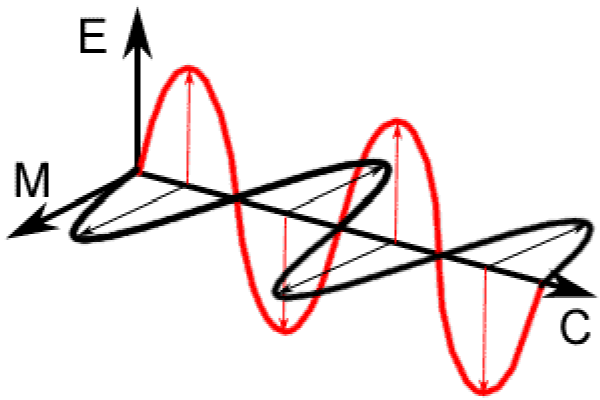


Many of the operational characteristics (pulses of energy rather than continuous energy) of radars actually reduce human exposure to radio frequency radiation. The majority of radars, such as the phased array radar, operate by emitting a directional beam that is usually sent out in pulses rather than continuously. The average power emitted in association with pulse radars is much lower than the peak pulse power, while continually operating radar would emit high level power at all times. Radars emit directional beams of energy. These beams are usually very narrow and resemble the beam of a spotlight. The intensity decreases significantly as you move away from the main beam. In most cases, these levels are thousands of times lower than the main beam. In addition, radar beams from phased array radars are continuously moving. As a result the direction of the beam is continuously changing and electromagnetic waves are not always directed towards the same area. (WHO, http://www.who.int/mediacentre/factsheets/fs226/en/)

C.2 Electromagnetic Radiation

The radio frequency radiation generates both an electric and magnetic field, which are oriented at right angles to one another. The intensity of these fields is measured by their strength (volts per meter) or by their power density (watts per square meter). Exhibit C-3 depicts how electric and magnetic fields are at right angles to one another.

Exhibit C-3. Electromagnetic Wave



Electromagnetic Radiation (EMR) consists of inter-related electric (E) and magnetic (H) fields that oscillate at the sending frequency and travel at the speed of light. EMR frequency and wavelength are related according to the equation.

Equation 1

λ = **c/f** – where

- **λ** = wavelength in meters (m)
- **c** = speed of light (3×10^8 m/sec)
- **f** = frequency in Hertz (Hz or cycles/sec)

Exhibit C-4 shows the relationship between EMR frequency in megaHertz (MHz) or gigaHertz (GHz) and wavelength (λ) in meters (m) and centimeters (cm) for selected frequencies between 10 MHz and 12 GHz. As an example, domestic microwave ovens operate at a frequency of 2,450 MHz with a power usually ranging from 500 to 1,100 watts. (http://www.who.int/peh-emf/publications/facts/info_microwaves/en/)

Exhibit C-4. EMR Frequency, Band, Wavelength (λ), and Penetration Depth (pd) in Muscle Tissues

Freq. (MHz)	Freq. (GHz)	Band	λ (m)	Penetration Depth (cm) muscle	Biological entity of similar size
10	0.01	HF	30		
30	0.03	VHF	10		
70	0.7	VHF	4.3		human
100	0.1	VHF	3	6.2	human
300	0.3	VHF/ UHF	1	3.3	goose
435	0.435	UHF	0.69		eagle
650	0.65	UHF	0.46		bobwhite, rat
915	0.915	UHF	0.33		plover, robin
1,000	1	UHF/L	0.30	2.5	catbird
2,000	2	L/S	0.15	2.0	swallow, mouse
2,450*	2.45	S	0.12		goose or eagle head
3,000	3.0	S	0.10	1.7	warbler
4,000	4.0	S/C	0.075		
5,000	5.0	C	0.06	1.0	
7,500	7.5	C	0.04		robin head
8,000	8.0	C/X	0.0375		
10,000	10.0	X	0.03	0.4	warbler head
11,000	11.0	X	0.0273		
12,000	12.0	X	0.025		

MHz = megahertz; GHz = gigahertz; HF = high frequency, VHF = very high frequency, UHF = ultrahigh frequency; L = long; S = short; C = compromise between X and S bands. Source for penetration depth = AFRL 2005, Figure 2.

* Conventional microwave oven

EMR is reflected or absorbed by different materials and objects to varying degrees depending on several parameters, including the material surface characteristics, its conductivity/impedance, the size and shape of the object relative to the wavelength of the incident EMR field, and orientation of the object relative to the incident field. Absorption of EMR is maximal when the long-axis of the object (e.g., animal body) is oriented in the direction of the electric field vector, i.e. the incident plane wave is perpendicular to the body. When wavelengths are much shorter than the length of an animal body, ERM is absorbed in the skin surface facing the source. For wavelengths approximating twice the length of the body, the body itself acts as an antenna to enhance the coupling of the EMR energy into the body. Dosimetry studies for humans have demonstrated that maximum energy transfer occurs when the height of an individual approximates four-tenths the length of the EMR wavelength. The frequency of maximal absorption is called the resonance frequency, and for humans, it is between 70 and 100 MHz.

The depth to which radar EMR can penetrate biological materials generally decreases with increasing frequency and depends on the impedance of the material. Measured penetration depths for muscle tissue are included for some frequencies in Exhibit C-4. Thus, the higher the EMR frequency, the more shallow the penetration and potential warming effects in an animal, with C-band and X-band radars penetrating from 1-cm to 0.4-cm into muscle tissues, respectively.

Exhibit C-4 includes the corresponding wavelengths for comparison with birds of different sizes (considering the length of the body from head to base of tail). For reference, we have also included in Exhibit C-4 the human and laboratory rat and mouse. Because it is possible for the head (or other body parts) of an animal to have its own resonance and absorption characteristics, we have included estimates of the size of the head of a few types of birds as well. From Exhibit C-4, it is clear that the EMR frequencies of most concern for migrating birds range from 300 to 10,000 MHz, which include C- and X-band radars (wavelengths from about 100 to 3 cm, respectively). EMR with shorter or longer wavelengths is outside of the principal resonant frequencies for migrating birds.

The most common way to express the strength of an electromagnetic field is by calculating its power density, which is expressed in (W/m^2). Power density combines the field strength of the electric and magnetic fields to express their combined intensity correctly reflecting the strength of the entire electromagnetic field. The greater the power density of an electromagnetic field the more intense the field. (FCC, 1999)

The power in a radar beam at some distance from the source depends on the power at the source, the radar power efficiency, the antenna gain, and the distance from the source. It is often expressed as a power density (S) (e.g., in milliWatts (mW) per unit area, often cm^2). Due to spherical spread, S decreases with the square of the reciprocal of the distance from the radar.

In the "far-field", that is at distances where the angular EMR field distribution is essentially independent of the distance from the radar and has a predominantly plane-wave character; S can be calculated as follows.

Equation 2

$\mathbf{S = (P/4 \pi r^2) \times G}$ – where

S = power density (mW/cm^2)
P = power source (mW)

r = distance from the source (cm)
G = antenna gain (along the main axis of beam)

The antenna gain (G) describes the degree to which the radar is able to concentrate its power in a single direction, is direction-specific, and is highest along the main axis of the radar beam. Gain in the equation above is expressed as the ratio of the maximum radiation intensity of the actual antenna over the radiation intensity of an isotropic antenna (i.e., radiating energy in all directions) with the same power input, and is dimensionless. Effective antenna gain can be calculated from information on the width of the radar beam (the degree to which the energy is concentrated in a narrow beam instead of spherically), assuming a standard antenna radiation pattern and efficiency of power transmission (after losses from internal heating, etc.).[5]

As an example of a power density calculation, S is calculated below for a 100 kW source with an effective gain (G) of 30, using 100 ft as the distance from the source. The power density at 100 ft, or 3,047 cm, is calculated as

$$\mathbf{S} = (100{,}000{,}000 \text{ mW}/4 \cdot \pi \cdot 3047^2 \text{ cm}^2)\ 30 = 25.7 \text{ mW/cm}^2$$

Note that in this example the Effective Radiated Power (ERP) would equal 100 kW times 30 or 3,000 kW.

Gain usually is expressed in units of decibels (dBs) instead of as the ratio described above (or dBi, which is decibels relative to an isotropic antenna). A gain of 30, for example, usually would be reported as a gain of 14.8 or 15 dB, or

$$\mathbf{G\ (dB)} = 10 \log_{10} [30/1]$$

Thus, to estimate the ERP for a 100 kW radar with a gain of 15 dB, the source power can be estimated in dB so that the gain (G) can be added to it as follows (NAWC 2005).

