Final Environmental Assessment for

Deployment of Chaff and Flares in Military Operations Areas (Phase I)

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Air National Guard

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August 2002

Contents

Appendixes

Tables

Figures

Acronyms and Abbreviations

ACHP	Advisory Council on Historic Preservation
ACS	Aircraft Control Squadron
AFI	Air Force Instruction
AFFSA	Air Force Flight Standards Agency
AFR	Air Force Regulation
AGL	above ground level
ANG	Air National Guard
AR	Air Refueling Track
ATCAA	Air Traffic Control Assigned Airspace
BIA	Bureau of Indian Affairs
BNI	But Not Including
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CRTC	Combat Readiness Training Center
CWA	Clean Water Act
DOD	Department of Defense
DOI	Department of the Interior
DOPAA	Description of Proposed Actions and Alternatives
EA	Environmental Assessment
EIAP	Environmental Impact Analysis Process
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FCC	Fire Condition Code (or Fire Control Code)

FL	Flight Level
FONSI	Finding of No Significant Impact
FW	Fighter Wing
IFR	instrument flight rules
IICEP	Interagency and Intergovernmental Coordination for Environmental Planning
MOAs	military operations areas
MSL	mean sea level
MTRs	military training routes
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NGB	National Guard Bureau
NHPA	National Historic Preservation Act of 1966
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NRHP	National Register of Historic Places
NWR	National Wildlife Refuge
PL	Public Law
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
ROI	region of influence
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SUA	Special use airspace
THPO	Tribal Historic Preservation Officer
USAF	United States Air Force
USFWS	U.S. Fish and Wildlife Service
VFR	visual flight rules

1 Purpose, Need, and Scope

1.1 Introduction

The National Guard Bureau (NGB), on behalf of the Air National Guard (ANG) units identified in this document, has prepared this *Environmental Assessment (EA) for Deployment of Chaff and Flares (Phase I)*, in accordance with the National Environmental Policy Act (NEPA), its implementing regulations, and related Air Force directives. The purpose of this EA is to discuss and analyze issues, impacts, and any relevant mitigation measures resulting from either the continued use of chaff and flares in select ANG military operations areas (MOAs), or the introduced use of chaff and flares into select ANG MOAs that currently do not use them.

If the analyses presented in this EA indicate that the proposed action will not result in significant environmental impacts, then a Finding of No Significant Impact will be issued. If significant environmental impacts that cannot be avoided or mitigated to insignificant levels will result, then an Environmental Impact Statement will be required.

The ANG and other Department of Defense (DoD) components have been deploying chaff since as early as the late 1940s or 1950s as part of their training for combat readiness. This activity has been most prevalent with bomber type aircraft; however, all fighter type aircraft and some airlift type aircraft also deploy chaff as part of their training.

In the early 1990s, the US Air Force (USAF) alerted their various commands, through message traffic, that they considered the deployment of chaff an issue that may require environmental analysis or study. The USAF allowed each command to propose and implement their own policy on this issue. The ANG policy was to allow the use of chaff and flares to continue in military training airspace; however, environmental documentation would be required for new military training airspace or existing airspace that proposed this usage as a new action. Some units elected to suspend their use of chaff, pending environmental analysis.

In the interim, to ensure appropriate scientific inquiry was conducted, the USAF Air Combat Command (ACC), commissioned a scientific study on the effects of chaff and flares deployment. This study was an effort to build upon existing studies conducted in the 1970s and 1980s. The results of this study, a subsequent study commissioned by the U.S. Navy Research Laboratory (USNRL) and conducted by an independent select panel of experts, and a 1998 report by the General Accounting Office (GAO), formed the basis for the analysis performed in this EA.

It was recommended that each using agency consider the use of a public input process to ensure further peer review of the technical studies and to identify any additional impacts or issues that may be pertinent to the deployment of chaff and flares. The ANG chose to employ the Environmental Impact Analysis Process (EIAP) as outlined in Air Force Instruction (AFI) 32-7061 (32 CFR Part 989), not only for areas proposing to deploy chaff and flares as a new action, but also for some areas where deployment is already occurring, to allow coordination with environmental resource agencies and to ensure no unique set of site-specific conditions that were not covered in the technical documents were resulting in environmental impact. This EA is the first of two programmatic-level documents covering use of chaff and flares in numerous MOAs in the United States.

1.2 Purpose and Need for the Proposed Action

Combat-effective chaff and flare deployment requires training and frequent use by aircrews in order to both master the devices' capabilities and ensure safe and efficient handling by ground crews. The ANG needs to conduct training operations using chaff and flares, in order to provide aircrews with the skills needed to meet and defeat potential hostile challenges to the nation's security and vital interests.

Training is conducted through simulated battle conditions within Department of Defense (DOD) weapons ranges, electronic combat ranges, and other airspace areas, such as MOAs and military training routes (MTRs) that have been assessed and approved for chaff or flare use. Chaff and flares also are used in field exercises. The training resources represented by the use of chaff and flares must be available to support development and implementation of the tactics necessary to prevail in potential crisis situations.

1.3 Proposed Action

The ANG proposes to either continue, reintroduce, or introduce the use of chaff and/or flares in the course of training flight operations, by ANG and other units, in 15 MOAs that are managed by 8 ANG units throughout the United States. This proposed action is described briefly in the following subsections and in more detail in Section 2 ("Description of the Proposed Action").

1.3.1 Chaff and Flares

Chaff has been used by DOD for over 50 years, both in combat and in training and testing. Chaff consists of small, extremely fine fibers of aluminum or, since the 1980s, aluminum-coated glass. These fibers disperse widely in the air when ejected from the aircraft, forming the electromagnetic equivalent of a visual smoke screen to temporarily hide the aircraft from radar. It also decoys radar, allowing aircraft to maneuver or egress from the area. In the air, the initial burst from a chaff bundle forms a sphere that shows up on radar screens as an electronic cloud. The aircraft is obscured by the cloud, which confuses enemy radar. Because chaff can obstruct radar, its use is coordinated with the Federal Aviation Administration (FAA).

Self-protection flares are magnesium pellets that, when ignited, burn for a short period of time (less than 10 seconds) at 2,000 degrees Fahrenheit. The burn temperature is hotter than the exhaust of an aircraft and therefore attracts and decoys heat-seeking weapons targeted on the aircraft.

1.3.2 Military Operations Areas

1.3.2.1 Locations of MOAs

Table 1-1 and Figure 1-1 identify and show the locations of the 15 MOAs (and associated airspace) for which the proposed use of chaff and flares in training by ANG units will be evaluated in this EA. In two of these MOAs (Volk and Falls), flares are currently used in ongoing training exercises, but chaff usage was suspended in the 1990s and is proposed to resume after EIAP is complete. One of these MOAs (Dolphin) was recently changed from an air refueling range, where training exercises did not occur, to a MOA. Use of chaff and/or flares has been and is ongoing in the other MOAs. Further descriptions of these MOAs are provided in Section 2.

TABLE 1-1
Military Operations Areas to be Evaluated in this EA

ANG Unit	Name of MOA(s)	State(s)
173 FW (Kingsley, OR)	Goose MOA (expanded)[1]	OR, CA
	Hart MOA	OR, CA, NV
	Juniper Low North/South MOA	OR
	Dolphin North/South (new)[1]	OR, CA
133 ACS (Fort Dodge, IA)	Crypt North/Central/South MOA	IA
114 FW (Sioux Falls, SD)	Lake Andes MOA	SD, NE
148 FW (Duluth, MN)	Beaver MOA	MN
	Snoopy East/West MOA	MN
Alpena CRTC (MI)	Steelhead MOA	MI
	Pike East/West MOA	MI
Volk Field CRTC (WI)	Volk East/West/South MOA	WI
	Falls 1 and 2 MOA	WI
138 FW (Tulsa, OK)	Rivers MOA	OK
188 FW (Fort Smith, AR)	Hog Low/High North/South MOA	AR, OK
	Shirley MOA	AR

1. The Dolphin MOA was previously an air refueling range. The boundaries of Goose MOA were recently expanded southward. These airspace changes were submitted to the FAA for approval in 2000 and became effective in April 2002. They are included so that this EA can address all potential areas of impact from chaff and flares associated with the above-listed units. Any other issues related to this airspace change are evaluated in separate documentation.

Acronyms:

ACS = Aircraft Control Squadron
FW = Fighter Wing
CRTC = Combat Readiness Training Center

Representatives of the ANG units or Fighter Wings that are responsible for these MOAs and associated airspace were interviewed, to obtain information about the types and quantities of chaff bundles and self-protection flares that are used or proposed to be used annually, and to identify where these countermeasures are employed. This information is summarized in Section 2.

1.3.2.2 Definitions of Military Airspace Terms

Special use airspace (SUA) refers to airspace of defined vertical and lateral dimensions, within which activities must be confined. Most training missions are flown in SUA. These areas were designed to provide safe operating distances from commercial air routes and airports. A MOA is one type of SUA that is defined in FAA orders as being designated for nonhazardous military activity, established outside Class A airspace (below 18,000 feet) and within U.S. territorial airspace. MOAs may lie over large areas of land that are not owned or controlled by DOD. MOAs are shown on aeronautical charts.

Activities conducted in MOAs include, but are not limited to, aerobatics, air combat tactics, intercepts, and formation training. Designation of this airspace serves to segregate nonparticipating instrument flight rules (IFR) aircraft from such activities and to inform nonparticipating visual flight rules (VFR) aircraft where these activities are being conducted. VFR aircraft are not restricted from flying through MOAs.

Air Traffic Control Assigned Airspace (ATCAA) is defined airspace that is normally established inside Class A airspace (above 18,00 feet) by a letter of agreement with the air traffic control facility responsible for the airspace. Unlike MOAs, most ATCAAs are within positive control airspace. ATCAAs are not shown on aeronautical charts. Nonparticipating aircraft are separated from the military activity being conducted within the ATCAA by air traffic control. In most cases, ATCAAs are located directly above the associated MOAs.

Restricted areas, where restrictions are placed on all nonparticipating aircraft, are used to contain military activities that are hazardous to nonparticipating aircraft. “Hazardous” implies, but is not limited to, live firing of weapons or aircraft testing. Restricted areas are established by the FAA and are shown on aeronautical charts.

1.4 Scope

This EA documents and analyzes the potential environmental and socioeconomic effects that are associated with the proposed action and alternatives, as described in this document. The affected areas evaluated by this Phase I EA are the MOAs identified in Table 1-1 and surrounding areas, as described in Section 2.

Additional EAs will be prepared for specific MOAs (in different regions of the US), for which chaff and flare data were not available at the time this EA was prepared.

An interdisciplinary team of environmentalists, biologists, planners, economists, engineers, scientists, and military experts has analyzed the proposed action and alternatives against existing conditions in the affected areas and has identified the potential beneficial and adverse effects associated with the proposed action.

MOAs

1 JUNIPER NORTH MOA, OR
2 JUNIPER LOW MOA, OR
3 JUNIPER SOUTH MOA, OR
4 HART NORTH MOA, OR
5 HART SOUTH MOA, OR
6 GOOSE NORTH MOA, OR (proposed change)
7 GOOSE SOUTH MOA, OR (proposed change)
8 DOLPHIN NORTH MOA, OR (proposed new)
9 DOLPHIN SOUTH MOA, CA (proposed new)
10 LAKE ANDES MOA, SD
11 CRYPT NORTH MOA, IA
12 CRYPT CENTRAL MOA, IA
13 CRYPT SOUTH MOA, IA
14 BEAVER MOA, MN
15 SNOOPY WEST MOA, MN
16 SNOOPY EAST MOA, MN
17 FALLS 1 MOA, WI
18 FALLS 2 MOA, WI
19 VOLK WEST MOA, WI
20 VOLK FIELD, WI (R6904A)
21 VOLK FIELD, WI (R6904B)
22 VOLK SOUTH MOA, WI
23 VOLK EAST MOA, WI
24 MINNOW MOA, WI
25 PIKE WEST MOA, MI
26 PIKE EAST MOA, MI
27 STEELHEAD MOA, MI
28 RIVERS MOA, OK
29 HOG NORTH (HIGH/LOW) MOA, AR
30 HOG HIGH SOUTH MOA, AR
31 HOG LOW SOUTH MOA, AR
32 SHIRLEY MOA, AR

MOA Boundaries
FAA Regional Boundaries
Contiguous United States

Scale: 1 in = 275 mi

150 0 150 300 450 600 Miles

Figure 1-1:
MOAs AND FAA REGIONS

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Separate NEPA documentation has addressed the effects of the ANG's training flights, other than the use of chaff and flares, and the effects of ground operations at the supporting airfield facilities from which the flights originate; therefore, these actions are not further evaluated in this EA.

1.5 Regulatory Requirements

Regulations governing chaff and flare use are based primarily on safety and environmental considerations and limitations. General baseline guidance and restrictions have been established at the Air Force or Major Command level, and units have supplemented these procedures as necessary for their particular MOAs or other training locations. General procedures are described below; specific procedures for individual training areas may also be available.

1.5.1 General

Federal Aviation Regulation (FAR) Part 91.15 prohibits pilots of civil aircraft from allowing any object to be dropped from the aircraft in flight that creates a hazard to persons or property. AFI 11-206, *General Flight Rules* (July 1994), is the Air Force counterpart restriction. It prohibits Air Force pilots from allowing any object to be dropped from an aircraft, except in emergency, without approval. The Air Force approving agency must ensure that any object dropped does not create a hazard to persons, property, or other air traffic.

AFI 13-201, *U.S. Air Force Airspace Management* (July 1994), provides guidance for developing special use airspace and establishes practices to decrease disturbances from flight operations that might cause adverse public reaction. It emphasizes the Air Force's responsibility to ensure that the public is protected, to the maximum extent practicable, from the hazards and effects associated with flight operations. AFI 11-214, *Aircrew and Weapons Director and Terminal Attack Controller Procedures for Air Operations* (July 1994), delineates procedures for chaff, flare, and smoky devil employment. It prohibits arming of dispensing systems with intent to dispense, unless in an approved area.

Individual AFIs that implement training requirements for specific aircraft (for example, AFI-11-2F-15, *F-15, Aircrew Training* (February 2000) specify what pilot training programs should include, to ensure safe operation of aircraft and the capabilities needed to accomplish the unit's mission. Demonstration of chaff/flares use is among the skills required. For example, "Chaff event: inflight dispensing of chaff during a tactical mission profile in response to an actual or simulated threat. Event requires actual release and is limited to logging of one event per engagement."

1.5.2 Chaff

Current USAF policy on the use of chaff and flares was established by the Airspace Subgroup of HQ Air Force Flight Standards Agency (AFFSA) in 1993. It requires units to obtain a frequency clearance from the USAF Frequency Management Center and HQ FAA prior to using chaff, to ensure training with chaff is conducted on a basis of noninterference with civilian radar. This requirement ensures electromagnetic compatibility between the FAA, the Federal Communications Commission, and DOD agencies. USAF does not place any restrictions on use of chaff, provided those conditions are met.

In October 1998, DOD updated certain controls over the use of chaff in Section 3212.02 of the Chairman of the Joint Chiefs of Staff manual (*Performing Electronic Attack in the United States and Canada for Tests, Training, and Exercises,* CJCSM 3212.02, October 1998). This section sets procedures for controlling the types of chaff used, areas where it can be used, and altitudes at which it can be released (GAO, 1998).

1.5.3 Flares

Current USAF policy on flare use (as reflected in the AFFSA memorandum of 28 June 1993) permits flare drops over military owned/controlled land and in Water Warning Areas. Flare drops are permitted in MOAs and MTRs when environmental analysis has been completed. Minimum altitudes for the release of flares must be observed by all aircraft employing them.

AFI 11-214, *Aircrew, Weapon Director, and Terminal Attack Controller Procedures for Air Operations* (February 1997), in addition to prohibiting the arming of flare systems except in approved areas with intent to dispense, sets certain conditions for the deployment of flares and smoky devils. Flares are authorized over government-owned and -controlled property as well as over Water Warning Areas with no minimum altitude restrictions when there is no fire hazard. If a fire hazard exists, minimum altitudes will be maintained in accordance with the applicable directive or range order.

AFI 13-212, *Weapons Ranges* (July 1994), states that use of flares will be suspended when warranted by the fire condition code (FCC). FCC is a rating system, typically using a high-medium-low (red-yellow-green) scale, that is used by natural resource and forest managers on Air Force installations to gauge the likelihood of wildfires. The system is based on fire weather index systems originally developed by the U.S. Forestry Service (USFS) and is used to determine when incendiary activities may occur. AFI 13-212 advises airspace managers to consult local authorities and federal agencies, such as the USFS, to develop a local FCC.

1.6 Environmental Requirements

1.6.1 National Environmental Policy Act

In accordance with NEPA, federal agencies are required to take into consideration potential environmental consequences of proposed actions in their decision-making process. The intent of NEPA is to protect, restore, or enhance the environment through well-informed federal decisions. The Council on Environmental Quality (CEQ) was established under NEPA to implement and oversee federal policy in this process. The CEQ subsequently issued the *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act* (40 CFR 1500-1508). These regulations specify that an EA should be prepared to:

- Briefly provide sufficient analysis and evidence for determining whether to prepare an Environmental Impact Statement (EIS) or a Finding of No Significant Impact (FONSI);
- Aid in an agency’s compliance with NEPA when no EIS is necessary; and
- Facilitate preparation of an EIS when one is necessary.

Specific guidance for the Air Force and ANG Environmental Impact Analysis Process (EIAP) is provided by AFI 32-7061, *Environmental Impact Analysis Process*, which was published as a final rule (32 CFR 989) on July 15, 1999.

To comply with NEPA and other pertinent environmental requirements and to assess the impacts on the environment, the decision-making process includes a study of environmental issues related to the use of chaff and flares in ANG-managed MOAs.

1.6.2 Interagency and Intergovernmental Coordination for Environmental Planning

NEPA and its implementing regulations help to ensure that environmental information is made available to the public during the decision-making process. The premise of NEPA is that the quality of decisions made by federal agencies will be enhanced by providing information to the public and involving the public in the decision-making process. The CEQ's regulations implementing NEPA require an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action, which is referred to as scoping.

NEPA regulations also require federal agencies to conduct intergovernmental agency notification before making any detailed statement of environmental impacts. Through the Interagency and Intergovernmental Coordination for Environmental Planning (IICEP) process (Executive Order 12372 and AFI 32-7061), the ANG notifies relevant federal, state, and local agencies and allows them sufficient time to make known their environmental concerns specific to a proposed action. IICEP also provides the ANG an opportunity to cooperate with and consider the views of state and local agencies when planning and implementing a proposed action.

The ANG provided a *Description of Proposed Action and Alternatives (DOPAA)* document to the federal, state, and tribal agencies and individuals listed on the "IICEP Distribution List" in Appendix A, for a 60-day scoping comment period. A copy of the IICEP letter and the responses received are included in Appendix A. Additional copies of the DOPAA were provided to several agencies and individuals upon request. Comments and concerns submitted by the agencies and individuals who responded were incorporated into the analysis of potential environmental impacts in the Draft Final EA.

In October 2001, a Draft FONSI was mailed to the IICEP distribution list, a Notice of Availability (NOA) was published in a local newspaper by each of the ANG units that schedule the MOAs evaluated in this EA, and a copy of the Draft Final EA was placed in local libraries in those areas (specified in the NOAs and FONSI cover letters). Additional copies of the Draft Final EA were provided to several agencies and individuals upon request. Comments and concerns submitted by the agencies and individuals who responded have been incorporated, as appropriate, into this Final EA and a final FONSI. Appendix A contains a summary of comments and responses.

1.6.3 Other Environmental Statutes and Executive Orders

Some of the other environmental requirements that may apply to the proposed action are summarized below.

1.6.3.1 Clean Air Act

Under the Clean Air Act (CAA), the U.S. Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS). NAAQS are time-averaged concentrations of criteria pollutants that may not be exceeded in the ambient air more than a specified number of times. NAAQS are to be achieved through state implementation plans (SIPs), which provide limitations, schedules, and timetables for compliance with NAAQS. The General Conformity Rule, 40 CFR 93, which implements Section 176(c) of the CAA, requires that all applicable non-exempt federal actions be assessed for their conformity to applicable SIPs.

1.6.3.2 Clean Water Act

The Clean Water Act (CWA), which seeks to restore and maintain the chemical, physical, and biological integrity of the nation's waters, identifies certain pollutants and sets required treatment levels for those pollutants. Section 404 of the CWA establishes the national regulation and protection of wetlands. Freshwater wetland permits are required for any discharge of dredged or fill material into waters of the United States. Waters of the United States are defined as including wetlands as delineated by the U.S. Army Corps of Engineers definitions. State regulations for managing and protecting freshwater wetlands also are authorized and required under the CWA.

1.6.3.3 Endangered Species Act

Under the Endangered Species Act, federal agencies are required to conserve and protect species that have been listed as endangered or threatened. All federal agencies must consult with the USFWS to ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any endangered or threatened species, or to result in destruction or adverse modification of its critical habitat.

1.6.3.4 National Historic Preservation Act

The National Historic Preservation Act (NHPA) of 1966, as amended, requires federal agencies to consider the effects of any action on historic resources. The NHPA and regulations implementing Section 106 (36 CFR Part 800) also provide the means for determining the effect a particular undertaking or action might have on historic resources. Coordination with State Historic Preservation Officers (SHPOs), Tribal Historic Preservation Officers (THPOs), and, as necessary, with the Advisory Council on Historic Preservation (ACHP) helps to fulfill the purposes of the NHPA.

New regulations implementing the 1992 amendments to the NHPA, published in the *Federal Register* on May 18, 1999, allow federal agencies to use the process and documentation required under NEPA to comply with Section 106, in lieu of separate procedures, if the ACHP and interested SHPO/THPOs are notified in advance and if other standards are met.

1.6.3.5 Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) provides the basis for EPA to define hazardous wastes and to regulate their generation, treatment, storage, transportation, and disposal. EPA also establishes technical and performance requirements for hazardous waste management units and exercises responsibility over a permit system for hazardous waste management facilities. RCRA also is the source for regulations pertaining to solid waste management and underground storage tank management.

1.6.3.6 Executive Orders

The following executive orders address topics that may be relevant to the proposed action and alternatives:

- *Executive Order 12088*, "Federal Compliance with Pollution Control Standards" (October 13, 1978), provides that federal agencies are to comply with all federal, state, and local environmental requirements.
- *Executive Order 12898*, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations" (February 11, 1994), requires that federal agencies to conduct their programs, policies, and activities that could substantially affect human health or the environment in a manner that does not subject persons (including populations) to discrimination under such programs, policies, and activities, because of their race, color, or national origin. Specific guidance for the USAF and ANG is provided by the *Guide for Environmental Justice Analysis with the EIAP (*Department of the Air Force, November 1997).
- *Executive Order 13045*, "Protection of Children from Environmental Health Risks and Safety Risks" (April 21, 1997), recognizes that a growing body of scientific knowledge demonstrates that children may suffer disproportionately from environmental health and safety risks. The executive order requires federal agencies, to the extent permitted by law and mission, to identify and assess such risks and to ensure that their programs, policies, and activities address any disproportionate risks to children that may result from environmental health or safety risks.

2 Description of Proposed Action and Alternatives

The proposed action evaluated by this EA is to either continue, reintroduce, or introduce the use of chaff and/or flares in the course of training flight operations, by ANG and other units, in the specific MOAs described in the following subsections.

2.1 Current Operations

2.1.1 Altitudes and Maneuvers

Fighter and bomber units use chaff and flares over a wide range of altitudes and flight maneuvers or tactics. Deployment of chaff and flares does not interfere with the flight characteristics of the dispensing aircraft. Fighters drop chaff or flares at any approved altitudes during flight maneuvers. Although less maneuverable than fighters, bombers can drop chaff or flares at any approved altitudes while in a turn, climb, or descent. Specific descriptions of how chaff or flares are actually employed in training for a combat situation are not releasable.

During peacetime operations, the particular altitude profile typically flown by each fighter or bomber unit is generally dependent on the parameters of the range or airspace to be used. Fighter Intercept Exercises and Red Flag and Warfighter exercises are normally when chaff and flares are used. Altitude blocks for fighter and bomber type aircraft are similar. Typical altitudes and airspeeds are:

- Low Altitude – surface to 5,000 feet above ground level (AGL), 500 to 600 knots for fighter aircraft and 200 to 400 knots for B-52 and A-10 aircraft.
- Medium Altitude – 5,000 feet AGL to 15,000/25,000 feet mean sea level (MSL), subsonic airspeeds 0.8 to 0.9 mach.
- High Altitude – 15,000/25,000 feet MSL to aircraft service ceiling, at or near 0.8 to 2.0 mach.

Table 2-1 presents the altitude boundaries of the MOAs evaluated in this EA.

Fighter aircraft flight profiles are more diverse in vertical movement than bomber profiles, due to their low altitude air-to-ground and higher air-to-air roles. Fighter-type aircraft may ingress to a low-level target to establish their climb angle, climb to acquire the target, release the weapon, execute a hard turn while descending, with multiple hard turns to exit the target area. Chaff and/or flares are generally released as the initial climb is established, just prior to weapon release, after weapon release, and as the hard turns are executed.

High-altitude ingress to a target area may require a "combat descent" to the target area; chaff and/or flares may be used in the descent. Depending on the aircraft involved, the descent may be accomplished at 30 to 60 degrees or near vertical angle, at airspeeds ranging from

500 to 600 knots. Air-to-air attacks occur from low to high altitude; chaff and/or flares are often used during maneuvering to defeat adversary air-to-air weapons.

TABLE 2-1
Altitude Boundaries

ANG Unit	MOAs	Altitude Boundaries	Altitude Class
173 FW	Goose (expanded)[1]	MOA: 3000 AGL to BNI 18,000 MSL	Low–Medium
173 FW	Hart	MOA: 11,000 MSL to BNI 18,000MSL	Medium
173 FW	Juniper Low Juniper North/South	Low: 500 AGL to 11,000 MSL MOA: 11,000 MSL to BNI 18,000MSL	Low–Medium Medium
173 FW	Dolphin North/South (new)[1, 2]	MOA: 11,000 MSL to FL510 (50,000 MSL)	Medium-High
133 ACS	Crypt North/Central/South	Central & South: 7,000 MSL to 27,000 AGL North: 7,000 MSL to 44,000 AGL	Medium–High Medium–High
114 FW	Lake Andes	6,000 MSL to BNI 18,000 MSL	Medium
148 FW	Beaver	300 AGL to BNI 18,000 MSL	Low–Medium
148 FW	Snoopy East/West	6,000 MSL to FL 310 (31,000 MSL)	Medium–High
Alpena	Steelhead	6,000 MSL to 50,000 MSL	Medium–High
Alpena	Pike East/West	East: 300 AGL to FL 500 (50,000 MSL) West: 6,000 feet MSL to 50,000 MSL	Low–High Medium–High
Volk Field	Volk East/West /South	East: 8,000 MSL to BNI 18,000 MSL South: 500 AGL to BNI 18,000 MSL West: 100 AGL to BNI 18,000 MSL	Medium Low–Medium Low–Medium
Volk Field	Falls 1 and 2	500 AGL to BNI 18,000 MSL	Low–Medium
138 FW	Rivers	6,000 AGL to FL 220 (22,000 MSL)	Medium
188 FW	Hog Low/High North/South	Low N/S: 100 AGL to BNI 6,000 MSL High N/S: 6,000 MSL to BNI 18,000 MSL	Low–Medium Medium
188 FW	Shirley	10,000 MSL to 29,000 MSL	Medium–High

1. Airspace changes that were submitted to the FAA for approval in 2000 and became effective in April 2002. These recent changes are included so that this EA can address all areas potentially affected by chaff and flares. Any other issues related to these recent airspace changes are evaluated separately.
2. The new Dolphin MOA was previously an Air Refueling Range operating at FL 180-230.

Acronyms:

MSL – Mean Sea Level (feet)
FL – Flight Level (100s of feet)
AGL – Above Ground Level (feet)
BNI – But Not Including
AR – Air Refueling Range

B-52 aircrews may drop chaff during training missions, with the exception of local sorties in the traffic pattern, which includes both low- and high-altitude flights. Flare drops are accomplished almost exclusively during low-level flight. Bomber aircrews train for low- and high-ordnance deliveries, in which they would use chaff and flares to defeat ground-based radar, infrared missile systems, and airborne radar systems.

2.1.2 Aircraft Types and Sorties

While a wide range of aircraft types use the MOAs for training, the largest number of sorties originate with the ANG Fighter Wings, composed primarily of F-16s. These average more than 80 percent of the sorties for all of the MOAs and increase to an average of more than 90 percent of sorties when combined with F-15 sorties.

Table 2-2 summarizes the number of sorties reported in 1998, unless indicated otherwise, by the controlling ANG units. Descriptions of aircraft and typical training missions can be found in Appendix B.

TABLE 2-2
Annual Number of Sorties by Aircraft Types

MOA	F-16/F-15	Support[4]	Other[5]
Goose[1]	780	20	0
Hart North/South[1, 2]	1,973	100	10
Juniper Low/North/South[1, 2]	1,973	100	10
Dolphin North/South	[2]	[2]	[2]
Crypt Central	700	300[4]	0
Crypt North	1,300	200[4]	0
Crypt South	1,100	200[4]	0
Lake Andes	NP[6]	NP[6]	NP[6]
Beaver	1,500	0	0
Snoopy East/West	1,500	0	0
Steelhead	1,712	0	175
Pike West	1,542	0	125
Pike East	1,712	0	175
Volk East	3,136	0	111
Volk South	1,529	0	59
Volk West	5,259	0	150
Falls 1	1,751	0	36
Falls 2	1,546	0	35
Rivers	319	51	0
Hog[3]	1,990	48	66
Shirley	1,005	20	42

TABLE 2-2
Annual Number of Sorties by Aircraft Types

An aircraft may use several MOAs on a single training flight, so the same sorties may be counted in more than one airspace.

1. Sortie numbers projected in 1998 for the year 2000
2. Roughly 20-30% of the sorties that had gone to Hart or Juniper MOAs will go to the new Dolphin MOA. The total number of sorties is not expected to increase.
3. Includes Hog North/South High/Low, combined
4. Support includes refueling (KC-135) sorties
5. Includes B-1, B-52, A-10, KC-135, C-21, HH-60, C-130, E-3, and AT-38 sorties
6. Not provided

2.1.3 Chaff and Flare Usage in Individual MOAs

A bundle or round of chaff is a precut load of chaff fibers (dipoles) in a container, such as a plastic tube or cardboard box. Chaff is ejected either mechanically, from cardboard boxes that are torn open when ejected from the aircraft, or pyrotechnically. Pyrotechnic ejection uses an explosive impulse cartridge to push a small plastic piston down a tube filled with chaff fibers; the tube itself remains in the aircraft. Most chaff bundles contain several million very fine fibers, typically 1 mil (25.4 microns) in diameter and anywhere from 0.3 to 2 inches long. Chaff is designed to remain in the air long enough to confuse enemy radar. The length of time it remains airborne and how far it drifts depends on the altitude at which it is deployed and local weather conditions at the time. Chaff eventually settles out of the air to deposit on land or water.

Self-protection flares are mostly made up of magnesium and Teflon, with smaller amounts of more sensitive materials that are used to ignite the main body of the flare, contained in an aluminum case. An explosive impulse cartridge pushes a piston, the flare material, and an end cap out of the aircraft. When ignited, these flares burn for less than 10 seconds at approximately 2,000 degrees Fahrenheit. Other types of flares, such as emergency or locator flares that are fired by users on the ground, are designed to be much longer-burning than the self-protection flares evaluated in this EA. By contrast, self-protection flares are designed to burn out before reaching the ground. Flares that operate properly only deposit incidental debris from flare canisters on the surface but, on occasion, duds or burning flares reach the ground.

Appendix C contains descriptions of the types of chaff and flares used by ANG units and others.

For each MOA (or group of MOAs that are scheduled together), Table 2-3 summarizes the estimated number of chaff rounds reported in 1998 (unless indicated otherwise), or planned to be used in future.

TABLE 2-3
Annual Number of Chaff Rounds

MOA	RR-170/180/188 [8] chaff (currently used)	RR-170/180/188 [8] chaff (proposed-not currently used)
Goose[1, 2]	5,816	[2]
Hart North/South[1,3]	5,904	
Juniper Low/North/South [1,3,4]	5,904	[4]
Dolphin[1,3]		[3]
Crypt Central	7,100	
Crypt North	7,100	
Crypt South	7,100	
Lake Andes	8,000	
Beaver	3,000	
Snoopy East/West	3,000	
Steelhead [5]	15,600	
Pike West [5]	[5]	
Pike East [5]	[5]	
Volk East [6]		26,430
Volk South [6]		16,931
Volk West [6]		50,477
Falls 1 [6]		24,553
Falls 2 [6]		21,950
Rivers	2,000	
Hog [7]	1,990	
Shirley	2,000	

Notes:

1. Usage numbers projected in 1998 for the year 2000.
2. Not currently used in the newly expanded area of Goose South. Upon completion of this EA and coordination with the FAA, a portion of the usage in Goose could go to Goose South.
3. Dolphin MOA was formerly an AR. Upon completion of this EA and coordination with the FAA, Dolphin MOA will get 20-30% of the usage that would have gone to Hart or Juniper MOAs.
4. Occasional use of chaff in Juniper Low MOA may begin, upon completion of this EA and coordination with the FAA, as a small proportion of the overall usage in Juniper North/South (and Dolphin) MOAs.
5. Approximate total for all three MOAs scheduled by Alpena CRTC
6. Not used since the early 1990s; projected maximum usage (actual use could be 1/3 to 2/3 of this total)
7. Includes Hog North/South and Hog High/Low
8. R-188 is training chaff that does not interfere with use of FAA radar. Use of R-170/180 is declining as stockpiles are depleted and replaced with R-188 (or variations as they are developed).

Table 2-4 summarizes the estimated number of flares reported or planned to be used in each MOA in 1998. Unless indicated otherwise, use of flares is ongoing in all these MOAs.