Equation 3

$$\mathbf{P\ (dB)} = 10 \log_{10} [P\ (W)/1 \text{ mW}]$$

So, for example,

$$\begin{aligned} P\ (dB) &= 10 \log_{10} [100 \text{ W}/1 \text{ mW}] \\ &= 10 \log_{10} [100{,}000 \text{ mW}/1 \text{ mW}] \\ &= 10 \times 5 \\ &= 50 \text{ dB} \end{aligned}$$

[5] https://ewhdbks.mugu.navy.mil/antennas.htm

The Effective Radiated Power (ERP) can now be calculated as follows.

Equation 4

$$
\begin{aligned}
\textbf{ERP} &= P(dB) + G(dB) \\
&= 50 \text{ dB} + 15 \text{ dB} \\
&= 65 \text{ dB} \\
&= 3{,}000 \text{ W}
\end{aligned}
$$

Alternatively, the antenna gain in dB can be converted to the dimensionless ratio so that Equation 2 can be used.

For plane waves, power density (S) is related to electric field strength (E) and magnetic field strength (H) by the impedance of free space, i.e., 377 Ohms (Ω) as identified in Equations 5 and 6.

Equation 5

$$
\begin{aligned}
\textbf{S} &= E^2/377 \\
&= 377 \times H^2
\end{aligned}
$$

where S is in units of W/m^2, E is in units of volts (V)/m, and H is in units of amperes (A)/m

Equation 6

$$
\begin{aligned}
\textbf{S} &= E^2/(377 \times 10) \\
&= 377 \times 10 \times H^2
\end{aligned}
$$

where S is in units of mW/cm^2, E is in units of V/m, and H is in units of A/m

In the "near field," that is the region in proximity to the radar, the electric and magnetic fields are not substantially plane-wave in character, but vary from point to point (IEEE 1999). The near-field region is further subdivided into two regions, the reactive near field and the radiating near field. The reactive near field, which is closest to the radiating structure, contains most or almost all of the stored energy. For most radar antennas, the outer boundary of this reactive near-field region is assumed to exist at a distance of one-half wavelength from the antenna surface. The radiating near-field region is where the radiation field is dominant, but is lacking in substantial plane-wave pattern, and the profile of EMR power density with spatial location is more complex. In the radiating near-field, the power density calculated using Equation 2 overestimates the actual power density..

The start of the far field region, given by Equation 7, is where the antenna gain versus angular direction is independent of range for both the mainlobe and sidelobes of the antenna pattern. However, a well formed mainlobe can appear at ranges less than the range computed by Equation 7. In the near field, the power density estimated using Equation 2 overestimates the power density to some extent, particularly for phased-array radars.

Equation 7

Far Field Range (m) = 2 · (antenna diameter (m))^2 / wavelength (m)

At distances less than that calculated using Equation 7, Equation 2 overestimates the power densities by an increasing amount as the distance to the antenna decreases. A generalized equation for calculating power density in the near field does not exist. Radar-specific models must be used to accurately estimate near field power densities.

Because the size of the mobile radars is fairly small, the near field and its associated power densities would not exceed the controlled hazard areas. The near field would be within the controlled hazard area.

C.3 Human Health Issues

Exposure to electromagnetic radiation generated from radars, in particular microwaves and their associated electromagnetic fields, has the potential to adversely impact human health. Microwave fields oscillate very rapidly and produce very short wavelengths which results in absorption by human tissue. This can lead to burns and conduction by cell membranes, which can affect the cytoplasm within the cells; shocks induced from nearby metallic objects are also a risk. Anecdotal evidence has pointed to a connection between radar use and increased risk of cancer, but at this time, no conclusive evidence has been found to link the two.

The degree of the impact of absorbing electromagnetic radiation is dependent on the frequency of the radiation generated, the length of exposure, the size and orientation of the person relative to the source of the wave, and the power at which the radar operates. For electromagnetic radiation to be largely absorbed by an object, the size of the object and the wavelength of the radiation must be roughly the same size. Typically for people the range in frequency for absorption is between 35 megahertz (adults) and 200 megahertz (babies). Electromagnetic radiation with a frequency of greater than 5 gigahertz is largely unabsorbed by the human body.

Due to these absorption levels and the inherent risk of exposure, threshold values for exposure to electromagnetic radiation have been established by a number of organizations. For frequencies between 30 kilohertz to 300 gigahertz, the American Conference of Government Industrial Hygienists (ACGIH) and the American National

Standards Institute (ANSI) have established levels based on the frequency of the electromagnetic radiation generated. These exposure limits are presented in Exhibit C-5 and were selected to limit the specific absorption rate (SAR) of the human body to 0.4 W/kg in any six minute period.

Exhibit C-5. Electromagnetic Radiation Threshold Limits

	Frequency	Power Density (mW/cm^2)	Electric Field Strength Squared (V^2/m^2)	Magnetic Field Strength Squared (A^2/m^2)
ACGIH	30 kHz to 3 MHz	100	377,000	2.65
ACGIH	3 MHz to 30 MHz	$900/f^2$ (1 to 100)	3,770 x 900/c	$900/(37.7 \times f^2)$
ACGIH	30 MHz to 100 MHz	1.0	3,770	0.027
ACGIH	100 MHz to 1 GHz	f/100 (1 to 10)	3,770 x f/100	f/(37.7 x 100)
ACGIH	1 GHz to 300 GHz	10	37,700	0.265
ANSI	30 kHz to 3 MHz	100	400,000	2.5
ANSI	3 MHz to 30 MHz	$900/f^2$ (1 to 100)	$4{,}000 \times 900/f^2$	$0.025 \times 900/f^2$
ANSI	30 MHz to 300 MHz	1.0	4,000	0.025
ANSI	300 MHz to 1.5 GHz	f/300 (1 to 5)	4,000 x (f/300)	0.025 x (f/300)
ANSI	1.5 GHz to 100 GHz	5.0	20,000	0.125

Source: Final Theater Missile Defense Programmatic EIS, Ballistic Missile Defense Organization, September, 1993

Additional standards have been established by the International Radiation Protection Association (IRPA), the U.S. Army and the Occupational Safety and Health Administration (OSHA). The IRPA exposure limits are presented in Exhibit C-6 and are based on a level of exposure to electromagnetic radiation that is known to cause thermal changes in objects. The U.S. Army's blanket exposure limit is a power density of 5 mW/cm^2 for continuous exposure to microwave energy over a six-minute period. OSHA advises that radiation emitted from radar equipment not exceed 10 mW/cm^2 for frequencies ranging from 10 megahertz to 100 gigahertz over a six-minute period of time.

Exhibit C-6. IRPA Exposure Limits Guidelines

Frequency (MHz)	Electric Field (V/m)	Magnetic Field (A/m)	Power Density ($mW/cm^{2)}$
0.1-1.0	87	0.23	2
1.0-10	$87/f^{1/2}$	$0.23/f^{1/2}$	2/f
10-400	27.5	0.073	0.2
400-2,000	$1{,}275f^{1/2}$	$0.0037f^{1/2}$	f/2,000
2,000-300,000	61	0.16	1

Source: Final Theater Missile Defense Programmatic EIS, Ballistic Missile Defense Organization, September, 1993

The World Health Organization recommends that the SAR not exceed 4 W/kg for frequencies between 1 megahertz and 10 gigahertz. This is the level at which adverse human health effects are likely to occur. At frequencies above 10 GHz, the majority of the electromagnetic radiation is absorbed by the skin and very little of the radiation penetrates below the surface. However, if the power density of the electromagnetic radiation at 10 GHz exceeds 1,000 W/m^2, it can still result in cataracts and skin burns.

Generally, the potential risk level for significant impact from EMR exposure is dependent on the intensity of the electromagnetic radiation and the population density (see Exhibit C-7). For example, if the intensity of electromagnetic radiation is greater than 5 mW/cm^2 and there is any human population nearby, there is a medium to high risk of health impacts from exposure. However, if the intensity of electromagnetic radiation is less than 1 mW/cm^2 and the human population is high, there is only a medium risk and any other smaller population is considered having a low risk of exposure.