TABLE 2-4
Annual Number of Flares by Type

MOA	MJU-7, M-206	M-206	MJU-7	MJU-10
Goose[1]	1,452		1,320	132
Hart North/South[1,2]	1,474		1,340	134
Juniper Low/North/South[1,2]	1,474		1,340	134
Dolphin[2]	[2]	[2]	[2]	[2]
Crypt Central			700	
Crypt North			700	
Crypt South			700	
Lake Andes	2,000			
Beaver		750	750	
Snoopy East/West		750	750	
Steelhead [3]	15,600			
Pike West [3]	[3]			
Pike East [3]	[3]			
Volk East	8,334			
Volk South	6,564			
Volk West	30,865	2		
Falls 1	11,981			
Falls 2	10,260			
Rivers		750		
Hog [4]	3,980			
Shirley	2,000			

Notes:

1. Usage numbers projected in 1998 for the year 2000
2. Dolphin MOA was previously an AR. In future, Dolphin MOA will get 20-30% of the usage that would have gone to Hart or Juniper MOAs. Flares are not currently used or planned to be used in Juniper Low, but are ongoing in Juniper MOA (above Juniper Low).
3. Approximate total for all three MOAs scheduled by Alpena CRTC
4. Includes Hog North/South and Hog High/Low

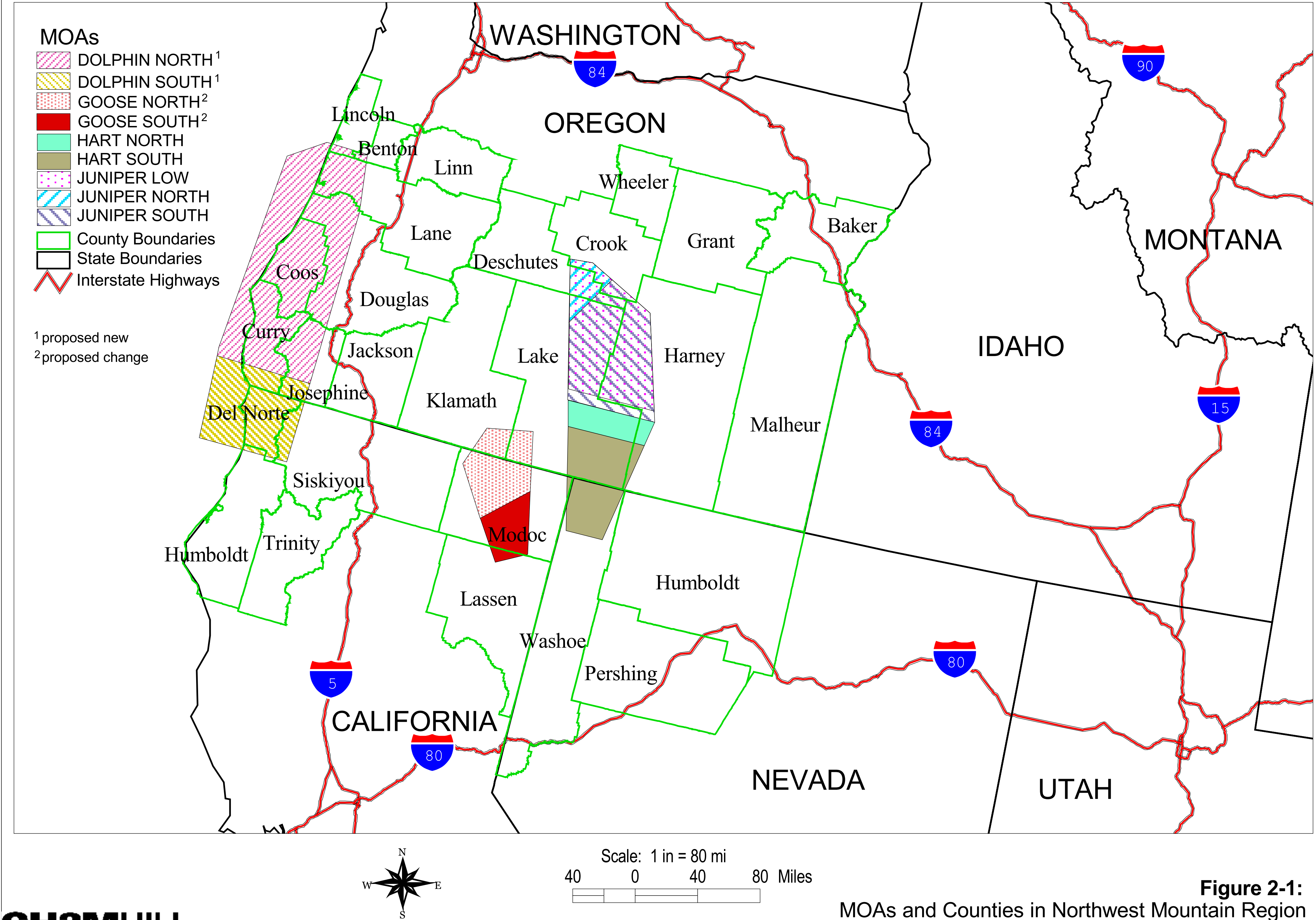

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Figure 2-1:
MOAs and Counties in Northwest Mountain Region

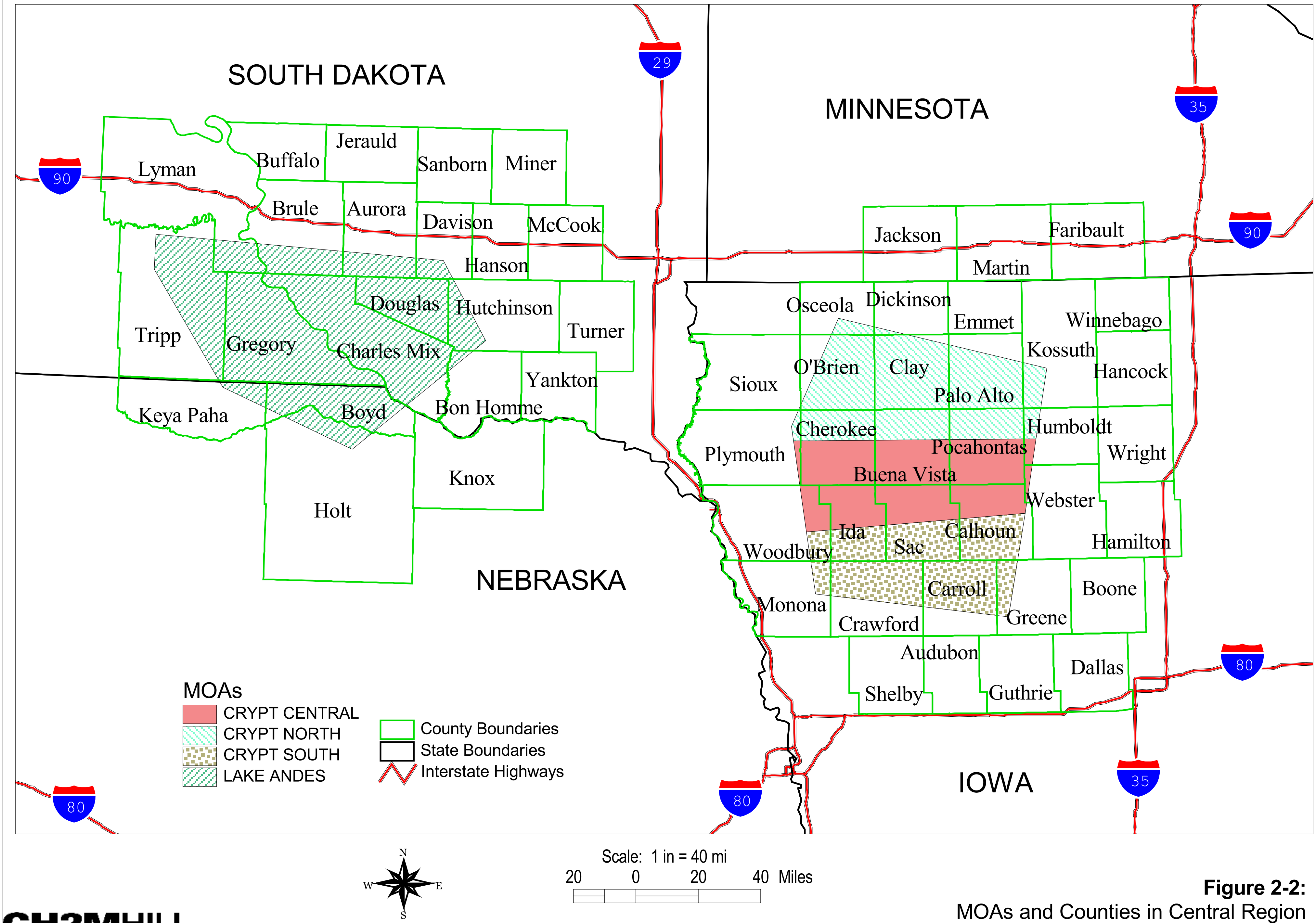

Figure 2-2:
MOAs and Counties in Central Region

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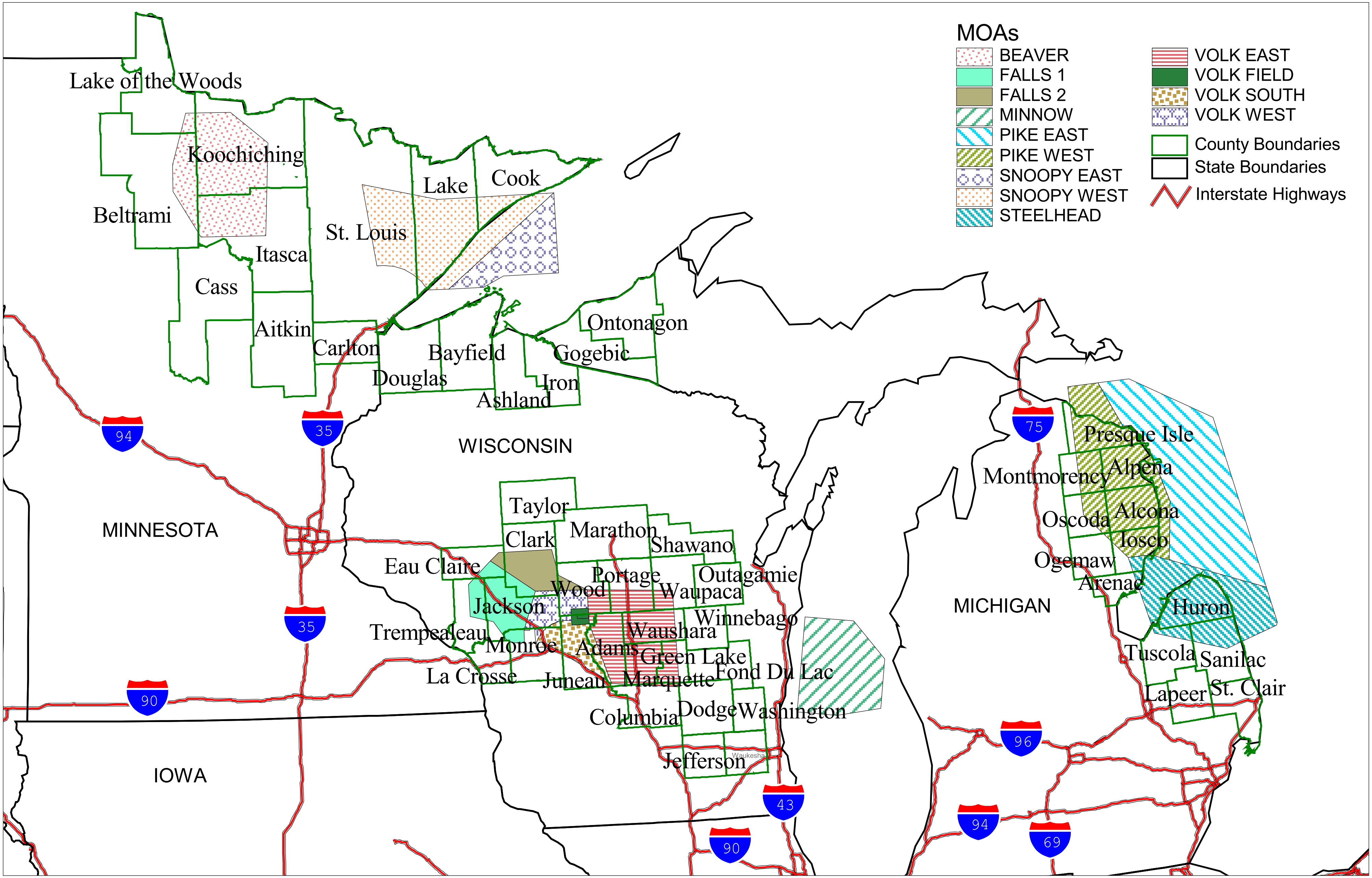

N W E S

Scale: 1 in = 75 mi

25 0 25 50 75 Miles

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Figure 2-3:
MOAs and Counties in Great Lakes Region

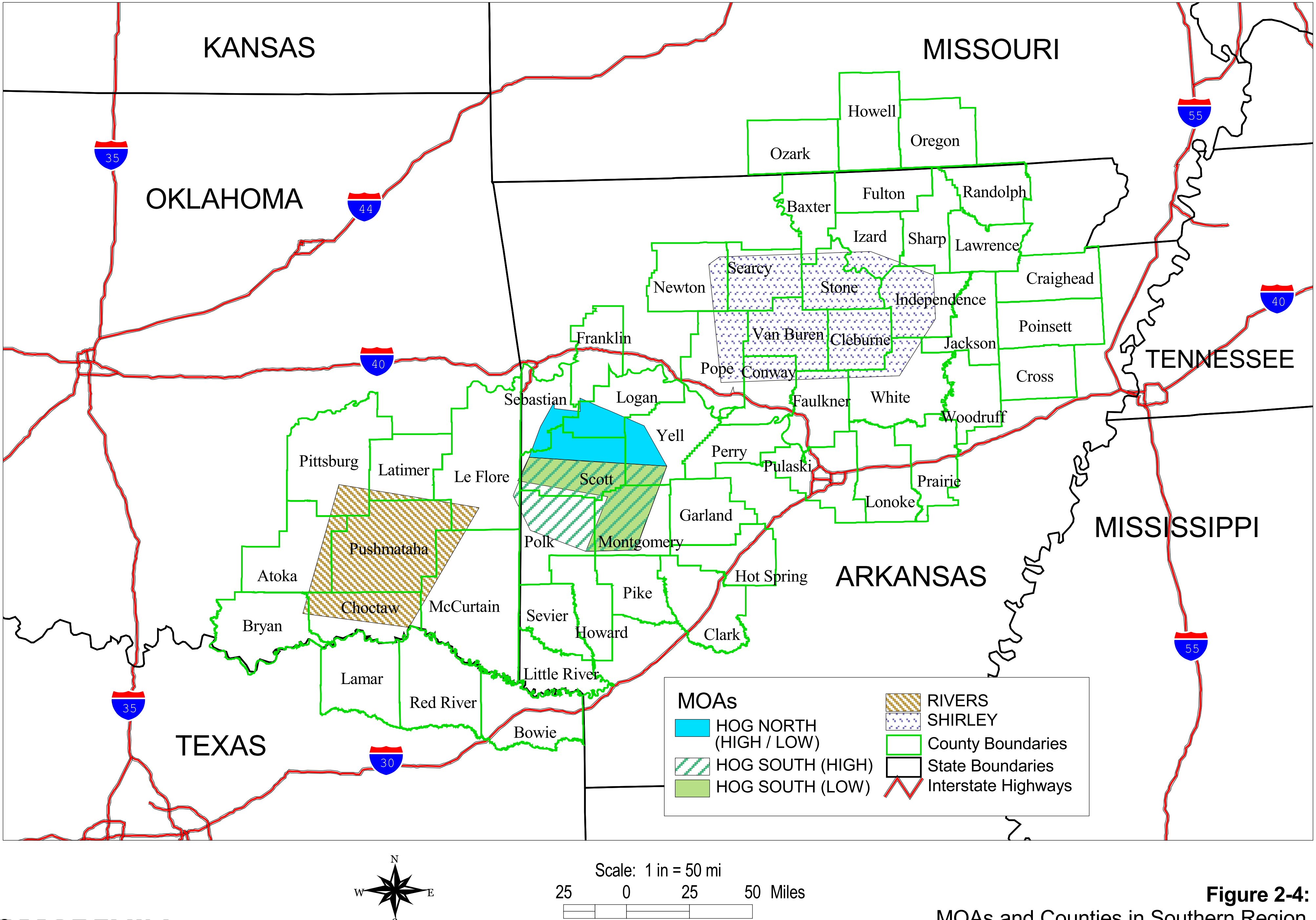

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Figure 2-4:
MOAs and Counties in Southern Region

2.2 Description of MOAs

This subsection provides a summary description of each MOA and other designated areas where chaff and/or flares are used by Air National Guard and other aircraft. Additional information on any special procedures or restrictions for each MOA may be found in the controlling unit's special operations procedures.

The 14 ANG-managed MOAs evaluated in this EA are located throughout the continental United States. Subsequent EAs will address additional MOAs. As depicted in Figures 2-1 through 2-4 and in Table 2-5, these MOAs are located in four geographic regions of the United States: Northwest, Great Lakes, Central, and Southern.

TABLE 2-5
MOA Locations and Areas

MOA	Area (square miles)	Region	States
Goose (previous)	1,520	Northwest	OR, CA
Goose (expanded) [1]	2,805	Northwest	OR, CA
Hart	3,291	Northwest	OR, CA, NV
Juniper	4,453	Northwest	OR
Dolphin [1]	11,710	Northwest	OR, CA
Crypt	6,067	Central	IA
Lake Andes	4,637	Central	SD, NE
Beaver	3,305	Great Lakes	MN
Snoopy	5,094	Great Lakes	MN
Steelhead	2,930	Great Lakes	MI
Pike	8,458	Great Lakes	MI
Volk	3,829	Great Lakes	WI
Falls 1 and 2	1,798	Great Lakes	WI
Rivers	2,560	Southern	OK
Hog	2,623	Southern	AR, OK
Shirley	4,067	Southern	AR

1. Airspace changes effective April 2002

2.2.1 Region of Influence

The geographical area that is potentially affected by an action is referred to as the region of influence (ROI). For the purposes of this EA, the ROI for chaff and flare usage in each MOA is defined as all of the counties underlying the MOA plus the adjacent counties in the direction(s) of the prevailing winds at the surface and operational altitudes. Table 2-6 and

Figures 2-1 through 2-4 portray the underlying and adjacent counties for MOAs in each ROI. Wind rose diagrams for these MOAs are presented in Appendix D.

TABLE 2-6
Region of Influence

MOAs	States	Underlying Counties	Prevailing Winds (Surface / Operational)	Adjacent Downwind Counties
Goose [1]	OR, CA	Modoc, Lassen, CA; Klamath, Lake, OR	Light & Variable / SW – NW	Harney, Deschutes, Crook, OR; Washoe, NV
Hart	OR, CA, NV	Lake, Harney, OR; Modoc, CA; Washoe, NV	Light & Variable / SW – NW	Malheur, Grant, Crook, OR; Humboldt, Pershing, NV
Juniper	OR	Lake, Harney, Crook, Deschutes, OR	Light & Variable / SW – NW	Wheeler, Grant, Baker, Malhuer, OR; Humboldt, NV
Dolphin [1]	OR, CA	Del Norte, Humboldt, Siskiyou, CA; Benton, Coos, Curry, Douglas, Josephine, Lincoln, OR	Light & Variable / SW – NW	Trinity, CA; Jackson, Lane, Linn, OR
Crypt	IA	Buena Vista, Calhoun, Cherokee, Humboldt, Ida, Plymouth, Pocahontas, Sac, Webster, Woodbury, Carroll, Crawford, Greene, Monona, Clay, Dickinson, Kossuth, O'Brien, Osceola, Palo Alto, Sioux, IA	WNW – N & ESE – S / SW – NW	Jackson, Marin, Fairbault, MN; Emmet, Winnebago, Hancock, Wright, Hamilton, Boone, Dallas, Guthrie, Audubon, Shelby, IA
Lake Andes	SD, NE	Aurora, Bon Homme, Brule, Charles Mix, Davison, Douglas, Gregory, Hutchinson, Lyman, Tripp, SD; Boyd, Holt, Keya Paha, NE	WNW – N & ESE – S / SW – NW	Buffalo, Jerauld, Sanborn, Miner, Hanson, McCook, Turner, Yankton, SD; Knox, NE
Beaver	MN	Beltrami, Lake of the Woods, Itasca, Koochiching, MN	Variable / WSW – NW	St. Louis, Aitkin, MN
Snoopy	MN	Snoopy East: none Snoopy West: Cook, Lake, St. Louis, MN	Variable / WSW – NW	Douglas, Bayfield, Ashland, Iron, WI; Gogebic, Ontonagon, MI
Steelhead	MI	Arenac, Huron, Sanilac, Tuscola, MI	S – WNW / SW – NW	Lapeer, St. Clair, MI
Pike	MI	Alcoma, Alpena, Iosco, Presque Isle, MI	S – WNW / SW – NW	None
Volk	WI	Juneau, Wood, Adams, Columbia, Dodge, Green Lake, Marquette, Portage, Waupaca, Waushara, Jackson, Monroe, Clark, WI	SSW – NW / SW – NW	Marathon, Shawano, Outagamie, Winnebago, Fond du Lac, Washington, Jefferson, Waukesha, WI
Falls 1 and 2	WI	Clark, Eau Claire, Jackson, La Crosse, Monroe, Trempealeau, Wood, WI	SSW – NW / SW – NW	Taylor, Marathon, Portage, Adams, Juneau, WI

TABLE 2-6
Region of Influence

MOAs	States	Underlying Counties	Prevailing Winds (Surface / Operational)	Adjacent Downwind Counties
Rivers	OK	Atoka, Bryan, Choctaw, Latimer, Le Flore, McCurtain, Pittsburg, Pushmataha, OK	Light & Variable / SW – NW	Sebastian, Scott, Polk, Sevier, Little River, AR; Red River, Bowie, TX
Hog	AR, OK	Franklin, Logan, Scott, Sebastian, Yell, Montgomery, Polk, AR; Le Flore, OK	Light & Variable / SW – NW	Pope, Conway, Perry, Garland, Hot Spring, Clark, Pike, AR
Shirley	AR, MO	Baxter, Cleburne, Conway, Faulkner, Independence, Izard, Jackson, Newton, Pope, Searcy, Sharp, Stone, Van Buren, White, AR	Light & Variable / SW – NW	Fulton, Randolph, Lawrence, Jackson, Woodruff, Prairie, Lonoke, Pulaski, AR; Ozark, Howell, Oregon, MO

1. Airspace changes effective April 2002

2.2.2 Potentially Affected Tribal Lands

American Indian reservations are legal entities having boundaries established by treaty, statute, executive order, or court order. Additional areas outside of tribal lands may have religious or cultural significance. Table 2-7 lists the American Indian tribal organizations that are located in or adjacent to each MOA. Tribal government representatives and Bureau of Indian Affairs (BIA) offices for the affected reservations were included among the government agencies and non-governmental organizations in the IICEP distribution list, for both the DOPAA and Draft Final EA, to help identify concerns relevant to the proposed action (see Appendix A).

2.3 Alternatives

2.3.1 Introduction

This section describes the alternatives for chaff and flare use in the ANG-controlled MOAs under consideration. These alternatives have been developed in accordance with NEPA and its implementing regulations, including AFI 32-7061 ("The Environmental Impact Analysis Process"). They are intended to help the NGB identify the potential environmental impacts that are expected of the proposed action.

TABLE 2-7
Potentially Interested Tribal Organizations

MOA	States	BIA Area Offices	Tribal Organizations
Goose[1]	OR, CA	Portland, Sacramento	Alturas Rancheria, Cedarville Rancheria, Fort Bidwell Reservation

TABLE 2-7
Potentially Interested Tribal Organizations

MOA	States	BIA Area Offices	Tribal Organizations
Hart	OR, CA, NV	Portland, Sacramento	Alturas Rancheria, Cedarville Rancheria, Fort Bidwell Reservation, Burns Paiute Tribe General Council, Klamath General Council, Confederated Tribes of the Warm Springs Reservation
Juniper	OR	Portland	Burns Paiute Tribe General Council, Klamath General Council, Confederated Tribes of the Warm Springs Reservation
Dolphin[1]	OR, CA	Portland, Sacramento	Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians, Cow Creek Government Offices, Coquille Indian Tribe, Siletz Tribal Council, Karuk Tribe of California, Smith River Rancheria, Yurok Tribe
Crypt	IA	Minneapolis	None Identified
Lake Andes	SD, NE	Aberdeen	Crow Creek Sioux Tribal Council, Rosebud Sioux Tribal Council, Yankton Sioux Tribal Council
Beaver and Snoopy	MN	Minneapolis	Bois Forte Reservation Business Committee, Grand Portage Reservation Business Committee, Minnesota Chippewa Tribe, Fond du Lac Reservation Business Committee, Leech Lake Reservation Business Committee, Red Lake Band of Chippewa Indians of Minnesota, White Earth Reservation Business Committee
Steelhead	MI	Minneapolis	None Identified
Pike	MI	Minneapolis	None Identified
Volk and Falls 1 and 2	WI	Minneapolis	Menominee Indian Tribe of Wisconsin, Stockbridge Munsee Community of Wisconsin, Oneida Tribe of Indians of Wisconsin, Ho-Chunk Nation
Rivers	OK	Muskogee	Choctaw Nation of Oklahoma
Hog	AR, OK	Eastern, Muskogee	Choctaw Nation of Oklahoma
Shirley	AR	Eastern	None Identified

Notes:

1. Airspace changes effective April 2002

2.3.2 Range of Alternatives to be Considered

Federal agencies must analyze reasonable alternatives to the proposed action in NEPA documents. Reasonable alternatives are those that "meet the underlying purpose and need for the proposed action and that would cause a reasonable person to inquire further before choosing a particular course of action" (AFI 32-7061).

The alternatives considered in this EA include: (1) using chaff and/or flares in training missions in all MOAs; (2) limiting the number of MOAs available for the use of chaff or flares for an ANG unit; (3) increasing the minimum altitude for flare use within a given MOA; (4) limiting chaff or flare use to certain times of year. The effects of these alternatives will be described and compared where they would result in appreciably different impacts; ultimately, these alternatives could be implemented as mitigation measures in selected areas where warranted.

2.3.2.1 Alternative 1 (Preferred Alternative)—Normal Operations

The preferred alternative is to continue the current use of chaff and/or flares in all MOAs, to resume the use of chaff and flares in those MOAs where use was suspended pending EIAP, and to allow the use of chaff and/or flares in newly established or expanded MOAs as described previously. ANG units and other aircraft would maintain current training methods without reduction in combat readiness for individual pilots. Alternative 1 is the proposed action described in Section 2.

2.3.2.2 Alternative 2—Minimize Number of MOAs Available

One alternative (or potential mitigation measure) is to limit the MOAs available to an ANG unit where the use of chaff or flares is allowed. This action has two potential consequences, an impact on training operations due to a reduced number of sorties available for chaff or flare use, and the concentration of chaff and/or flare material within a smaller area.

2.3.2.3 Alternative 3—Increasing Minimum Altitude for Flare Use

Another possible alternative (or potential mitigation measure) is to increase the minimum altitude for flares. This action could decrease the risk of fire from flares, particularly in areas where there is a high general risk of fire due to climate and vegetation.

2.3.2.4 Alternative 4 – Limiting Use to Certain Times of Year

Another possible alternative (or potential mitigation measure) is to limit the use of chaff or flares to certain times of the year. This action could decrease seasonally related risks identified in this EA. Examples could include a higher fire risk during the dry season or exposure to wildlife during critical breeding or migration times.

2.3.2.5 No-Action Alternative

The No-Action Alternative is prescribed by CEQ and AF regulations implementing NEPA. For those MOAs where chaff and/or flares are currently in use, the No-Action Alternative is the same as Alternative 1 – Current Operations. This document refers to the No-Action Alternative as the continuation of existing environmental and socioeconomic conditions.

2.3.2.6 Alternatives Ruled Out

- Restricting deployment of chaff or flares to specific subareas with a single MOA, in order to avoid potential impacts on specific sensitive resources, is not operationally practicable due to the speed of aircraft and the large buffers that would be required within a MOA to account for the drift factor.

- Eliminate deployment of chaff in any MOA where FAA or DOD radar would be disrupted, unless disruption of DOD radar is an intentional part of a training exercise.

- In areas where deployment during training exercises would disrupt FAA and DOD radar, another alternative would be to release chaff over a limited area, strictly for maintenance of dispensing systems. This alternative would be selected only if the proposed action would result in significant environmental impacts in a given MOA and no other alternative was found to be acceptable.

- The alternative of entirely ceasing the use of chaff and flares is not a reasonable alternative, because of critical USAF training and readiness requirements. AFI 11-2F-16V1 and AFI 11-2F-15V1, as well as other AFIs, require using defensive measures. These AFIs also require training to ensure aircrew proficiency in the use of these defensive measures. Ending the use of chaff or flares in training would result in National Guard units being required to use methods in combat for which they have never been trained, which does not satisfy the purpose and need for training and is not acceptable.

3 MOA Resource Descriptions

This section provides a brief description of the existing environmental conditions in the region(s) of influence for the proposed action. Included are descriptions of the earth resources, climate, water resources, biological resources, land use and visual resources, infrastructure, utilities and transportation, cultural resources, and socioeconomics in each of the 15 MOAs (14 of which are already in use and one–Dolphin–that was recently changed from an existing air refueling track to a MOA). In cases where MOAs are located in close proximity to each other, resource descriptions were combined (e.g., for Goose, Hart, and Juniper). Descriptions include both the counties underlying the MOAs and the adjacent countries in the direction(s) of prevailing winds. Combined, these two sets of counties comprise the region of influence for each MOA.

3.1 Goose, Hart, and Juniper

The Goose, Hart, and Juniper MOAs encompass portions of Klamath, Lake, Harney, Crook and Deschutes counties in southeastern Oregon, Modoc and Lassen counties in northeastern California and Washoe County in northwestern Nevada (Figure 3-1). The area of the Goose MOA was expanded in April 2002. Therefore, information is provided on both the previous and new areas.

3.1.1 Earth Resources

The lands underlying the Goose, Hart, and Juniper MOAs are characteristic of the Great Basin physiographic region. The typical landscape types associated with this region include north-south ranges alternating with broad basins. Some of the basins contain intermittent lakes. These lands are relatively dry, and the soils include chestnut, or dark-brown, soils and the gray desert soils characteristic of the Basin province.

3.1.2 Climate

The climate in the vicinity of the Goose, Hart, and Juniper MOAs is generally described as semiarid, mid-latitude climate. Summers are warm and winters are cold. Precipitation is 10 to 20 inches annually. The climate is generally moderate with January average temperatures of 35°F and July average temperatures of 65°F, but temperatures above 80°F are common during the summer months.

3.1.3 Water Resources

The areas underlying the Goose, Hart, and Juniper MOAs contain numerous small lakes and reservoirs including Goose Lake, Tule Lake, Clear Lake Reservoir, Gerber Reservoir Drews Reservoir, Big Sage Reservoir, West Valley Reservoir, Moon Lake, Lake Albert, Summer Lake, Warner Lakes, Hart Lake and Crump Lake.

3.1.4 Biological Resources

The Goose, Hart, and Juniper MOAs contain a wide variety of plant species, including big sagebrush, western juniper, Idaho fescue, bluebunch wheatgrass, ponderosa pine, white fir, low sagebrush, jeffrey pine, lodgepole pine, aspen and sedge meadow communities. This region also has a diverse wildlife population including mule deer, elk, pronghorn, black bear, mountain lion, coyote, bobcat, yellow-bellied marmot, wolverine, jackrabbit and porcupine. Birds include eagles, hawks, owls, woodpeckers, falcons, osprey, quail and sage grouse. The Goose, Hart, and Juniper MOAs contain wetlands that are important resting, feeding and nesting areas for migrating waterfowl. In river valleys and lowlands, some species of deciduous trees, including alder, ash, maple, and white oak are fairly common. Deciduous trees found in eastern Oregon include cottonwood, aspen, and birch. Juniper, a conifer, is found throughout eastern Oregon. In the high desert of southeastern Oregon, sagebrush and bunchgrass prevail.

As Table 3-1 shows, in the counties underlying the Goose MOA, there are a total of 29 threatened or endangered species of flora and fauna (21 in Oregon and 8 in California). In the adjacent downwind counties, there are a total of 18 threatened or endangered flora and fauna species (15 in Oregon and 3 in Nevada)(Table 3-2).

TABLE 3-1
Threatened and Endangered Flora and Fauna in Goose MOA (Underlying Counties)

Common Name	Scientific Name	Status
Oregon		
Western Snowy Plover	*Charadrius alexandrinus nivosus*	LT
American Peregrine Falcon	*Falco peregrinus anatum*	SE
Bald Eagle	*Haliaeetus leucocephalus*	LT
Northern Spotted Owl	*Strix occidentalis caurina*	LT
Shortnose Sucker	*Charsmistes Brevirostris*	LE
Lost River Sucker	*Deltistes luxatus*	LE
Bull Trout	*Salvelinus Confluentus*	LT
Gray Wolf	*Canis lupus*	LE
California Wolverine	*Gulo gulo luteus*	ST
Kit Fox	*Vulpes macrotis*	ST
Applegate's Milk-Vetch	*Astragalus applegatei*	LE
Peck's Milk-Vetch	*Astragalus peckii*	ST
Pumice Grape-Fern	*Botrychium pumicola*	ST
Modoc Sucker	*Catostomus microps*	LE
Warner Sucker	*Catostomus warnerensis*	LT

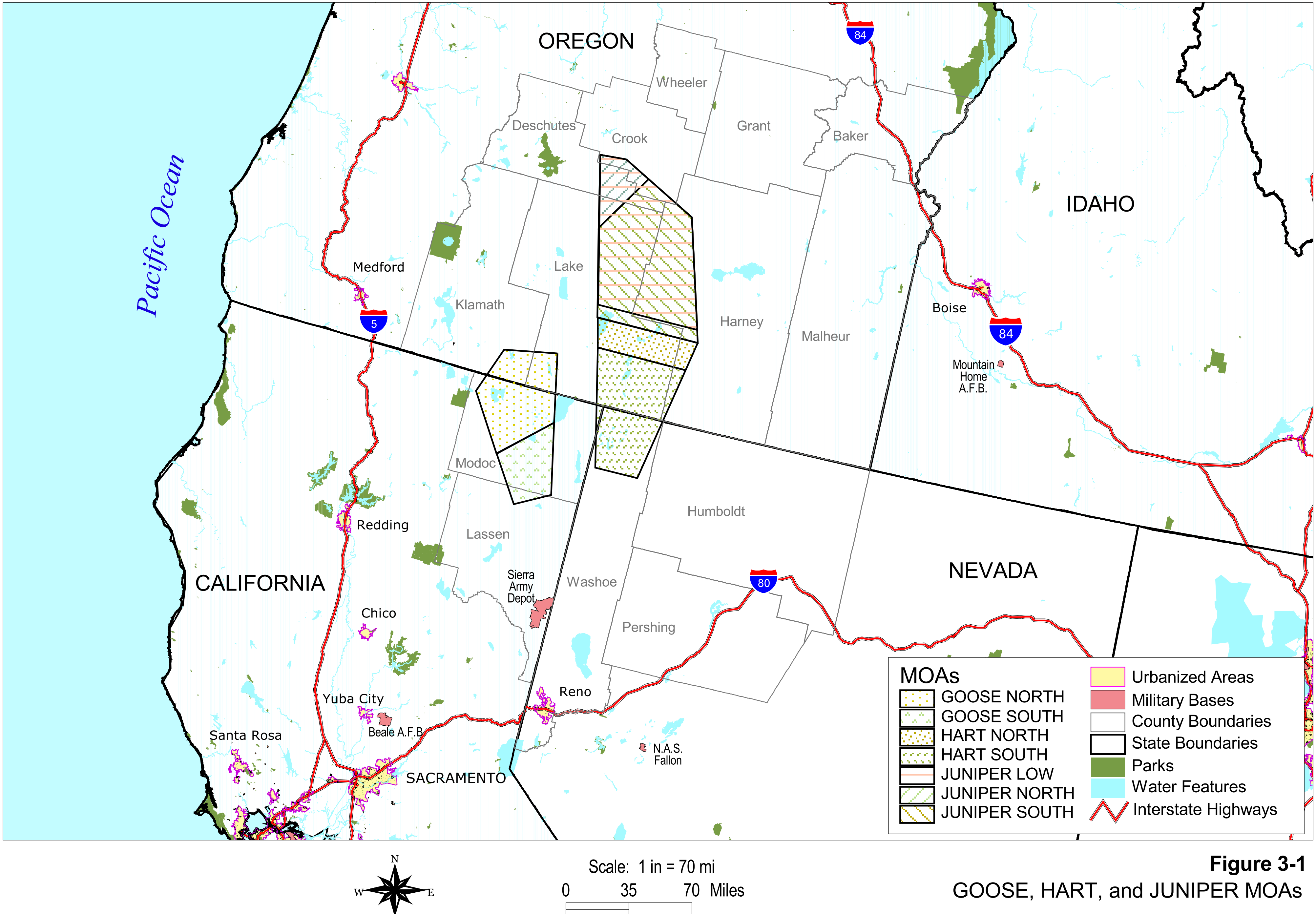

Figure 3-1

GOOSE, HART, and JUNIPER MOAs

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TABLE 3-1
Threatened and Endangered Flora and Fauna in Goose MOA (Underlying Counties)

Common Name	Scientific Name	Status
Hutton Spring Tui Chub	*Gila bicolor*	LT
Foskett Spring Speckled Dace	*Rhinichthys osculus*	LT
Crosby's Buckwheat	*Eriogonum crosbyae*	ST
Boggs Lake Hedge-Hyssop	*Gratiola heterosepala*	ST
Grimy Ivesia	*Ivesia rhypara var rhypara*	SE
Oregon Semaphore Grass	*Pleuropogon oregonus*	ST
California		
Swainson's Hawk	*Buteo swainsoni*	ST
Greater Sandhill Crane	*Grus canadensis tabida*	ST
Bank Swallow	*Riparia riparia*	ST
Great Gray Owl	*Strix nebulosa*	SE
California Bighorn Sheep	*Ovis canadensis californiana*	ST
Sierra Nevada Red Fox	*Vulpes vulpes necator*	ST
California (proposed expansion area)		
Slender Orcutt Grass	*Orcuttia tenuis*	LT
Willow Flycatcher	*Empidonax traillii*	SE

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

TABLE 3-2
Threatened and Endangered Flora and Fauna in the Region of Influence of the Goose MOA (Adjacent Counties)

Common Name	Scientific Name	Status
Oregon		
Western Snowy Plover	*Charadrius alexandrinus nivosus*	LT
Bald Eagle	*Haliaeetus leucocephalus*	LT
Borax Lake Chub	*Gila boraxobius*	LE
Lahontan Cutthroat Trout	*Oncorhynchus clarki henshawi*	LT
Bull Trout	*Salvelinus confluentus*	LT
California Wolverine	*Gulo gulo luteus*	ST

TABLE 3-2
Threatened and Endangered Flora and Fauna in the Region of Influence of the Goose MOA (Adjacent Counties)

Common Name	Scientific Name	Status
Kit Fox	*Vulpes macrotis*	ST
Crosby's Buckwheat	*Eriogonum crosbyae*	ST
Malheur Wire-Lettuce	*Stephanomeria malheurensis*	LE
Owyhee Clover	*Trifolium owyheense*	SE
Middle Columbia River Steelhead	*Oncorhynchus mykiss*	LT
Northern Spotted Owl	*Strix occidentalis caurina*	LT
Gray Wolf	*Canis lupus*	LE
Peck's Milk-Vetch	*Astragalus peckii*	ST
Pumice Grape-Fern	*Botrychium pumicola*	ST
Nevada		
Warner Sucker	*Catostomus warnerensis*	LT
Cui-Ui	*Charsmistes cujus*	LE
Desert Dace	*Eremichthys acros*	LT

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

In the counties underlying the Hart MOA, there are a total of 29 threatened or endangered species of flora and fauna (19 in Oregon, 8 in California and 2 in Nevada). In the adjacent downwind counties, there are a total of 25 threatened or endangered flora and fauna species (22 in Oregon and 3 in Nevada) (Tables 3-3 and 3-4).