Exhibit C-7. Potential Risk Levels for Exposure to Electromagnetic Radiation

Population Density	Electromagnetic Radiation Intensity		
	Low[a]	**Medium[b]**	**High[c]**
Small[d]	Low	Low	Medium
Medium[e]	Low	Medium	High
High[f]	Medium	Medium	High

low[a]: less than 1 mW/cm^2; medium[b]: 1 mW/cm^2 to 5 mW/cm^2 ; high[c]: greater than 5 mW/cm2; small[d]: rural or non-urban; medium[e]: metropolitan area; high [f]: consolidated metropolitan area

C.4 Relevant Safety Procedures

For each proposed location and for each land-based mobile sensor that would be used at that particular location, an EMR/electromagnetic interference survey would be conducted that considers Hazards of Electromagnetic Radiation to Personnel (HERP), Hazards of Electromagnetic Radiation to Fuels (HERF), and Hazards of Electromagnetic Radiation to Ordnance (HERO), as appropriate (where sensors and ordinance co-exist). The analysis would provide recommendations for sector blanking and safety systems to minimize exposures.

The values collected for the radio frequency ground hazard area are derived from the IEEE standards and applicable OSHA standards including the pamphlet, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields," OET Bulletin 65, dated August 1997. The analysis presents two sets of criteria, one for the general population/uncontrolled exposure that allows up to 30 minutes of exposure, and one for Occupational/Control Exposure that allows up to 6 minutes of exposure. The most protective values are associated with emissions between 30 to 300 MHz (0.2 mW/cm^2 for the general population for 30 minutes of exposure and 1.0 mW/cm^2 for the occupational population for 6 minutes of exposure). The mobile radars emit between 4,000 and 12,000 MHz, which has protective levels of 1.0 mW/cm^2 for the general population for 30 minutes of exposure and 5.0 mW/cm^2 for the occupational population for 6 minutes of exposure.

For general equipment, the accepted levels for high power effects are 1 megawatt per square centimeter for military equipment and 0.1 megawatt per square centimeter for civilian equipment. During radar operating conditions, full power operation would involve either surveillance or tracking operations. During tracking operations the radar tracks a moving object through the atmosphere with the beam pointed at an angle above the horizon and the beam only moves to keep pace with the tracked object. During surveillance operations a surveillance zone is continuously and repeatedly scanned, thus the radar beam is constantly moving. In addition, potential safety consequences associated with radar interference with other electronic and emitter units (flight navigation systems, tracking radars, etc.) would also be examined before startup. Adherence to AADC, FAA, and DoD safety procedures would be followed. Radar and transceiver operations at the test locations would be coordinated with the FAA, U.S. Coast Guard, and other groups or agencies as appropriate. Notice to Airmen and Notice to Mariners would be issued as necessary.

C.5 Wildlife Health Issues

The wildlife health analysis in this appendix focuses on the impacts on wildlife from radars. The impacts on wildlife from mobile telemetry, command and control, optical and optical laser sensors were not considered because they do not present the same potential for impact when compared to radars. Telemetry, command and control, and optical sensors are passive systems. Some of these sensors may use a radar or other active sensor for tracking and pointing activities; however, the impacts to wildlife from the use of these systems would be less than those described for the radars considered in this appendix. Optical laser sensors use both passive cameras and a solid state eye safe laser. Because the laser is considered “eye safe” the impacts to wildlife from the operation of this sensor are not considered in this appendix. The radars that are considered in this appendix include TPS-X, FBX-T, Mk-74, and MPS-36. Note the characteristics of the TPS-X and the FBX-T are similar to the mobile THAAD radar; however, both the TPS-X and FBX-T are slightly more powerful than the THAAD radar and represent a more conservative evaluation. Where appropriate, data on other MDA radars are included to provide context for the potential impacts to health and safety from the operation of mobile sensors.

Because mobile sensors would be directed above the horizon during pre-operational testing and operational activities, the only type of wildlife that has the potential to be impacted from the main radar beam would be birds. The MDA has considered the impacts to birds from the operation of radars as part of earlier environmental analyses. Specifically, the 1993 Ground-Based Radar Family of Radars Environmental Assessment

(EA) analyzed potential impacts on wildlife from EMR, in particular migrating birds that might fly through the radar beams. That analysis concluded that because the main beam would normally be in motion, it would be extremely unlikely that a bird would remain within the most intense area of the beam for any considerable length of time. That analysis also noted that the size of the beam is "relatively small," further reducing the probability of birds remaining within this limited region of space, even if the beam remained still. (U.S. Army Space and Missile Defense Command, 2003) The MDA has also undertaken additional analyses on the potential impacts to wildlife, particularly migratory birds from EMR, the results of which are presented in this appendix. The extent of exposure of migrating birds to radar beams depends both on the behavior of the birds and the motion and output of the radars (see Appendix B for additional information).

C.5.1 Estimates of Exposure Duration

Exposure duration is a function of the position and movement of the radar beam as well as the speed and movement of the bird. The beam of a phased array radar system moves position approximately every 10 to 100 milliseconds to scan the appropriate airspace for potential incoming missiles, the duration for a single pulse is brief (e.g., <20 milliseconds). Dish radars, move the beam mechanically rather than by varying the intensity of emissions from the array of antennas and therefore, move the beam more slowly when scanning. During target tracking tasks and testing of these systems, the radar beam is aimed in essentially one direction. For this analysis, MDA considered a stationary beam that would provide estimates of maximum exposure durations. During surveillance operations, exposure durations will generally be less than 0.02 seconds because of the movement of the radar beam.

To estimate the maximum amount of time that a single migrating bird is likely to remain in a stationary main radar beam at varying distances from the radar it is necessary to consider the radar beam width. For each of the mobile radars evaluated in the Environmental Assessment, Exhibit C-8 presents Unclassified specifications for these radars. Mobile sensor radars operate in the X and C bands. The analysis only evaluates the most powerful radar in each band. Thus only the X-band phased array radar (TPS-X and FBX-T) and the C-band radar (MPS-36) are analyzed.

Exhibit C-8. Unclassified Specifications for Mobile Radars Operating in X and C Bands

Type	Frequency	Peak Power (kW)	Average Power (kW)	-3 dB Beam Width (deg)	Antenna Diameter or Length (m)	Antenna Height (m)	Wavelength (cm)	Gain (dB)
		Upper Bound (all values approximate)						
Phased Array (TPS-X, FBX-T)	X-band (8 - 12 GHz)	400	100	0.6	4.6	2.01	3.0	52
Dish (MK-74)	X-band (8 - 12 GHz)	5						
Dish (MK-74)	C-band (4 - 8 GHz)	165						
Dish (MPS-36)	C-band (4 - 8 GHz)	1,000	0.64	1.2	3.7	N/A	5.17	50

[a] Technical Realities: An Analysis of the 2004 Deployment of a U.S. National Missile Defense System, Union of Concerned Scientists, May 2004
[b] Range Instrumentation Handbook, Vandenberg Air Force Base, September 2000
[c] GMD Validation of Operational Concept Environmental Assessment, Missile Defense Agency, April 2002
[d] NMD Deployment Final Environmental Impact Statement, Ballistic Missile Defense Organization, July 2000

During surveillance tasks, the beam of a phased array radar system moves position every 10 to 100 milliseconds to scan the appropriate air space for potential incoming missiles. The actual duration of a single pulse is less than 16 milliseconds. Dish radars, which move the beam mechanically rather than by varying the phase of emissions from an array of radar antenna, move the beam more slowly when scanning. However, during target tracking tasks and during testing of these systems, the radar beam might be aimed in essentially a single direction. Thus, to estimate maximum possible exposure durations that might occur when testing target tracking functions, a stationary beam was assumed through which migrating birds fly. Exposure durations during surveillance tasks generally will be less than 0.02 seconds owing to the movement of the radar beam in addition to the movement of the birds.

The -6 dB radar beam widths were used to estimate the maximum amount of time that a single migrating bird is likely to remain in a stationary main radar beam at varying distances from the radar. In Exhibit C-8, the width of a radar beam is specified in degrees, where 360 degrees equals a full circle. Thus, the width of the beam increases with increasing distance from the source. The duration of time a bird might spend flying through only the main beam was estimated. The -6 dB beam width contains approximately 90 percent of the energy emitted. The width of a radar beam for birds flying perpendicular to the direction of the beam at distances between 100 and 3,000 meters from the radar antenna was examined. The distance a bird would fly through a radar beam for birds flying parallel to the direction of the beam was also examined.