TABLE 3-3
Threatened and Endangered Flora and Fauna in the Hart MOA (Underlying Counties)

Common Name	Scientific Name	Status
Oregon		
Western Snowy Plover	*Charadrius alexandrinus nivosus*	LT
Bald Eagle	*Haliaeetus leucocephalus*	LT
Modoc Sucker	*Catostomus microps*	LE
Warner Sucker	*Catostomus warnerensis*	LT
Hutton Spring Tui Chub	*Gila bicolor*	LT

TABLE 3-3
Threatened and Endangered Flora and Fauna in the Hart MOA (Underlying Counties)

Common Name	Scientific Name	Status
Foskett Spring Speckled Dace	*Rhinichthys osculus*	LT
Bull Trout	*Salvelinus confluentus*	LT
Gray Wolf	*Canis lupus*	LE
California Wolverine	*Gulo gulo luteus*	ST
Pumice Grape-Fern	*Botrychium pumicola*	ST
Crosby's Buckwheat	*Eriogonum crosbyae*	ST
Bogg's Lake Hedge-Hyssop	*Gratiola heterosepala*	ST
Grimy Ivensia	*Ivesia rhypara var rhypara*	SE
Oregon Semaphore Grass	*Pleuropogon oregonus*	ST
Borax Lake Chub	*Gila boraxobius*	LE
Lahontan Cutthroat Trout	*Oncorhynchus clarki henshawi*	LT
Kit Fox	*Vulpes macrotis*	ST
Malheur Wire-Lettuce	*Stephanomeria malheurensis*	LE
Owyhee Clover	*Trifolium owyheense*	SE
California		
Shortnose Sucker	*Chasmistes brevirostris*	LE
Lost River Sucker	*Deltistes luxatus*	LE
Swainson's Hawk	*Buteo swainsoni*	ST
Greater Sandhill Crane	*Grus canadensis tabida*	ST
Bank Swallow	*Riparia riparia*	ST
Great Gray Owl	*Strix nebulosa*	SE
California Bighorn Sheep	*Ovis canadensis californiana*	ST
Sierra Nevada Red Fox	*Vulpes vulpes necator*	ST
Nevada		
Cui-Ui	*Catostomus warnerensis*	LT
Desert Dace	*Eremichthys acros*	LT

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

TABLE 3-4
Threatened and Endangered Flora and Fauna in the Region of Influence of the Hart MOA (Adjacent Counties)

Common Name	Scientific Name	Status
Oregon		
Bald Eagle	*Haliaeetus leucocephalus*	LT
Middle Columbia River Steelhead	*Oncorhynchus mykiss*	LT
Bull Trout	*Calvelinus confluentus*	LT
Gray Wolf	*Canis lupus*	LE
California Wolverine	*Gulo gulo luteus*	ST
South John Day Milk-Vetch	*Astragalus diaphanus var diurnus*	ST
Colonial luina	*Luina serpentina*	ST
Arrow-Leaf Thelypody	*Thelypodium eucosmum*	ST
Lahontan Cutthroat Trout	*Oncorhynchus clarki henshawi*	LT
Kit Fox	*Vulpes macrotis*	ST
Malheur Valley Fiddleneck	*Amsinckia carinata*	ST
Mulford's Milk-Vetch	*Astragalus mulfordiae*	SE
Sterile Milk-Vetch	*Astragalus sterilis*	ST
Golden Buckwheat	*Eriogonum chrysops*	ST
Cronquist's Stickseed	*Hackelia cronquistii*	ST
Snake River Goldenweed	*Haplopappus radiatus*	SE
Grimy Ivesia	*Ivesia rhypara var rhypara*	SE
Davis' Peppergrass	*Lepisdium Davisii*	ST
Smooth Mentzelia	*Mentzelia mollis*	SE
Packard's Mentzelia	*Mentzelia packardiae*	ST
Ertter's Senecio	*Senecio ertterae*	ST
Howell's Spectacular Thelypody	*Thelpodium howellii*	LT
Nevada		**Status**
Warner Sucker	*Catostomus warnerensis*	LT
Cui-Ui	*Chasmistes cujus*	LE
Desert Dace	*Eremichthys acros*	LT

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

In the counties underlying the Juniper MOA, there are a total of 21 threatened or endangered species of flora and fauna (all in Oregon). In the adjacent downwind counties, there are a total of 26 threatened or endangered flora and fauna species (23 in Oregon and 3 in Nevada) (Tables 3-5 and 3-6).

TABLE 3-5
Threatened and Endangered Flora and Fauna in the Juniper MOA (Underlying Counties)

Common Name	Scientific Name	Status
Oregon		
Bald Eagle	*Haliaeetus leucocephalus*	LT
Middle Columbia River Steelhead	*Oncorhynchus mykiss*	LT
California Wolverine	*Gulo gulo luteus*	ST
Northern Spotted Owl	*Strix occidentalis caurina*	LT
Bull Trout	*Salvelinus confluentus*	LT
Gray Wolf	*Canis lupus*	LE
Peck's Milk-Vetch	*Astragalus peckii*	ST
Pumice Grape-Fern	*Botrychium pumicola*	ST
Western Snowy Plover	*Charadrius alexandrinus nivosus*	LT
Warner Sucker	*Catostomus warnerensis*	LT
Hutton Spring Tui Chub	*Gila Bicolor*	LT
Foskett Spring Speckled Dace	*Rhinichthys osculus*	LT
Crosby's Buckwheat	*Eriogonum crosbyae*	ST
Boggs Lake Hedge-Hyssop	*Gratiola heterosepala*	ST
Grimy Ivesia	*Ivesia rhypara var rhypara*	SE
Oregon Semaphore Grass	*Pleuropogon oregonus*	ST
Borax Lake Chub	*Gila boraxobius*	LE
Lahontan Cutthroat Trout	*Oncorhynchus clarki henshawi*	LT
Kit Fox	*Vulpes macrotis*	ST
Malheur Wire-Lettuce	*Stephanomeria malheurensis*	LE
Owyhee Clover	*Trifolium owyheense*	SE

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

TABLE 3-6
Threatened and Endangered Flora and Fauna in the Region of Influence of the Juniper MOA (Adjacent Counties)

Common Name	Scientific Name	Status
Oregon		
Bald Eagle	*Haliaeetus leucocephalus*	LT
Middle Columbia River Steelhead	*Oncorhynchus mykiss*	LT
California Wolverine	*Gulo gulo luteus*	ST
Arrow-Leaf Thelypody	*Thelypodium eucosmum*	ST
Bull Trout	*Salvelinus confluentus*	LT
Gray Wolf	*Canis lupus*	LE
Snake River Goldenweed	*Haplopappus radiatus*	SE
Red-Fruited Lomatium	*Lomatium erythrocarpum*	SE
Howell's Spectacular Thelypody	*Thelypodium howellii*	LT
South John Day Milk-Vetch	*Astragalus diaphanus var diurnus*	ST
Colonial Luina	*Luina serpentina*	ST
Lahontan Cutthroat Trout	*Oncorhynchus clarki henshawi*	LT
Kit Fox	*Vulpes macrotis*	ST
Malheur Valley Fiddleneck	*Asmsinckia carinata*	ST
Mulford's Milk-Vetch	*Astragalus mulfordiae*	SE
Sterile Milk-Vetch	*Astragalus sterilis*	ST
Golden Buckwheat	*Eriogonum chrysops*	ST
Cronquist's Stickseed	*Hackelia cronquistii*	ST
Grimy Ivesia	*Ivesia rhypara var rhypara*	SE
Davis' Peppergrass	*Lepidium davisii*	ST
Smooth Mentzelia	*Mentzelia mollis*	SE
Packard's Mentzelia	*Mentzelia packardiae*	ST
Owyhee Clover	*Trifolium owyheense*	SE
Nevada		
Warner Sucker	*Catostomus warnerensis*	LT
Cui-Ui	*Chasmistes cujus*	LE
Desert Dace	*Eremichthys acros*	LT

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

3.1.5 Land Use and Visual Resources

Dominant land use/land cover in the Goose, Hart, and Juniper MOAs is forest and shrub/brushland (Tables 3-7 to 3-14). The area is generally referred to as high desert country and is sparsely populated. There are several wilderness and natural areas in the Goose, Hart, and Juniper area, including the Clear Lake National Wildlife Refuge (NWR), Tule Lake NWR, Gearhart Mountain Wilderness Area, Lava Beds National Monument, Modoc NWR, South Warner Wilderness Area, Hart Mountain NWR, Sheldon NWR, Malheur NWR, and Newberry National Volcanic Monument. National Forests in this region include the Malheur National Forest, Klamath National Forest, Deschutes National Forest, Fremont National Forest, and Modoc National Forest.

TABLE 3-7
County Land Uses in the Current Goose MOA (Underlying Counties)

County	Total Acreage	Percent						
		Agriculture	Barren	Forest	Grassland	Shrub / Brushland	Urban / Rural Development	Water
Klamath	3,920,189	2.86		82.46	0.40	1.23	9.96	3.10
Lake	5,340,291	5.10	1.71	30.64	3.02	55.09	1.66	2.77
Modoc	2,685,993	5.66	0.14	61.16	2.24	18.55	7.95	4.31

TABLE 3-8
County Land Uses in the Current Goose MOA (Adjacent Counties)

County	Total Acreage	Percent						
		Agriculture	Barren	Forest	Grassland	Shrub / Brushland	Urban / Rural Development	Water
Crook	1,907,951	14.43		26.09	2.66	51.02	5.50	0.30
Deschutes	1,884,252			60.46	1.39	31.68	1.99	1.05
Harney	6,533,199	5.95	4.58	10.44	5.02	71.21	1.05	1.76
Washoe	4,187,613	1.02	7.47	6.41	3.35	77.68	0.65	3.42

TABLE 3-9
County Land Uses in the Proposed Goose MOA (Underlying Counties)

County	Total Acreage	Percent						
		Agriculture	Barren	Forest	Grassland	Shrub / Brushland	Urban / Rural Development	Water
Klamath	3,920,189	2.86		82.46	0.40	1.23	9.96	3.10
Lake	5,340,291	5.10	1.71	30.64	3.02	55.09	1.66	2.77

TABLE 3-9
County Land Uses in the Proposed Goose MOA (Underlying Counties)

County	Total Acreage	Percent						
		Agriculture	Barren	Forest	Grassland	Shrub / Brushland	Urban / Rural Development	Water
Lassen	3,017,460	3.05	1.84	61.39	2.09	26.37	3.28	1.99
Modoc	2,685,993	5.66	0.14	61.16	2.24	18.55	7.95	4.31

TABLE 3-10
County Land Uses in the Proposed Goose MOA (Adjacent Counties)

County	Total Acreage	Percent						
		Agriculture	Barren	Forest	Grassland	Shrub / Brushland	Urban / Rural Development	Water
Crook	1,907,951	14.43		26.09	2.66	51.02	5.50	0.30
Deschutes	1,884,252			60.46	1.39	31.68	1.99	1.05
Harney	6,533,199	5.95	4.58	10.44	5.02	71.21	1.05	1.76
Washoe	27,345						0.65	

TABLE 3-11
County Land Uses in the Hart MOA (Underlying Counties)

County	Total Acreage	Percent						
		Agriculture	Barren	Forest	Grassland	Shrub / Brushland	Urban / Rural Development	Water
Harney	6,533,199	5.95	4.58	10.44	5.02	71.21	1.05	1.76
Lake	5,340,291	5.10	1.71	30.64	3.02	55.09	1.66	2.77
Modoc	2,685,993	5.66	0.14	61.16	2.24	18.55	7.95	4.31
Washoe	4,187,613	1.02	7.47	6.41	3.35	77.68	0.65	3.42

TABLE 3-12
County Land Uses in the Hart MOA (Adjacent Counties)

County	Total Acreage	Percent						
		Agriculture	Barren	Forest	Grassland	Shrub / Brushland	Urban / Rural Development	Water
Crook	1,907,951	14.43		26.09	2.66	51.02	5.50	0.30
Grant	2,892,442	12.29		68.28	2.57	11.60	5.24	0.02

TABLE 3-12
County Land Uses in the Hart MOA (Adjacent Counties)

Humboldt	6,172,424	2.77	10.24	3.16	5.98	77.22	0.62	0.01
Malheur	6,343,465	5.92	8.38	0.72	2.61	80.50	1.14	0.74
Pershing	3,878,541	0.80	12.47	1.18	2.57	81.89	1.00	0.09

TABLE 3-13
County Land Uses in the Juniper MOA (Underlying Counties)

County	Total Acreage	Percent						
		Agriculture	Barren	Forest	Grassland	Shrub / Brushland	Urban / Rural Development	Water
Crook	1,907,951	14.43		26.09	2.66	51.02	5.50	0.30
Deschutes	1,951,133	3.43		60.46	1.39	31.68	1.99	1.05
Harney	6,533,199	5.95	4.58	10.44	5.02	71.21	1.05	1.76
Lake	5,340,291	5.10	1.71	30.64	3.02	55.09	1.66	2.77

TABLE 3-14
County Land Uses in the Juniper MOA (Adjacent Counties)

County	Total Acreage	Percent						
		Agriculture	Barren	Forest	Grassland	Shrub / Brushland	Urban / Rural Development	Water
Baker	1,972,230	20.93		39.43	9.41	17.68	11.86	0.68
Grant	2,892,442	12.29		68.28	2.57	11.60	5.24	0.02
Humboldt	6,172,424	2.77	10.24	3.16	5.98	77.22	0.62	0.01
Malheur	6,343,465	5.92	8.38	0.72	2.61	80.50	1.14	0.74
Wheeler	1,095,403	9.72		37.58	2.92	46.66	3.11	

3.1.6 Infrastructure, Transportation, and Utilities

The Goose, Hart, and Juniper MOAs are traversed by three principal state highways. Highways 97 and 395 provide for north–south travel in this region. Highways 20 and 31 provide for east–west travel. The remainders of the road networks are minor road connections. There are no airports. Several power utilities serve the area (Table 3-15).

TABLE 3-15
Major Power Utilities Serving the Goose, Hart, and Juniper MOAs

Power Utility	Location (Counties, State)
Central Electric Cooperative, Inc	Crook, Deschutes OR
Harney Electric Cooperative, Inc	Crook, Deschutes, Harney, Lake OR
Idaho Power Company	Harney, OR
Lassen Municipal Utility District	Lassen, CA
Midstate Electric Cooperative, Inc	Deschutes, Klamath, Lake OR
Oregon Trail Electric Consumers Cooperative, Inc	Harney, OR
Pacific Gas and Electric Company	Lassen, CA
PacifiCorp	Crook, Deschutes, Klamath, Lake OR; Modoc, CA
Plumas-Sierra Rural Electric Cooperative	Lassen, CA
Sierra Pacific Power Company	Washoe, NV
Surprise Valley Electrification Corporation	Lake, OR; Washoe, NV; Modoc, Lassen, CA

3.1.7 Cultural Resources

There are several potentially interested tribal organizations in the Goose, Hart, and Juniper MOAs. These include the Alturas Rancheria, Cedarville Rancheria, Fort Bidwell Reservation, Burns Paiute Tribe General Council, Klamath General Council, and Confederated Tribes of the Warm Springs Reservation.

3.1.8 Socioeconomics

The region of the Goose, Hart, and Juniper MOAs is sparsely populated. The largest town in the region is Lakeview, Oregon with a population of 2,474. Cattle ranching and agriculture are the leading sources of income. Population and income data are presented in Table 3-16.

TABLE 3-16
Socioeconomic Characteristics of the Goose and Hart MOAs (Underlying Counties)

County	Area[1]	Population[2]	Density[3]	Median Household Income ($)[4]
Deschutes, OR	3,018	115,367	38.2	37,046
Crook County, OR	2,979	19,182	6.4	33,188
Lake County, OR	8,136	7,422	0.9	30,427
Harney, OR	10,134	7,609	0.8	29,809
Klamath, OR	5,944	63,775	10.7	30,781
Modoc, CA	3,944	9,449	2.4	28,174
Lassen, CA	4,557	33,828	7.4	36,819

TABLE 3-16
Socioeconomic Characteristics of the Goose and Hart MOAs (Underlying Counties)

County	Area[1]	Population[2]	Density[3]	Median Household Income ($)[4]
Washoe, NV	6,342	339,486	53.5	42,070
Total/Average	45,054	596,118	13.2	33,539

1. US Census Bureau - Land Area, Population, and Density for States and Counties, 2000
2. US Census Bureau - Estimated population for 2000 <www.census.gov/population/estimates/county/
3. Calculated - County Population divided by County Area.
4. US Census Bureau - Small Area Income and Poverty Estimates Program – 1997 Model based income and poverty estimates for counties

3.1.9 Environmental Justice

On February 11, 1994, President Clinton signed Executive Order No. 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." The purpose of this order is to require federal agencies to identify and address any disproportionately high and adverse environmental effects that its programs and policies might have on minority or low-income populations.

To provide the baseline against which any such impacts can be identified and analyzed, demographic information on race, ethnicity, and poverty status in the counties underlying the Goose, Hart and Juniper MOAs are presented in Table 3-17. Statistics for the states of California, Oregon, and Nevada are presented to provide context.

The December 1997 guidance document from the Council on Environmental Quality (CEQ), *Environmental Justice: Guidance Under the National Environmental Policy Act*, defines the term "minority population" as including people who identify themselves as Black, Asian or Pacific Islander, Native American or Alaskan Native, or Hispanic. A minority population exists where the percentage of minorities in an affected area either exceeds 50 percent or is meaningfully greater than in the general population of the larger surrounding area (CEQ, 1997).

Low-income populations are identified using the US Census Bureau's statistical poverty threshold, which is based on income and family size. The Census Bureau defines a "poverty area" as a Census tract where 20 percent or more of the residents have incomes below the poverty threshold and an "extreme poverty area" as one with 40 percent or more below the poverty level (Bureau of the Census, 1995).

As Table 3-17 shows, total minority population in the counties underlying the Goose, Hart, and Juniper MOAs are less than the surrounding states. Several of the counties have slightly higher percentages of some minority groups than the statewide percentages (Black residents in Lassen County and American Indian residents in all except Deschutes), but minorities represent less than 15 percent of the population in each county. Madoc County meets the 20 percent definition of a poverty area and Lassen comes very close (21.1 and 19.4, respectively), while the state wide poverty rate for California is 16 percent.

TABLE 3-17
Demographic Statistics for the Goose, Hart and Juniper MOAs

Jurisdiction	Total Persons (2000)	Percentage						
		White (2000)	Black (2000)	American Indian[2] (2000)	Asian [3] (2000)	Other (2000)	Hispanic Origin[4] (2000)	Poverty Rate[5] (1997)
California	33,871,648	59.9	6.7	1	11.2	16.8	32.4	16
Oregon	3,421,399	86.6	1.6	1.3	3.2	4.2	8.0	11.6
Nevada	1,998,257	75.2	6.8	1.3	3.7	8	19.7	10.7
Goose MOA[1] Counties								
Modoc Co., CA	9,449	85.9	0.7	4.2	0.7	5.7	11.5	21.1
Lassen Co., CA	33,828	80.8	8.8	3.3	1.1	3.2	13.8	19.4
Klamath Co., OR	63,775	87.3	0.6	4.2	0.9	3.4	7.8	15.9
Lake Co., OR	7,422	91	0.1	2.4	0.8	3.2	5.4	14.7
Hart MOA Counties								
Harney Co., OR	7,609	91.9	0.1	4	0.6	1.3	4.2	14.8
Washoe, NV	339,486	80.4	2.1	1.8	4.8	7.7	16.6	9.8
Juniper MOA Counties								
Crook Co., OR	19,182	93	(Z)	1.3	0.4	3.8	5.6	12.8
Deschutes Co., OR	115,367	94.8	0.2	0.8	0.8	1.4	3.7	10.6

Source: U.S. Bureau of the Census, 2000

Notes:
1. Includes Goose MOA expansion effective April 2002
2. Includes Alaska native and Aleutian Islander
3. Includes Pacific Islander
4. Race refers to Census respondents' self-identification of racial background. Hispanic origin refers to ethnicity and language, not race, and may include persons whose heritage is Puerto Rican, Cuban, Mexican, and Central or South American.
5. The values shown are 1997 Census Bureau estimates of percent persons with household incomes below the poverty threshold.

(Z) values are greater than zero but less than half unit of measure shown.

3.2 Dolphin

The Dolphin MOA, which was formerly an air refueling range, encompasses portions of Benton, Lane, Coos, Curry, Douglas, Josephine and Lincoln counties in Oregon, and Del Norte, Humboldt, and Siskiyou counties in California. The affected environment in the Dolphin MOA is in the Pacific Border physiographic region, which encompasses the Coast Range and the Klamath Mountains (Figure 3-2). The new Dolphin MOA has received FAA approval and is scheduled to be charted as an official MOA in April 2002.

3.2.1 Earth Resources

The lands underlying the Dolphin MOA are characteristic of the Pacific Border physiographic region. The area is bordered by the Pacific Ocean to the west. The most prominent geologic features in this area are the Coast Range mountains, with ridges running parallel to the coast and narrow valleys between the ridges. The crests of the ridges reach an average height of 3,600 ft. Abutting the Coast Range are the higher and more rugged Klamath Mountains, which extend from Oregon southward into northwestern California. Their highest peaks exceed 7,000 ft. The coastline of Oregon is regular, with few indentations or promontories. Beaches fringed with low dunes line many parts of the coast. Rugged cliffs and headlands make up the rest of the shoreline. Coos Bay is the most important ocean harbor for freighters between Portland and San Francisco. In western Oregon, where the conditions for soil formation include fairly heavy rainfall and moderate year-round temperatures, the soil cover is thick but has been highly leached of its soluble minerals.

3.2.2 Climate

Dolphin MOA has a temperate marine climate. Because of the moderating effect that nearby ocean water has on seasonal temperatures, summers are cool and winters are mild. Average temperatures in January and July are 40° F and 70° F, respectively. Annual precipitation varies, with rainfall closer to the Pacific Ocean between 50 and 70 inches annually. On the east side of the Coast Range mountains, average rainfall is between 30 and 40 inches annually. Summers are characterized by fog, cool temperatures, and higher humidity than inland.

3.2.3 Water Resources.

The Dolphin MOA includes the coastal areas of northern California and southern Oregon and a portion of the Pacific Ocean. This area contains numerous streams and rivers which drain to the Pacific Ocean. Significant water bodies in the area include the Pacific Ocean, Lake Earl, Smith River, Rogue River, Coquille River, Umpqua River, Siuslaw River, Siltcaps Lake, Coos Bay and Fern Ridge Reservoir. Most of the streams and lakes provide opportunities for recreational activities. The rivers of the northern Oregon coast are short, generally draining only the western side of the mountains, although the Siuslaw and Umpqua rivers traverse the entire Oregon Coast Range and the Rogue River drains a large area in the southwest of the state. The rivers of the Coast Ranges in California are relatively short, except for the 250-mile long Klamath River, which rises in Oregon and flows through northwestern California.

3.2.4 Biological Resources

The Dolphin MOA contains vast tracts of forested lands, and the lumber industry is a predominant industry in this region. Predominant species include redwood, douglas-fir, Oregon white oak, and coast live oak. This region contains a variety of birds, fish and animal including Roosevelt elk, black-tailed deer, black bear, mountain lion, coyote, bobcat, raccoon, skunks, marten, fisher and river otter. Birds include eagles, hawks, owls, peregrine falcon, osprey and a variety shorebirds and waterfowl along the coastal part of the MOA. Streams and rivers are used by anadromous fish. Species of concern include marbled murrelet and northern spotted owl. The forested areas of Northern California are the most densely forested areas of California.

In the counties underlying the Dolphin MOA, there are a total of 58 threatened or endangered species of flora and fauna (39 in Oregon counties and 19 in California counties). In the adjacent downwind counties, there are a total of 36 threatened or endangered flora and fauna species (32 in Oregon and 4 in California) (Tables 3-18 and 3-19).

TABLE 3-18
Threatened and Endangered Flora and Fauna in the Dolphin MOA (Underlying Counties)

Common Name	Scientific Name	Status
Oregon		
Marbled Murrelet	*Brachyramphus marmoratus*	LT
Western Snowy Plover	*Charadrius alexandrinus nivosus*	LT
Bald Eagle	*Haliaeetus leucocephalus*	LT
Brown Pelican	*Pelecanus occidentalis*	LE
Northern Spotted Owl	*Strix occidentalis caurina*	LT
Coho Salmon	*Oncorhynchus kisutch*	LT
Northern Sea Lion	*Eumetopias jubatus*	LT
California Wolverine	*Gulo gulo luteus*	ST
Oregon Silverspot Butterfly	*Speyeria zerene hippolyta*	LT
Salt-Marsh Bird's Beak	*Cordylanthus maritimus*	SE
Coast Range Fawn-Lily	*Erhthronium elgans*	ST
American Peregrine Falcon	*Falco peregrinus anatum*	SE
Gray Wolf	*Canis lupus*	LE
Red Mt. Rockcress	*Arabis modesta*	LE
Howell's Mariposa Lily	*Calochortus howellii*	ST
Sexton Mt. Mariposa-Lily	*Calochortus indecorus*	SE
Umpqua Mariposa-Lily	*Calochortus indecorus*	SE
Gentner's Fritillaria	*Fritillaria gentneri*	LE
Large-Flowered Rush-Lily	*Hastingsia bracteosa*	ST

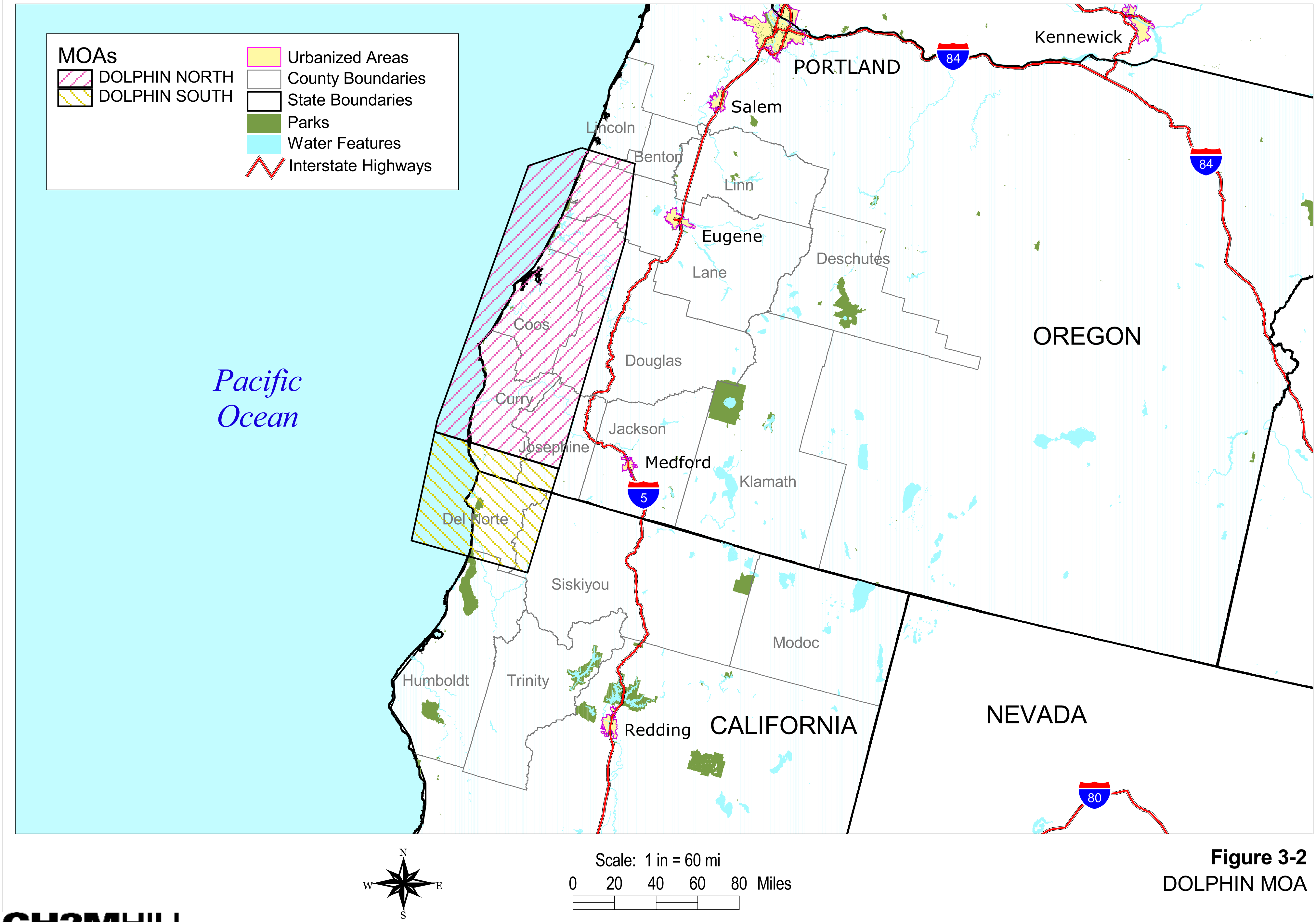

Figure 3-2
DOLPHIN MOA

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TABLE 3-18
Threatened and Endangered Flora and Fauna in the Dolphin MOA (Underlying Counties)

Common Name	Scientific Name	Status
Agate Desert Lomatium	*Lomatium cookii*	SE
Howell's Microseris	*Microseris howellii*	ST
A Popcornflower	*Plagiobothrys lamprocarpus*	SE
Columbian White-Tailed Deer	*Odocoileus virginianus leucurus*	LE
Pink Sandverbena	*Abronia umbellata*	SE
Wayside Aster	*Aster vialis*	ST
Cox's Mariposa Lily	*Calochortus coxii*	SE
Kincaid's Lupine	*Lupinus sulphureus*	LT
Rough Popcorn Flower	*Plagiobothrys hirtus*	LE
Aleutian Canada Goose	*Branta canadensis leucopareia*	LT
Southern Sea Otter	*Enhydra lutris nereis*	LT
Western Lily	*Lilium occidentale*	LE
Wolf's Evening-Primrose	*Oenothera wolfii*	ST
Silvery Phacelia	*Phacelia argentea*	ST
Upper Willamette River Steelhead	*Oncorhynchus mykiss*	LT
Oregon Chub	*Oregonichthys crameri*	LE
Fender's Blue Butterfly	*Icaricia icarioides fenderi*	LE
Williamette Valley Daisy	*Erigeron decumbens var decumbens*	LE
Bradshaw's Lomatium	*Lomatium bradshawii*	LE
Nelson's Sidalcea	*Sidalcea nelsoniana*	LT
California		
Tidewater Goby	*Eucyclogobius newberryi*	LE
Bank Swallow	*Riparia riparia*	ST
Humboldt Milk-Vetch	*Astragalus agnicidus*	SE
Humboldt Bay Wallflower	*Erysimum menziesii ssp eurekense*	LE
Beach Layia	*Layia carnosa*	LE
California Clapper Rail	*Rallus longirostris obsoletus*	LE
McDonald's Rock Cress	*Arabis macdonaldiana*	LE
Ashland Thistle	*Cirsium ciliolatum*	SE
Trinity Buckwheat	*Eriogonum alpinum*	SE
Slender Orcutt Grass	*Orcuttia tenuis*	LT
Yreka Phlox	*Phlox hirsuta*	SE

TABLE 3-18
Threatened and Endangered Flora and Fauna in the Dolphin MOA (Underlying Counties)

Common Name	Scientific Name	Status
Shortnose Sucker	*Chasmistes brevirostris*	LE
Lost River Sucker	*Deltistes luxatus*	LE
Siskiyou Mountains Salamander	*Plethodon stormi*	ST
Swainson's Hawk	*Buteo swainsoni*	ST
Western Yellow-Billed Cuckoo	*Coccyzus americanus occidentalis*	SE
Willow Flycatcher	*Empidonax traillii*	SE
Greater Sandhill Crane	*Grus canadensis tabida*	ST
Sierra Nevada Red Fox	*Vulpes vulpes necator*	ST

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

TABLE 3-19
Threatened and Endangered Flora and Fauna in the Dolphin MOA (Adjacent Counties)

Scientific Name	Common Name	Status
Oregon		
Marbled Murrelet	*Brachyramphus marmoratus*	LT
Western Snowy Plover	*Charadrius alexandrinus nivosus*	LT
American Peregrine Falcon	*Falco peregrinus anatum*	SE
Bald Eagle	*Haliaeetus leucocephalus*	LT
Brown Pelican	*Pelecanus occidentalis*	LE
Northern Spotted Owl	*Strix occidentalis caurina*	LT
Coho Salmon	*Oncorhynchus kisutch*	LT
Chinook Salmon	*Oncorhynchus tshawytscha*	LT
Oregon Chub	*Oregonichthys crameri*	LE
Bull Trout	*Salvelinus confluentus*	LT
Gray Wolf	*Canis lupus*	LE
Northern Sea Lion	*Eumetopias jubatus*	LT
Columbian White-Tailed Deer	*Odocoileus virginianus leucurus*	LE
Fender's Blue Butterfly	*Icaricia icarioides fenderi*	LE
Oregon Silverspot Butterfly	*Speyeria zerene hippolyta*	LT
Pink Sandverbena	*Abronia umbellata ssp breviflora*	SE
White-Topped Aster	*Aster curtus*	ST

TABLE 3-19
Threatened and Endangered Flora and Fauna in the Dolphin MOA (Adjacent Counties)

Scientific Name	Common Name	Status
Wayside Aster	*Aster vialis*	ST
Willamette Valley Daisy	*Erigeron dcumbens var decumbens*	LE
Bradshaw's Lomatium	*Lamatium bradshawii*	LE
Kincaid's Lupine	*Lupinus sulphureus ssp kincaidii*	LT
California Wolverine	*Gulo gulo luteus*	ST
Vernal Pool Fairy Shrimp	*Branchinecta lynchi*	LT
Umpqua Mariposa-Lily	*Calochortus umpquaensis*	SE
Genter's Fritillaria	*Fritillaria gentneri*	LE
Big-Flowered Wooly Meadowfoam	*Limnanthes floccosa ssp grandiflora*	SE
Dwarf Wooly Meadow-Foam	*Limnanthes floccosa ssp pumila*	ST
Agate Desert Lomatium	*Lomatium cookii*	SE
Wolf's Evening-Primrose	*Oenothera wolfii*	ST
Upper Willamette River Steelhead	*Oncorhynchus mykis*	LT
Golden Indian-Paintbrush	*Castilleja levisecta*	LT
Nelson's Sidalcea	*Sidalcea nelsoniana*	LT
California		
McDonald's Rock Cress	*Arabis macdonaldiana*	LE
Trinity Buckwheat	*Eriogonum alpinum*	SE
Trinity Bristle Snail	*Monadenia setosa*	ST
Sierra Nevada Fox	*Vulpes vulpes necator*	ST

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

3.2.5 Land Use and Visual Resources

The dominant land use/land cover in and around the Dolphin MOA is forest (Tables 3-20 and 3-21). Numerous parks and natural areas within these forested areas provide opportunities for camping and recreational activities in the Dolphin MOA. In general, the Pacific coastline and coastal communities are major tourist attractions. Natural areas in Dolphin MOA include Redwood National Park, Smith River National Recreation Area, Castle Rock NWR, Oregon Islands NWR, Siskiyou Wilderness Area, Kalmiopsis Wilderness Area, Grassy Knob Wilderness Area, Wild Rogue Wilderness Area, Rock Creek Wilderness Area, and Cummins Wilderness Area. National Forests in this region include the Elliot State National Forest, the Rogue River National Forest, the Siskiyou National Forest, Siuslaw National Forest, and the Six Rivers National Forest. Some of the world's tallest trees grow in the Redwood National Park in the northwestern portion of California.

TABLE 3-20
County Land Uses in the Dolphin MOA (Underlying Counties)

County	Total Acreage	Percent					
		Agriculture	Forest	Grassland	Shrub / Brushland	Urban / Rural Development	Water
Benton	433,555	2.10	71.51	0.53		25.87	
Coos	1,022,486	1.25	96.09	0.48	0.40	1.21	0.54
Curry	1,040,066	0.55	97.08	0.16		1.55	0.65
Del Norte	636,422	1.30	95.18	0.03		3.03	0.38
Douglas	3,230,585	0.41	96.68	0.39	0.04	2.16	0.09
Humboldt	2,247,580	0.86	90.66	0.23	0.01	8.00	0.18
Josephine	1,048,938	0.14	99.58	0.05		0.24	
Lincoln	622,370	0.62	97.20	0.07		0.86	1.05
Siskiyou	4,056,481	3.08	82.52	1.34	2.03	10.15	0.89

TABLE 3-21
County Land Uses in the Dolphin MOA (Adjacent Counties)

County	Total Acreage	Percent					
		Agriculture	Forest	Grassland	Shrub / Brushland	Urban / Rural Development	Water
Jackson	1,790,046	0.18	96.90	0.32	0.95	1.63	0.03
Lane	2,943,775	1.90	91.95	0.31	0.28	5.14	0.35
Linn	1,474,476	10.73	74.05	0.28	0.03	13.60	1.31
Trinity	2,050,304	0.05	96.12	0.37	0.08	1.41	1.96

3.2.6 Infrastructure, Transportation, and Utilities

The Dolphin MOA is served by Highway 101 which provides for north – south travel along the coasts of California and Oregon. There are several smaller highways and local roads that provide for east – west travel from the coastal areas to inland communities. North Bend Airport is located in the MOA and Mahlon Sweet Airport is located just east of the MOA. Several power utilities serve the area (Table 3-22).

TABLE 3-22
Major Power Utilities Serving the Dolphin MOA

Power Utility	Location (Counties, State)
City of Bandon	Coos, Curry, OR
City of Drain	Douglas, OR
Consumers Power, Inc	Benton, Lincoln, OR
Coos-Curry Electric Cooperative, Inc	Coos, Curry, Douglas, OR
Douglas Electric Cooperative, Inc	Douglas, OR
Emerald People's Utility District	Douglas, OR
Pacific Gas and Electric Company	Siskiyou, Humboldt, CA
PacifiCorp	Benton, Coos, Douglas, Josephine, Lincoln, OR; Siskiyou, Del Norte, CA
Tillamook People's Utility District	Lincoln, OR

3.2.7 Cultural Resources

The potentially interested tribal organizations in the Dolphin MOA include the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians, Cow Creek Government Offices, Coquille Indian Tribe, Siletz Tribal Council, Karuk Tribe of California, Smith River Rancheria, and Yurok Tribe.

3.2.8 Socioeconomics

The population centers in the Dolphin MOA are comprised of towns with relatively small populations (e.g. Coos Bay at 15,374, Florence at 7,263) while major economic areas are located just outside of the MOA in the Willamette Valley cities of Eugene, Medford, and Grants Pass. The lumber industry and tourism are major sources of income for the coastal communities of Oregon and Northern California. Since the 1940s Oregon has been the largest producer of lumber in the US. Population and income data are provided in Table 3-23.

TABLE 3-23
Socioeconomic Characteristics of the Dolphin MOA (Underlying Counties)

County	Area[1]	Population[2]	Density[3]	Median Household Income ($)[4]
Lincoln, OR	980	44,479	45.4	30,294
Benton, OR	676	78,153	115.6	43,632
Coos, OR	1,600	62,779	39.2	29,933
Lane, OR	4,554	322,959	70.9	34,672
Curry, OR	1,627	21,137	13.0	28,463
Douglas, OR	5,037	100,399	19.9	32,005

TABLE 3-23
Socioeconomic Characteristics of the Dolphin MOA (Underlying Counties)

County	Area[1]	Population[2]	Density[3]	Median Household Income ($)[4]
Josephine, OR	1,640	75,726	46.2	26,988
Del Norte, CA	1,008	27,507	27.3	29,044
Humboldt, CA	3,572	126,518	35.4	30,426
Siskiyou, CA	6,287	44,301	7	28,178
Total/Average	26,981	903,958	33.5	31,364

1. US Census Bureau - Land Area, Population, and Density for States and Counties, 2000.
2. US Census Bureau – Estimated population for 2000 <www.census.gov/population/estimates/county
3. Calculated - County Population divided by County Area.
4. US Census Bureau - Small Area Income and Poverty Estimates Program – 1997 Model based income and poverty estimates for counties

3.2.9 Environmental Justice

Demographic information on race, ethnicity, and poverty status in the counties underlying the Dolphin MOA are presented in Table 3-24. Statistics for the states of California and Oregon are included to provide context. (See subsection 3.3 for the definitions of minority population and poverty areas).

Total minority population in the counties underlying the Dolphin MOA is less than the surrounding states. Several of the counties have slightly higher percentages of some minority groups than the statewide percentages (Asians in Benton County and American Indians in all except Benton and Josephine counties), but minorities represent less than 15 percent of the population in the California counties (except DelNorte County) and less than 5 percent in the Oregon counties (except Benton and Lincoln Counties). One county meets the definition of a poverty area, Del Norte with a poverty rate of 22.9 percent.

TABLE 3-24
Demographic Statistics for the Dolphin MOA

Jurisdiction	Total Persons (2000)	Percentage						
		White (2000)	Black (2000)	American Indian[1] (2000)	Asian[2] (2000)	Other (2000)	Hispanic Origin[3] (2000)	Poverty Rate[4] (1997)
California	33,871,648	59.9	6.7	1	11.2	16.8	32.4	16
Oregon	3,421,399	86.6	1.6	1.3	3.2	4.2	8	11.6
Dolphin MOA Counties								
Del Norte Co., CA	27,507	78.9	4.3	6.4	2.4	3.9	13.9	22.9
Humboldt Co., CA	126,518	84.7	0.9	5.7	1.9	2.4	6.5	18.5

TABLE 3-24
Demographic Statistics for the Dolphin MOA

Jurisdiction	Total Persons (2000)	Percentage						
		White (2000)	Black (2000)	American Indian[1] (2000)	Asian[2] (2000)	Other (2000)	Hispanic Origin[3] (2000)	Poverty Rate[4] (1997)
Siskiyou Co., CA	44,301	87.1	1.3	3.9	1.3	2.8	7.6	19
Benton Co., OR	78,153	89.2	0.8	0.8	4.7	1.9	4.7	9.1
Coos Co., OR	62,779	92	0.3	2.4	1.1	1.1	3.4	16.7
Curry Co., OR	21,137	92.9	0.2	2.1	0.8	1.1	3.6	13.9
Douglas Co., OR	100,399	93.9	0.2	1.5	0.6	1	3.3	14.6
Josephine Co., OR	75,726	93.9	0.3	1.3	0.7	1.2	4.3	18.7
Lincoln Co., OR	44,479	90.6	0.3	3.1	1.1	1.7	4.8	14.7

Source: U.S. Bureau of the Census, 2000

Notes:
1. Includes Alaska native and Aleutian Islander
2. Includes Pacific Islander
3. Race refers to Census respondents' self-identification of racial background. Hispanic origin refers to ethnicity and language, not race, and may include persons whose heritage is Puerto Rican, Cuban, Mexican, and Central or South American.
4. The values shown are 1997 Census Bureau estimates of percent persons with household incomes below the poverty threshold.

3.3 Crypt

The Crypt MOA is located in the western part of Iowa and encompasses the counties of Buena Vista, Calhoun, Cherokee, Humboldt, Ida, Plymouth, Pocahontas, Sac, Webster, Woodbuy, Carroll, Crawford, Greene, Montana, Clay, Dickinson, Kossuth, O'Brien, Osceola, Palo Alto, and Sioux (Figure 3-3). The affected environment region of influence includes these counties underlying the Crypt MOA, as well as the adjacent counties of Jackson, Marin, and Fairbault in southwest Minnesota and Emmet, Winnebago, Hancock, Wright, Hamilton, Boone, Dallas, Guthrie, Audubon, and Shirley in central Iowa.

3.3.1 Earth Resources

Iowa lies entirely within the Central Lowland physiographic region, which in turn forms part of the Interior Plains. The Central Lowland can be divided into several subregions, or sections, four of which extend into Iowa. These four sections are the Till Plains, the Dissected Till Plains, the Western Young Drift section, and the Driftless section.

The Crypt MOA is located primarily in the northwestern part of Iowa. The western section of the MOA is occupied by Dissected Till Plains. The eastern section of the MOA and the adjacent counties are in the north central part of the state, which is occupied by the Western Young Drift Section.

The Dissected Till Plains were glaciated during the early part of the ice age, and are generally more dissected, or eroded, than more recently formed glacial drift or till areas. The terrain varies from almost flat prairie east of the south central part of the state to distinctly hilly areas to the south and west. Much of the Dissected Till is covered by extensive deposits of *loess (* a wind-carried form of glacial silt) during the last part of the Ice Age. Near the Missouri River and other major rivers, the loess deposits were deposited by wind action to form steep-sided bluffs that rise as much as 150 ft above the river surface.

In contrast, the Western Young Drift section is generally a flat area that has been leveled by the most recent glaciation. Its flat surface has received little alteration from erosion, but contains glacial boulders. Small lake-filled depressions were once numerous in the western part of this region, but most of them have been filled in or drained by agriculture. The Iowa Prairie lands along the west central part of the state is the area of most recent glaciation, and is characterized by a series of pronounced ridges or rises along the west and the east which are the terminal moraines left by the last ice sheet.

Although the Western Young Drift section lacks the loess deposits which are common to southern Iowa, fertile soils have developed on the thick layer of recent glacial drift. These areas constitute the most productive cropland in the state and is ideally suited for large-scale farming. Gently rolling hills and poorly drained plains are found in the counties underlying the Crypt MOA.

Iowa, as a whole, contains deep fertile soils derived from glacial till. The glacial till in many areas were once covered by loess blown in from nearby flood plains along the major rivers. The soils were later enriched by the humus content derived from the growth of densely rooted prairie grasses. These so-called tall grass prairie soils, with thick, black or very dark gray surface layers, dominated most of central, western, and northern Iowa. However, the prairie grasses have been cleared and have long since been put to agricultural uses. Among the most productive soils are those of the Prairie Pothole region along the north central part of the state, and the fertile alluvial soils of the Missouri River Valley.

3.3.2 Climate

Iowa’s climate is characterized by warm, generally moist summers and cold winters. Temperatures usually vary considerably on a seasonal, and occasionally on a daily basis. Monthly average temperatures are relatively uniform and usually vary less than 10° in all areas. Average monthly temperatures in July range from less than 72° F in northern half of the state, to more than 76° F in the southern half. Daytime high temperatures in summer are usually between 85° and 90° F in most parts of the state, with temperatures in the lower 110°s F occurring infrequently. Average January temperature range from less than 14° F in the north to more than 24° F in the extreme southeast, with most areas experiencing lows in the upper -20°s F.

Most of the state receives between 26 and 36 in of precipitation (rainfall and snowfall) annually, with precipitation decreasing from an east to west direction. The growing season ranges from about 180 days in the southeastern and southwestern corners of the state to about 130 days in the extreme northwest. The last killing frost in the spring usually occurs in

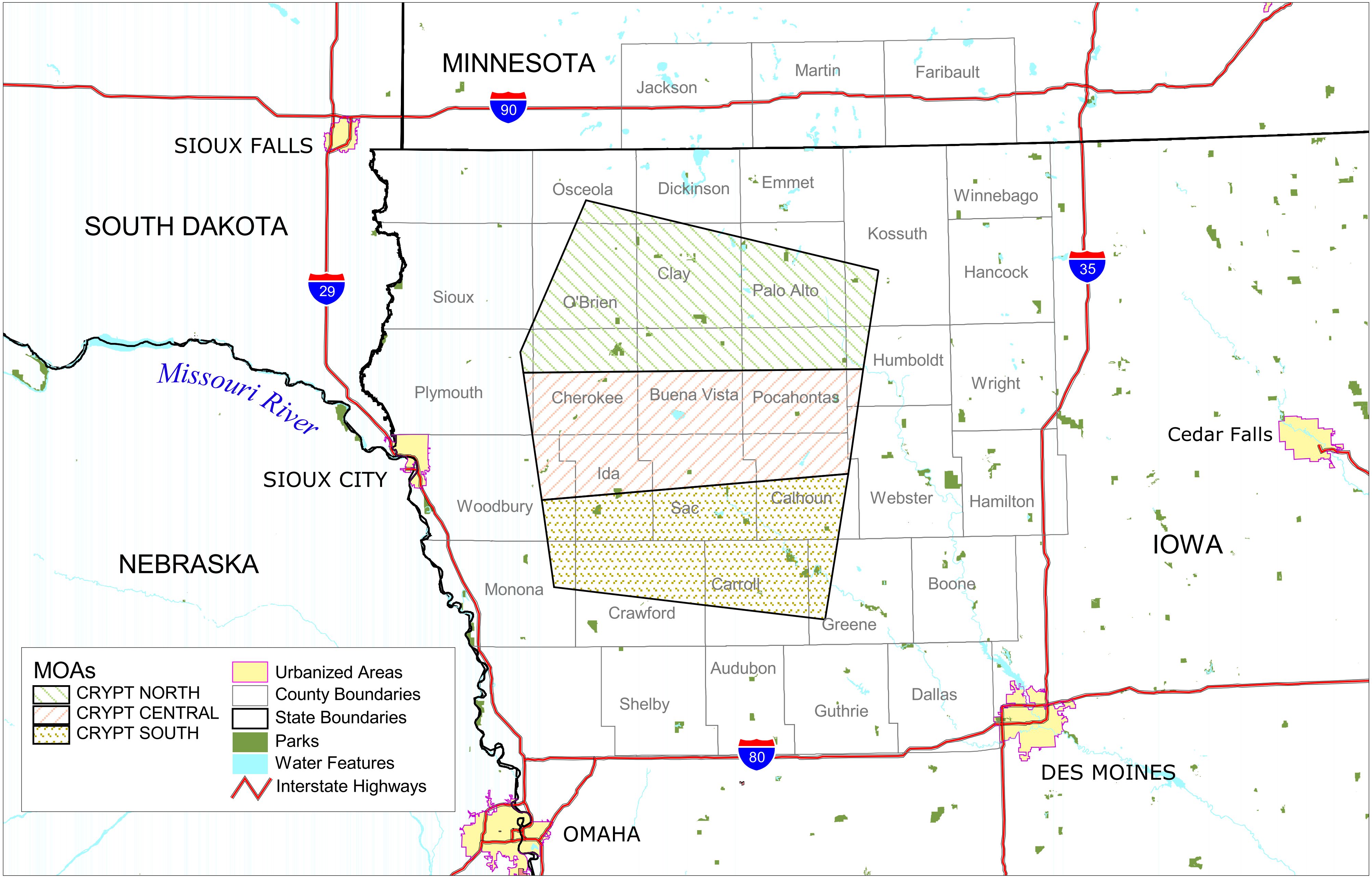

Figure 3-3
CRYPT MOA

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late April in the south and in early May in the north. The first killing frost in the fall generally occurs in late September or early October in the north and in the second week of October in the south. Although total snowfall is not usually very great, the severity of winter is often increased by high winds which produces blizzard conditions accompanied by prolonged periods of very low temperatures.

3.3.3 Water Resources

Water Resources. The rivers of Iowa flow either southeastward to the Mississippi River or southwestward to the Missouri River. The watershed divide between the rivers flowing southeastward and southwestward, runs down the western side of the state. The Crypt MOA is located along the watershed divide. The rivers which drain to the Mississippi River are much longer than those that drain to Missouri River and flow in shallow, roughly parallel valleys. The rivers which drain to the Missouri River include the Ocheyedan, Little Sioux, Maple, and Boyer River which drains the western half of the MOA, while the Des Moines, Lizard, North Raccoon, and Middle Raccoon River drains the eastern half of the MOA. The Iowa River and the Des Moines River, which drain the region of influence of the MOA, are among the longest rivers in the state.

There are about 100 small natural lakes in Iowa and most of them located in the Western Young Drift section near the vicinity of, or within the Crypt MOA. Significant natural lakes in the Crypt MOA include Storm Lake, in Buena Vista County, Lost Island and Trumbull Lake in Clay County, Blackhawk Lake in Sac County, and Twin Lakes in Calhoun County. A number of reservoirs have been created by damming several smaller Iowa rivers, and these are located outside of the MOA and its general region of influence.

3.3.4 Biological Resources

Prior to settlement, much of Iowa was covered by tall prairie grass vegetation, with ribbons of forestland along the major watercourses and by lakes, ponds, and swamp areas. The most common vegetation types were the big bluestem and little bluestem, which were intermingled during warmer months by a variety of wildflowers, including wild roses, pasqueflowers, asters, phlox, wild indigo brooms, goldenrods, lilies, and gentians. However, much of this original prairie, or grassland, has long been cleared for cultivation. Prairie flowers and grasses are now found in small plots and along roadsides throughout the state. Other common wildflowers found in Iowa include the trillium, bloodroot, hepatica, anemone, and mayapple. Pondweed, bladderwort, crowfoot, duckweed, hornwort, marsh marigold, and sedge are found in the few remaining marshy areas.

Woodlands and forested areas are generally scarce and cover about five percent of Iowa. The remaining forested lands are mainly found in the Driftless section and along the major rivers systems and contain mostly second-growth and third-growth timber (the original trees have been cut during early settlement). Since there are few extensively forested areas, many of the larger woodland areas are preserved in state forests and parks. The most common trees found in Iowa are oak, hickory, maple, and elm. Green ash, willow, and cottonwood occur along river valleys across the state.

In the region of the Crypt MOA, vegetation composition has been estimated as 95 percent agriculture, and 5 percent oak-hickory stands. The oak-hickory stands are located primarily in along the Little Sioux River valley.

Prior to 19th century settlement, the prairie and woodland areas of Iowa supported a varied wildlife population. Currently, much of the fauna has been reduced by hunting and habitat loss. The remaining animal population consists primarily of small mammals such as the muskrat, raccoon, red fox, jackrabbit, cottontail, fox squirrel, and gray squirrel. Other animals found in Iowa are the coyote, beaver, badger, weasel, mink, striped skunk, gray fox, opossum, gopher, woodchuck, and the white-tailed deer. Finally, Iowa also contains a number of species of reptiles, which include poisonous snakes such as the massassauga, prairie, and timber rattlesnakes.

Iowa lies within the Mississippi Flyway which is a major migratory route followed by millions of birds during their annual migration along the Mississippi and Missouri river valleys. Waterfowl are numerous in the flyway and include species such as the mallard, redhead, blue-winged teal, American coot, Canada goose, and snow goose. In addition to waterfowl, Iowa is also home to game birds are the ring-necked pheasant, ruffed grouse, and bobwhite quail. The bald eagle is known to spend winter months in Iowa, and several species of hawk pass through the state in the summer.

Many of Iowa's rivers and streams are well stocked with fish, and include both warm water and cold water fish species. Several varieties of catfish are common, along with smallmouth bass, trout species, pike, yellow perch, crappie, bluegill, and common carp. The cluster of lakes in the northern part of the Crypt MOA, as well as the numerous tributaries are home to these species.

In the counties underlying the Crypt MOA, there are a total of 21 threatened and endangered flora and fauna (Table 3-25). In the adjacent counties, there are a total of 26 threatened and endangered flora and fauna species (15 in Iowa and 11 in Minnesota; Table 3-26).

TABLE 3-25
Threatened and Endangered Flora and Fauna in the Crypt MOA (Underlying Counties)

Common Name	Scientific Name	Status
Iowa		
Bald Eagle	*Haliaeetus leocephalus*	LT
Blacknose Shiner	*Notropis heterolepis*	ST
Bobcat	*Lynx rufus*	SE
Eastern Spotted Skunk	*Spilogale putorius*	ST
Henslow's Sparrow	*Ammodramus henslowii*	ST
King Rail	*Rallus elegans*	LE
Long-Eared Owl	*Asio otus*	ST
Mudpuppy	*Necturus maculosus*	SE

TABLE 3-25
Threatened and Endangered Flora and Fauna in the Crypt MOA (Underlying Counties)

Common Name	Scientific Name	Status
Northern Grasshopper Mouse	*Onychomys leucogaster*	ST
Northern Harrier	*Circus cyaneus*	LE
Orangethroat Darter	*Etheostoma spectabile*	ST
Ornate Box Turtle	*Terrapene ornata*	ST
Pallid Sturgeon	*Scaphirhynchus albus*	LE
Piping Plover	*Charadrius melodus*	LE
Plains Pocket Mouse	*Perognathus flavescens*	SE
Prairie Rattlesnake	*Crotalus viridis*	SE
Pugnose Shiner	*Notropis anogenus*	SE
Smooth Green Snake	*Liochlorophis vernalis*	ST
Topeka Shiner	*Notropis topeka*	LE
Weed Shiner	*Notropis texanus*	SE
Western Sand Darter	*Ammocrypta clara*	ST

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

TABLE 3-26
Threatened and Endangered Flora and Fauna in the Region of Influence of the Crypt MOA (Adjacent Counties)

Common Name	Scientific Name	Status
Iowa		
Bald Eagle	*Haliaeetus leucocephalus*	LE
Topeka Shiner	*Notropis topeka*	LE
Short-Eared Owl	*Asio flammeus*	SE
Red-Shouldered Hawk	*Buteo Lineatus*	SE
Northern Harrier	*Circus cyaneus*	SE
Southern Red-Backed Vole	*Clethrionomys gapperi*	SE
Bobcat	*Lynx rufus*	SE
Plains Pocket Mouse	*Perognathus flavescens*	SE
Western Sand Darter	*Ammocrypta clara*	ST
Chestnut Lamprey	*Ichthyomyzon castaneus*	ST

TABLE 3-26
Threatened and Endangered Flora and Fauna in the Region of Influence of the Crypt MOA (Adjacent Counties)

Common Name	Scientific Name	Status
Blacknose Shiner	*Notropis heterolepis*	ST
River Otter	*Lutra canadensis*	ST
Eastern Spotted Skunk	*Spilogale putorius*	ST
Smooth Green Snake	*Liochlorophis vernalis*	ST
Long-Eared Owl	*Asio otus*	ST
Minnesota		
Burrowing Owl	*Speotyto cunicularia*	ST
Fescue Sedge	*Carex festucacea*	ST
Hair-Like Beak-Rush	*Rhynchospora capillacea*	ST
King Rail	*Rallus elegans*	ST
Ottoe Skipper	*Hesperia ottoe*	ST
Prairie Bush Clover	*Lespedeza leptostachya*	LT
Sullivant's Milkweed	*Asclepias sullivantii*	ST
Tuberous Indian-Plantain	*Arnoglossum plantagineum*	ST
Tuberous Indian-Plantain	*Arnoglossum plantagineum*	ST
Whorled Nut-Rush	*Scleria verticillata*	ST
Wilson's Phalarope	*Phalaropus tricolor*	ST

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

3.3.5 Land Use and Visual Resources

Until the settlers arrived, much of the northern half of Iowa had been unsuitable for farming. Water saturated much of the land into early summer. As these low-lying lands were drained, the prairies were transformed into a fertile farm region.

The Crypt MOA and its adjacent counties contain flat plains and gently rolling hills that are ideally suited for farming. Farming is usually carried out on a large scale. The pattern of farming is the "crop-and-livestock" system which is practiced in much of the Corn Belt. In this system, the production of corn and other crops is used mainly to fatten cattle and hogs for market. The combinations of livestock and crops differ from place to place and may also change annually, with many farms devoted exclusively to the production of either livestock or crops. On the flat, fertile prairie lands farmers cultivate corn, soybeans, and other field crops, while in the hilly sections, much of the land is used for pasturing beef cattle and for raising hay. The principal land uses in the Crypt MOA region of influence is agriculture (Tables 3-27 and 3-28).

TABLE 3-27
County Land Uses in the Crypt MOA (Underlying Counties)

County	Total Acreage	Percent				
		Agriculture	Forest	Grassland	Shrub / Brushland	Water
Buena Vista	370,608	98.13	1.13			0.73
Calhoun	365,666	99.80	0.20			
Carroll	364,380	100.00				
Cherokee	368,860	99.17	0.83			
Clay	365,752	95.70	4.16			0.14
Crawford	456,883	99.89	0.11			
Dickinson	257,867	95.03	1.51	0.10		3.37
Greene	364,951	99.00	1.00			
Humboldt	278,358	97.24	2.76			
Ida	276,175	100.00				
Kossuth	622,468	98.88	1.08	0.04		
Monona	446,557	88.38	11.32	0.07		0.22
O'Brien	366,221	98.81	1.19			
Osceola	255,200	99.62	0.38			
Palo Alto	363,760	97.73	2.13			0.14
Plymouth	551,977	94.47	1.14	4.39		
Pocahontas	370,008	98.77	1.16			0.07
Sac	369,560	99.93	0.07			
Sioux	491,016	99.27	0.58	0.15		
Webster	458,779	92.43	7.51	0.05		
Woodbury	560,580	92.95	4.88	1.85	0.04	0.26

TABLE 3-28
County Land Uses in the Crypt MOA (Adjacent Counties)

County	Total Acreage	Percent			
		Agriculture	Forest	Grassland	Water
Audubon	283,466	99.39	0.43	0.17	
Boone	366,485	92.02	7.91	0.07	
Dallas	378,138	96.41	3.53	0.07	
Emmet	257,032	96.30	3.67		0.03

TABLE 3-28
County Land Uses in the Crypt MOA (Adjacent Counties)

Faribault	460,919	98.60	1.18		0.22
Guthrie	378,990	97.45	2.55		
Hamilton	368,963	95.95	4.05		
Hancock	366,148	98.39	1.61		
Jackson	459,555	98.49	0.82		0.69
Martin	466,001	99.36	0.45		0.19
Shelby	377,917	100.00			
Winnebago	255,516	91.37	8.24		
Wright	8,632		2.32		

Corn and soybeans are the two most valuable and most widely cultivated crops in Iowa. Other leading crops are hay and oats. Nearly all of the corn that is planted is hybrid corn, which provides greater yields per acre and is more resistant to disease or to prolonged drought than non hybrid corn. Soybean cultivation is used primarily for livestock feed and is an important rotational crop.

Due to its relatively flat topography, there are few scenic areas within the Crypt MOA. However, there are a number of state parks that are located within the MOA, a few of which provide camping and other recreational facilities. These include the Mill Creek State Park, Kalsow Prairie State Preserve, Twin Lakes State Park, Wanata State Park, Ambrose A. Call State Park, Black Hawk State Park, and Swan Lake State Park. The most significant tourist attraction in the MOA is located in West Bend and is known as the Grotto of the Redemption. The Grotto of the Redemption is a series of 70 year old ornate religious structures constructed of precious and semi precious stones from around the world. Among tourist attractions within the MOA are the Storm Lake Parks, in the town of Storm Lake in Buena Vista County.

Within the Crypt MOA region of influence there a number of notable visual resource and tourist attractions. The Pilot Knob State Park, located northwest of Mason City in Hancock County contains a 300-foot hill which provides tourists with a panoramic view of the surrounding farmlands, and is a popular winter sports area. The Dolliver Memorial State Park near Fort Dodge in Webster County encompasses a region of sandstone cliffs, deep ravines, and woodlands. Other nearby scenic attractions include popular winter sports areas such as Ledges State Park and Ski Valley Ski Area in Boone County, Silver Creek Recreational Ski Area in Humboldt County, and Riverside Hills Ski Area in Emmet County. Finally, there is a cluster of well-known state parks in Dickinson County, which provide recreational opportunities. These include Gull Point State Park, Pillsbury Point State Park, Pikes Point State Park, and Trappers Bay State Park.

3.3.6 Infrastructure, Transportation, and Utilities

Iowa roads are laid out in a grid pattern and are used extensively by farmers and trucking companies to carry Iowa's farm produce to market or to the nearest railroad depot. The Crypt MOA is traversed by US Highway 59 and US Highway 71 which are the secondary north-south connections along the western part of Iowa (with the primary connection as Interstate Highway [I] 29). These highways run roughly parallel to each other between the towns and manufacturing centers within the MOA. The Crypt MOA is also traversed by four highways which run in an east west direction, consisting of US Highway 18, State Highway 3, US Highway 20, and US Highway 30. These east west highways run roughly parallel to each other and divide the Crypt MOA into 4 equal sections.

In 1997, Iowa had a total of 227 airports, some of which were private airfields. While there are no major airports listed within the Crypt MOA, a number of municipal airports are located in its region of influence to the east and north of the MOA. These include the Fort Dodge Municipal Airport in Webster County, and the Mason City Municipal Airport at the Hancock –Cerro Gordo County border, both in Iowa; and the Fairmont Municipal Airport in Martin County, Minnesota. In addition to airports, other transportation systems within the MOA are railroads which converge in Sioux City at Woodbury County, at the western end of the Crypt MOA.

Of the electricity generated in Iowa in 1998, 87 percent came from steam-driven power plants burning fossil fuels (mainly coal). Another 10 percent came from the state's only nuclear power plant, the Duane Arnold Energy Center (near Cedar Rapids), which began commercial operation in 1975. A small amount, just 2 percent, came from hydroelectric facilities. Most of these plants are owned by private utilities. Major power utilities in the counties underlying and adjacent to the Crypt MOA are provided in Tables 3-29 and 3-30, respectively.

TABLE 3-29
Major Power Utilities Serving the Crypt MOA (Underlying Counties)

Power Utility	Location (Counties, State)
Bancroft Municipal Utilities	Kossuth, IA
Boone Valley Electric	Humboldt, IA
Calhoun County Electric Cooperative Association	Calhoun, Pocahontas, Sac, Webster, IA
City of Akron	Plymouth, IA
City of Algona	Kossuth, IA
City of Alta	Buena Vista, IA
City of Alton	Sioux, IA
City of Anthon	Woodbury, IA
City of Auburn	Sac, IA
City of Bigelow	Osceola, IA
City of Breda	Carroll, IA
City of Burt	Kossuth, IA

TABLE 3-29
Major Power Utilities Serving the Crypt MOA (Underlying Counties)

Power Utility	Location (Counties, State)
City of Callender	Webster, IA
City of Coon Rapids	Carroll, IA
City of Dayton	Webster, IA
City of Denison	Crawford, IA
City of Farnhamville	Calhoun, IA
City of Fonda	Pocahontas, IA
City of Glidden	Carroll, IA
City of Graettinger	Palo Alto, IA
City of Grand Junction	Greene, IA
City of Hartley	Obrien, IA
City of Hawarden	Sioux, IA
City of Hawarden	Sioux, IA
City of Hinton	Plymouth, IA
City of Lake Park	Dickinson, IA
City of Lake View	Sac, IA
City of Laurens	Pocahontas, IA
City of Lehigh	Webster, IA
City of Livermore	Humboldt, IA
City of Manning	Carroll, IA
City of Mapleton	Monona, IA
City of Marathon	Buena Vista, IA
City of Milford	Dickinson, IA
City of Onawa	Monona, IA
City of Orange City	Sioux, IA
City of Paton	Greene, IA
City of Paullina	Obrien, IA
City of Pocahontas	Pocahontas, IA
City of Primghar	Obrien, IA
City of Remsen	Plymouth, IA
City of Renwick	Humboldt, IA
City of Sanborn	Obrien, IA
City of Sergeant Bluff	Woodbury, IA

TABLE 3-29
Major Power Utilities Serving the Crypt MOA (Underlying Counties)

Power Utility	Location (Counties, State)
City of Sibley	Osceola, IA
City of Sioux Center	Sioux, IA
City of Spencer	Clay, IA
City of Wall Lake	Sac, IA
City of West Bend	Humboldt, Kossuth, Palo Alto, IA
City of Whittemore	Kossuth, IA
Federated Rural Electric Association	Dickinson, Kossuth, Osceola IA
Glidden Rural Electric Cooperative	Calhoun, Sac, Carroll, Greene IA
Gowrie Municipal Utilities	Webster, IA
Guthrie County Rural Electric Cooperative Association	Greene, IA
Hancock County Rural Electric Cooperative	Humboldt, IA
Harrison County Rural Electric Cooperative	Crawford, Monona, IA
Humboldt County Rural Electric Cooperative	Humboldt, Pocahontas, Webster, Kossuth, IA
Ida County Rural Electric Cooperative	Cherokee, Ida, Sac, Woodbury, Crawford IA
IES Utilities, Inc	Buena Vista, Calhoun, Cherokee, Ida, Pocahontas, Sac, Webster, Woodbury, Carroll, Greene, Clay, Dickinson, Kossuth, Obrien, Osceola, Palo Alto, Sioux, IA
Inc City of Aurelia	Cherokee, IA
Interstate Power Company	Kossuth, IA
Iowa Lakes Electric Cooperative	Buena Vista, Cherokee, Ida, Plymouth, Pocahontas, Clay, Dickinson, Kossuth, Obrien, Osceola, Palo Alto, IA
Lyon Rural Electric Cooperative	Osceola, Sioux, IA
MidAmerican Energy Company	Calhoun, Cherokee, Humboldt, Ida, Plymouth, Pocahontas, Sac, Webster, Woodbury, Carroll, Crawford, Monona, Kossuth, Obrien, Palo Alto, Sioux, IA
Midland Power Cooperative	Webster, Greene, IA
Nishnabotna Valley Rural Electric Cooperative	Crawford, IA
Nobles Cooperative Electric	Osceola, IA
North West Rural Electric Cooperative	Cherokee, Plymouth, Clay, Obrien, Osceola, Sioux, IA
Osceola Electric Cooperative, Inc	Obrien, Osceola, IA
Plymouth Electric Cooperative Association	Ida, Plymouth, Obrien, Sioux IA
Sac County Rural Electric Cooperative	Buena Vista, Calhoun, Ida, Sac, Crawford, IA

TABLE 3-29
Major Power Utilities Serving the Crypt MOA (Underlying Counties)

Power Utility	Location (Counties, State)
Town of Manilla	Crawford, IA
Town of Westfield	Plymouth, IA
Western Iowa Power Cooperative	Ida, Sac, Woodbury, Carroll, Crawford, Monona, IA
Winnebago Rural Electric Cooperative Association	Kossuth, IA
Woodbury County Rural Electric Cooperative Association	Cherokee, Ida, Plymouth, Woodbury, Monona, IA
Wright County Rural Electric Cooperative	Humboldt, Webster IA

TABLE 3-30
Major Power Utilities Serving the Crypt MOA (Adjacent Counties)

Power Utility	Location (Counties, State)
Atlantic Municipal Utilities	Audubon, Shelby, IA
Blue Earth-Nicollet-Faribault	Faribault, MN
Boone Valley Electric Cooperative	Hancock, Wright, IA
Cass Electric Cooperative	Wright, Hamilton, IA
City of Alpha	Jackson, MN
City of Blue Earth	Faribault, MN
City of Ceylon	Martin, MN
City of Coon Rapids	Guthrie, IA
City of Corwith	Hancock, IA
City of Dunnell	Martin, MN
City of Ellsworth	Hamilton, IA
City of Estherville	Emmet, IA
City of Forest City	Winnebago, IA
City of Forest City	Hancock, IA
City of Harlan	Shelby, IA
City of Jackson	Jackson, MN
City of Kimballton	Audubon, IA
City of Lake Mills	Winnebago, IA
City of Lakefield	Jackson, MN
City of Ogden	Boone, IA
City of Panora	Guthrie, IA

TABLE 3-30
Major Power Utilities Serving the Crypt MOA (Adjacent Counties)

Power Utility	Location (Counties, State)
City of Shelby	Shelby, IA
City of Story City	Hamilton, Boone, IA
City of Stratford	Hamilton, IA
City of Stuart	Guthrie, IA
City of Tennant	Shelby, IA
City of Webster City	Hamilton, IA
City of Wells	Faribault, MN
City of Woolstock	Wright, IA
Fairmont Public Utilities Commission	Martin, MN
Farmers Electric Cooperative, Inc	Guthrie, Audubon, IA
Federated Rural Electric Association	Jackson, Martin, Faribault, MN; Emmet, IA
Franklin Rural Electric Cooperative	Wright, IA
Glidden Rural Electric Cooperative	Guthrie, Audubon, IA
Guthrie County Rural Electric Cooperative Association	Dallas, Guthrie, Audubon, IA
Hancock County Rural Electric Cooperative	Winnebago, Hancock, Wright, IA
Harrison County Rural Electric Cooperative	Shelby, IA
Humboldt County Rural Electric Cooperative	IA Hancock, Wright, IA
IES Utilities, Inc	Emmet, Hancock, Wright, Hamilton, Boone, Dallas, Guthrie, Audubon, IA
Interstate Power Company	Jackson, Martin, Faribault, MN; Winnebago, IA
Iowa Lakes Electric Cooperative	Emmet, IA
MidAmerican Energy Company	Emmet, Wright, Dallas, Guthrie, Audubon, Shelby, IA
Midland Power Cooperative	Hamilton, Boone, Dallas, Guthrie, IA
Nishnabotna Valley Rural Electric Cooperative	Audubon, Shelby, IA
Nobles Cooperative Electric	Jackson, MN
Northern States Power Company	Faribault, MN
South Central Electric Association	Jackson, Martin, MN
Stanhope Municipal Electric Utility	Hamilton, IA
Steele-Waseca Cooperative Electric	Faribault, MN
Truman Public Utilities Commission	Martin, MN
Western Iowa Power Cooperative	Audubon, Shelby, IA

TABLE 3-30
Major Power Utilities Serving the Crypt MOA (Adjacent Counties)

Power Utility	Location (Counties, State)
Winnebago Rural Electric Cooperative Association	Faribault, MN; Winnebago, Hancock, IA
Wright County Rural Electric Cooperative	Hancock, Wright, Hamilton, IA

3.3.7 Cultural Resources

Although Iowa is rich in Native American and early exploration history, most of the significant historical and cultural areas are outside of the Crypt MOA region of influence. No tribal organizations were identified within the area under consideration. Historical and cultural resources that do exist within the region of influence are described below.

Since the arrival of French explorers in 1673, only a small number of missionaries, fur traders, and soldiers passed through Iowa during the period of French ownership. After the Louisiana purchase in 1803, the Lewis and Clark expedition sailed the Missouri River from St. Louis and explored Iowa's western border for several weeks, cataloging plant and animal life and establishing relations with the native inhabitants. Currently, a sandstone monument of Sergeant Charles Floyd, a member of the Lewis and Clark expedition, stands along Sioux City which lies within Woodbury County just outside of the western boundary of the MOA.

In addition to the historical monument, there are museums and art galleries lying within and in the vicinity of the Crypt MOA. These include the Sanford Museum and Planetarium in the town of Cherokee within the MOA, and the Humboldt County Historical Museum in Huimboldt County, Plymouth County Historical Museum in Plymouth County, the Fort Dodge Historical Museum, and Blandon Art Gallery in Webster County, all within the region of influence of the Crypt MOA.

Finally, there are areas which are considered part of the state’s natural heritage, which include the Shredder Praire State Preserve in Guthrie County, Kalsow Lake State preserve in Pocahontas County, Holst State Forest in Boone County and the Union Slough National Wildlife Refuge in Kossuth County, Iowa. These remnant areas provide residents with a reminder of the prairie environmental conditions prior to settlement.