For birds flying perpendicular to the direction of the beam, the length of an arc in a beam intersecting an imaginary circle centered at the radar antenna is calculated at distance r from the radar antenna as:

Equation 8

$$\text{arc (feet)} = 2 \cdot \pi \cdot \mathbf{r} \cdot (\mathbf{w}/360) \text{ - where}$$

r = radius or distance from the source (feet)
w = beam width (degrees)

The values for the beam width at various distances from the antenna are listed in Exhibit C-9 for each radar type. Considering the radar with the widest beam angle of 1.2 degrees, the radar beam would range between approximately in horizontal width 100 meters from the radar to approximately in width 3,000 meters from the radar.

Exhibit C-9. Width of Main Radar Beam at Increasing Distance from the Radar

Radar Type	-3 dB Beam width (degrees)	Maximum width of radar beam (m) with distance from radar						
		100 m	300 m	500 m	700 m	900 m	1,500 m	3,000 m
X-band	0.6	4.6	6.3	10.5	14.7	18.8	31.4	62.8
C-band	1.2	4.2	12.6	21.0	29.3	37.7	62.8	125.7

The slowest moving birds would spend the most time in a stationary radar beam; therefore, the time required for a small bird (e.g., warbler) flying at 10 mph (4.5 meters per second) to fly perpendicularly through a stationary beam at the same distances from the radar was estimated, as shown in Exhibit C-10. Note that for the maximum beam width evaluated (1.2 degrees), a small bird could fly through the beam in about 28 seconds at a distance of 3,000 meters and in one second at a distance of 100 meters from the radar, where the power density of the beam would be much higher. For birds flying 20 to 40 mph, as do many migrant species, the exposure durations of the birds flying perpendicularly through a stationary radar beam would be one half to one quarter of the values listed in Exhibit C-10.

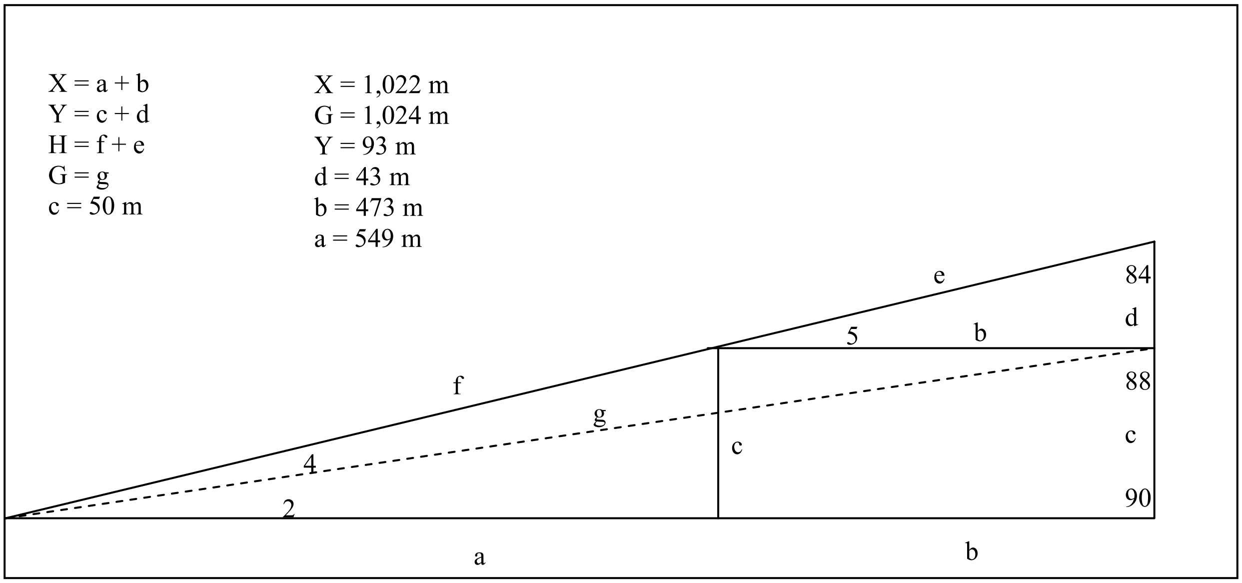
Exhibit C-10. Maximum Duration of Flight Perpendicular to and within a Stationary Main Radar Beam at Increasing Distance from the Radar for a Bird Flying 10 miles per hour

Radar Type	-3 dB Beam width (degrees)	Flight duration (seconds) in main radar beam with distance from radar						
		100 m	300 m	500 m	700 m	900 m	1,500 m	3,000 m
X-band	0.6	1.0	1.4	2.3	3.3	4.2	7.0	14.1
C-band	1.2	0.9	2.8	4.7	6.6	8.4	14.1	28.1

For birds flying parallel to the radar beam, the distance the bird must cover to fly through the beam horizontally will be longer than for flight perpendicular to the radar beam. Thus, as the beam moves closer to horizontal, the longer a bird would be in the beam to fly through it horizontally. Exhibit C-11 analyzes a case where a radar that has a -6 dB beam width of 2.4 degrees is directed with an angular elevation of 4 degrees above horizontal (most proposed BMDS radars do not project less than 3 degrees above horizontal). We further assumed a worst case of the bird flying as low as an altitude of 50 meters above the height of the radar (e.g., as during bad weather), which would result in the bird flying through higher power densities than if the bird were flying at higher altitudes. Because in the far field, power density diminishes with the reciprocal of the square of the distance to the source (see Equation 2), whereas duration of a horizontal flight through the beam increases linearly with the distance from the source at which the bird intersects the beam, the highest risk to the bird will be the closest intersection with the beam, which occurs at the lowest altitude, here assumed to be 50 m, relative to the altitude of the radar.

In Exhibit C-11, the distance covered by a bird flying through such a radar beam is represented by line segment b. Line segment g (entire dashed line) represents the lower edge of the 2.4 degree radar beam, which would be 2.8 degrees above horizontal. Line H (line segments f plus e) represents the upper edge of the 2.4 degree radar beam, which is elevated 5.2 degrees above horizontal. Using the relationships depicted in Exhibit C-11, the bird would fly along a distance of 473 m to fly through this beam if it were stationary. A bird flying 4.5 m/sec (10 mph) could traverse 473 m in approximately 106 seconds. However, note that the power density associated with this flight would range between the power densities associated with a distance of 552 m (line segment f) to 1,024 m (line g) from the source.

Exhibit C-11. Side View of Radar Beam 4 Degrees in Width Elevated 4 Degrees from Horizontal



Thus, for stationary radar beams, the total time a bird is likely to be in the main beam will be a function of the distance from the radar, the beam's elevation, the altitude of the bird, and the air speed of the migrating bird. The power densities encountered will depend on the distance from the radar.

For moving radar beams, as during surveillance testing and operations, the maximum duration of an EMR pulse in one direction, and thus the maximum likely exposure duration for a given bird encountering a beam, would be on the order of milliseconds.

C.5.2 Estimates of Exposure Magnitude

The previous section demonstrated that exposure durations for birds migrating through an area in which a mobile land-based radar is operating in a tracking or calibration mode such that the beam is stationary are on the order of seconds to tens of seconds, even for the slowest migrants traveling at approximately 4.5 m/sec. Migrating bird and bird population exposure durations for radars in surveillance mode are likely to be no longer than 16 milliseconds and usually less than 1 millisecond. The analysis evaluates whether it is possible for some of the radars to be sufficiently powerful to exceed the power density threshold of 10 mW/cm^2 for migratory birds flying at low altitudes and slow flying speeds.

The far field equation for calculating EMR power density (S) at a specified distance from a radar source was provided in Section C-2 (Equation 2). Because the duration of the "on" pulse is generally under 0.02 seconds and the duty cycle is less than 0.1 seconds, it

is most appropriate to use the average, not peak, power at the source to calculate average power densities that would apply to exposure durations of longer than 0.1 seconds.
For birds flying at distances less than the far field from a radar, the power densities are less, and may be substantially less, than calculated using Equation 2. However, at distances as close as one third of the far field distance, Equation 2 yields a reasonable approximation of the actual power density. Equation 7 calculates the beginning of the far field region. For the X- and C-band radars described in Exhibit C-8, use of Equation 7 and the midpoint of the range of wavelengths listed indicate that the far field region begins at approximately 1,354 and 530 meters, respectively. One third of these distances are 451 and 177 meters, respectively.