3.3.8 Socioeconomics

During early settlement, fur trading and farming were a very important part of the Iowa economy. As settlement advanced westward from the Mississippi River, agriculture became the leading economic activity. The expansion of railroad system enabled the state's farm produce to reach eastern markets and helped to bring about a shift in emphasis from growing wheat as a cash crop to growing corn for fattening livestock. With the widespread demand for agricultural products, food processing developed as the primary manufacturing activity. As the manufacturing industry grew, the dominance of agriculture began to decline but the processing of food products grown in the Iowa continues to be mainstay of the manufacturing industry. Currently, food processing and the production of industrial machinery are Iowa's leading industrial activities and account for two-fifths of the total income generated by manufacturing in the state.

Iowa's total work force numbered 1,574,000 in 1999. Of those, 27 percent worked in the diverse services sector, doing such jobs as working in restaurants or data processing. Another 22 percent worked in wholesale or retail trade; 14 percent in manufacturing; 13 percent in federal, state, or local government, including those in the military; 8 percent in farming (including agricultural services), forestry, or fishing; 6 percent in finance, insurance, or real estate; 5 percent in construction; and 4 percent in transportation or public utilities. Employment in mining was insignificant.

Currently, Iowa is the nation's third most productive agricultural state, behind only California and Texas in the value of its yearly farm output. About 81 percent of Iowa's farmland are cropland, while the rest is mostly pastureland. Iowa also ranks third among the states in the value of the livestock and livestock products, with a significant share of all the hogs marketed in the United States. Many of the cattle, hogs, and sheep come from the western and southwest parts of Iowa. Based on the generally level to gently rolling topography and fertile soils, large-scale farming is likely the most important contributor to the local economy of the Crypt MOA.

Although most of the principal industrial cities are located outside of the Crypt MOA and the MOA region of influence, industry is scattered in small centers throughout the state. Sioux City, located in Woodbury County just outside of the western boundary of the MOA, is known as a major center for meatpacking and shipping, and has many large stockyards. Fort Dodge in Webster County at the MOA region of influence is the center of Iowa's gypsum industry.

The estimated 2000 population of the counties underlying the Crypt MOA is 425,480 persons. Additional population and income data are provided in Tables 3-31 and 3-32. The population centers within the Crypt MOA are small towns with populations of less than 12,000 persons. These include the town of Spencer in Clay County (population 11,317), Carroll in Carroll County (10,106), Storm Lake in Buena Vista County (10,076), Denison in Crawford County (7,339), Algona in Kossuth County (5,741), and Cherokee in Cherokee County (5,369). In addition to these areas, there are many small rural hamlets with populations of less than 2000 persons which are distributed throughout the MOA. These hamlets include Pocahontas (population 1,970), Rockwell City (2,264), West Bend (834), Ruthven (711), Early (605), Mallard (298), Cushing (246), and Meriden (184).

With the exception of Sioux City (population 85,013), the population centers within the region of influence of the Crypt MOA are comprised of small cities and towns with populations of less than 26,000 persons. These include the city of Fort Dodge in Webster County (population 25,136), Webster City in Hamilton County (8,176), Boone in Boone County (12,803), and the town of Perry in Dallas County (7,633), Estherville in Emmet County (6,656), and Harlan in Shelby County (5,282). As in the MOA, the region of influence contain small rural hamlets with populations of typically less than 2000 persons. These include Bancroft (population 808), Britt (2,052), Guthrie Center (1,668), Goldfield (680), Woolstock (204), Boxholm (215), and Beaver (53).

TABLE 3-31
Socioeconomic Characteristics of the Crypt MOA Region (Underlying Counties)

County	Area[1]	Population[2]	Density[3]	Median Household Income ($)[4]
Buena Vista, IA	575	20,411	35.5	35,545
Calhoun, IA	570	11,115	19.5	32,924
Carroll, IA	569	21,421	37.6	36,859
Cherokee, IA	577	13,035	22.6	34,690
Clay, IA	569	17,372	30.5	37,019
Crawford, IA	714	16,942	23.7	32,555
Dickinson, IA	381	16,424	43.1	36,739
Greene, IA	568	10,366	18.3	33,384
Humboldt, IA	434	10,381	23.9	37,018
Ida, IA	432	7,837	18.1	34,459
Kossuth, IA	973	17,163	17.6	34,492
Monona, IA	693	10,020	14.5	30,266
Obrien, IA	573	15,102	26.4	35,048
Osceola, IA	399	7,003	17.6	34,804
Palo Alto, IA	564	10,147	18	32,699
Plymouth, IA	864	24,849	28.8	40,109
Pocahontas, IA	578	8,662	15	34,867
Sac, IA	576	11,529	20	32,612
Sioux, IA	768	31,589	41.1	40,895
Webster, IA	715	40,235	56.3	34,353
Woodbury, IA	873	103,877	119	36,357
Total/Average	12,966	425,480	32.8	35,127

1. US Census Bureau - Land Area, Population, and Density for States and Counties, 2000.
2. US Census Bureau – Estimated population for 2000 <www.census.gov/population/estimates/county
3. Calculated - County Population divided by County Area.
4. U.S. Census Bureau – Money Income for all counties in Iowa 1997.

TABLE 3-32
Socioeconomic Characteristics of the Crypt MOA Region (Adjacent Counties)

County	Area[1]	Population[2]	Density[3]	Median Household Income ($)[4]
Audubon, IA	443	6,830	15.4	31,376
Boone, IA	571	26,224	45.9	37,774
Dallas, IA	586	40,750	69.5	45,825
Emmet, IA	396	11,027	27.8	32,841
Guthrie, IA	591	11,353	19.6	33,467
Hamilton, IA	577	16,438	28.5	37,073
Hancock, IA	571	12,100	21.2	36,048
Shelby, IA	591	13,173	22.3	34,588
Winnebago, IA	401	11,723	29.3	34,048
Wright, IA	581	14,334	24.7	35,533
Faribault, MN	714	16,181	22.8	31,670
Jackson, MN	702	11,268	16.1	33,304
Martin, MN	709	21,802	30.8	34,839
Total/Average	7433	213,203	28.7	35,260

1. US Census Bureau - Land Area, Population, and Density for States and Counties, 2000.
2. US Census Bureau - Estimated population for 2000
<www.census.gov/population/estimates/county/
3 Calculated - County Population divided by County Area.
4 U.S. Census Bureau – Money Income for all counties in Iowa 1997.

3.3.9 Environmental Justice

Demographic information on race, ethnicity, and poverty status in the counties underlying the Crypt MOA are presented in Table 3-33 . Statistics for the state of Iowa are included to provide context. (See subsection 3.3 for the definitions of minority population and poverty areas).

The minority population in the majority of the counties underlying the Crypt MOA is less than in the surrounding state of Iowa. Total minority population is less than 5 percent in nearly all of these counties. Woodbury County has a somewhat higher percentage of American Indian population (1.7 percent) than statewide (0.3 percent). None of the counties approach the definition of a poverty area.

TABLE 3-33
Demographic Statistics for the Crypt MOA

Jurisdiction	Total Persons (1997)	Percentage						
		White (1996)	Black (1996)	American Indian[1] (1996)	Asian[2] (1996)	Other (1996)	Hispanic Origin[3] (1996)	Poverty Rate[4] (1993)
Iowa	2,852,423	96.6	1.9	0.3	1.2	0	1.7	11.1
Crypt MOA counties								
Buena Vista Co., IA	19,565	97.1	0.3	0.1	2.6	0	1.1	9.7
Calhoun Co., IA	11,426	99.0	0.7	0.1	0.2	0	0.5	11.1
Cherokee Co., IA	13,418	99.3	0.2	0.3	0.3	0	0.5	9.5
Humboldt Co., IA	10,398	99.5	0.1	0.1	0.3	0	0.5	9.1
Ida Co., IA	7,935	99.6	(Z)	0.1	0.3	0	0.4	9.8
Plymouth Co., IA	24,649	99.5	0.1	0.1	0.3	0	0.4	7.6
Pocahontas Co., IA	8,835	99.7	(Z)	0.1	0.2	0	0.4	10.6
Sac Co., IA	11,890	99.7	(Z)	0.1	0.2	0	0.5	10.9
Webster Co., IA	38,616	96.9	2.3	0.3	0.5	0	1.8	13.3
Woodbury Co., IA	102,092	94.2	2.1	2.0	1.7	0	4	13
Carroll Co., IA	21,703	99.3	0.1	0.1	0.4	(Z)	0.6	9.7
Crawford Co., IA	16,389	98.8	0.3	0.2	0.6	(Z)	0.8	13
Greene Co., IA	10,043	99.5	(Z)	0.1	0.4	0	0.4	11
Monona Co., IA	9,998	99.5	0.1	0.2	0.2	0	0.4	13.9
Clay Co., IA	17,600	99.1	0.1	0.2	0.6	0	0.4	9.7
Dickinson Co., IA	15,985	99.5	0.1	0.2	0.2	0	0.6	8.3

Source: U.S. Bureau of the Census, 2000

Notes:
1. Includes Alaska native and Aleutian Islander

2. Includes Pacific Islander

3. Race refers to Census respondents' self-identification of racial background. Hispanic origin refers to ethnicity and language, not race, and may include persons whose heritage is Puerto Rican, Cuban, Mexican, and Central or South American.

4. The values shown are 1997 Census Bureau estimates of percent persons with household incomes below the poverty threshold.

(Z) values are greater than zero but less than half unit of measure shown

3.4 Lake Andes

The Lake Andes MOA is located in the south central part of South Dakota and encompasses portions of Aurora, Bon Homme, Brule, Charles Mix, Davison, Douglas, Gregory, and Hutchinson, Lyman and Tripp County, as well as a portion of Boyd, Holt, and Keya Paha County in Nebraska (Figure 3-4). The affected environment (region of influence) is comprised of counties underlying the Lake Andes MOA, as well as the adjacent counties of Buffalo, Jerauld, Sanborn, Miner, Hanson, McCook, Turner, and Yankton in South Dakota, and Knox County in Nebraska.

3.4.1 Earth Resources

There are two major natural physiographic regions that cover South Dakota and Nebraska: the Central Lowland, and the Great Plains. In South Dakota, the Great Plains region covers the western and central sections of the state, while the Central Lowland region covers the eastern part of the state. The boundary between these two regions follows the eastern edge of the glaciated sections of the Missouri Plateau and extends in a north to south direction between the Missouri and the James rivers. In Nebraska, the eastern fifth of the state is in the Central Lowland region near the Missouri River, while the remainder of the state is part of the Great Plains region. The Lake Andes MOA is situated along the boundary of the Central Lowlands, between the James and Missouri River, along a belt of low hills known as the Coteau du Missouri. For the most part, the counties underlying the western half of the Lake Andes MOA are located in the Great Plains region, while the counties to the east are located in the Central Lowlands region.

The Central Lowlands were covered by extensive ice sheets during the course of the last Ice Age, which ended about 10,000 years ago. The eastern area of influence for the Lake Andes MOA is a subregion of the Central Lowlands known as the James River Highlands, a group of three ridges of drift-covered bedrock known as Turkey, James, and Yankton ridges. Near the Iowa border are stream-dissected highlands made of a thick mantle of loessial (wind blown) soils. Finally, the southern boundary of the Central Lowland region is the southern section of the deeply cut Missouri River Trench, a flat, wide river trench.

West of the James River, in the central part of the Lake Andes MOA, a feature known as the Coteau du Missouri is characterized by an unevenly dissected highland covered with glacial drift, and contains several massive ridges and broad abandoned stream valleys. It marks the western extent of glaciation. West of that subregion is the Missouri River Trench, a narrow, steep river valley now occupied by four large reservoirs. West of the Missouri River is a feature known as the Sand Hills, a 400 square mile extension of the Nebraska Sand Hills. The Sand Hills are a series of grass-covered sand dunes that may cover more than a hectare each, with sandy soils that are extremely porous and contain little variation in texture and composition. North of the Sand Hills, towards the capital city of Pierre, a zone of young rocks, mesas, and buttes are present, along with incised streams in an area known as the White River Badlands.

The most productive soils in South Dakota are chernozems (or black earth soils), which cover most of South Dakota east of the Coteau du Missouri. These soils are dark brown to black in color and are rich in humus, or organic matter. To the rest of South Dakota, chestnut soils are dominant, except for the Black Hills region. Less rich in humus than the chernozems, the chestnut soils are characteristically dark brown to dark grayish brown at the surface and grade downward to a light gray or white subsoil at about two feet below the surface. Grazing is the predominant activity on the chestnut soils, especially in areas of deficient rainfall, but good crops of wheat are often obtained in years of greater-than-average rainfall.

The Lake Andes MOA is situated in area of rich alluvial soils from the Missouri River, and contain portions of chernozems, sand hills soils (loess), and chestnut soils.

3.4.2 Climate

The states of South Dakota and Nebraska as a whole have hot summers and cold winters associated with a continental climate. Average January temperatures are everywhere less than 24° F and decrease to less than 10° F in some northern sections. In Sioux Falls, near the eastern end of the ROI, January temperature range from 3° to 24° F, with nighttime lows of -20° F during most winters. July averages are in the low and middle 70°s F throughout most parts of the state. The average temperature range in Sioux Falls in July is 62° to 86° F.

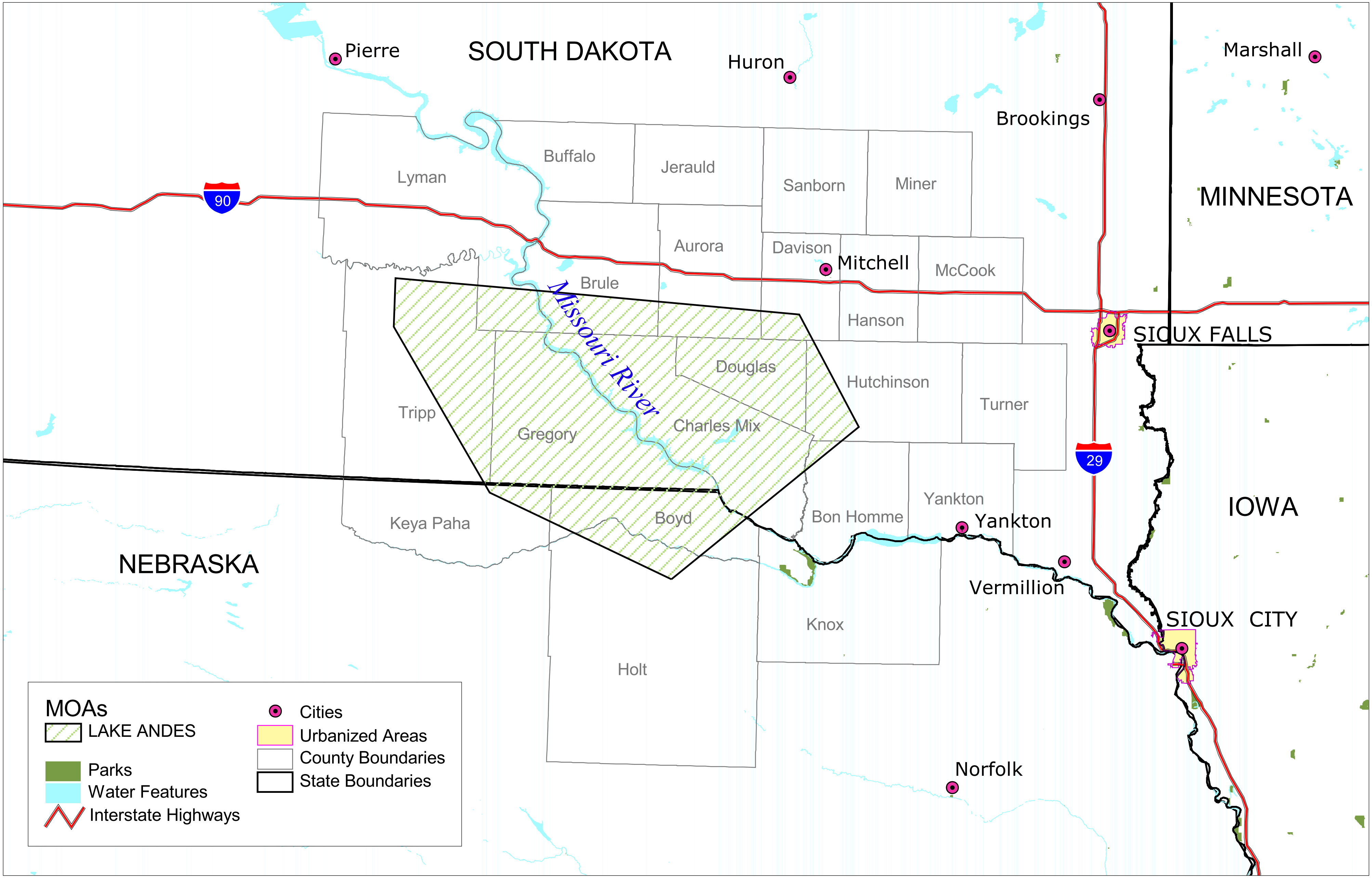
Average annual precipitation (rainfall and snowfall) increases from roughly west to east, ranging from about 13 inches in the northwest, to about 25 inches in the southeast. Precipitation varies considerably from year to year, and prolonged droughts can occur, especially in the western and central areas. Approximately three fourths of the precipitation falls during the April through September growing season.

The growing season in the area of the Lake Andes MOA is approximately 150 days. In the valleys of the Black Hills, the growing season totals as little as 101 days. The last killing frost occurs in early May, and the first killing frost in fall occurs at the end of September or in early October.

3.4.3 Water Resources

With the exception of the extreme northeast and northwest, nearly all rivers and streams of South Dakota and Nebraska are drained by the Missouri River. The Missouri River flows southward and then southeastward through South Dakota, along a deep, wide channel, and forms part of the South Dakota-Nebraska state line. The South Dakota section of the Missouri River has been impounded by large dams and is now made up of a chain of four reservoirs. These dams include Fort Randall, Gavins Point, Big Bend, and Oahe dams, which were built for flood control, irrigation, and hydroelectricity, as part of the Missouri Basin Project.

The Lake Andes MOA is bisected by the Missouri River, where the Fort Randall dam and reservoir are located. The eastern boundary of the MOA is very close to the James River, which flows southward in a roughly parallel course to join the Missouri River. The James River is the longest non-navigable river in North America. In the western part of the state the Grand, Moreau, Cheyenne, Bad, and White rivers flow generally eastward to join the Missouri. The northern boundary of the MOA contains the Old Lodge and Dog Ear River, which is part of the White River System, which drains much of western South Dakota.



Scale: 1 in = 30 mi

0 10 20 30 40 Miles

Figure 3-4
LAKE ANDES MOA

CH2MHILL

The southern boundary of the MOA encompasses a reach of the Niobara River and the Spencer Dam, which drain the Sand Hills of northern Nebraska. Lake Andes is a small lake located to the north of the Fort Randall dam. A portion of the lake is part of a wildlife preserve.

3.4.4 Biological Resources

The dominant cover type is grassland, with wooded or forested areas occupying only 3 percent of the South Dakota's total land area, and 1 percent of Nebraska's total land area. Most of the forested areas in South Dakota are in the Black Hills National Forest, with some cottonwoods found along the valleylands of the Missouri River and other rivers. A large variety of deciduous and coniferous trees are found in shelterbelts throughout the state.

The Lake Andes MOA is about 60 percent grassland, and 40 percent agriculture. Much of the grassland areas are located in Gregory County, on the western side of the Missouri River. The major plant species associated with the grasslands are bluestem, switch grasses, and sand dropseed. On the plateau areas west of the Missouri River the gumbo lily, the yucca, and a yellow-blossomed cactus are found. Cultivation and grazing have changed the composition of much of the grassland areas, with many invaders such as thistle, cactus, yucca, and noxious weeds growing to the detriment of native grasses.

Wildlife in South Dakota and Nebraska has been reduced as a result of extensive human settlement. The great herds of bison (American buffalo) that once roamed the plains are now restricted to preserves and private ranches. Populations of coyote, the South Dakota state animal, declined in the mid-1900s, but have grown tremendously in recent years. Although more mammals are found in the Black Hills area to the west, mammals that likely to be found in the general vicinity of the Lake Andes MOA include the pronghorn antelope, mule deer, white-tailed deer, jackrabbit, coyote, kit fox, raccoon, and prairie dogs.

Among the numerous species of birds found in the South Dakota and Nebraska are the western meadowlark, northern flicker, American goldfinch, belted kingfisher, American robin, brown thrasher, redwing blackbird, yellow-headed blackbird, Chinese pheasant, Hungarian partridge (or gray partridge), and Chinese ring-necked pheasant, which is the South Dakota state bird. Sage grouse, sharp-tailed grouse, prairie chickens, and wild turkeys are found on the prairies and plains, but are most abundant in the Black Hills.

The principal fish species that are found in the waterbodies within the Lake Andes MOA are walleye and northern pike, crappie, perch, bullhead, bluegill, and bass, which are common in Missouri River reservoirs. Catfish are also common in most rivers.

In the counties underlying the Lake Andes MOA, there are 8 threatened and endangered flora and fauna species in South Dakota, and 9 threatened and endangered flora and fauna species in Nebraska (Table 3-34). In the counties adjacent to the Lake Andes MOA, there are 3 threatened and endangered flora and fauna species in South Dakota, and 6 threatened and endangered flora and fauna species in Nebraska (Table 3-35).

TABLE 3-34
Threatened and Endangered Flora and Fauna in the Lake Andes MOA (Underlying Counties)

Common Name	Scientific Name	Status
South Dakota		
American Burying Beetle	*Nicrophorus americanus*	LE
Banded Killifish	*Fundulus diaphanus*	SE
Black-Footed Ferret	*Mustela nigripes*	LE
False Map Turtle	*Graptemys pseudogeographica*	ST
Pearl Dace	*Margariscus margarita*	ST
Sicklefin Chub	*Macrhybopsis meeki*	ST
Sturgeon Chub	*Macrohybopsis gelida*	ST
Topeka Shiner	*Notropis topeka*	LE
Nebraska		
Blacknose Shiner	*Notropis heterolepis*	SE
Bald Eagle	*Haliaeetus leucocephalus*	LE
Whooping Crane	*Grus americana*	LE
Piping Plover	*Charadrius melodus*	LE
Interior Least Tern	*Sterna antillarum athalassos*	LE
Northern Redbelly Dace	*Phoxinus eos*	ST
Finescale Dace	*Phoxinus neogaeus*	ST
Pallid Sturgeon	*Scaphirhynchus albus*	LE
Western Prairie Fringe Orchid	*Platanthera praeclara*	LT

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

TABLE 3-35
Threatened and Endangered Flora and Fauna in the Region of Influence of the Lake Andes MOA (Adjacent Counties)

Common Name	Scientific Name	Status
South Dakota		
False Map Turtle	*Graptemys pseudogeographica*	ST
Black-Footed Ferret	*Mustela nigripes*	LE
Topeka Shiner	*Notropis topeka*	LE
Nebraska		
Bald Eagle	*Haliaeetus leucocephus*	LT
Piping Plover	*Charadrius melodus*	LE
Interior Least Tern	*Sterna antillarum athalassos*	LE
Pallid Sturgeon	*Scaphirhynchus albaus*	LE
Blacknose Shiner	*Notropis heterolepis*	SE
Northern Redbelly Dace	*Phoxinus eos*	ST
Sturgeon Chub	*Macrhybopsis gelida*	SE

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

3.4.5 Land Use and Visual Resources

Most of the lands in the east-central part of South Dakota, and the northeastern part of Nebraska where the Lake Andes MOA is located is used for agricultural purposes (Tables 3-36 and 3-37). Generally, the more fertile soils to the east are used for the cultivation of crops, while the drier areas to the west are used for ranch and grazing lands. The sale of cattle and calves is among South Dakota's leading agricultural products, with hogs, poultry, and dairying as other important agricultural activities. In addition to agriculture, other land uses in the area of the MOA include mining, with sand, gravel, granite, quartzite, and limestone quarried in many counties.

TABLE 3-36
Lake Andes MOA Land Use (Underlying Counties)

County	Total Acreage	Percent					
		Agriculture	Forest	Grassland	Shrub / Brushland	Urban / Rural Development	Water
Aurora	455,128	60.41		39.59			
Bon Homme	371,373	86.35	0.82	10.61		0.21	1.99
Boyd	347,963	47.04	11.04	41.92			
Brule	540,632	53.96	0.04	42.49	0.24		3.27

TABLE 3-36
Lake Andes MOA Land Use (Underlying Counties)

County	Total Acreage	Percent					
		Agriculture	Forest	Grassland	Shrub / Brushland	Urban / Rural Development	Water
Charles Mix	734,791	52.24	0.32	42.61		0.09	4.74
Davison	279,009	75.25		24.75			
Douglas	277,321	60.28		39.72			
Gregory	672,964	27.29	0.31	70.12		0.04	2.24
Holt	1,544,729	86.39	0.65	12.32	0.02	0.63	
Hutchinson	520,227	86.16		13.84			
Keya Paha	494,602	64.87	5.83	29.25		0.05	
Lyman	1,090,372	36.73	0.31	61.06	0.18		1.73
Tripp	1,033,120	47.35		52.65			

TABLE 3-37
Lake Andes MOA Land Use (Adjacent Counties)

County	Total Acreage	Percent					
		Agriculture	Forest	Grassland	Shrub / Brushland	Urban / Rural Development	Water
Buffalo	311,328	61.10	0.45	34.78			3.66
Hanson	278,275	84.44		15.56			
Jerauld	340,228	29.53		70.47			
Knox	728,150	55.44	7.15	35.75		0.46	1.19
McCook	368,662	90.48	0.07	9.46			
Miner	365,306	63.06	0.13	36.81			
Sanborn	364,186	65.55		34.45			
Turner	394,458	99.75		0.25			
Yankton	20,908	5.10	12.45	70.79	1.36	1.36	23.88

The visual resources within the Lake Andes MOA are not as well known as the Black Hills area to the west, or at the lakes region to the east. The Fort Randall Reservoir, however, is a very popular recreational area along the Missouri River. Other attractions within the MOA include Lake Andes National Wildlife Refuge, the Buryanek Lakeside Use Area, and the state recreational areas of Snake Creek, Platte Creek, and Burke Lake. All these areas are located in Charles Mix county in the central part of MOA. Tourist attractions in the MOA are the Yankton Treaty Monument, Fort Randall, and the Karl E. Mundt National Wildlife Reserve in Charles Mix county.

Within the counties adjacent to Lake Andes MOA there are many notable visual resources and popular tourist attractions. The Lewis and Clark Lake in Bon Homme County is located along the South Dakota- Nebraska border, and is surrounded by a beautiful shoreline of wooded slopes and chalkstone cliffs. Other important recreational areas in South Dakota are Twin Lakes, Springfield, Lake Vermillion, and West Bend. The northern areas of Buffalo and Lyman counties (near Pierre) are considered scenic and contain many historical attractions such as Fort Kiowa, Fort Defiance, and Fort Hale, as well as the Fort Pierre National Grassland.

3.4.6 Infrastructure, Transportation, and Utilities

The Lake Andes MOA is traversed by State Highway 281 along its eastern side. State Highway 281 is a major north-south connecting route between the city of Grand Island, Nebraska and the cities of Huron and Aberdeen in South Dakota. The other major road within the MOA is State Highway 18, which passes in an east-west direction through the western part of the MOA. The adjacent counties contain 2 major highways. These are I-90, which travels east-west through the heart of the state, and I-81, oriented in a north-south direction just east of the MOA.

South Dakota has a total of 142 airports, most of which are private. The closest commercial airports are the Mitchell Airport in Davison County, just outside the northern boundary of the MOA, and Chan Gurney Municipal Airport in Yankton County east of the MOA.

Hydroelectric power plants generate 63 percent of the state's electricity. The largest hydropower dams (in terms of capacity) are located under or near the Lake Andes MOA. These large dams include those at Gavins Point, Fort Randall, and Big Bend on the Missouri River. The remainder of the state's electricity is generated in thermal plants, which are mostly fueled by coal. Power is also brought in from utility plants in neighboring states. Major power utilities in the Lake Andes MOA region of influence are listed in Tables 3-38 and 3-39.

TABLE 3-38
Major Power Utilities Serving the Lake Andes MOA Region (Underlying Counties)

Power Utility	Location (Counties, State)
Bon Homme Yankton Electric Association, Inc	Bon Homme, SD
Charles Mix Electric Association, Inc	Bon Homme, Brule, Charles Mix, Douglas, SD
Cherry-Todd Electric Cooperative, Inc	Keya Paha, NE
City of Burke	Gregory, SD
City of Plankinton	Aurora, SD
City of Spencer	Boyd, NE
City of Stuart	Holt, NE
City of Tyndall	Bon Homme, SD
Douglas Electric Cooperative, Inc	Aurora, Charles Mix, Davison, Douglas, Hutchinson, SD

TABLE 3-38
Major Power Utilities Serving the Lake Andes MOA Region (Underlying Counties)

Power Utility	Location (Counties, State)
Elkhorn Rural Public Power District	Holt, NE
Intercounty Electric Association, Inc	Davison, SD
KBR Rural Public Power District	Holt, NE
KBR Rural Public Power District	Keya Paha, NE
McCook Electric Cooperative, Inc	Hutchinson, SD
Nebraska Public Power District	Boyd, Holt, NE
Niobrara Valley Electric Membership Corporation	Boyd, Holt, NE
North Central Public Power District	Holt, NE
Northern States Power Company	Hutchinson, SD
Northwestern Public Service Company	Aurora, Bon Homme, Brule, Charles Mix, Davison, Douglas, Hutchinson, SD
Rosebud Electric Cooperative, Inc	Gregory, Lyman, Tripp, SD
Tri-County Electric Association, Inc	Aurora, Brule, SD
Turner-Hutchinson Electric Cooperative, Inc	Bon Homme, Douglas, Hutchinson, SD
West Central Electric Cooperative, Inc	Lyman, SD
Winner Municipal Utility	Tripp, SD

TABLE 3-39
Major Power Utilities Serving the Lake Andes MOA Region (Adjacent Counties)

Power Utility	Location (Counties, State)
Bon Homme Yankton Electric Association, Inc	Yankton, SD
Cedar-Knox Public Power District	Knox, NE
City of Howard	Miner, SD
City of Parker	Turner, SD
City of Wessington Springs	Jerauld, SD
Clay-Union Electric Corporation	Turner, Yankton, SD
Dakota Energy Cooperative, Inc	Buffalo, Sanborn, Miner, SD
Intercounty Electric Association, Inc	Sanborn, Miner, SD
Lincoln-Union Electric Company	Turner, SD
McCook Electric Cooperative, Inc	Miner, Hanson, McCook, Turner, SD
Nebraska Public Power District	Knox, NE
Niobrara Valley Electric Membership Corporation	Knox, NE

TABLE 3-39
Major Power Utilities Serving the Lake Andes MOA Region (Adjacent Counties)

Power Utility	Location (Counties, State)
North Central Public Power District	Knox, NE
Northern States Power Company	Sanborn, Miner, Hanson, McCook, Turner, SD
Northwestern Public Service Company	Jerauld, Sanborn, Hanson, Turner, Yankton, SD
Sioux Valley Empire Electric Association, Inc	Miner, McCook, Turner, SD
Tri-County Electric Association, Inc	Buffalo, Jerauld, SD
Turner-Hutchinson Electric Cooperative, Inc	Turner, Yankton, SD

3.4.7 Cultural Resources

Historically, the lands along the Missouri River and to a lesser extent, James River, played an important part of the early exploration, settlement, and trading in South Dakota, and therefore contain sites of cultural significance. The Lewis and Clark expedition explored up the Missouri River through South Dakota and catalogued plant and animal life, established relations with native inhabitants, and collected information about their culture. Two years later, they again passed through while returning to St. Louis. As federal representatives, they engaged in diplomacy, composed preliminary population estimates for all Sioux peoples, and mentioned the many fur-bearing animals in their reports. These reports encouraged fur trading as a large-scale activity in South Dakota. Fur traders and fur trading companies built numerous trading posts, or forts. Most of the forts were located along the Missouri River, particularly in the vicinity of present-day Pierre. Some forts later became permanent settlements, and the fur trade flourished well into the 1850s. Examples of forts include Fort Randall, Fort Kiowa, Fort Hale, and Fort Defiance which are located in the vicinity of the Lake Andes MOA.

The peoples encountered by European explorers of present-day South Dakota were mostly members of the Sioux federation, which included the Arikara, Yankton, Yanktonai, and the Lakota Sioux. Arikaras were farmers who lived in villages of earthen lodges, mainly along the Missouri River. By contrast, the other Sioux peoples were seminomadic and gathered food, fished, and farmed, but twice a year they traveled west beyond the Missouri River to hunt animals in the area of present-day South Dakota. The Yankton and Yanktonai hunted mainly in the James River basin, but shared hunting areas with the Lakota west of the Missouri.

Currently, Native Americans constitute about 10 percent of the population of South Dakota. The Lake Andes MOA contains the Yankton Indian Reservation, which is situated on the north shore of the Missouri River in Charles Mix County. Other Native American reservations include the Lower Brule and Crow Creek Indian Reservation in Lyman and Buffalo Counties respectively. Across the Missouri River southeast of the MOA, the Santee Indian Reservation is located in Knox County in Nebraska. Potentially interested tribal organizations in the Lake Andes MOA include the Crow Creek Sioux Tribal Council, Rosebud Sioux Tribal Council, and Yankton Sioux Tribal Council, which are headquartered in Aberdeen, South Dakota.

Other cultural attractions or activities in the vicinity of the Lake Andes MOA are historical museums, such as Friends of the Middle Border Pioneer Museum at Mitchell, and the Siouxland Heritage Museums at Sioux Falls. Additional tourist attractions include the Corn Palace in Mitchell, a unique building designed to promote the richness of the state's agriculture, which is the site of a week-long festival each September. Both the interior and exterior of the building are decorated with murals of multicolored corn that are changed each year.

Finally, educational institutions, such as the first sod schoolhouse that was erected in Bon Homme County in 1860, and Wesleyan University in Mitchell.

3.4.8 Socioeconomics

Since its early settlement in the mid-19th century, South Dakota and Nebraska's economy has been based on agriculture. Currently, farmland occupies about 91 percent of the land area of South Dakota. Manufacturing has increased in importance over the years, and has become diversified from the processing of primary products, such as foodstuffs and lumber. The state is also a national leader in the production of storm doors, computers, scoreboards, and medical products. Tourism, gambling, and other service industries, transportation, and commerce also play important parts in the state's economy. Sioux Falls and Rapid City are the principal trade centers in South Dakota.

South Dakota had a work force of 400,000 in 1999. Of those, the largest share, or 27 percent, worked in service industries, such as restaurants and data processing. Another 22 percent were employed in wholesale or retail trade; 14 percent in federal, state, or local government, including those serving in the military; 10 percent in manufacturing; 9 percent in farming 5 percent in construction; 4 percent in transportation or public utilities; and 0.5 percent in mining.

In the vicinity of the Lake Andes MOA, farming, tourism, and the service industry are important to the local economy, because of the rich alluvial soils found along the Missouri River and the abundance of state recreational areas. In nearby urbanized areas such as Mitchell and Huron, the processing of food products such as meat and meat products is important to the local economy.

The 2000 population of the counties underlying the Lake Andes MOA is 85,395 persons. The 2000 population in the adjacent counties is 58,732. The population center within the Lake Andes MOA is located in the city of Winner in Tripp County (population 3,137). Most other towns within the MOA contain populations of 1,600 or less (i.e., Wagner - 1,678; Corsica - 644; Ravinia - 79). Major population centers within the adjacent counties include the city of Mitchell (population 14,558) and the city of Yankton (population 13,528). Additional population and income data are provided in Tables 3-40 and 3-41.

TABLE 3-40
Socioeconomic Characteristics of the Lake Andes MOA Region (Underlying Counties)

County	Area[1]	Population[2]	Density[3]	Median Household Income ($)[4]
Boyd, NE	540	2,438	4.5	23,212
Holt, NE	2,413	11,551	4.8	29,517
Keya Paha, NE	773	983	1.3	20,756
Aurora, SD	708	3,058	4.3	26,723
Bon Homme, SD	563	7,260	12.9	28,703
Brule, SD	819	5,364	6.5	30,971
Charles Mix, SD	1,098	9,350	8.5	26,551
Davison, SD	436	18,741	43.1	33,409
Douglas, SD	434	3,458	8.0	29,365
Gregory, SD	1,016	4,792	4.7	24,383
Hutchinson, SD	813	8,075	9.9	30,293
Lyman, SD	1,640	3,895	2.4	27,283
Tripp, SD	1,614	6,430	4.0	28,631
Total/Average	12,867	85,395	6.6	27,677

1. US Census Bureau - Land Area, Population, and Density for States and Counties, 2000.
2. US Census Bureau - Population for 2000 <www.census.go/population/estimates/county.
3. Calculated - County Population divided by County Area.
4. U.S. Census Bureau – Money Income for all counties in Nebraska and South Dakota 1997.

TABLE 3-41
Socioeconomic Characteristics of the Lake Andes MOA Region (Adjacent Counties)

County	Area[1]	Population[2]	Density[3]	Median Household Income ($)[4]
Knox, NE	1108	9,374	8.5	26,711
Buffalo, SD	471	2,032	4.3	18,444
Hanson, SD	435	3,139	7.2	33,830
Jerauld, SD	530	2,295	4.3	28,026
McCook, SD	575	5,832	10.1	32,417
Miner, SD	570	2,884	5.1	28,085
Sanborn, SD	569	2,675	4.7	28,842
Turner, SD	617	8,849	14.3	32,510

TABLE 3-41
Socioeconomic Characteristics of the Lake Andes MOA Region (Adjacent Counties)

County	Area[1]	Population[2]	Density[3]	Median Household Income ($)[4]
Yankton, SD	522	21,652	41.5	32,997
Total	5396	58,732	10.9	25,762

1. US Census Bureau - Land Area, Population, and Density for States and Counties: 2000.
2. US Census Bureau - Population for 2000.
3. Calculated - County Population divided by County Area.
4. U.S. Census Bureau – Money Income for all counties in Nebraska and South Dakota 2000.

3.4.9 Environmental Justice

Demographic information on race, ethnicity, and poverty status in the counties underlying the Lake Andes MOA are presented in Table 3-42. Statistics for the states of South Dakota and Nebraska are included to provide context. (See subsection 3.3 for the definitions of minority population and poverty areas).

The total percentage of minority population in most of the 13 counties underlying the Lake Andes MOA is less than the surrounding states of South Dakota and Nebraska. However, Charles Mix and Lyman counties in South Dakota have substantially higher American Indian populations (28.3 and 33.3 percent, respectively) than the state as a whole (8.3 percent). Charles Mix and Lyman counties also meet the 20 percent definition for poverty areas and Tripp County comes very close to that, while the statewide poverty rate for South Dakota was 14.0 percent.

TABLE 3-42
Demographic Statistics for the Lake Andes MOA

Jurisdiction	Total Persons (2000)	Percentage						
		White (2000)	Black (2000)	American Indian[1] (2000)	Asian[2] (2000)	Other (2000)	Hispanic Origin[3] (2000)	Poverty Rate[4] (1997)
South Dakota	754,844	88.7	0.6	8.3	0.6	0.5	1.4	14.0
Nebraska	1,711,263	89.6	4.0	0.9	1.3	2.8	5.5	9.6
Lake Andes MOA Counties								
Aurora Co., SD	3,058	95.7	0.3	1.9	0.1	1.4	2.1	15.1
Bon Homme Co., SD	7,260	95.5	0.6	3.0	0.1	0.2	0.6	13.7
Brule Co., SD	5,364	89.9	0.3	8.3	0.5	0.1	0.5	15.8
Charles Mix Co., SD	9,350	69.6	0.1	28.3	0.1	0.5	1.9	23.9
Davison Co., SD	18,741	96.2	0.3	2.0	0.4	0.3	0.7	12.7
Douglas Co., SD	3,458	98.1	0.1	1.0	0.1	0.1	0.4	13.5

TABLE 3-42
Demographic Statistics for the Lake Andes MOA

Jurisdiction	Total Persons (2000)	Percentage						
		White (2000)	Black (2000)	American Indian[1] (2000)	Asian [2] (2000)	Other (2000)	Hispanic Origin[3] (2000)	Poverty Rate[4] (1997)
Gregory Co., SD	4,792	93.2	(Z)	5.6	0.2	0.1	0.9	21.1
Hutchinson Co., SD	8,075	98.8	0.1	0.6	0.1	0.1	0.5	13.2
Lyman Co., SD	3,895	64.7	0.1	33.3	0.2	0.1	0.5	24.3
Tripp Co., SD	6,430	87.5	(Z)	11.2	0.1	0.1	0.9	20.2
Boyd Co., NE	2,438	98.1	0.0	0.6	0.2	0.0	0.1	13.2
Holt Co., NE	11,551	98.9	(Z)	0.3	0.2	0.2	0.7	12.9
Keya Paha Co., NE	983	99.4	0.0	0.2	0.0	0.0	3.9	19.1

Source: U.S. Bureau of the Census, 2000

Notes:
1. Includes Alaska native and Aleutian Islander

2. Includes Pacific Islander

3. Race refers to Census respondents' self-identification of racial background. Hispanic origin refers to ethnicity and language, not race, and may include persons whose heritage is Puerto Rican, Cuban, Mexican, and Central or South American.

4. The values shown are 1997 Census Bureau estimates of percent persons with household incomes below the poverty threshold.

(Z) values are greater than zero but less than half unit of measure shown

3.5 Snoopy and Beaver

Snoopy West MOA encompasses portions of Lake, Cook and St. Louis counties in Northern Minnesota, while Snoopy East MOA is located entirely over Lake Superior (Figure 3-5). The affected environment in the Snoopy West MOA is in the Superior Uplands physiographic region of the northeastern corner of the state, while the Snoopy East MOA is primarily centered on the aquatic environment of the western basin of Lake Superior. Beaver MOA encompasses Koochiching, Beltrami, Itasca and Lake of the Woods counties in Minnesota (Figure 3-5). State and national forests cover most of these counties.

3.5.1 Earth Resources

The Snoopy West MOA lands are underlain by primarily ancient igneous and crystalline metamorphic rocks which are characteristic of the larger Laurentian Upland, or Canadian Shield physiographic feature. The typical landscape types associated with this feature consist of many low, rounded hills and glacially scoured lake basins. There are many swampy and poorly drained areas, and most stream valleys are shallow with frequent falls and rapids. The upland areas are high in elevation. Eagle Mountain, in Cook County, is the highest point in the state (2,301 ft). A series of sharp pointed hills, known as the Sawtooth Mountains are located near the Lake Superior shoreline. The elevation drops abruptly to between 500 and 900 ft at the lakefront with the lake itself at an elevation of 600 ft above sea level.

Soils in the northeastern part of Minnesota are generally considered to be acidic, infertile, and spread thinly over bedrock. However, patches of rich red soils composed of glacial till also occur in some areas. The north central portion of Minnesota are typical richer and originate from glacial Lake Agassiz and glacial till.

The Snoopy East MOA is located in the offshore waters of Lake Superior. These offshore waters are deep and oligotrophic, with approximately 90% of the total lake area occupying depth contours of 89 ft (27 m) and greater.

The eastern portion of the Beaver MOA contains many of the characteristics of the Superior Uplands, but becomes flatter towards its western boundary. Due to the influence of glacial Lake Agassiz during prehistoric periods, some of the largest peat bogs are present in this region.

3.5.2 Climate

The climate in the vicinity of the Snoopy MOAs and Beaver MOAs is generally described as humid continental and is largely controlled by its location in the interior of the large landmass of North America. Extreme seasonal variations in temperature are usually encountered, with January averages of 0° F, with periodic drops to – 20° F. July average temperatures can be as low as 60° F, but heat waves with temperatures of 100° F are common. Precipitation is generally adequate, and varies from 30 to 20 inches annually. Snow cover is common throughout this part of the state for long periods.

3.5.3 Water Resources

The Snoopy West MOA contains numerous small glacial lakes and rivers which drain to the north shore of Lake Superior, Rainy River and the Lake of the Woods water system. The network of waterways is most prevalent along Cook and Lake Counties, within the Superior National Forest at the northern boundary of the MOA. Most of the streams draining to the Lake Superior shoreline are in deep cut valleys, which plunge over the abrupt escarpment as it approaches the lakefront. Significant river systems in the Snoopy West MOA are the St. Louis River system in St. Louis County, Isabella in Lake County, and Temperance River in Cook County. Surface water bodies comprise a total of 616,002 acres, representing 9.1 percent of the total land area in St. Louis, Cook, and Lake Counties.

Similarly, the Beaver MOA also contains a network of lakes and waterbodies. The majority of lakes in the Beaver MOA are located in the south within the Chippewa National Forest. Major waterbodies within the MOA includes the Upper and Lower Red Lake, Lake Winnibigoshish, Big Fork River, and its tributaries Sturgeon and Caldwell River. The northwest part of the MOA drains to the west and is part of the Red River river system. Surface water bodies comprise a total of 592,174 acres, representing 10.1 percent of the total land area in Koochiching, Beltrami, and Itasca Counties. The portion of Lake of the Woods

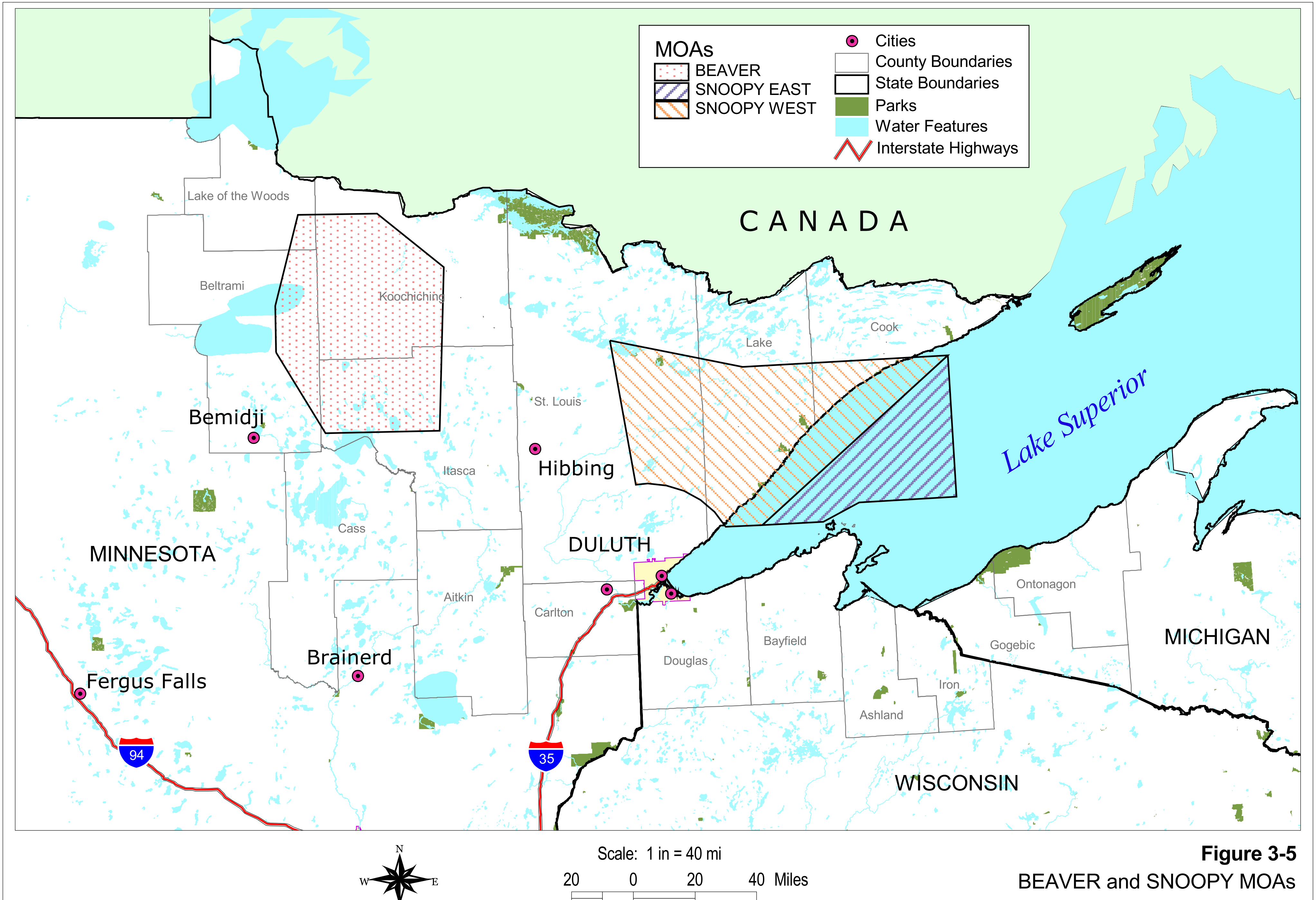


Figure 3-5
BEAVER and SNOOPY MOAs

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County encompassed by the Beaver MOA contains fewer waterbodies in relation to these other counties.

3.5.4 Biological Resources

The Snoopy West MOA and Beaver MOA contain vast tracts of boreal coniferous forests that once extended as far south as the St. Paul/Minneapolis area. However, early logging has removed a great deal of white pine and other conifers from the forest zone, with replacement of birch, poplar, and various species of scrub growth occurring in many places. The current tree composition of the forested area in Snoopy MOA is estimated to be 80% aspen-birch, 15% white-red-jack pine, and 5% maple-beech-birch associations. The current tree composition of the forested areas in Beaver MOA is estimated to be 70% aspen-birch, 20% white-red-jack pine, and 10% maple-beech-birch associations.

The forested lands support populations of black bear, eastern timber wolf, moose, white-tailed deer, fisher, pine marten, river otter, weasel, muskrat, striped skunk, beaver, woodchuck, fox, tree squirrel and occasionally bobcat in the northern part of the state. The diverse animal life includes five species of tree squirrel and two species of flying squirrel. In addition to the diversity in mammals, there 20 species of amphibians and 29 species of reptiles that are known to occur in Minnesota, which are likely found within the Snoopy West MOA. Of these, the timber rattlesnake, massauga rattlesnake, wood turtle and Blanding's turtle are listed as either threatened or endangered in the state.

Northern Minnesota is located at the northern end of the Mississippi Flyway, which is used by millions of migrating waterfowl. Tundra swans, trumpeter swans, sandhill cranes, Canada geese, wood ducks, and mallards are known to occur in the state. The many lakes found within the Snoopy West MOA are inhabited by the common loon, which is recognized as the state bird. In addition to waterfowl, a variety of raptors, including 11 species of hawk, 11 species of owl, and two species of eagles are also known to occur in northern Minnesota. There were about 600 American bald eagle nesting pairs found within Minnesota in 1990. The Beaver MOA occupies a portion of Red Lake Wildlife Management Area, which contains significant wetland wildlife populations.

Minnesota is inhabited by 153 species of fish, with 140 considered to be native. The lakes in the northern part of the state contain large populations of walleye, lake trout, salmon, muskellunge, largemouth bass, and sunfish. Lake Superior is known to support a cold water fishery, consisting primarily of lake trout, whitefish, and introduced salmon and rainbow trout.

In the counties underlying the Snoopy and Beaver MOAs, there are 47 threatened and endangered flora and fauna species (Table 3-43). In the counties adjacent to the Snoopy and Beaver MOAs, there are 91 threatened and endangered flora and fauna species (Table 3-44).

TABLE 3-43
Threatened and Endangered Flora and Fauna in the Snoopy and Beaver MOAs (Underlying Counties)

Common Name	Scientific Name	Status
Alpine billberry	*Vaccinium uliginosum*	ST
Wild chives	*Allium schoenoprasum var sibiricum*	ST

TABLE 3-43
Threatened and Endangered Flora and Fauna in the Snoopy and Beaver MOAs (Underlying Counties)

Common Name	Scientific Name	Status
Mooth woodsia	*Woodsia glabella*	ST
Rocky mountain woodsia	*Woodsia scopulina*	ST
Purple crowberry	*Empetrum eamesii*	SE
Black crowberry	*Empetrum nigrum*	SE
Northern spikemoss	*Selaginella selaginoides*	SE
Norwegian whitlow grass	*Draba norvegica*	SE
Encrusted saxifrage	*Saxifraga paniculata*	ST
Sticky locoweed	*Oxytropis viscida*	SE
Knotty pearlwort	*Sagina nodosa spp borealis*	SE
Holboel’s rock cress	*Arabis holboelli var retrofracta*	ST
Nodding saxifrage	*Saxifraga cernua*	SE
Bog adder’s mouth	*Malaxis paludosa*	SE
Wilson’s phalarope	*Phalaropus tricolor*	ST
Alpine milk vetch	*Astragalus alpinus*	TE
Auricled twayblade	*Listera auriculata*	TE
Awlwort	*Subularia aquatica*	ST
Beaked spike rush	*Eleocharis stellata*	ST
Black hawthorn	*Crataegus douglasii*	ST
Blunt lobed grapefern	*Botrychium oneidense*	SE
Braun’s holly fern	*Polystichum braunii*	TE
Chilean sweet cicely	*Osmorhiza berteroi*	SE
Cloudberry	*Rubus chamaemorus*	ST
Common moonwort	*Botrychium lunaria*	ST
Common tern	*Sterna hirudo*	ST
Encrusted Saxifrage	*Saxifraga paniculata*	ST
Hair like beak rush	*Rhynchospora capillacea*	ST
Kathadin sedge	*Carex katahdinensis*	ST
Lance leaf violet	*Viola lanceolata*	ST
Large leaved sandwort	*Moehringia macrophylla*	ST
Long leaved arnica	*Arnica lonchophylla*	ST
Luminous moss	*Schistostega pennata*	SE
Maidenhair spleenwort	*Asplenium trichomanes*	ST

TABLE 3-43
Threatened and Endangered Flora and Fauna in the Snoopy and Beaver MOAs (Underlying Counties)

Common Name	Scientific Name	Status
Neat Spike Rush	*Eleocharis nitida*	ST
Olivaceous spike rush	*Eleocharis olivacea*	ST
Pale moonwort	*Botrychium pallidum*	SE
Peregrine Falcon	*Falco peregrinus*	ST
Piping plover	*Charadrius melodus*	SE
Ram's head ladyslipper	*Cypripedum arietinum*	ST
Small false asphodel	*Tofieldia pusilla*	SE
Small white water lily	*Nymphaea leibergii*	ST
St. Lawrence grape fern	*Botrychium rugulosum*	ST
Sterile sedge	*Carex sterilis*	ST
Triangle moonwort	*Botrychium lanceolatum*	ST
Trumpeter swan	*Cygnus buccinator*	ST
Tuberculed rein orchid	*Plathanthera flava var herbiola*	SE
Wood turtle	*Clemmys insculpta*	ST

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

TABLE 3-44
Threatened and Endangered Flora and Fauna in the Snoopy and Beaver MOAs (Adjacent Counties)

Common Name	Scientific Name	Status
Algae-Like Pondweed	*Potamogeton confervoides*	ST*
Alpine Milk Vetch	*Astragalus alpinus*	SE
American Peregrine Falcon	*Falco peregrinus anatum*	LT
Arrow-Leaved Sweet-Coltsfoot	*Petasites sagittatus*	ST
Assiniboa sedge	*Carex assiniboinensis*	ST
Auricled twayblade	*Listera auriculata*	SE
Awlwort	*Subularia aquatica*	ST
Bald Eagle	*Haliaeetus leucocephalus*	LT
Beach grass	*Ammophila breviligulata*	ST
Beautiful Sedge	*Carex concinna*	ST

TABLE 3-44
Threatened and Endangered Flora and Fauna in the Snoopy and Beaver MOAs (Adjacent Counties)

Common Name	Scientific Name	Status
Blandings Turtle	*Emydoidea blandingii*	ST
Blunt lobed grapefern	*Botrychium oneidense*	SE
Bog bluegrass	*Poa paludigena*	ST
Braun's Holly Fern	*Polystichum braunii*	ST
Broad-Leaved Twayblade	*Listera convallarioides*	ST
Calypso or fairy slipper	*Calypso bulbosa*	ST
Canada Gooseberry	*Ribes oxyacanthoides*	ST
Canadian milk vetch	*Astragalus canadensis*	ST
Caspian Tern	*Sterna caspia*	SE
Cerulean Warbler	*Dendroica cerulea*	ST
Coast Sedge	*Carex exilis*	ST
Common Butterwort	*Pinguicula vulgaris*	SE
Common loon	*Gavia immer*	ST
Common moonwort	*Botrychium lunaria*	ST
Common tern	*Sterna hirudo*	ST
Downy sunflower	*Helianthus mollis*	ST
Drooping Sedge	*Carex prasina*	ST
Dwarf Huckleberry	*Vaccinium cespitosum*	SE
Dwarf Milkweed	*Asclepias ovalifolia*	ST
English Sundew	*Drosera anglica*	ST
Fairy bells	*Disporum hookeri*	SE
Farwell’s water milfoil	*Myriophyllum farwelli*	ST
Fassett's Locoweed	*Oxytropis campestris var chartacea*	LT
Floating marsh marigold	*Caltha natans*	SE
Garber’s sedge	*Carex garberi*	ST
Gilt Darter	*Percina evides*	ST
Ginseng	*Panax quinquefolius*	ST
Goblin moonwort	*Botrychium mormo*	ST
Greater Redhorse	*Moxostoma valenciennesi*	ST
Hedge hyssop	*Gratiola aurea*	ST
Hill's Thistle	*Cirsium hillii*	ST
Kathadin sedge	*Carex katahdinensis*	ST

TABLE 3-44
Threatened and Endangered Flora and Fauna in the Snoopy and Beaver MOAs (Adjacent Counties)

Common Name	Scientific Name	Status
Lake-Cress	*Armoracia lacustris*	SE*
Lapland Buttercup	*Ranunculus lapponicus*	SE
Large toothwort	*Dentaria maxima*	ST
Large Water-Starwort	*Callitriche heterophylla*	ST
Large-Leaved Sandwort	*Moehringia macrophylla*	SE
Lesser Wintergreen	*Pyrola minor*	SE
Little Goblin Moonwort	*Botrychium mormo*	SE*
Marsh Grass-Of-Parnassus	*Parnassia palustris*	ST
Michaux Sedge	*Carex michauxiana*	ST
Moonwort Grape-Fern	*Botrychium lunaria*	SE
Mountain Cranberry	*Vaccinium vitis-idaea ssp minus*	SE
Narrow False Oats	*Trisetum spicatum*	ST
Neat Spike Rush	*Eleocharis nitida*	ST
Northern Bur-Reed	*Sparganium glomeratum*	ST
Olivaceous spike rush	*Eleocharis olivacea*	ST
Osprey	*Pandion haliaetus*	ST
Pale Green Orchid	*Platanthera flava var herbiola*	ST
Pale moonwort	*Botrychium pallidum*	SE
Pale sedge	*Carex pallescens*	SE
Peregrine Falcon	*Falco peregrinus*	ST
Pine drops	*Pterospora andromedea*	ST
Piping Plover	*Charadrius melodus*	LE
Prairie buttercup	*Ranunuculus rhomboideus*	ST
Pugnose Shiner	*Notropis anogenus*	ST
Purple Wartyback	*Cyclonaias tuberculata*	SE
Pygmy Snaketail	*Ophiogomphus howei*	ST
Pygmy Weed	*Crassula aquatica*	ST
Ram’s head ladyslipper	*Cypripedum arietinum*	ST
Red-Shouldered Hawk	*Buteo lineatus*	ST
Round-Leaved Orchis	*Amerorchis rotundifolia*	ST
Satiny Willow	*Salix pellita*	SE
Seaside Crowfoot	*Ranunculus cymbalaria*	ST

TABLE 3-44
Threatened and Endangered Flora and Fauna in the Snoopy and Beaver MOAs (Adjacent Counties)

Common Name	Scientific Name	Status
Shore Sedge	*Carex lenticularis*	ST
Showy orchis	*Galearis spectabilis*	ST
Slenderleaf Sundew	*Drosera linearis*	ST
Small blue eyed mary	*Collinsia parviflora*	ST
Small yellow pond lily	*Nuphar pumila*	SE
Small Yellow Water Crowfoot	*Ranunculus gmelinii var hookeri*	SE
Smith Melic Grass	*Melica smithii*	SE
Snailseed pondweed	*Potamogeton bicupulatus*	SE
Spruce Grouse	*Falcipennis canadensis*	ST
St. Lawrence grape fern	*Botrychium rugulosum*	ST
Sweet colsfoot	*Petasites sagittatus*	ST
Tea-Leaved Willow	*Salix planifolia*	ST
Triangle moonwort	*Botrychium lanceolatum*	ST
Western Jacob's ladder	*Polemonium occidentale spp.lacustre*	SE
Wild chives	*Allium schoenoprasum var sibiricum*	ST
Wilson's phalarope	*Phalaropus tricolor*	ST
Wood turtle	*Clemmys insculpta*	ST
Yellow Rail	*Coturnicops noveboracensis*	ST

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

3.5.5 Land Use and Visual Resources

A significant portion of the Snoopy MOA overlies the Superior National Forest. As a result, the dominant cover type is forest (Tables 3-45 and 3-46). The most forest occurs in Cook County, while the greatest number of wetlands are found in St. Louis County. Based on the amount of undeveloped lands in this region, the Snoopy West MOA is situated in area that is important both recreationally and from a natural heritage conservation perspective. The hilly, mountainous terrain and escarpment areas along the Lake Superior waterfront provide visitors with a visually appealing resources that attracts both vacationers and tourists. Significant natural resource areas in Snoopy West and East MOAs include Superior National Forest, Boundary Waters Canoe Area Wilderness, Apostle Islands National Lakeshore, Cloquet Valley State Forest, Finland State Forest, Pat Bayle State Forest, and Vermillon Iron Range. Noted recreational features in the vicinity of the Snoopy MOA are

Castle Danger, Giants Ridge Ski Area, Hidden Valley Ski Resort, Lutsen Mountain Resort and Ski Area, and the US Hockey Hall of Fame near the city of Virginia. Lake Superior underlies the Snoopy East MOA.

The Beaver MOA is situated in Koochiching, Beltrami, Itasca, and Lake of the Woods County which is dominated by Pine Island State Forest and the Chippewa National Forest. The dominant cover type within the Beaver MOA region of influence is forest (Tables 3-47 and 3-48). The most forest occurs in Beltrami and Itasca Counties, while the greatest number of wetlands are found in Koochiching County. Unlike the Snoopy MOA, the Beaver MOA contains a great deal of bogs and fens. Based on the amount of state owned and nationally protected forested lands and wildlife refuges in this region, the Beaver MOA is important both recreationally, and from a natural heritage conservation perspective. Scenic areas along State Highway 71 and Highway 6 attract vacationers and tourists. Significant forested areas in Beaver MOA include Pine Island State Forest, Chippewa National Forest, Koochiching State Forest, Blackduck State Forest and Red Lake State Forest.

TABLE 3-45
Snoopy West MOA Land Use (Underlying Counties)

County	Total Acreage	Percent Agriculture	Percent Forest	Percent Shrub / Brushland	Percent Water
Cook	1,017,031	0.26	96.86		2.89
Lake	1,454,495	1.37	95.45		3.18
St. Louis	4,252,287	5.02	91.59	0.05	2.38

TABLE 3-46
Snoopy West MOA Land Use (Adjacent Counties)

County	Total Acreage	Percent Agriculture	Percent Forest	Percent Water
Ashland	633,325	2.71	95.21	2.08
Bayfield	957,758	1.89	97.70	0.41
Carlton	558,286	9.79	90.05	0.09
Douglas	848,286	2.45	97.18	0.11
Gogebic	727,888	0.44	98.27	1.30
Iron	512,616	0.30	94.59	5.11
Ontonagon	846,792	0.82	98.09	1.09

TABLE 3-47
Beaver MOA Land Use (Underlying Counties)

County	Total Acreage	Percent Agriculture	Percent Forest	Percent Grassland	Percent Shrub / Brushland	Percent Water
Beltrami	1,949,277	6.51	77.29			16.21
Itasca	1,870,324	2.78	94.53		0.01	2.67
Koochiching	2,005,584	1.61	97.83		0.03	0.52
Lake of the Woods	1,126,254	5.48	69.28	0.02	0.13	25.09

TABLE 3-48
Beaver MOA Land Use (Adjacent Counties)

County	Total Acreage	Percent Agriculture	Percent Forest	Percent Shrub / Brushland	Percent Water
Aitkin	1,272,868	5.22	89.43		5.35
Cass	1,539,923	11.28	76.73	0.02	11.97
St. Louis	4,252,287	5.02	91.59	0.05	2.38

3.5.6 Infrastructure, Transportation, and Utilities

The Snoopy West MOA is comprised primarily of forested lands, which contain a very sparse infrastructure, transportation and utility network. There are two main highways which originate from Duluth. Highway 53 runs north to the city of Virginia at the western border of the MOA. Highway 61 runs along the north shore of Lake Superior to the Canadian border. The remainder of the road network are minor road connections within the state parks and ski areas. Due to the scarcity of urbanized areas, existing servicing infrastructure is largely non-existent and is located within settled areas such as Virginia.

There are two airports that are present in close proximity to the Snoopy West MOA. These include Chisholm-Hibbing Airport, located just west of the city of Virginia, and the Duluth International Airport. The majority of the power utilities are in St. Louis County (Table 3-49).

The Beaver MOA is also heavily forested with a very sparse infrastructure, transportation, and utility network. US Highway 71 originates from Bemidji just outside of the southwest boundary of the MOA and proceeds northeast to International Falls at the vicinity of the Canadian border, traversing the Beaver MOA in a northeast-southwest direction. State Highway 72 is located along the western boundary and proceeds in a north-south direction from Baudette to the Red Lake State Forest. The remainders of the road network are minor road connections within the Chippewa National Forest and the Koochiching State Forest.

There are two airports in close proximity to the Beaver MOA. These include Falls International Airport in the city of International Falls at the northeast border, and the Bemidji Municipal Airport at the southwest border of the MOA. Table 3-50 presents a summary of power utilities located in the Beaver MOA region of influence.

TABLE 3-49
Major Power Utilities Serving the Snoopy West MOA Region

Power Utility	Location (Counties, State)
Arrowhead Electric Cooperative, Inc	Cook, Lake, MN
City of Biwabik	Saint Louis, MN
City of Buhl	Saint Louis, MN
City of Ely	Saint Louis, MN
City of Gilbert	Saint Louis, MN
City of Grand Marais	Cook, MN
City of Mountain Iron	Saint Louis, MN
City of Two Harbors	Lake, MN
City of Virginia	Saint Louis, MN
Hibbing Public Utilities Commission	Saint Louis, MN
Lake Country Power	Lake, Saint Louis, MN
Minnesota Power & Light Company	Lake, Saint Louis, MN
North Star Electric Cooperative, Inc	Saint Louis, MN
Proctor Public Utilities Commission	Saint Louis, MN
The Cooperative Light & Power Association of Lake County	Lake, Saint Louis, MN

TABLE 3-50
Major Power Utilities Serving the Beaver MOA Region

Power Utility	Location (Counties, State)
Beltrami Electric Cooperative, Inc	Beltrami, Itasca, Koochiching, MN
City of Baudette	Lake of The Woods, MN
City of Nashwauk	Itasca, MN
Clearwater-Polk Electric Cooperative, Inc	Beltrami, MN
Grand Rapids Public Utility Commission	Itasca, MN
Keewatin Public Utilities	Itasca, MN
Lake Country Power	Itasca, Koochiching, MN
Minnesota Power & Light Company	Itasca, Koochiching, MN
North Itasca Electric Cooperative, Inc	Beltrami, Itasca, Koochiching, MN
North Star Electric Cooperative, Inc	Koochiching, MN
North Star Electric Cooperative, Inc	Lake of The Woods, MN

TABLE 3-50
Major Power Utilities Serving the Beaver MOA Region

Power Utility	Location (Counties, State)
Red Lake Electric Cooperative, Inc	Beltrami, MN
Roseau Electric Cooperative, Inc	Beltrami, Lake of The Woods, MN

3.5.7 Cultural Resources

The counties of Cook, Lake, and St. Louis have had a long history of mining activity. Accordingly, the Minnesota Museum of Mines and the Iron Range Interpretive Center provide a chronicle of early mining and prospecting in the nearby iron ranges. A notable historical feature is the Hull Rust Mahoning Mine, which is currently the world's largest open pit ore mine (3 miles long and 600 ft deep). In addition to mining, the nearby counties share a history of early voyageur settlement. A Voyageur Visitor Center is located in St. Louis County.

There are a three Native American reservations located in close proximity to Snoopy West MOA. These are Bois Forte (Ness Lake) Indian Reservation to the west, Fond Du Lac Indian Reservation to the south, and Grand Portage Indian Reservation to the east. Potential tribal organizations that may have an interest in the proposed action include Bois Forte Reservation Business Committee, Grand Portage Reservation Business Committee, Minnesota Chippewa Tribe, Fond du Lac Reservation Business Committee, Leech Lake Reservation Business Committee, Red Lake Band of Chippewa Indians of Minnesota, and White Earth Reservation Business Committee.

There are fewer cultural resources in the vicinity of the Beaver MOA. Some of the these areas are the Count Beltrami State Monument and the Paul Bunyan and the Blue Ox Statue, which is part of American folklore.

There are two Native American reservations in close proximity to Beaver MOA. The Deer Creek Indian Reservation is located in the eastern section while the Red Lake Indian Reservation is located to the west and north sections of the MOA. Potential tribal organizations that may have an interest in the proposed action are the same as those identified above for the Snoopy West MOA.

3.5.8 Socioeconomics

The estimated 2000 population of the counties within the Snoopy MOA reveal that St. Louis and Cook County have the high and low populations in the MOA (200,528 and 6,168). St. Louis County has the fifth largest population within the state. The average total income per capita from the 1997 U.S Bureau of Economic Analysis is $36,254 for St. Louis County, $35,598 for Lake County, and $33,460 for Cook County, which are below the national average of $37,005. Mining, tourism, and the service industry (ski resorts, recreation) play an important role in the economy of the counties in the MOA region of influence.

In the Beaver MOA, county populations tend to be low (Itasca – 43,992; Beltrami – 39,650; Koochiching – 14,355; Lake of the Woods - 4,522). Within the MOA boundaries, the settlement pattern is along the Highway 71 corridor, where small communities exist (e.g., Blackduck, Funkley, Northome, Mizpah, Gemmel, Margie, Big Falls, and Grand Falls). The average total income per capita from the 1997 US Bureau of Economic Analysis is $29,851 for Beltrami County, $34,633 for Koochiching County, $32,769 for Itasca County and $32,302 for Lake of the Woods County, which are below the national average of $37,005. As for Snoopy MOA, mining, tourism, and the service industry (ski resorts, recreation) play an important role in the economy of the counties in the MOA region of influence.

The manufacturing of forest products (lumber, pulp and paper) and the servicing industry are among the fastest growing sectors of the economy within the state of Minnesota.

3.5.9 Environmental Justice

Demographic information on race, ethnicity, and poverty status in the counties underlying the Snoopy and Beaver MOAs are presented in Table 3-51 . Statistics for the state of Minnesota are included to provide context. (See subsection 3.3 for the definitions of minority population and poverty areas).

The total percentages of minority population in 5 of the 7 counties underlying the Snoopy and Beaver MOAs are less than the statewide percentage. However, Beltrami County (Beaver MOA) and Cook County (a small portion of Snoopy West MOA) have substantially higher American Indian populations (20.4 and 7.6 percent, respectively) than in the state of Minnesota as a whole (1.1 percent). Beltrami County comes close to meeting the 20 percent definition of a poverty level with a 18.9 poverty rate.

TABLE 3-51
Demographic Statistics for the Snoopy and Beaver MOAs

Jurisdiction	Total Persons (2000)	Percentage						
		White (2000)	Black (2000)	American Indian[1] (2000)	Asian [2] (2000)	Other (2000)	Hispanic Origin[3] (2000)	Poverty Rate[4] (1997)
Minnesota	4,919,479	89.4	3.5	1.1	2.9	1.3	2.9	8.9
Beaver MOA Counties								
Beltrami Co., MN	39,650	76.7	0.4	20.4	0.6	0.2	1.0	18.9
Lake of the Woods Co., MN	4,522	97.2	0.3	1.1	0.2	0.1	0.6	9.1
Itasca Co., MN	43,992	94.6	0.2	3.4	0.3	0.2	0.6	12.3
Koochiching Co., MN	14,355	96.1	0.2	2.2	0.3	0.1	0.6	11.7
Snoopy MOA Counties								
Cook Co., MN	5,168	89.5	0.3	7.6	0.3	0.3	0.8	7.7
Lake Co., MN	11,058	98.0	0.1	0.7	0.2	0.1	0.6	8.1

TABLE 3-51
Demographic Statistics for the Snoopy and Beaver MOAs

Jurisdiction	Total Persons (2000)	Percentage						
		White (2000)	Black (2000)	American Indian[1] (2000)	Asian [2] (2000)	Other (2000)	Hispanic Origin[3] (2000)	Poverty Rate[4] (1997)
St. Louis Co., MN	200,528	94.9	0.8	2.0	0.7	0.2	0.8	11.7

Source: U.S. Bureau of the Census, 2000

Notes:

1. Includes Alaska native and Aleutian Islander

2. Includes Pacific Islander

3. Race refers to Census respondents' self-identification of racial background. Hispanic origin refers to ethnicity and language, not race, and may include persons whose heritage is Puerto Rican, Cuban, Mexican, and Central or South American.

4. The values shown are 1997 Census Bureau estimates of percent persons with household incomes below the poverty threshold.

3.6 Pike and Steelhead

Pike West MOA encompasses portions of Presque Isle, Alpena, Montomercy, Oscoda, Alcona, Ogomaw, and Iosco counties in northeastern Michigan, while Pike East is located entirely over the confines of Lake Huron (Figure 3-6). The Steelhead MOA is located in a lacustrine plain area in eastern Michigan (i.e., the "thumb" of the lower Michigan peninsula), and encompasses the counties of Huron, Tuscola, Sanilac, Arenac, and Iosco. The affected environment of the MOA is primarily the agricultural land in Huron and Sanilac Counties and the surrounding embayment and nearshore areas of Lake Huron.

3.6.1 Earth Resources

The lands underlying the Pike West MOA are characteristic of the Great Lakes section of the Central Lowland physiographic feature. The typical landscape types associated with this feature consist of flat plains, which mark the bottom of an Ice Age lake (i.e., the Michigan Basin). The flat lacustrine plains are found along sections which border the Lake Huron shoreline, with moraines, till plains, and outwash plains towards the western section of the MOA. The lakefront area is characterized by a sandy shoreline, with rocky shorelines to the north. Along the border plains, the elevations are 600 to 800 ft above sea level. In the hilly lands to the west, elevations increase to 1,200 ft. The mean elevation above sea level is 900 ft in the State of Michigan.