Exhibit C-12 presents the power density results in mW/cm^2. In Exhibit C-12, the far field equation (Equation 2) was used to estimate power density. Note that the reference power density of 10 mW/cm^2 for use as a value indicating no impacts on migrating birds is associated with a six-minute averaging period. Higher power densities are allowed for correspondingly shorter periods of time.

For comparison with the IEEE Standard c95.1-1999 peak power density limit of 2,652 W/cm^2, the peak power output for each radar (i.e., the power during the on phase) was also used to estimate peak power densities at varying distance from each radar type. Exhibit C-13 presents those results.

Exhibit C-12. Average Power Density at Increasing Distance from the Source for Different Types of Radars

Radar Type	Average kW	Gain (dB)	Average power density (mW/cm^2) with distance from radar (m)						
			100 m	300 m	500 m	700 m	900 m	1,500 m	3,000 m
X-band	100	51	10,018	1,113	401	204	124	44	11
C-band	0.64	50	50.93	5.66	2.04	1.04	0.63	0.23	0.06

Exhibit C-13. Peak Power Density at Increasing Distance from the Source for Different Types of Radars

Radar Type	Average kW	Gain (dB)	Peak power density (W/cm^2) with distance from radar (m)						
			100 m	300 m	500 m	700 m	900 m	1,500 m	3,000 m
X-band	100	51	40	4.4	1.6	0.8	0.5	0.2	0.04
C-band	0.64	50	79	8.8	3.2	1.6	1.0	0.3	0.09

C.5.3 Impact Characterization

This section evaluates the estimated exposures against the thresholds for assuming no impact to characterize potential impacts on a bird that does encounter a radar beam. The potential for population-level impacts is then estimated by considering the likelihood that one or more birds in a migrating flock would actually encounter the radar beam, including some discussion of the uncertainties and conservative bias in the impact estimates.

C.5.3.1 Risks to Individual Migrating Birds and Resident Populations

This section estimates the potential for birds that encounter a beam from each category of radar to be exposed at a combination of exposure duration and power density sufficient to exceed reference values for no harm. Three evaluations are included.

1. The potential to exceed the IEEE Std c95.1-1999 peak power density limit of 2,652 W/cm^2
2. The potential for the average power density encountered to exceed the reference value of 10 mW/cm^2 averaged over six minutes, after adjusting for duration of exposure
3. The potential for single pulse of 20 milliseconds at peak power to result in an encounter that exceeds a relevant reference value.

Peak Power Density Limit

Examination of Exhibit C-13 reveals that no birds would be exposed to ERM that exceeds the IEEE Std c95.1-1999 peak power density limit of 2,652 W/cm^2.

Average Power Density Limits

The reference value for this impact assessment for migrating birds and bird populations is an average power density of 10 mW/cm^2 associated with a six minute exposure period. The applicable power density for shorter exposures is higher. For this assessment, both the longest exposure-duration estimates (for a stationary beam) listed in Exhibit C-9 and the estimates of average power density presented in Exhibit C-10 are used. Exhibit C-14 lists the product of the exposure duration in Exhibit C-10 and the power density in Exhibit C-12 divided by the six-minute averaging time for each of the corresponding cells. Exhibit C-14 values are in units of mW/cm^2. Where Exhibit C-14 values exceed 10 mW/cm^2, a bird at that distance from that type of radar could be exposed to more EMR than represented by the reference value.

Exhibit C-14. Average Power Density (mW/cm^2) Multiplied by Exposure Duration Divided by Six Minutes, with Increasing Distance from the Source for Different Types of Radar for Bird Flight Paths Perpendicular to the Radar Beam

Radar Type	Average kW	Gain (dB)	Power density (mW/cm^2) multiplied by exposure duration (min) / 6 minutes						
			100 m	300 m	500 m	700 m	900 m	1,500 m	3,000 m
X-band	100	51	27.8	4.3	2.6	1.9	1.4	0.9	0.4
C-band	0.64	50	0.1	0.0	0.0	0.0	0.0	0.0	0.0

Exhibit C-14 indicates concern for slow flying (10 mph) small birds within 100 meters of the X-band radar and flying perpendicularly through the radar beam. The analysis indicates no risks to birds flying 30 mph or faster. Using the bird-specific six-minute reference values of 38 to 61 mW/cm^2 for birds ranging in size from warblers to 7.7 pounds in weight developed in the 1993 EA, none of the radars would pose a risk to migrating birds.

Note that the values presented in Exhibit C-14 represent a conservative assessment that may overestimate risks. An air speed of 10 mph was assumed for migrating warblers, the slowest of the migrating birds. Exhibit C-14 also assumes that the radar beam is stationary, which is approximately true for phased-array radars only when the radar is tracking targets or during calibration operations. For the dish radars operating in the C-band, mechanical movement of the radar will be slower, but for this radar, even the assumption of a stationary beam does not result in risks of exceeding the no-harm reference value of 10 mW/cm^2 (six-minute average). Finally, the far field equation, which significantly overestimates power densities close to a radar, was used to determine the values in Exhibit C-14. Thus, the actual power density may not exceed the 10 mW/cm^2 threshold.

Potential risks to birds flying in the direction of stationary beams elevated only 4 degrees above horizontal also was evaluated. The combinations of beam width and corresponding exposure duration calculated for altitudes of 50 meters above the C-band radar using the relationships in Exhibit C-11 did not exceed the no-harm reference value. For the X-band radar the reference value, 10 mW/cm^2, was exceeded at altitudes of less than 150 meters above the radar. The far field equation, which significantly overestimates power densities close to a radar, was used to determine these values. Thus, the actual power density may not exceed the 10 mW/cm^2 threshold.

Single Pulse Exposures

The estimate of risks to birds that do encounter a radar beam considers exposure to a single beam pulse, and is appropriate to radars operating in the surveillance mode. After each pulse is emitted, the radar "listens" for returning echoes and then changes direction before emitting the next pulse. The chance of the direction change coinciding with the direction the bird is traveling is very small. Thus a bird would not encounter subsequent pulses. This assessment uses the estimates of peak power density at varying distances from the radar in Exhibit C-13. An exposure duration of 10 milliseconds was assumed as the emitted pulse duration for each BMDS radar. This is a conservative estimate; most radars use pulse widths of 1 millisecond or less in most situations.

Exhibit C-15 shows the results of multiplying the peak power densities at the varying distances from the radar antenna (Exhibit C-13) by 0.010 sec pulse duration and dividing by 360 sec (six minutes). In Exhibit C-15, values less than the reference value of 10 mW/cm^2 indicate a negligible risk of impacting a bird encountering the beam at the specified distance. Exhibit C-15indicates that there are no possible risks to individual birds encountering a radar beam from the mobile radars.

Exhibit C-15. Peak Power Density (mW/cm^2) Multiplied by Exposure Duration (0.010 seconds) Divided by 360 seconds, with Increasing Distance from the Source for Different Types of Radar

Radar Type	Peak kW	Gain (dB)	Peak Power density (mW/cm^2) multiplied by 0.010 seconds / 360 seconds						
			100 m	300 m	500 m	700 m	900 m	1,500 m	3,000 m
X-band	400	51	1.1	0.1	0.04	0.02	0.01	<0.01	<0.01
C-band	1000	50	2.2	0.2	0.09	0.04	0.03	<0.01	<0.01

Radars in Surveillance Mode

This section evaluates whether birds flying in the surveillance zone for phased array radars, whose main function is surveillance, would experience exposures above the threshold of 10 mW/cm^2 averaged over six minutes. Only the X-band (FBX and TPX) radar is evaluated.

In the surveillance mode of the radar the surveillance zone is covered repetitively, and the surveillance pulses have a longer pulse duration than for tracking. The analysis estimates the surveillance zone and beam area in steradians (solid angle measurement) to determine the number of beam positions required to cover the surveillance zone. A bird in the surveillance zone will be exposed to one beam dwell time per surveillance period. Thus the number of times a bird in the surveillance zone is exposed to the beam over a six minute period depends on the time to complete a survey of the entire surveillance zone.

For TPS-X and FBX-T, the surveillance region is assumed to be 120 degrees in azimuth and 3 to ten degrees in elevation or 0.254 steradians (= 120/360 2π (Sin (10) – Sin (3))). The beamwidth is approximately 0.00015 steradians, so that there are about 1,700 beam positions to be covered by the radar.