The Pike East MOA is located in the offshore waters of Lake Huron, which are situated in the proximity of the Michigan-Ontario border. These offshore waters are oligotrophic, with about 75 percent of the total lake area occupying depth contours of 89 feet (27 meters) and greater.

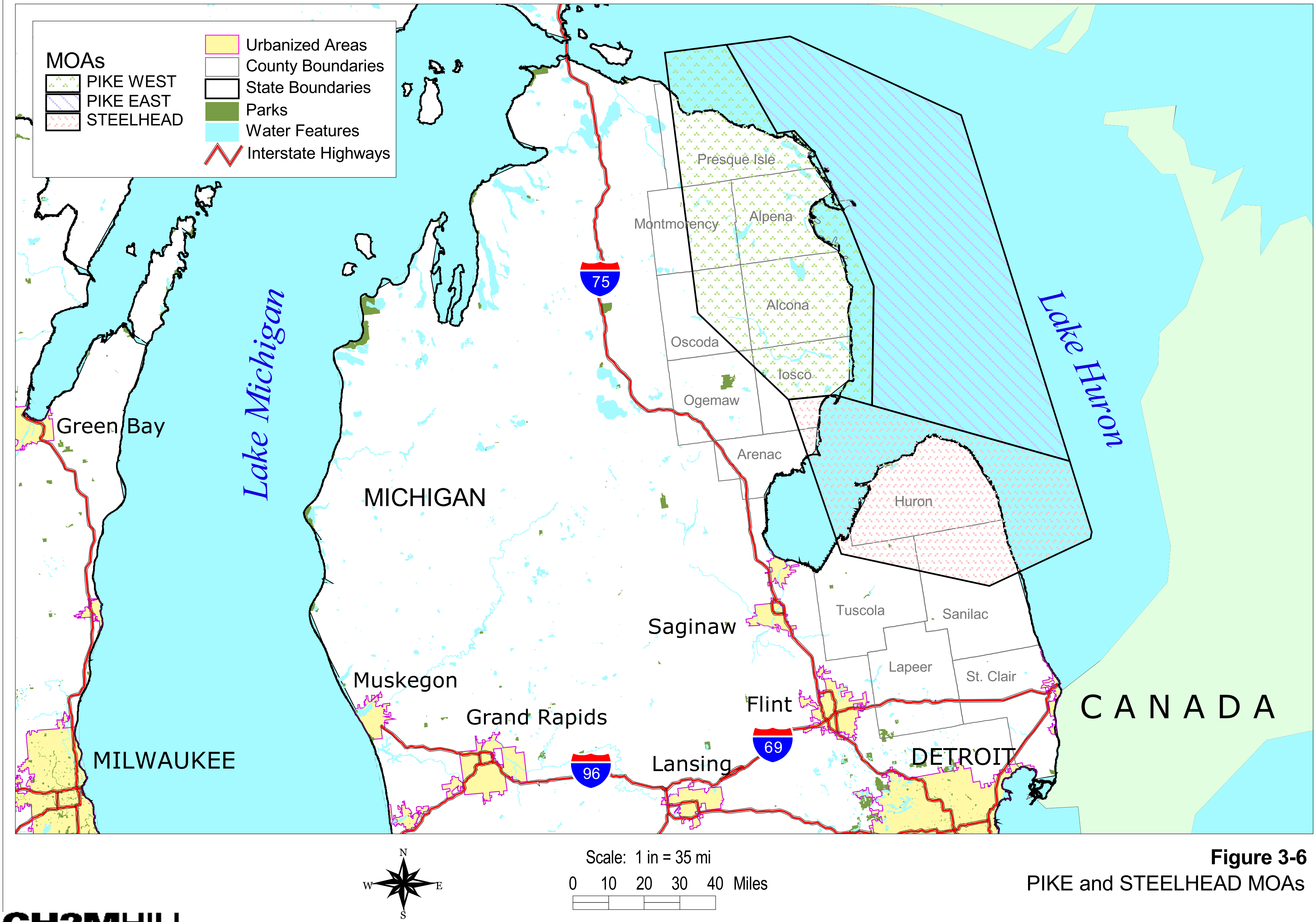

Figure 3-6
PIKE and STEELHEAD MOAs

CH2MHILL

The Steelhead MOA also occupies a fairly level lake border plain, containing some swamplands in Sanilac County. These lands are derived from a lacustrine plain, with moraine lands to the south. The lakefront area contains predominantly sandy shorelines, with isolated rocky areas along the northern tip of Huron County. The Steelhead MOA also contains Saginaw Bay, which is a relatively shallow embayment area of Lake Huron.

Soils in Michigan generally fall into two broad groups, sandy spodosols and loamy affisols. The spodosols are derived from coniferous forest conditions and are generally found in the upper two-thirds of Michigan. They tend to be acidic, nutrient poor, and have a thin dark surface layer and a nearly white subsurface layer. These soils are interspersed with loamy soils and large muck areas which often support agricultural activities. The loamy affisols are found in the southern half of the lower peninsula, and are characterized by thick, dark surface layers and farmed areas of muck that have developed under a natural cover of hardwood forest and swamp vegetation.

3.6.2 Climate

The climate in the vicinity of the Pike and Steelhead MOAs is generally described as continental, and is characterized by four definite seasons with moist, mild to hot summers and snowy, cold winters. Winds from Lake Superior and Lake Michigan in the winter months create heavy accumulations of snow in nearby areas. January temperature averages range from 10 to 27° F throughout most areas, and the range in July falls between 60 and 74° F. Precipitation is fairly uniform, with ranges of about 26 inches in the interior of the lower peninsula to about 36 in the extreme southern part of the state. Snowfall is generally heavy in the higher elevations of the northern lower peninsula.

3.6.3 Water Resources.

In general, the inland rivers within the Michigan state borders do not rank among the major river systems in the US, although several are considered navigable. The Pike West MOA contains a number of lakes and rivers, which drain to the eastern shore of Lake Huron. The network of waterways is most prevalent in Alpena and Iosco Counties. In Alpena County, significant water bodies include Hubbard Lake, Fletcher Pond, Long Lake, and Grand Lake, which are likely used for a variety of recreational purposes. Most of these water bodies are located in the Thunder Bay River watershed, which drains to the Thunder Bay area in the city of Alpena. In Iosco County, significant water bodies include the Au Sable River system, which drains eastward to the towns of Au Sable and Oscoda. The Au Sable River contains a number of small impoundments created through dam construction. Lake Huron is located below the Pike East MOA.

The Steelhead MOA contains fewer waterbodies and no lakes. Three stream systems, Pigeon, Pinnebog and Willow, are located in Huron County. They each drain northward to Lake Huron. The remainder of the river systems drain to the southwest and southeast (North Branch of Cass River and Black River, respectively).

3.6.4 Biological Resources

Until the late 1800s, much of Michigan was forested with a mix of coniferous and deciduous trees. In the southern areas of the state, hardwoods such as oak, maple, hickory, beech, basswood, elm, soft maple, and ash were dominant. Tracts of the original forest still remain in a few areas, such as the Hartwick Pines State Forest. Much of the current Michigan forest is a product of an extensive reforestation program that began in 1899, when the state forestry commissions was established. Of all the forested areas of the state, two-thirds are owned by private interests, while the remainder is under state and federal ownership.

In Pike West MOA, the most significant forested area is the Huron National Forest, which is located along the Au Sable River watershed. The forest tree composition is primarily white-red-jack pine coniferous stands, which are found throughout the Au Sable River watershed and hilly areas of Montomercy and Presque Isle counties. The coniferous stands are bordered by aspen and birch stands. In Steelhead MOA, there are very few natural and forested areas. Scattered aspen and birch occur in patches in parts of northern Sanilac and Huron counties.

A number of trees and plants are listed as threatened or endangered because of disease and disturbance to their natural habitat. Threatened and endangered tree species include the swamp or black cottonwood and the American chestnut. Other rare plants include the prairie fringed orchid, dwarf lake iris, pitcher's thistle, Houghton's goldenrod, Michigan monkey flower, smaller whorled pogonia, hart's tongue fern, and wild ginseng.

A diverse animal population is found throughout the forested areas on the lower Michigan peninsula. Examples of animals that are distributed throughout the Pike West MOA include black bear, otter, osprey, beaver, muskrat, mink, raccoon, red fox, badger, wild turkey, snowshoe hare, and sandhill crane. White-tailed deer is also widespread, and controlled herds of elk are found in some parts of the northern portion of the Lower peninsula.

Correspondence with Michigan Department of Natural Resources indicates that threatened and endangered species that may be present in the area include the Kirtland's warbler, bald eagle, common loon, red shouldered hawk, osprey, and the caspian tern. US Fish and Wildlife Service federal lists for the state of Michigan include 7 threatened plants and 1 endangered plant, and 3 threatened and 11 endangered animals. Threatened and endangered flora and fauna in the counties underlying Pike and Steelhead MOAs are presented in Tables 3-52, 3-53, and 3-54.

Coastal areas along the Lake Huron shoreline include the Tawas Point State Park at the southern end of the Pike MOA, which is an important stopover location for migrating song birds along the Mississippi Flyway. A unique sand dune ecosystem is also found at this location.

TABLE 3-52
Threatened and Endangered Flora and Fauna in the Pike MOA (Underlying Counties)

Common Name	Scientific Name	Status
Lake sturgeon	*Acipenser fulvescens*	ST
Lake cress	*Armoracia lacustris*	ST
Walking fern	*Asplenium rhizophyllum*	ST
Western moonwort	*Botrychium hesperium*	ST

TABLE 3-52
Threatened and Endangered Flora and Fauna in the Pike MOA (Underlying Counties)

Common Name	Scientific Name	Status
Red-shouldered hawk	*Buteo lineatus*	ST
Calypso or fairy-slipper	*Calypso bulbosa*	ST
Bulrush sedge	*Carex scirpoidea*	ST
Pitcher's thistle	*Cirsium pitcheri*	ST, LT
Common loon	*Gavia immer*	ST
Bald eagle	*Haliaeetus leucocephalus*	ST, LT
Dwarf lake iris	*Iris lacustris*	ST, LT
Osprey	*Pandion haliaetus*	ST
Channel darter	*Percina copelandi*	SE
Butterwort	*Pinguicula vulgaris*	SC
Pine-drops	*Pterospora andromedea*	ST
Caspian tern	*Sterna caspia*	ST
Common tern	*Sterna hirundo*	ST
Lake huron tansy	*Tanacetum huronense*	ST
False pennyroyal	*Trichostema brachiatum*	ST
Bayonet rush	*Juncus militaris*	ST
Migrant loggerhead shrike	*Lanius ludovicianus migrans*	SE
Hill's pondweed	*Potamogeton hillii*	ST
Houghton's goldenrod	*Solidago houghtonii*	ST, LT
Lake huron locust	*Trimerotropis huroniana*	ST

(Adjacent downwind counties: none)

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

TABLE 3-53
Threatened and Endangered Flora and Fauna in the Steelhead MOA (Underlying Counties)

Common Name	Scientific Name	Status
Lake sturgeon	*Acipenser fulvescens*	ST
Lake cress	*Armoracia lacustris*	ST

TABLE 3-53
Threatened and Endangered Flora and Fauna in the Steelhead MOA (Underlying Counties)

Common Name	Scientific Name	Status
Tall green milkweed	*Asclepias hirtella*	ST
Sullivant's milkweed	*Asclepias sullivantii*	ST
Red-shouldered hawk	*Buteo lineatus*	ST
Piping plover	*Charadrius melodus*	SE, (LE-LT)
Pitcher's thistle	*Cirsium pitcheri*	ST, LT
Spotted turtle	*Clemmys guttata*	ST
White lady-slipper	*Cypripedium candidum*	ST
Prairie warbler	*Dendroica discolor*	SE
Kirtland's warbler	*Dendroica kirtlandii*	SE, LE
Large toothwort	*Dentaria maxima*	ST
Eastern fox snake	*Elaphe vulpina gloydi*	ST
Northern riffleshell	*Epioblasma torulosa rangiana*	SE, LE
Snuffbox	*Epioblasma triquetra*	SE
Common loon	*Gavia immer*	ST
Bald eagle	*Haliaeetus leucocephalus*	ST, (PS)
Wavy-rayed lampmussel	*Lampsilis fasciola*	ST
Migrant loggerhead shrike	*Lanius ludovicianus migrans*	SE
River redhorse	*Moxostoma carinatum*	ST
American burying beetle	*Nicrophorus americanus*	SE, LE
Round hickorynut	*Obovaria subrotunda*	SE
Ginseng	*Panax quinquefolius*	ST
Osprey	*Pandion haliaetus*	ST
Silphium borer moth	*Papaipema silphii*	ST
Channel darter	*Percina copelandi*	SE
River darter	*Percina shumardi*	SE
Prairie fringed orchid	*Platanthera leucophaea*	SE, LT
Salamander mussel	*Simpsonaias ambigua*	SE
Caspian tern	*Sterna caspia*	ST
Common tern	*Sterna hirundo*	ST
Purple lilliput	*Toxolasma lividus*	SE
Lake huron locust	*Trimerotropis huroniana*	ST

TABLE 3-53
Threatened and Endangered Flora and Fauna in the Steelhead MOA (Underlying Counties)

Common Name	Scientific Name	Status
Blunt-lobed woodsia	*Woodsia obtusa*	ST
Wild-rice	*Zizania aquatica var aquatica*	ST

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

TABLE 3-54
Threatened and Endangered Flora and Fauna in the Steelhead MOA (Adjacent Counties)

Common Name	*Scientific Name*	Status
Lake sturgeon	*Acipenser fulvescens*	ST
Gattinger's gerardia	*Agalinis gattingeri*	SE
Skinner's gerardia	*Agalinis skinneriana*	SE
Eastern sand darter	*Ammocrypta pellucida*	ST
Three-awned grass	*Aristida longespica*	ST
Sullivant's milkweed	*Asclepias sullivantii*	ST
Canadian milk-vetch	*Astragalus canadensis*	ST
Slough grass	*Beckmannia syzigachne*	ST
Large water-starwort	*Callitriche heterophylla*	ST
Greenish-white sedge	*Carex albolutescens*	ST
Broad-leaved sedge	*Carex platyphylla*	ST
American chestnut	*Castanea dentata*	SE
Spotted turtle	*Clemmys guttata*	ST
White lady-slipper	*Cypripedium candidum*	ST
Large toothwort	*Dentaria maxima*	ST
Creeping whitlow-grass	*Draba reptans*	ST
Eastern fox snake	*Elaphe vulpina gloydi*	ST
Snuffbox	*Epioblasma triquetra*	SE
Showy orchis	*Galearis spectabilis*	ST
White gentian	*Gentiana flavida*	SE
Downy gentian	*Gentiana puberulenta*	SE
Stiff gentian	*Gentianella quinquefolia*	ST

TABLE 3-54
Threatened and Endangered Flora and Fauna in the Steelhead MOA (Adjacent Counties)

Common Name	*Scientific Name*	Status
Limestone oak fern	*Gymnocarpium robertianum*	ST
Bald eagle	*Haliaeetus leucocephalus*	ST, LT
Mooneye	*Hiodon tergisus*	ST
Goldenseal	*Hydrastis canadensis*	ST
Short-fruited rush	*Juncus brachycarpus*	ST
Wavy-rayed lampmussel	*Lampsilis fasciola*	ST
River redhorse	*Moxostoma carinatum*	ST
Round hickorynut	*Obovaria subrotunda*	SE
Ginseng	*Panax quinquefolius*	ST
Leiberg's panic-grass	*Panicum leibergii*	ST
Channel darter	*Percina copelandi*	SE
Heart-leaved plantain	*Plantago cordata*	SE
Orange or yellow fringed orchid	*Platanthera ciliaris*	ST
Prairie fringed orchid	*Platanthera leucophaea*	SE, LT
Bog bluegrass	*Poa paludigena*	ST
Jacob's ladder or greek-valerian	*Polemonium reptans*	ST
Carey's smartweed	*Polygonum careyi*	ST
Vasey's pondweed	*Potamogeton vaseyi*	ST
Pine-drops	*Pterospora andromedea*	ST
King rail	*Rallus elegans*	SE
Spearwort	*Ranunculus ambigens*	ST
Prairie buttercup	*Ranunculus rhomboideus*	ST
Few-flowered nut-rush	*Scleria pauciflora*	SE
Salamander mussel	*Simpsonaias ambigua*	SE
Common tern	*Sterna hirundo*	ST
Sauger	*Stizostedion canadense*	ST
Painted trillium	*Trillium undulatum*	SE
Barn owl	*Tyto alba*	SE
Rayed bean	*Villosa fabalis*	SE

TABLE 3-54
Threatened and Endangered Flora and Fauna in the Steelhead MOA (Adjacent Counties)

Common Name	*Scientific Name*	Status
Frost grape	*Vitis vulpina*	ST
Wild-rice	*Zizania aquatica var aquatica*	ST

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

3.6.5 Land Use and Visual Resources

Pike West MOA is primarily forested (Table 3-55) and most of the forest is used as parkland. The Huron National Forest encompasses a vast area along the southern section of the Pike MOA and provides numerous camping and recreational opportunities. Important recreational areas in close proximity include Michigan Islands National Wildlife Refuge, Jewell Lake, Silver Valley, Mack Lake, and the Rifle River state recreational area. The lakefront area along I-23 is scenic. I-23 provides connection between various points of interest. These include the numerous state parks such as Tawas Point, Harrisville, Negwegon, Thompson’s Harbor, and P.H. Hoeft which are known for their sandy beaches. The undeveloped Negwegon wilderness tract is believed to be the “crown jewel” of the Michigan State Park system. Notable points of interest are the Lumberman’s monuments in Iosco County, Mio Mountain Ski Area in Oscoda County, and Michigan Islands National Wildlife Refuge in Alpena County. The Pike West MOA is also in close proximity to a number of popular ski resorts such as Tyrolean Hills, Treetops Sylvan Ski Area, Michawaye Slopes, Hanson, and Skyline Ski Area.

The Steelhead MOA is dominated by farmland (Tables 3-56 and 3-57). As in the Pike West MOA, the major scenic areas and points of interest are located along the Lake Huron shoreline traversed by State Highway 23. These include Albert E. Sleeper and Port Crescent State Parks.

TABLE 3-55
Pike West MOA Land Use (Underlying Counties)

County	Total Acreage	Percentage				
		Agriculture	Forest	Grassland	Shrub / Brushland	Water
Alcona	439,415	6.16	92.11			1.74
Alpena	377,213	9.96	87.54			2.49
Iosco	359,492	28.88	67.81	0.07		3.24
Montmorency	359,162	3.63	95.83			0.54
Ogemaw	367,016	22.78	77.15			0.07
Oscoda	364,984	2.78	97.22			

TABLE 3-55
Pike West MOA Land Use (Underlying Counties)

County	Total Acreage	Percentage				
		Agriculture	Forest	Grassland	Shrub / Brushland	Water
Presque Isle	433,019	10.78	86.82		0.05	2.18
(Adjacent Counties N/A)						

TABLE 3-56
Steelhead MOA Land Use (Underlying Counties)

County	Total Acreage	Percentage			
		Agriculture	Forest	Grassland	Water
Arenac	230,370	55.68	41.87		2.45
Huron	532,369	93.78	6.11		0.11
Iosco	359,492	28.88	67.81	0.07	3.24
Sanilac	612,591	90.33	9.59		0.08
Tuscola	520,486	80.12	19.88		

TABLE 3-57
Steelhead MOA Land Use (Adjacent Counties)

County	Total Acreage	Percentage				
		Agriculture	Forest	Grassland	Shrub / Brushland	Water
Lapeer	423,212	72.48	27.28			0.23
St. Clair	454,663	68.78	29.00	0.05	0.58	1.10

3.6.6 Infrastructure, Transportation, and Utilities

The Pike West MOA is traversed by three principal highways. U.S.-23 runs north-south along the eastern shore of Lake Huron to the main urban area of Alpena. The remaining highways run in an east-west direction and consist of Highway 32 which originates from Alpena, and Highway 72, which traverses the Au Sable River watershed towards the city of Grayling.

There is one airport within the Pike West MOA. The Alpena County Regional Airport is located near the city of Alpena at the north central portion of the MOA. Major power utilities within the Pike MOA region of influence are listed in Table 3-58.

The Steelhead MOA is traversed by two principal highways. State Highway 25 traverses the northern section of the MOA and provides a linkage between Bay City and Port Huron. State Highway 53 provides a north-south linkage between Detroit and the town of Port Austin at the Lake Huron shoreline.

There are no major airports located within the Steelhead MOA. However, the Tri City airport is located a short distance to the southwest in the vicinity of Midland, Bay City, and Saginaw. Table 3-59 lists the major power utilities in the Steelhead MOA region of influence.

TABLE 3-58
Major Power Utilities Serving the Pike West MOA region

Power Utility	Location (Counties, State)
Alpena Power Company	Alcona, Alpena, Montmorency, MI
Consumers Energy Company	Alcona, Alpena, Iosco, Montmorency, Ogemaw, Oscoda, MI
Presque Isle Electric & Gas Cooperative	Alcona, Alpena, Montmorency, Oscoda, MI
Top O'Michigan Electric Company	Montmorency, MI

TABLE 3-59
Major Power Utilities Serving the Steelhead MOA region

Power Utility	Location (Counties, State)
Underlying Counties:	
City of Croswell	Sanilac, MI
City of Sebewaing	Huron, MI
Consumers Energy Company	Iosco, Tuscola, MI
The Detroit Edison Company	Huron, Sanilac, Tuscola, MI
Thumb Electric Cooperative of Michigan	Huron, Sanilac, Tuscola, MI
Adjacent Counties:	
Consumers Energy Company	Lapeer, MI
The Detroit Edison Company	Saint Clair, Lapeer, MI

3.6.7 Cultural Resources

There are three areas of cultural interest within the Pike West MOA. A large limestone quarry is located along the northern end of the MOA near the town of Roger’s City. The Besser Museum is located to the north of Alpena. The Lumbermen’s Monument is located in the Huron National Forest near the town of Au Sable. The Lumberman’s Monument contains an interpretive center which chronicles the white pine logging history of the area. No tribal organizations were identified within the area under consideration.

There are fewer cultural resources in the vicinity of the Steelhead MOA. Some of the areas of cultural significance are the discovery of Native American petroglyphs near Cass City, and a Pioneer Huron City near Grind Stone City. In addition, the Sanilac shores underwater preserve contains the remains of early shipwrecks. No tribal organizations were identified within the area under consideration.

3.6.8 Socioeconomics

Michigan’s largest share of employment is in the services industry. However, the manufacturing sector produces the largest sector of the state’s income and trade. The manufacturing sector dominates the southern one-third of the state, while in the northern two-thirds, the leading sources of income are in government, services, retail trade, and small scale manufacturing.

The estimated 2000 population of the counties within the Pike West MOA is 126,161 persons. County population estimates, density, and median income distribution among the underlying counties are provided in Table 3-60. The major population center within the Pike West MOA is the city of Alpena, with a population of about 11,304.

In this area, lumbering was important in the early part of the century. In locations such as Oscoda in the Au Sable watershed, streams provided access to lumber in the interior. Limestone was considered to be an important commodity in the northern portion of the Lower Peninsula, with major deposits found along the northeastern shoreline. Limestone quarrying and shipping are major activities in the Alpena region. The city of Alpena is also a center for cement and concrete production, wood product processing, and metals industries.

The estimated 2000 population of the counties underlying the Steelhead MOA is 183,500 persons (Table 3-61). Another 252,139 persons live in the adjacent counties. The population centers within the Steelhead MOA have small populations (e.g., Bad Axe - 3,462; Cass City - 2,643; Elkton Village - 863; Port Austin – 737; Port Hope - 310). In the adjacent counties, the major cities are Port Huron (population 32,338) and Lapeer (population 9,072).

Major economic areas are located just outside of the MOA in the cities of Saginaw, Bay City, and Midland. Saginaw contains automobile manufacturing industries, food processing, and is a producer of foundry work and machinery. Bay City is home to a major Great Lakes Port that distributes regional agricultural and industrial products, as well as a variety of industries including ship building. Midland is known for its manufacture of chemicals. In Michigan’s "thumb" and the Saginaw lowlands in the vicinity of the MOA, agricultural production of soybeans, sugar beets, navy beans, and wheat are common. Salt mines are common in the Saginaw and Bay City Area near the western boundary of the Steelhead MOA.

TABLE 3-60
Socioeconomic Characteristics of the Pike West MOA Region

County	Area[1]	Population[2]	Density[3]	Median Household Income [4]
Alcona Co., MI	674	11,719	17.4	$25,466
Iosco Co., MI	549	27,339	49.8	$27,140
Montmorency Co., MI	548	10315	18.8	$25,297
Oscoda Co., MI	565	9,418	16.7	$25,044
Ogemaw Co., MI	564	21,645	38.4	$25,383
Alpena Co., MI	574	31,314	5436	$31,836
Presque Isle Co., MI	660	14,411	21.8	$28,886
Total/Average	4,134	126,161	30.5	$27,007

1. US Census Bureau - Land Area, Population, and Density for States and Counties: 2000.
2. US Census Bureau - Estimated population for 2000 <www.census.gov/population/estimates/county
3 Calculated - County Population divided by County Area.
4 U.S. Census Bureau – Money Income for all counties in Michigan 1997, www.tier2.census.gov/cgi-win/usac

TABLE 3-61
Socioeconomic Characteristics of the Steelhead MOA Region

County	Area[1]	Population[2]	Density[3]	Median Household Income [4]
Underlying Counties:				
Arenac Co., MI	367	17,269	47.1	$27,758
Huron Co., MI	837	36,079	43.1	$33,362
Iosco Co., MI	549	27,339	49.8	$27,140
Sanilac Co., MI	964	44,547	46.2	$32,199
Tuscola Co., MI	813	58,266	71.8	$36,568
Total/Average	3,530	179,404	50.8	$31,405
Downwind Counties:				
Lapeer Co., MI	654	87,904	134.4	$47,774
St. Clair Co., MI	724	164,235	226.8	$42,617
Total/Average	3,571	251,146	70.33	$45,196

1. US Census Bureau - Land Area, Population, and Density for States and Counties: 2000.
2. US Census Bureau - Estimated population for 2000. <www.census.gov/population/estimates/county
3 Calculated - County Population divided by County Area.
4 U.S. Census Bureau – Money Income for all counties in Michigan 1997, www.tier2.census.gov/cgi-win/usac

3.6.9 Environmental Justice

Demographic information on race, ethnicity, and poverty status in the counties underlying the Steelhead and Pike MOAs are presented in Table 3-62 . Statistics for the state of Michigan are included to provide context. (See subsection 3.3 for the definitions of minority population and poverty areas).

The minority population in all of the counties underlying the Steelhead and Pike MOAs is much lower than in the state of Michigan. None of the counties meets the definition of a poverty area, although Arenac County comes close with a poverty rate of 16.6.

TABLE 3-62
Demographic Statistics for the Steelhead and Pike MOAs

Jurisdiction	Total Persons (2000)	Percentage						
		White (2000)	Black (2000)	American Indian[1] (2000)	Asian [2] (2000)	Other (2000)	Hispanic Origin[3] (2000)	Poverty Rate[4] (1997)
Michigan	9,938,444	80.2	14.2	0.6	1.8	1.3	3.3	11.5
Steelhead MOA Counties								
Arenac Co., MI	17,269	95.4	1.8	0.9	0.3	0.2	1.4	16.6
Huron Co., MI	36,079	98.0	0.2	0.3	0.4	0.3	1.6	12.0
Iosco Co., MI	27,339	96.9	0.4	0.7	0.6	0.2	1.0	13.6
Sanilac Co., MI	44,547	96.9	0.3	0.4	0.3	1.1	2.8	12.2
Tuscola Co., MI	58,266	96.0	1.1	0.6	0.3	0.7	2.3	11.0
Pike MOA Counties								
Alpena Co., MI	31,314	98.2	0.2	0.4	0.3	0.1	0.6	12.9
Presque Isle Co., MI	14,411	98.1	0.3	0.6	0.2	0.1	0.5	12.1

Source: U.S. Bureau of the Census, 2000

Notes:
1. Includes Alaska native and Aleutian Islander

2. Includes Pacific Islander

3. Race refers to Census respondents' self-identification of racial background. Hispanic origin refers to ethnicity and language, not race, and may include persons whose heritage is Puerto Rican, Cuban, Mexican, and Central or South American.

4. The values shown are 1997 Census Bureau estimates of percent persons with household incomes below the poverty threshold.

3.7 Volk and Falls

The Falls 1 and 2 MOAs are located in northwestern Wisconsin and encompass portions of Clark, Eau Claire, Jackson, La Crosse, Monroe, Trempeleau, and Wood County (Figure 3-7). The affected environment includes these underlying counties, as well as the adjacent counties of Taylor, Marathon, Portage, Adams, and Juneau in the central region of the state.

The Volk West, South, and East MOAs are located in the central portion of Wisconsin and encompass portions of Juneau, Wood, Adams, Columbia, Dodge, Green Lake, Marquette, Portage, Waupaca, Waushara, Jackson, Monroe, and Clark County (Figure 3-7). The affected environment of the MOA includes these underlying counties, as well as the adjacent counties of Marathon, Shawano, Outagamie, Winnebago, Fond du Lac, Washington, Jefferson, and Waukesha in the east central portion of the state.

3.7.1 Earth Resources

Wisconsin is generally divided into two major natural regions, or physiographic provinces, each of which is a part of one of the broader physiographic divisions of North America. The two natural regions are the Central Lowland and the Superior Upland. The Central Lowland, which is a part of the larger physiographic division known as the Interior Plains, covers southern Wisconsin. The Superior Upland, a southward extension of the Canadian Shield, occupies northern Wisconsin.

The Central Lowland is the larger of the two natural regions and covers a predominantly low-lying area across the southern two-thirds of the state. Over the eastern part of the region the underlying rocks have been covered by thick deposits of glacial clays and sands known as till, or drift. Most of this glaciated area is referred to as the Eastern Lake section of the Central Lowland, but a small area in the south is a continuation of the Till Plains, a section that covers adjoining areas of Illinois. Some sections, especially those south of the Wisconsin River, are quite rocky, steep, and rugged, but most land is only moderately hilly and is suitable for farming.

The Superior Upland occupies northern Wisconsin and is underlain by ancient and very hard rocks. The region is higher than the Central Lowland and for this reason is sometimes referred to as the Northern Highland. Most of its hills are from 1,300 to 1,400 ftabove sea level. Several isolated peaks rise considerably above this level.

The Falls and Volk MOAs are located in the central and south central portions of Wisconsin, near the boundary of the Central lowland and Superior Uplands physiographic regions. The MOAs lie over historic Glacial Lake Wisconsin, a roughly 1,800 square-mile area centered near Necedah. This area is flat, poorly drained, and supports extensive wetland communities. The soils in the Superior Upland region are usually characterized as spodosols, which are generally acidic, coniferous forest soils of sandy outwash and loamy till. These soils are seldom used for agriculture in Wisconsin. The Central lowlands are characterized by gray-brown alphasols which are more productive (although applications of lime and fertilizer are needed to maintain their fertility). Areas of fertile prairie soil exist in the southern quarter of Wisconsin, and there are scattered areas of bog and alluvial soil in the state. These soils are generally productive for agriculture. The bulk of soils where the MOAs are located most likely belong to this latter category.

3.7.2 Climate

The climate within the vicinity of the Falls and Volk MOAs is generally described as humid continental climate, which is characteristic of Wisconsin as a whole. Winters are long and cold, and summers are short and fairly hot. The waters of Lakes Superior and Michigan exert a moderating effect along coastal areas, and are generally milder in winter and cooler in summer than interior sections of the state. Average July temperatures range from more than 72° F in the southwest to less than 66° F in some northern areas. Daytime temperatures are seldom much higher than 90° F, and cool weather is not unusual. Summer nights are generally cool. January averages fall below freezing throughout Wisconsin. They range from less than 10° F in the interior northern areas to 22° F in the southeast along the Lake Michigan shore. During winter, extremely cold weather persists for several weeks at a time.

Average annual precipitation ranges from 28 to 32 in. Rainfall is generally heaviest during the spring and summer, and snowfall is generally moderate in the south, but can be heavy in the north. Thunderstorms (sometimes accompanied by tornados) are common in spring and summer, particularly in the southern part of the state.

The growing season ranges from less than 90 days in some areas of the north to more than 160 days along parts of the Lake Michigan shore. Land situated within about 2 milesof Lake Superior has an extended frost-free period averaging 114 days.

3.7.3 Water Resources

In general, rivers of Wisconsin drain into either the Mississippi River system, which flows southward into the Gulf of Mexico, or into the Great Lakes-Saint Lawrence system, which flows eastward into the Atlantic Ocean. The Mississippi is the only river navigable by commercial vessels, and its principal tributaries are the Saint Croix (which also forms part of the Minnesota state line), Chippewa, Black, Rock, and Wisconsin rivers. The principal rivers draining into Lake Michigan are the Menominee, which forms part of the Michigan state line, the Fox River, and its tributary, the Wolf River.

The Falls MOA is situated in the western end of Wisconsin. This area drains to the Mississippi River. Major river systems include the Black River and its tributaries, which flow southward from Clark, Jackson, and Trempealeau Counties. A short section of Wood County drains eastward to the Wisconsin River.

The Volk MOAs are primarily drained by the Wisconsin River, which meanders southward from Portage, Adams, and Juneau Counties. Within the MOA, the reaches of the Wisconsin River are very wide and have been impounded by dams. The Petenwell and Castle Rock reservoirs on the Wisconsin River are among the largest artificially created lakes within the state.

Wisconsin has many lakes, with nearly 9,000 smaller lakes scattered over the surface of the Superior Upland and Central Lowland. The largest natural lake is Lake Winnebago, which covers 206 sq mi. It lies east of the Volk MOAs in the adjacent counties of Winnebago and Fond du Lac. Other nearby lakes includes Green Lake, Lake Poygan, Lake Mendota, Lake Koshkonong, Lake Chippewa, and Beaver Dam.

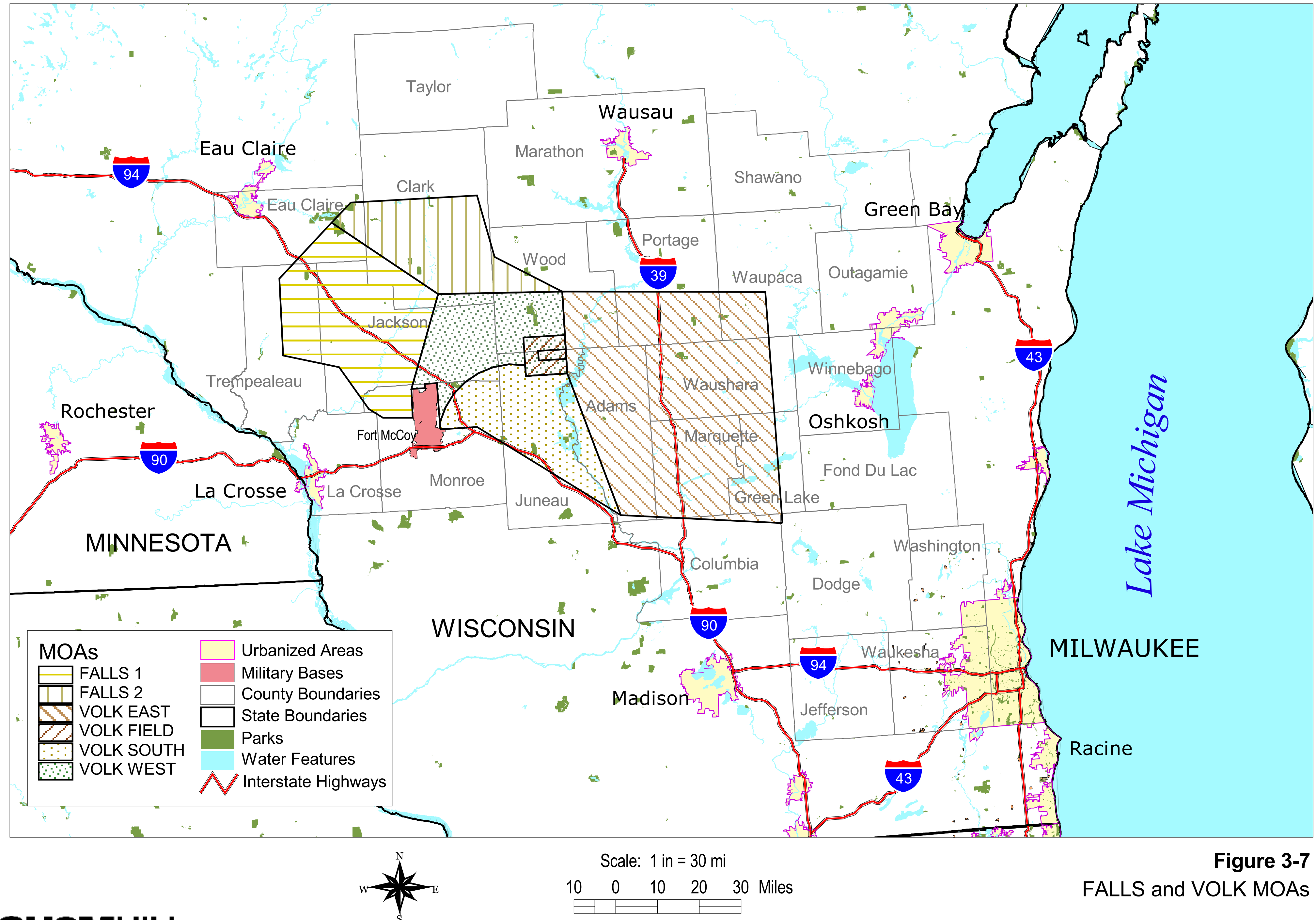

Figure 3-7
FALLS and VOLK MOAs

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3.7.4 Biological Resources

Extensive forests once covered most of Wisconsin. Currently, they now cover an estimated 44 percent of the state's land area. Most of the forested lands in Wisconsin are privately owned. The typical forest stands in northern Wisconsin consist of northern hardwoods mixed with conifers. Around the beginning of the 20th century, young pioneer species of hardwoods replaced the stands of white pines that were cleared in the l9th century. The aspen and birch are the two most common trees in these second-growth forest, along with sugar maple. Other tree species in the northern forests include white pine, red pine, jack pine, basswood, spruce, hemlock, and red maple. Typical shrubs associated with these northern forest stands include blueberry, raspberry, beaked hazel, chokecherry, bog rosemary, and red-berried elder. There are a total of 6 federally-listed threatened plants, 7 state-listed threatened plants, and 2 endangered plants in Wisconsin.