The specific revisit time is dependent on the pulse duration assigned to each surveillance pulse. Assuming a pulse-duration of ten milliseconds, the eleven per cent duty time devoted to surveillance, the 1,700 beam positions would be covered in about 155 seconds. Thus, a bird flying through the surveillance zone would experience one pulse encounter every 155 seconds or 2.3 encounters every six minutes.

Exhibit C-16 shows the results of these calculations. The results indicate that birds within 500 meters of the radars might be exposed to EMR above the threshold of 10 mW/cm^2 average over six minutes while the radars is in the surveillance mode. Because the peak power was estimated using the far field equation and the distance is well within the near field, the actual exposures may be less.

Exhibit C-16. Peak Power Density (mW/cm^2) Multiplied by the Number of Exposures in Six Minutes Divided by 360 seconds, with Increasing Distance from the Antenna for Different Types of Radar

Radar Type	Peak kW	Gain (dB)	Peak power density (mW/cm^2) with distance from radar (m)						
			100 m	300 m	500 m	700 m	900 m	1,500 m	3,000 m
X-band	400	51	256	28.1	10.2	5.1	3.2	1.3	0.2

C.6 Conclusion

This conservative analysis indicates that only the X-band mobile radars may present a small risk in spring and fall to some migrating birds during periods of inclement weather, when birds migrate at lower altitudes than usual, as well as to resident bird populations. Therefore, there is likely to be no or a very small risk to migrating birds from flying over areas where mobile X-band radars are operating. The analysis further shows that, under both tracking and surveillance modes that there is very low probability of an impact on migrating birds and on resident bird populations.

C.7 References

Cochran, W.W., H. Mouritsen, and M. Wilelski. 2004. Migrating songbirds recalibrate their magnetic compass daily from twilight cues. *Science* 304: 405-408.

CUROL (Clemson University Radar Ornithology Laboratory). 2005. Home page at http://virtual.clemson.edu/groups/birdrad/ click on "Introduction", click on "Birds on NEXRAD", select different options. "Migrating Birds" includes figure relating bird density (measured in dBZ) to altitude.

Gauthreaux, S. 2005. Personal communication with M.E. McVey, ICF Consulting, February 7, 2005. (sagth@clemson.edu; 864-656-3584).

Hagstrum, J, 2000. Infrasound and the avian navigational map. J. Exp. Biology 203:1103-1111.

Lincoln, F.C., Peterson, S.R., and J.L. Zimmerman. 1998. Migration of Birds. U.S. Department of the Interior, U.S. Fish and Wildlife Service, Washington, DC. Circular 16. Jamestown, ND: Northern Prairie Wildlife Research Center Home Page. http:// www.npwrc.usgs.gov/resource/othrdata/migratio/migratio.htm (accessed on 02/04/05).

Mouritsen, H., and O.N. Larsen. 2002. Migrating songbirds tested in computer-controlled Emlen funnels use stellar cues for a time-independent compass. *J. Exp. Biol.* 204: 3855-3865.

Missile Defense Agency, 2002. GMD Validation of Operational Concept Environmental Assessment. 2002.

U.S. Army Space and Strategic Defense Command. 1993. *Final Ground-Based Radar Family of Radars Environmental Assessment*, June.

U.S. Army Space and Missile Defense Command, 2003. Ground-Based Midcourse Defense Extended Test Range Environmental Impact Statement. July.

Union of Concerned Scientists, 2004. Technical Realities: An Analysis of the 2004 Deployment of a U.S. National Missile Defense System. May.

Union of Concerned Scientists, 2001. An Assessment of the Intercept Test Program of the Ground-Based Midcourse National Missile Defense System. 2001.

Vandenberg Air Force Base, 2000. Range Instrumentation Handbook.

Wiltschko, W., and R. Wiltschko. 1996. Magnetic orientation in birds. J. Exp. Biology 199: 29-38.

APPENDIX D

Generator and Aircraft Emissions and State-specific Standards

APPENDIX D

Generator and Aircraft Emissions and State-specific Standards

D.1 Generator Emissions for Land-Based Sensors

The emissions from portable generators vary by size, operating conditions, year of manufacture, and level of use. The regulated primary pollutants from internal combustion engines are NO_X, TOC, CO, and particulates. Nitrogen oxide formation is directly related to high pressures and temperatures during the combustion process and to the nitrogen content, if any, in the fuel. The other pollutants, TOC and CO, and particulates, are primarily the result of incomplete combustion. Additives to the fuel (ash or metallic compounds) also contribute to the particulate content of the exhaust. SO_X also appear in the exhaust from internal combustion engines; however, the emissions of SO_X are directly related to the sulfur content in the fuel. (EPA, 1996)

To calculate the emissions associated with the generators that may power the mobile land-based sensors, MDA reviewed the Federal and State regulatory standards for non-road compression-ignition engines, reviewed state-specific generator permit applications and associated best available control technology (BACT), and the emissions reported by the various manufacturers. By reviewing this information, MDA was able to develop a conservative emissions value for the air quality pollutants regulated under the CAA. Exhibit A-1, lists the range of emission standards presented in the various regulations while operating at a full load. The emission factors do not account for any change during operation.

Exhibit D-1. Emission Criteria

Pollutant	Up to 600 hp Diesel Engines (g/hp/hour)	Greater than 600 hp Diesel Engines (g/hp/hour)	California BACT (g/hp/hour)	Industry* (g/hp/hour)
NO_X	14.06	5.90 to 10.89	6.9 to 10.4	8.07
CO	3.08	2.49	8.5	0.51
SO_X	0.93	3.67	0.2328	Not listed
PM_{10}	1.00	0.32	0.38 to 1.0	0.091
CO_2	521.63	526.17	Not listed	Not listed
TOC	1.12	0.32	0.3 to 1.1	0.22

Notes: * Data measurements consistent with those described in EPA CFR 40 Part 89, Subpart D and E.

The control measures associated with the best available control technology are primarily directed at limiting NO_X and CO emissions, because they are the primary pollutants of concern. (EPA, 1996) The most common NO_X control technique for diesel engines focuses on modifying the combustion process, while selective catalytic reduction and non selective catalytic reduction, which are post-combustion control techniques are becoming available. Specific combustion process techniques include injection timing retard, pre-ignition chamber combustion, air-to-fuel ratio adjustments, and derating. (EPA, 1996)

The emission factors presented in Exhibit D-1 represent a range of conservative emission estimates, which can vary permit by permit and state by state. The emission standards vary based on the particular designation of the generator. EPA classifies internal combustion diesel engines below and above 600 HP, while California classifies internal combustion diesel engines below and above 228 HP. In addition to HP classifications, emission factors specific to particular uses have been developed and include non-road, stationary, emergency, and portable internal combustion diesel engines. For example, EPA regulates the emissions under 40 CFR Part 89, of new non-road compression-ignition engines that are sold into commerce. The non-road engine is any internal combustion engine that, by itself or in or on a piece of equipment, is portable or transportable, meaning designed to be and capable of being carried or moved from one location to another.

State-Specific Requirements

The emissions associated with generators that would power the mobile sensors must be evaluated and compared to the regulations for the state in which the activity is occurring. For example, state rules could require a permit be issued or that a risk assessment be conducted. The following subsections provide more detail about each of the states where the mobile land based sensors would be used and their requirements.

California

California Air Pollution Control Laws are updated annually, and can be accessed online at http://www.arb.ca.gov/bluebook/bluebook.htm. If NO_X emissions are greater than ten pounds on the highest day measured, it is required that BACT be used. If diesel particulates (PM_{10}) reach 0.64 pounds per year, then a Toxic Risk Screening Analysis is required. (CARB Regulation 2-2-30) Additional regulations that should be taken into consideration include:

- Reg. 6 (particulate matter and visible emissions standards)
- Reg. 9-1 (Sulfur dioxide)
  - ✓ Reg. 9-1-301 (inorganic gaseous pollutants: sulfur dioxide for limitations on ground level concentrations)
  - ✓ Reg. 9-1-304 (sulfur limitations of diesel fuel)
- Reg. 9-8 (NO_X and CO from stationary internal combustion engines)
  - ✓ Reg. 9-8-110 (inorganic gaseous pollutants: nitrogen oxides from stationary gas turbines)
  - ✓ Reg. 9-8-330 (allowable operating hours and record keeping)

- Reg. 2-1-412 (project is within 1,000 feet of the nearest school – required public notice)
- Reg. 1-301 (public nuisance)

Virginia

On behalf of Virginia's Air Pollution Control Board, the Department of Environmental Quality's (DEQ) office of Air Program Coordination is responsible for carrying out the mandates of the Virginia Air Pollution Control Law. The laws are available online at http://www.deq.state.va.us/air/regulations/airregs.html. Chapter 40, Existing Stationary sources, and Chapter 80, Permits for Stationary Sources, should both be reviewed. More information about the Virginia DEQ Air Program Coordination can be accessed online at: http://www.deq.state.va.us/air/homepage.html.

Virginia evaluates all air pollution sources for permit applicability based on their potential to emit. A diesel generator could require a permit based on potential NO_X emissions. An exemption should apply if: the engines do not exceed 500 hours of operation per year at a single stationary source with diesel engines powering electrical generators having an aggregate rated electrical power output of less than 1,125 Kilowatts. Exemptions are also applicable for diesel engines with an aggregate rated brake (output) horsepower of less than 1,675 Horsepower. [9-VAC-5-80-1320, Item (B)(2)(B)] Full length text of the regulation is accessible at: http://www.deq.virginia.gov/air/pdf/airregs/806.pdf.

Even though an exemption might apply, an applicant must fill out a Form 7 for the proposed unit in order to make a determination. The form is available at: ftp://ftp.deq.virginia.gov/pub/air/permitting/form7.doc. If the area where the source will be located is in nonattainment for $PM_{2.5}$, a risk assessment would be required.

New Mexico

The New Mexico Environment Department, Air Quality Bureau is responsible for administering the New Mexico Air Quality Regulations, which are available online at: http://www.nmenv.state.nm.us/aqb/regs/index.html. The contact information for the agency is located online at: http://www.nmenv.state.nm.us/aqb/contact.html.

An applicant does not need to do anything as long as emissions are less than 10 tons per year and less than 10 pounds an hour. If emissions are more than 10 tons per year, a notice of intent is required per 20.2.73 part 200. If emissions are greater than 25 tons a year or greater than 10 pounds per hour, a permit is required per 20.2.72 part 200. There is an exemption for diesel generators if they are used for unavoidable loss of commercial power for less than 500 hours a year (20.2.72, part 202, B3).

Washington

Washington State's requirements depend on the jurisdiction. There are seven local air agencies, and the requirements would be subject to that particular region. Washington State's air quality regulations would still apply as well, and are available online at: http://www.ecy.wa.gov/laws-rules/ecywac.html.

For the purposes of this document, the area in question (Whidbey Island) would be subject to the Northwest Clean Air Agency's jurisdiction, which covers Skagit, Island, and Whatcom Counties. There is a state rule that requires permits based on heat input in millions of BTUs per hour. In this case, if the generator's input was greater than or equal to 1,000,000 BTUs per hour, then a permit would be required. This requirement, Northwest Clean Air Agency Regulation 300.4 (c)(4), does not consider the total number of hours or emissions generated in a year. Because this requirement has triggered so many permits, the Northwest Clean Air Agency and other local air agencies are referring to a Federal rule that requires a permit only if the generator is operated more than 500 hours per year. This Federal rule was used in order to "waitlist" applications. This means that an applicant can conduct its activities without a permit while it is on the waitlist.

Hawaii

The Hawaii State Department of Health's Clean Air Branch is responsible for air pollution control in the state of Hawaii. The branch enforces the Federal and state air pollution control laws and regulations. More information is available online at: http://www.hawaii.gov/health/environmental/food_drug/air/cab/index.html.

An exemption applies if emissions are less than one Ton per year for all criteria pollutants and less than 0.1 tons per year for Hazardous Air Pollutants. This requirement falls under non-covered sources of Hawaii Administrative Rule Ch. 4, Section 11-60.1-62(d). Although an exemption probably applies, an applicant may consult directly with the Clean Air Branch to receive an official determination. More information on Hawaii's Administrative Rules is available at: http://www.hawaii.gov/health/about/rules/11-60-1.pdf

Alaska

Air quality is regulated by the Alaska Department of Environmental Conservation (DEC) Division of Air Quality. Alaska's Administrative Code (AAC) regulates air quality, and more information is is available online at: http://www.state.ak.us/dec/air/ap/regulati.htm. Contacts within the Division of Air Quality can be located online at: http://www.state.ak.us/dec/air/ap/mainair.htm.

Applications for using diesel generators are approved on a case-by-case basis. An applicant must fill out an application that will provide a pre-approved emission limit per 18 AAC 50.230(c). If the source will remain stationary, a pre-approved emission limit can be obtained with no additional department approval or permitting necessary. However, an applicant should confer with the DEC in any case.
http://www.state.ak.us/dec/air/ap/docs/palgen.pdf;
http://www.state.ak.us/dec/regulations/pdfs/50mas.pdf

Exhibit D-2, Summary of State Regulations, presents a summary of the state specific regulations.

Exhibit D-2. Summary of State Regulations

State	Threshold	Regulation	Contact
California	NO_X emissions >10 pounds/highest day triggers BACT; diesel particulates (PM_{10}) 0.64 pounds/year requires Toxic Risk Screening Analysis	Regulation 2-2-30; http://www.arb.ca.gov/bluebook/bluebook.htm	California Air Resources Board
Virginia	An exemption applies if engines do not exceed 500 hours of operation per year at a single stationary source as follows: diesel engines powering electrical generators having an aggregate rated power output of less than 1,125 kilowatts. However, it is necessary to fill out a Form 7 for a proposed unit.	9-VAC-5-80-1320, Item (B)(2)(b) available at: http://www.deq.virginia.gov/air/pdf/airregs/806.pdf Form 7 available at: ftp://ftp.deq.virginia.gov/pub/air/permitting/form7.doc	Virginia Department of Environmental Quality Air Program Coordination (http://www.deq.state.va.us/air/homepage.html)
New Mexico	No requirements if emissions are <10 tons/year and <10 pounds/hour. If emissions are >10 tons/year, a notice of intent is required. If	20.2.73 part 200; 20.2.72 part 200 (http://www.nmenv.state.nm.us/aqb/regs/index.html)	New Mexico Environment Department, Air Quality Bureau (http://www.nmenv.state.nm.us/aqb/contact.htm

State	Threshold	Regulation	Contact
	emissions are >25 tons/year or >10 pounds/hour, a permit is required.		1)
Washington	If input is greater than or equal to 1,000,000 BTUs/hour, then a permit is required. All generators operating less than 500 hours/year are being waitlisted, where operations may proceed without a permit.	Northwest Clean Air Agency Regulation 300.4 (c)(4) (http://www.ecy.wa.gov/laws-rules/ecywac.html)	Northwest Clean Air Agency[6]
Hawaii	No permit is needed if emissions are <1 ton/year for all criteria pollutants and <0.1 tons/year for hazardous air pollutants. If exempt, not required to consult with agency.	Non-covered sources, Ch. 4, 11-60.1-62 (d)(1) (http://www.hawaii.gov/health/about/rules/11-60-1.pdf)	Hawaii State Department of Health Clean Air Branch
Alaska	All diesel generators are approved on a case-by-case basis, by filling out an application for a pre-approved emission limit.	18 Alaska Administrative Code 50.230(c)	Alaska Department of Environmental Conservation, Division of Air Quality

D.2 Air Emissions Calculations for Airborne Sensors

This section includes the calculations and assumptions used to calculate impacts from air emissions produced by the Gulfstream IIB and DC-10 aircraft used to support airborne sensor systems.

Gulfstream IIB

The time in mode and fuel flow per minute for the Gulfstream IIB was determined as shown in Exhibit D-3. The modes considered for this analysis are only those that occur

[6] This is one of seven local air agencies in the state of Washington, and it covers Skagit, Island and Whatcom Counties. This area is where Whidbey Island is located.

below 914 meters (3,000 feet) which includes activities that produce emissions that would impact ground level air quality.

Exhibit D-3. Time in Mode for Gulfstream IIB

Mode	Time in Mode in minutes	Fuel Flow in pounds per minute
Idle[1]	13	16.8
Takeoff	0.4	117.86
Climb out	0.5	96.03
Approach	1.6	36.77

[1] For this analysis, idle includes both idle in and idle out. Time in mode for both idle in and out was determined to be 6.5 minutes.
Source: http://www.epa.gov/otaq/inventory/r92009.pdf, Table 5-1

Using the fuel flow per minute and the time in mode it was possible to determine the emissions in each mode per engine. Exhibit D-4 shows the emission calculations.

Exhibit D-4. Emissions per Engine

Emissions		Takeoff	Climb out	Approach	Idle
Emissions (pound/1,000 pounds fuel)	HC	0.09	0.12	0.18	3.69
	CO	0.12	0.63	2.65	31.77
	NO_X	22.7	17.3	7.2	3.6
	SO_2	0.54	0.54	0.54	0.54
Emissions (pounds per minute)	HC	0.0106074	0.0115236	0.0066186	0.061992
	CO	0.0141432	0.0604989	0.0974405	0.533736
	NO_X	2.675422	1.661319	0.264744	0.06048
	SO_2	0.0636444	0.0518562	0.0198558	0.009072
Emissions (grams)	HC	2	3	5	366
	CO	3	14	71	3,147
	NO_X	458	377	192	357
	SO_2	12	12	14	53

Source: http://www.epa.gov/otaq/inventory/r92009.pdf, Table 5-4

The Gulfstream IIB uses two Rolls Royce Spey MK511-8 engines. The total emissions from the Gulfstream IIB including both engines is as presented in Exhibit D-5.

Exhibit D-5. Total Emissions from the Gulfstream IIB

	HC	CO	NO_X	SO_2
Emissions in grams	750	6,468	2,822	182
Emissions in kilograms	0.7	6.5	2.8	0.2

DC-10

The time in mode and fuel flow per minute for the DC-10 was determined as shown in Exhibit D-6. The modes considered for this analysis are only those that occur below 914 meters (3,000 feet) which includes activities that produce emissions that would impact ground level air quality.

Exhibit D-6. Time in Mode for DC-10

Mode	Time in Mode in minutes	Fuel Flow in pounds per minute
Idle[1]	26	31.35
Takeoff	0.7	323
Climb out	2.2	264.5
Approach	4	90

[1] For this analysis, idle includes both idle in and idle out. Time in mode for idle in is 19 minutes and for idle out is 7 minutes.

Source: http://www.epa.gov/otaq/inventory/r92009.pdf, Table 5-1

Using the fuel flow per minute and the time in mode it was possible to determine the emissions in each mode per engine. Exhibit D-7 shows the emission calculations.

Exhibit D-7. Emissions per Engine

Emissions		Takeoff	Climb out	Approach	Idle
Emissions (pound/1,000 pounds fuel)	HC	0.2	0. 2	0.3	12
	CO	0.2	0.2	1.7	53
	NO_X	31.6	25.6	7.8	3
	SO_2	0.54	0.54	0.54	0.54
Emissions (pounds per minute)	HC	0.0646	0.0529	0.027	0.3762
	CO	0.0646	0.0529	0.153	1.66155
	NO_X	10.2068	6.7712	0.702	0.09405
	SO_2	0.17442	0.14293	0.0486	0.016929
Emissions (grams)	HC	21	53	49	4,437
	CO	21	53	278	19,595
	NO_X	3,241	6,757	1,274	1,109
	SO_2	55	143	88	200

Source: http://www.epa.gov/otaq/inventory/r92009.pdf, Table 5-4

The DC-10 uses three Pratt and Whitney JT9D-59A engines. The total emissions from the DC-10 including all three engines are as presented in Exhibit D-8.

Exhibit D-8. Total Emissions from the DC-10

	HC	CO	NO_X	SO_2
Emissions in grams	13,677	59,838	37,143	1,458
Emissions in kilograms	13.7	59.8	37.1	1.5

C-130

The time in mode and fuel flow per minute for the C-130 was determined as shown in Exhibit D-9. The modes considered for this analysis are only those that occur below 914 meters (3,000 feet) which includes activities that produce emissions that would impact ground level air quality.

Exhibit D-9. Time in Mode for C-130

Mode	Time in Mode in minutes	Fuel Flow in pounds per minute
Idle[1]	15.9	9.98
Takeoff	0.4	36.98
Climb out	1.2	36.98
Approach	5.1	33.27

[1] For this analysis, idle includes both idle in and idle out. Time in mode for idle in is 6.7 minutes and for idle out is 9.2 minutes.
Source: http://www.epa.gov/otaq/inventory/r92009.pdf, Table 5-1

Using the fuel flow per minute and the time in mode it was possible to determine the emissions in each mode per engine. Exhibit D-10 shows the emission calculations.

Exhibit D-10. Emissions per Engine

Emissions		Takeoff	Climb out	Approach	Idle
Emissions (pound/1,000 pounds fuel)	HC	0.16	0.16	0.17	27.32
	CO	0.65	0.65	0.42	30.11
	NO_X	10.45	10.45	9.93	3.53
	SO_2	0.54	0.54	0.54	0.54
Emissions (pounds per minute)	HC	0.005917	0.005917	0.005656	0.272654
	CO	0.024037	0.024037	0.013973	0.300498
	NO_X	0.386441	0.386441	0.330371	0.035229
	SO_2	0.019969	0.019969	0.017966	0.005389
Emissions (grams)	HC	1	3	13	1,966
	CO	4	13	32	2,167
	NO_X	70	210	764	254
	SO_2	4	11	42	39

Source: http://www.epa.gov/otaq/inventory/r92009.pdf, Table 5-7

The C-130 uses four Rolls Royce T56-A-16 engines. The total emissions from the C-130 including all four engines are presented in Exhibit D-11.

Exhibit D-11. Total Emissions from the C-130

	HC	CO	NO_X	SO_2
Emissions in grams	7,936	8,868	5,196	380
Emissions in kilograms	7.9	8.9	5.2	0.4

C-5

The time in mode and fuel flow per minute for the C-5 was determined as shown in Exhibit D-12. The modes considered for this analysis are only those that occur below 914 meters (3,000 feet) which includes activities that produce emissions that would impact ground level air quality.

Exhibit D-12. Time in Mode for C-5

Mode	Time in Mode in minutes	Fuel Flow in pounds per minute
Idle[1]	15.9	22.24
Takeoff	0.4	321.17
Climb out	1.2	254.63
Approach	5.1	87.86

[1] For this analysis, idle includes both idle in and idle out. Time in mode for idle in is 6.7 minutes and for idle out is 9.2 minutes.
Source: http://www.epa.gov/otaq/inventory/r92009.pdf, Table 5-1

Using the fuel flow per minute and the time in mode it was possible to determine the emissions in each mode per engine. Exhibit D-13 shows the emission calculations.

Exhibit D-13. Emissions per Engine for the C-5

Emissions		Takeoff	Climb out	Approach	Idle
Emissions (pound/1,000 pounds fuel)	HC	0.6	0.7	1	49.3
	CO	0.5	0.5	5.7	81.3
	NO_X	36.5	29.6	9.7	2.4
	SO_2	0.54	0.54	0.54	0.54
Emissions (pounds per minute)	HC	0.192702	0.178241	0.08786	1.096432
	CO	0.160585	0.127315	0.500802	1.808112
	NO_X	11.72271	7.537048	0.852242	0.053376
	SO_2	0.173422	0.1375	0.047444	0.01201
Emissions (grams)	HC	35	97	203	7,908
	CO	29	69	1,159	13,040
	NO_X	2,127	4,102	1,972	385
	SO_2	31	75	110	87

Source: http://www.epa.gov/otaq/inventory/r92009.pdf, Table 5-7

The C-5 uses four General Electric CF6 engines. The total emissions from the C-5 including all four engines are presented in Exhibit D-14.

Exhibit D-14. Total Emissions from the C-5

	HC	CO	NO_X	SO_2
Emissions in grams	32,972	57,188	34,344	1,212
Emissions in kilograms	33.0	57.2	34.3	1.2

D.3 References

California Air Resources Board (CARB). 2005. BACT Clearinghouse Database. I.C. Engines – Compression Ignition, Non-Emergency => 228 hp; I.C. Engines – Compression Ignition, Non-Emergency < 228 hp; I.C. Engines – Compression Ignition, Emergency; and I.C. Engines – Compression Ignition, Portable. http://www.arb.ca.gov/bact/bact.htm

Caterpillar Diesel Generator Set (1,000 kW). 2002. Specifications Sheet. April 4.

U.S. Environmental Protection Agency (USEPA). 1996. AP 42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources, Sections 3.3 Gasoline and Diesel Industrial Engines, October 1996, and Large Stationary Diesel and All Stationary Dual-fuel Engines, October.

U.S. EPA's Office of Transportation and Air Quality (OTAQ). 2005. ICAO Aircraft Engine Emissions Databank. http://www.epa.gov/otaq/aviation.htm