The hardwood forests of southern Wisconsin are dominated by red and white oaks, hickories, maples, and basswoods. Beech is found primarily in eastern regions of the state. Typical shrubs in the southern forests include chokecherry, dogwood, juneberry, poison ivy, staghorn sumac, and prickly ash.

The forests within Falls MOA are predominantly hardwoods (aspen-birch, oak-hickory, and maple-beech-birch), which are distributed in the southwest and the northcentral part of the MOA. Stands of white-red-jack pine are located to the southeast. In the Volk MOAs, there are scattered stands of aspen-birch and white-red-jack pine.

Wisconsin's mammal populations have endured many changes over the past century. The black bear is once again growing in number, while the resident population of timber wolves remains on the state's endangered list. Elk have been reintroduced to the northwest portion of the state, as well as the fisher and pine marten in the northern forested areas. Among the more common mammals found throughout Wisconsin are the white-tailed deer, muskrat, woodchuck, red fox, coyote, skunk, raccoon, mink, otter, beaver, cottontail, flying squirrel, and gray squirrel. Mammals found in some parts of Wisconsin include the badger, opossum, gray fox, porcupine, and snowshoe hare.

Wisconsin lies on the Mississippi Flyway, one of the migratory paths followed by millions of birds each spring and fall. Among the waterfowl commonly seen in Wisconsin during the migrations are Canada geese and several species of wild ducks. Horicon Marsh, in south central Wisconsin, is a major stopover for migrating waterfowl.

There are also ongoing efforts to establish an experimental migratory population of federally endangered whooping cranes (*Grus americana*) at the Necedah National Wildlife Refuge (NWR). The refuge has a large wetland complex that will provide high-quality habitat for the flock and support summer nesting. In 2001, a small group of individuals was reared at Necedah NWR, released and led to an overwintering site in Florida. In Spring 2002, several individuals returned to the Wisconsin release site. Over time, the goal is to establish a self-sustaining population of 125 whooping cranes, with a minimum of 25 nesting pairs.

Upland game birds in Wisconsin include the ring-necked pheasant, Hungarian partridge, sharp-tailed grouse, bobwhite, ruffed grouse, and woodcock. Hawks and owls are considered common, and wild turkeys have made a remarkable comeback in recent years.

The Wisconsin River is known for its sizable population of bald eagles. Songbirds include the robin (the state bird), juncos, house finches, English sparrows, nuthatches, cardinals, blue jays, bluebirds, tufted titmice, red-winged blackbirds, western meadowlarks, and prothonotary warblers. Also found in the state are flickers, hairy, downy and red-headed woodpeckers, yellow-bellied sapsuckers, crows, and ravens. The cedar waxwing summers in the state.

Wisconsin state waters contain game species such as the muskellunge, northern pike, walleye, lake trout, largemouth and smallmouth bass, perch, bullhead, and crappie. The lake sturgeon and shovelnose sturgeons were once abundant, but have become quite rare in Wisconsin waters, along with the true paddlefish, which is now protected.

In total, there are 2 federally-listed threatened animals, 7 federally-listed endangered animals, 8 state-listed threatened animals, and 5 state-listed endangered animals in the state of Wisconsin. Tables 3-63 through 3-66 list these species for the Falls and Volk MOAs.

TABLE 3-63
Threatened and Endangered Flora and Fauna in the Falls 1 and 2 MOAs (Underlying Counties)

Common Name	Scientific Name	Status
A Prairie Leafhopper	*Polyamia dilata*	ST
Acadian Flycatcher	*Empidonax virescens*	ST
American Beakgrain	*Diarrhena americana*	SE
American Peregrine Falcon	*Falco peregrinus anatum*	SE
Bald Eagle	*Haliaeetus Leucocephalus*	LT
Barn Owl	*Tyto alba*	SE
Bell's Vireo	*Vireo bellii*	ST
Black Buffalo	*Ictiobus niger*	ST
Black Redhorse	*Moxostoma duquesnei*	SE
Blanchard's Cricket Frog	*Acris crepitans blanchardi*	SE
Blanding's Turtle	*Emydoidea Blandingii*	ST
Blue Sucker	*Cycleptus elongatus*	ST
Bog Bluegrass	*Poa paludigena*	ST
Brittle Prickly-Pear	*Opuntia fragilis*	ST
Carey's Sedge	*Carex careyana*	ST
Carolina Anemone	*Anemone caroliniana*	SE
Cerulean Warbler	*Dendroica cerulea*	ST
Crystal Darter	*Ammocrypta asprella*	SE
Eastern Massasauga	*Sistrurus catenatus catenatus*	SE
Ebony Shell	*Fusconaia ebena*	SE
Ellipse	*Venustaconcha ellipsiformis*	ST

TABLE 3-63
Threatened and Endangered Flora and Fauna in the Falls 1 and 2 MOAs (Underlying Counties)

Common Name	Scientific Name	Status
Frosted Elfin	*Incisalia irus*	ST
Gilt Darter	*Percina evides*	ST
Goldeye	*Hiodon alosoides*	SE
Gray Wolf	*Canis lupus*	LE
Great Egret	*Casmerodius albus*	ST
Greater Prairie-Chicken	*Tympanuchus cupido*	ST
Greater Redhorse	*Moxostoma valenciennesi*	ST
Henslow's Sparrow	*Ammodramus henslowii*	ST
Higgins' Eye Pearly Mussel	*Lampsilis higginsi*	LE
Hill's Thistle	*Cirsium hillii*	ST
Karner Blue Butterfly	*Lycaeides melissa samuelis*	LE
Kentucky Warbler	*Oporornis formosus*	ST
Kirtland's Warbler	*Dendroica kirtlandii*	LE
Large Water-Starwort	*Callitriche heterophylla*	ST
Little Goblin Moonwort	*Botrychium mormo*	SE
Loggerhead Shrike	*Lanius ludovicianus*	SE
Musk-Root	*Adoxa moschatellina*	ST
Northern Wild Monkshood	*Aconitum noveboracense*	LT
Osprey	*Pandion haliaetus*	ST
Pale Green Orchid	*Platanthera flava var herbiola*	ST
Pallid Shiner	*Notropis amnis*	SE
Pecatonica River Mayfly	*Acanthametropus pecatonica*	SE
Phlox Moth	*Schinia indiana*	SE
Prairie Bush-Clover	*Lespedeza leptostachya*	LE
Prairie Milkweed	*Asclepias sullivantii*	ST
Prairie Parsley	*Polytaenia nuttallii*	ST
Prairie White-Fringed Orchid	*Platanthera leucophaea*	LE
Redfin Shiner	*Lythrurus umbratilis*	ST
Red-Shouldered Hawk	*Buteo lineatus*	ST
Red-Tailed Prairie Leafhopper	*Aflexia rubranura*	SE
River Redhorse	*Moxostoma carinatum*	ST
Rough Rattlesnake-Root	*Prenanthes aspera*	SE

TABLE 3-63
Threatened and Endangered Flora and Fauna in the Falls 1 and 2 MOAs (Underlying Counties)

Common Name	Scientific Name	Status
Sand Violet	*Viola fimbriatula*	SE
Small White Lady's-Slippers	*Cypripedium candidum*	ST
Snowy Campion	*Silene nivea*	ST
Speckled Chub	*Macrhybopsis aestivalis*	ST
Starhead Topminnow	*Fundulus dispar*	SE
Warpaint Emerald	*Somatochlora incurvata*	SE
Western Ribbon Snake	*Thamnophis proximus*	SE
Western Slender Glass Lizard	*Ophisaurus attenuatus*	SE
Wing Snaggletooth	*Gastrocopta procera*	ST
Wood Turtle	*Clemmys Insculpta*	ST
Yellow Gentian	*Gentiana alba*	ST

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

TABLE 3-64
Threatened and Endangered Flora and Fauna in the Falls 1 and 2 MOAs (Adjacent Counties)

Common Name	Scientific Name	Status
Acadian Flycatcher	*Empidonax virescens*	ST
Algae-Like Pondweed	*Potamogeton confervoides*	ST
Bald Eagle	*Haliaeetus leucocephalus*	LT
Barn Owl	*Tyto alba*	SE
Black Redhorse	*Moxostoma duquesnei*	SE
Blanchard's Cricket Frog	*Acris crepitans blanchardi*	SE
Blanding's Turtle	*Emydoidea blandingii*	ST
Bog's Bluegrass	*Poa paludigena*	ST
Brittle Prickly-Pear	*Opuntia fragilis*	ST
Brook Grass	*Catabrosa aquatica*	SE
Cerulean Warbler	*Dendroica cerulea*	ST
Cliff Cudweed	*Gnaphalium obtusifolium var saxicola*	ST
Drooping Sedge	*Carex prasina*	ST

TABLE 3-64
Threatened and Endangered Flora and Fauna in the Falls 1 and 2 MOAs (Adjacent Counties)

Common Name	Scientific Name	Status
Dwarf's Huckleberry	*Vaccinium cespitosum*	SE
Early Anemone	*Anemone multifida var hudsoniana*	SE
Eastern Massassauga	*Sistrurus catenatus catenatus*	SE
Extra-Striped Snaketail	*Ophiogomphus anomalus*	SE
False Hop Sedge	*Carex lupiliformis*	SE
Fassett's Locoweed	*Oxytropis campestris var chartacea*	LE
Forster's Tern	*Sterna forsteri*	SE
Frosted Elfin	*Incisalia irus*	ST
Gray Wolf	*Canis lupus*	LE
Greater Prairie-Chicken	*Tympanuchus cupido*	ST
Karner Blue Butterfly	*Lycaeides melissa samuelis*	LE
Little Goblin Moonroot	*Botrychium mormo*	SE
Marsh Valerian	*Valeriana sitchensis ssp uliginosa*	ST
Musk-Root	*Adoxa moschatellina*	ST
Northern Ribbon Snake	*Thamnophis sauritus*	SE
Osprey	*Pandion haliaetus*	ST
Pale False Foxglove	*Agalinis skinneriana*	SE
Pale Green Orchid	*Platanthera flava var herbiola*	ST
Prairie Parsley	*Polytaenia nuttallii*	ST
Pygmy Snaketail	*Ophiogomphus howei*	ST
Redfin Shiner	*Lythrurus umbratilis*	ST
Red-Shouldered Hawk	*Buteo lineatus*	ST
Regal Fritillary	*Speyeria idalia*	SE
Reticulated Nutrush	*Scleria reticularis*	SE
Roundstem Foxglove	*Agalinis gattingeri*	ST
Salamander Mussel	*Simpsonaias ambigua*	ST
Sand Violet	*Viola fimbriatula*	ST
Slender Madtom	*Noturus exilis*	SE
Snowy Campion	*Silene nivea*	ST
Squarestem Spikerush	*Eleocharis quadrangulata*	SE
Western Slender Glass Lizard	*Ophisaurus attenuatus*	SE
Wolf Spike-Rush	*Eleocharis wolfii*	SE

TABLE 3-64
Threatened and Endangered Flora and Fauna in the Falls 1 and 2 MOAs (Adjacent Counties)

Common Name	Scientific Name	Status
Wood Turtle	*Clemmys insculpta*	ST
Wooly Milkweed	*Asclepias lanuginosa*	ST
Yellow-Crowned Night-Heron	*Nyctanassa violacea*	ST

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

TABLE 3-65
Threatened and Endangered Flora and Fauna in the Volk MOAs (Underlying Counties)

Common Name	*Scientific Name*	Status
A Fat-Headed Mayfly	*Anepeorus simplex*	SE
A Prairie Leafhopper	*Polyamia dilata*	ST
Acadian Flycatcher	*Empidonax virescens*	ST
Algae-Like Pondweed	*Potamogeton confervoides*	ST
American Beakgrain	*Diarrhena americana*	SE
Bald Eagle	*Haliaeetus leucocephalus*	LT
Barn Owl	*Tyto alba*	SE
Bell's Vireo	*Vireo bellii*	ST
Black Buffalo	*Ictiobus niger*	ST
Blanchard's Cricket Frog	*Acris crepitans blanchardi*	SE
Blanding's Turtle	*Emydoidea blandingii*	ST
Blue Sucker	*Cycleptus elongatus*	ST
Bog Bluegrass	*Poa paludigena*	ST
Brittle Prickly-Pear	*Opuntia fragilis*	ST
Brook Grass	*Catabrosa aquatica*	SE
Buckhorn	*Tritogonia verrucosa*	ST
Bullhead	*Plethobasus cyphyus*	SE
Canada Horse-Balm	*Collinsonia canadensis*	SE
Cerulean Warbler	*Dendroica cerulea*	ST
Cliff Cudweed	*Gnaphalium obtusifolium var saxicola*	ST
Drooping Sedge	*Carex prasina*	ST

TABLE 3-65
Threatened and Endangered Flora and Fauna in the Volk MOAs (Underlying Counties)

Common Name	*Scientific Name*	Status
Dwarf Huckleberry	*Vaccinium cespitosum*	SE
Dwarf Umbrella-Sedge	*Fuirena pumila*	SE
Early Anemone	*Anemone multifida var hudsoniana*	SE
Eastern Massasauga	*Sistrurus catenatus catenatus*	SE
Ebony Shell	*Fusconaia ebena*	SE
Ellipse	*Venustaconcha ellipsiformis*	ST
False Hop Sedge	*Carex lupuliformis*	SE
Fassett's Locoweed	*Oxytropis campestris var chartacea*	LE
Forster's Tern	*Sterna forsteri*	SE
Frosted Elfin	*Incisalia irus*	ST
Gilt Darter	*Percina evides*	ST
Gray Wolf	*Canis lupus*	LE
Great Egret	*Casmerodius albus*	ST
Greater Prairie-Chicken	*Tympanuchus cupido*	ST
Greater Redhorse	*Moxostoma valenciennesi*	ST
Hill's Thistle	*Cirsium hillii*	ST
Karner Blue Butterfly	*Lycaeides melissa samuelis*	LE
Kentucky Warbler	*Oporornis formosus*	ST
Lake Cress	*Armoracia lacustris*	SE
Lapland Azalea	*Rhododendron lapponicum*	SE
Large Water-Starwort	*Callitriche heterophylla*	ST
Little Goblin Moonwort	*Botrychium mormo*	SE
Loggerhead Shrike	*Lanius ludovicianus*	SE
Long-Beaked Baldrush	*Psilocarya scirpoides*	ST
Longear Sunfish	*Lepomis megalotis*	ST
Marsh Valerian	*Valeriana sitchensis ssp uliginosa*	ST
Monkeyface	*Quadrula metanevra*	ST
Musk-Root	*Adoxa moschatellina*	ST
Northern Ribbon Snake	*Thamnophis sauritus*	SE
Northern Wild Monkshood	*Aconitum noveboracense*	LT
Ornate Box Turtle	*Terrapene ornata*	SE
Osprey	*Pandion haliaetus*	ST

TABLE 3-65
Threatened and Endangered Flora and Fauna in the Volk MOAs (Underlying Counties)

Common Name	*Scientific Name*	Status
Paddlefish	*Polyodon spathula*	ST
Pale False Foxglove	*Agalinis skinneriana*	SE
Pale Green Orchid	*Platanthera flava var herbiola*	ST
Pallid Shiner	*Notropis amnis*	SE
Phlox Moth	*Schinia indiana*	SE
Powesheik Skipperling	*Oarisma powesheik*	SE
Prairie Parsley	*Polytaenia nuttallii*	ST
Pugnose Shiner	*Notropis anogenus*	ST
Purple Milkweed	*Asclepias purpurascens*	SE
Queen Snake	*Regina septemvittata*	SE
Ram's-Head Lady's-Slipper	*Cypripedium arietinum*	ST
Redfin Shiner	*Lythrurus umbratilis*	ST
Red-Necked Grebe	*Podiceps grisegena*	SE
Red-Shouldered Hawk	*Buteo lineatus*	ST
Red-Tailed Prairie Leafhopper	*Aflexia rubranura*	SE
Regal Fritillary	*Speyeria idalia*	ST
Reticulated Nutrush	*Scleria reticularis*	SE
River Redhorse	*Moxostoma carinatum*	ST
Rough Rattlesnake-Root	*Prenanthes aspera*	SE
Roundstem Foxglove	*Agalinis gattingeri*	ST
Salamander Mussel	*Simpsonaias ambigua*	ST
Sand Violet	*Viola fimbriatula*	SE
Slender Bush-Clover	*Lespedeza virginica*	ST
Slender Madtom	*Noturus exilis*	SE
Slenderleaf Sundew	*Drosera linearis*	ST
Small White Lady's-Slipper	*Cypripedium candidum*	ST
Snowy Campion	*Silene nivea*	ST
Snuffbox	*Epioblasma triquetra*	SE
Soft-Leaf Muhly	*Muhlenbergia richardsonis*	SE
Spatterdock Darner	*Aeshna mutata*	ST
Speckled Chub	*Macrhybopsis aestivalis*	ST
Squarestem Spikerush	*Eleocharis quadrangulata*	SE

TABLE 3-65
Threatened and Endangered Flora and Fauna in the Volk MOAs (Underlying Counties)

Common Name	*Scientific Name*	Status
Sticky False-Asphodel	*Tofieldia glutinosa*	ST
Striped Shiner	*Luxilus chrysocephalus*	SE
Tussock Bulrush	*Scirpus cespitosus*	ST
Warpaint Emerald	*Somatochlora incurvata*	SE
Western Ribbon Snake	*Thamnophis proximus*	SE
Western Slender Glass Lizard	*Ophisaurus attenuatus*	SE
Winged Mapleleaf	*Quadrula fragosa*	LE
Wolf Spike-Rush	*Eleocharis wolfii*	SE
Wood Turtle	*Clemmys insculpta*	ST
Wooly Milkweed	*Asclepias lanuginosa*	ST
Yellow Gentian	*Gentiana alba*	ST
Yellow Giant Hyssop	*Agastache enepetoides*	ST
Yellow-Crowned Night-Heron	*Nyctanassa violacea*	ST

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

TABLE 3-66
Threatened and Endangered Flora and Fauna in the Volk MOAs (Adjacent Counties)

Common Name	*Scientific Name*	Status
Acadian Flycatcher	*Empidonax virescens*	ST
Bald Eagle	*Haliaeetus leucocephalus*	LT
Barn Owl	*Tyto alba*	SE
Beaked Spikerush	*Eleocharis rostellata*	ST
Black Redhorse	*Moxostoma duquesnei*	SE
Blanchard's Cricket Frog	*Acris crepitans blanchardi*	SE
Blanding's Turtle	*Emydoidea blandingii*	ST
Blue Ash	*Fraxinus quadrangulata*	ST
Bog Bluegrass	*Poa paludigena*	ST
Buckhorn	*Tritogonia verrucosa*	ST
Butler's Garter Snake	*Thamnophis butleri*	ST

TABLE 3-66
Threatened and Endangered Flora and Fauna in the Volk MOAs (Adjacent Counties)

Common Name	*Scientific Name*	Status
Caspian Tern	*Sterna caspia*	SE
Cerulean Warbler	*Dendroica cerulea*	ST
Common Tern	*Sterna hirundo*	SE
Eastern Prairie Fringed Orchid	*Platanthera leucophaea*	LT
Ellipse	*Venustaconcha ellipsiformis*	ST
False Hop Sedge	*Carex lupuliformis*	SE
Forked Aster	*Aster furcatus*	ST
Forster's Tern	*Sterna forsteri*	SE
Great Egret	*Casmerodius albus*	ST
Greater Prairie-Chicken	*Tympanuchus cupido*	ST
Greater Redhorse	*Moxostoma valenciennesi*	ST
Handsome Sedge	*Carex formosa*	ST
Harbinger-Of-Spring	*Erigenia bulbosa*	SE
Heart-Leaved Plantain	*Plantago cordata*	SE
Hemlock Parsley	*Conioselinum chinense*	SE
Hill's Thistle	*Cirsium hillii*	ST
Hooded Warbler	*Wilsonia citrina*	ST
Karner Blue Butterfly	*Lycaeides melissa samuelis*	LE
Kentucky Warbler	*Oporornis formosus*	ST
Kitten Tails	*Besseya bullii*	ST
Lake-Cress	*Armoracia lacustris*	SE
Longear Sunfish	*Lepomis megalotis*	ST
Marsh Valerian	*Valeriana sitchensis ssp uliginosa*	ST
Midwest Pleistocene Vertigo	*Vertigo hubrichti*	SE
Northern Ribbon Snake	*Thamnophis sauritus*	SE
Osprey	*Pandion haliaetus*	ST
Ozark Minnow	*Notropis nubilus*	ST
Pale Green Orchid	*Platanthera flava var herbiola*	ST
Pink Milkwort	*Polygala incarnata*	SE
Piping Plover	*Charadrius melodus*	LE
Powesheik Skipper	*Oarisma powesheik*	SE
Prairie Indian Plantain	*Cacalia tuberosa*	ST

TABLE 3-66
Threatened and Endangered Flora and Fauna in the Volk MOAs (Adjacent Counties)

Common Name	*Scientific Name*	Status
Prairie Milkweed	*Asclepias sullivantii*	ST
Prairie Parsley	*Polytaenia nuttallii*	ST
Prairie White-Fringed Orchid	*Plantanthera leucophaea*	LE
Pugnose Shiner	*Notropis anogenus*	ST
Purple Milkweed	*Asclepias purpurascens*	SE
Pygmy Snaketail	*Ophiogomphus howei*	ST
Queen Snake	*Regina septemvittata*	SE
Rainbow Shell	*Villosa iris*	SE
Ram's-Head Lady's-Slipper	*Cypripedium arietinum*	ST
Ravenfoot Sedge	*Carex crus-corvi*	SE
Redfin Shiner	*Notropis anogenus*	ST
Red-Necked Grebe	*Podiceps grisegena*	SE
Red-Shouldered Hawk	*Buteo lineatus*	ST
Red-Tailed Prairie Leafhopper	*Aflexia rubranura*	SE
River Redhorse	*Moxostoma carinatum*	ST
Rough Rattlesnake-Root	*Prenanthes aspera*	SE
Salamander Mussel	*Simpsonaias ambigua*	ST
Sand Dune Willow	*Salix cordata*	SE
Silphium Borer Moth	*Papaipema silphii*	SE
Slender Madtom	*Noturus exilis*	SE
Slenderleaf Sundew	*Drosera linearis*	ST
Slippershell Mussel	*Alasmidonta viridis*	ST
Small White Lady's-Slipper	*Cypripedium candidum*	ST
Snow Trillium	*Trillium nivale*	ST
Snowy Campion	*Silene nivea*	ST
Snuffbox	*Epioblasma triquetra*	SE
Squarestem Spikerush	*Eleocharis quadrangulata*	SE
Starhead Topminnow	*Fundulus dispar*	SE
Sticky False-Asphodel	*Tofieldia glutinosa*	ST
Striped Shiner	*Luxilus chrysocephalus*	SE
Swamp Metalmark	*Calephelis mutica*	SE
Tussock Bulrush	*Scirpus cespitosus var callosus*	ST

TABLE 3-66
Threatened and Endangered Flora and Fauna in the Volk MOAs (Adjacent Counties)

Common Name	*Scientific Name*	Status
Western Ribbon Snake	*Thamnophis proximus*	SE
Wood Turtle	*Clemmys insculpta*	ST
Wooly Milkweed	*Asclepias lanuginosa*	ST
Yellow Gentian	*Gentiana alba*	ST
Yellow Giant Hyssop	*Agastache nepetoides*	ST

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

3.7.5 Land Use and Visual Resources

The Falls MOA region of influence is primarily agricultural (Tables 3-67 and 3-68), with forested lands confined to Black River State Forest, Fairchild, Humbird, and the south fork of the Eau Claire River. Much of the Falls MOA land is public. Places of interest within or near the MOA include wildlife and fishery areas in Clark, Eau Claire, Jackson and Trempealeau Counties; Albion Rearing Station, Upper Mississippi River National Wildlife and Fish Refuge, Castle Mound and Pigeon Creek Camping Areas, Black River, Indian Mission in Jackson County, and Bruce Mound Winter Sports Area in Clark County.

The Volk MOA is also primarily agricultural (Tables 3-69 and 3-70), but contains many lakes and public lands, as well. Places of interest within the MOA include Black River State Forest, Necedah National Wildlife Refuge, Central Wisconsin Conservation Area, and the Standing Rocks and the Nordic Mountains Ski Areas in Portage and Waushara Counties. There are also numerous state parks along the Wisconsin River such as the Buckhorn, Mill Bluff, Roche A Cri, and Rocky Arbor. Scenic areas are found along State Highway 22 in Waushara County, and at Hartman Creek State Park. Some of the most significant tourist attraction sites, such as the Devils Lake State Park in the Baraboo range, Old Indian Agency House, and Devil’s Head Ski Lodge are just south of the Volk MOA.

TABLE 3-67
Falls MOA Land Use (Underlying Counties)

County	Total Acreage	Percentage			
		Agriculture	Forest	Grassland	Water
Clark	778,634	55.84	44.16		
Eau Claire	412,000	60.14	39.80		0.06
Jackson	638,674	52.74	47.26		

TABLE 3-67
Falls MOA Land Use (Underlying Counties)

County	Total Acreage	Percentage			
		Agriculture	Forest	Grassland	Water
La Crosse	306,871	41.92	55.63	0.08	2.37
Monroe	579,919	56.78	43.18		0.04
Trempealeau	473,719	52.01	47.33		0.66
Wood	516,850	57.19	42.20		0.61

TABLE 3-68
Falls MOA Land Use (Adjacent Counties)

County	Total Acreage	Percentage		
		Agriculture	Forest	Water
Adams	439,781	54.95	39.13	5.92
Juneau	513,212	54.83	38.92	6.25
Marathon	1,006,354	53.26	44.5	2.25
Portage	525,682	72.81	26.46	0.73
Taylor	628,529	16.65	83.35	

TABLE 3-69
Volk MOA Land Use (Underlying Counties)

County	Total Acreage	Percent			
		Agriculture	Forest	Shrub / Brushland	Water
Adams	439,781	54.95	39.13		5.92
Clark	778,634	55.84	44.16		
Columbia	508,542	80.09	19.62		0.29
Dodge	579,116	87.79	11.23		0.98
Green Lake	243,373	71.38	25.67	0.10	2.84
Jackson	638,674	52.74	47.26		

TABLE 3-69
Volk MOA Land Use (Underlying Counties)

County	Total Acreage	Percent			
		Agriculture	Forest	Shrub / Brushland	Water
Juneau	513,213	54.83	38.92		6.25
Marquette	296,013	71.69	27.73		0.59
Monroe	579,919	56.78	43.18		0.04
Portage	525,682	72.81	26.46		0.73
Waupaca	488,951	60.85	39.05		0.10
Waushara	407,328	63.82	35.07		1.11
Wood	516,850	57.19	42.20		0.61

TABLE 3-70
Volk MOA Land Use (Adjacent Counties)

County	Total Acreage	Percentage				
		Agriculture	Forest	Grassland	Shrub / Brushland	Water
Fond Du Lac	488,790	70.56	24.40			5.04
Jefferson	372,250	81.17	16.58	0.27	0.17	1.82
Marathon	1,006,355	53.26	44.50			2.25
Outagamie	411,748	79.85	20.06			0.09
Shawano	580,193	57.15	41.95			0.89
Washington	279,094	79.52	20.39			0.09
Waukesha	370,343	72.39	26.59	0.20		0.82
Winnebago	369,633	57.33	16.79		0.20	25.67

3.7.6 Infrastructure, Transportation, and Utilities

The Falls MOA contains a number of major highways and a road network that connect the cities of La Crosse, Eau Claire, Tomah, Marshfield, and Wisconsin Rapids. The western section of the MOA is traversed by I-94, which is a major traffic route between Madison and Eau Claire. Other major roadways are State Highways 10 and 12, which traverse the central and western section of the MOA, respectively.

The major airport within the Falls MOA ROI is the Marshfield Municipal Airport in Wood County. La Crosse and Eau Claire Municipal Airports are also located in close proximity to the Falls MOA. Other airports in the vicinity of the Falls MOA include the Volk Field and the Sparta-Fort McCoy Airport.

Wisconsin is primarily serviced by thermal power plants (fueled by coal) which produce 87 percent of state's electricity. The state has many small hydroelectric power plants, although they generate only 4 percent of the total electricity. Major power utilities located in the Falls MOA region of influence are listed in Tables 3-71 and 3-72.

The Volk MOA is traversed by I-39, the principal highway in central Wisconsin. Other important roadways include state Highway 13 and 21 which are located in the vicinity of Wisconsin River. The road network continues south to the principal population centers of Madison, Oshkosh, and Milwaukee.

Major airports within the Volk MOAs ROI include the Stevens Point Municipal Airport in Portage County and Alexander Field in Wood County. Other airports in the vicinity of Volk MOA include the Volk Field, Sparta-Ft. McCoy, Witman Regional, Dane County Regional, and the Outagamie Regional Airport. Major power utilities in the Volk MOA region of influence are listed in Tables 3-73 and 3-74.

TABLE 3-71
Major Power Utilities Serving the Falls MOAs (Underlying Counties)

Power Utility	Location (Counties, State)
Adams-Columbia Electric Cooperative	Wood, WI
Buffalo Electric Cooperative	Trempealeau, WI
City of Arcadia	Trempealeau, WI
City of Bangor	La Crosse, WI
City of Black River Falls	Jackson, WI
City of Marshfield	Clark, Wood, WI
City of Whitehall	Trempealeau, WI
Clark Electric Cooperative	Clark, Jackson, Wood, WI
Consolidated Water Power Company	Wood, WI
Eau Claire Electric Cooperative	Eau Claire, Jackson, Trempealeau, WI
Jackson Electric Cooperative, Inc	Clark, Eau Claire, Jackson, La Crosse, Monroe, Trempealeau, WI
Northern States Power Company	Clark, Eau Claire, Jackson, La Crosse, Monroe, Trempealeau, Wood, WI
Oakdale Electric Cooperative	Jackson, Monroe, Wood, WI
Taylor Electric Cooperative	Clark, WI
Trempealeau Electric Cooperative	Eau Claire, Jackson, La Crosse, Trempealeau, WI
Vernon Electric Cooperative	La Crosse, Monroe, WI

TABLE 3-71
Major Power Utilities Serving the Falls MOAs (Underlying Counties)

Power Utility	Location (Counties, State)
Village of Cashton	Monroe, WI
Village of Merrillan	Jackson, WI
Village of Trempealeau	Trempealeau, WI
Wisconsin Electric Power Company	Wood, WI
Wisconsin Power & Light Company	Jackson, Monroe, Wood, WI
Wisconsin Rapids Water Works & Lighting Commission	Wood, WI

Table 3-72

Major Power Utilities Serving the Falls MOAs (Adjacent Counties)

Power Utility	Location (Counties, State)
Adams-Columbia Electric Cooperative	Portage, Adams, WI
Central Wisconsin Electric Cooperative	Marathon, Portage, WI
Chippewa Valley Electric Cooperative	Taylor, WI
City of Elroy	Juneau, WI
City of Marshfield	Marathon, WI
City of Medford	Taylor, WI
City of New Lisbon	Juneau, WI
Clark Electric Cooperative	Taylor, Marathon, WI
Consolidated Water Power Company	Portage, WI
Jump River Electric Cooperative, Inc	Taylor, WI
Northern States Power Company	Taylor, Marathon, Portage, WI
Oakdale Electric Cooperative	Juneau, WI
Pioneer Power and Light Company	Adams, WI
Price Electric Cooperative, Inc	Taylor, WI
Stratford Municipal Electric Utility	Marathon, WI
Taylor Electric Cooperative	Taylor, Marathon, WI
Vernon Electric Cooperative	Juneau, WI
Wisconsin Power & Light Company	Marathon, Portage, Adams, Juneau, WI
Wisconsin Public Service Corporation	Marathon, Portage, WI
Wisconsin Rapids Water Works & Lighting Commission	Portage, WI
Wonewoc Electric & Water Utility	Juneau, WI

TABLE 3-73
Major Power Utilities Serving the Volk MOAs (Underlying Counties)

Power Utility	Location (Counties, State)
Adams-Columbia Electric Cooperative	Wood, Adams, Columbia, Dodge, Green Lake, Marquette, Portage, Waupaca, Waushara, WI
Central Wisconsin Electric Cooperative	Portage, Waupaca, WI
City of Black River Falls	Jackson, WI
City of Clintonville	Waupaca, WI
City of Columbus	Columbia, Dodge, WI
City of Elroy	Juneau, WI
City of Lodi	Columbia, WI
City of Marshfield	Wood, Clark, WI
City of New Lisbon	Juneau, WI
City of Princeton	Green Lake, WI
Clark Electric Cooperative	Wood, Jackson, Clark, WI
Consolidated Water Power Company	Wood, Portage, WI
Eau Claire Electric Cooperative	Jackson, WI
Jackson Electric Cooperative, Inc	Jackson, Monroe, Clark, WI
Juneau Utility Commission	Dodge, WI
New London Electric & Water Utility	Waupaca, WI
Northern States Power Company	Wood, Portage, Jackson, Monroe, Clark, WI
Oakdale Electric Cooperative	Juneau, Wood, Jackson, Monroe, WI
Pioneer Power and Light Company	Adams, Marquette, Waushara, WI
Taylor Electric Cooperative	Clark, WI
Trempealeau Electric Cooperative	Jackson, WI
Vernon Electric Cooperative	Juneau, Monroe, WI
Village of Cashton	Monroe, WI
Village of Hustisford	Dodge, WI
Village of Merrillan	Jackson, WI
Village of Pardeeville	Columbia, WI
Waupun Public Utilities	Dodge, WI
Westfield Milling & Electric Light Company	Marquette, WI
Wisconsin Dells Electric Utility	Columbia, WI
Wisconsin Electric Power Company	Wood, Dodge, Waupaca, Waushara, WI
Wisconsin Power & Light Company	Juneau, Wood, Adams, Columbia, Dodge, Green Lake, Marquette, Portage, Waupaca, Waushara, Jackson, Monroe, WI
Wisconsin Public Service Corporation	Portage, Waupaca, Waushara, WI
Wisconsin Rapids Water Works & Lighting Commission	Wood, Portage, WI
Wonewoc Electric & Water Utility	Juneau, WI

TABLE 3-74
Major Power Utilities Serving the Volk MOAs (Adjacent Counties)

Power Utility	Location (Counties, State)
Adams-Columbia Electric Cooperative	Jefferson, WI
Central Wisconsin Electric Cooperative	Marathon, Shawano, WI
City of Hartford Utilities	Washington, WI
City of Jefferson	Jefferson, WI
City of Kaukauna	Outagamie, WI
City of Lake Mills	Jefferson, WI
City of Marshfield	Marathon, WI
City of Menasha	Winnebago, WI
City of Oconomowoc	Waukesha, WI
City of Plymouth	Fond Du Lac, WI
Clark Electric Cooperative	Marathon, WI
New London Electric & Water Utility	Outagamie, WI
Northern States Power Company	Marathon, WI
Oconto Electric Cooperative	Shawano, WI
Rock County Electric Cooperative Association	Winnebago, WI
Shawano Municipal Utilities	Shawano, WI
Stratford Municipal Electric Utility	Marathon, WI
Taylor Electric Cooperative	Marathon, WI
Village of Gresham	Shawano, WI
Village of Slinger	Washington, WI
Waterloo Light and Water Commission	Jefferson
Waupun Public Utilities	Fond Du Lac, WI
Wisconsin Electric Power Company	Shawano, Outagamie, Winnebago, Fond Du Lac, Washington, Jefferson, Waukesha, WI
Wisconsin Power & Light Company	Marathon, Shawano, Winnebago, Fond Du Lac, Jefferson, WI
Wisconsin Public Service Corporation	Marathon, Shawano, Outagamie, Winnebago, Fond Du Lac, WI

3.7.7 Cultural Resources

The Falls and Volk MOAs are traversed by the Wisconsin River and tributaries which were once important navigation route for early explorers. Important modern cultural areas in the vicinity of the MOAs include the University of Wisconsin (Stevens Point), and the Fort McCoy Military Reserve.

The earliest inhabitants of Wisconsin were Paleo-Indians, a nomadic people who appeared in the Great Lakes area. Evidence from archaeological sites indicates the Paleo-Indians hunted with spears, killing caribou and other large animals. About 7,000 BC, with the warming climate, the Archaic culture emerged. The area was later inhabited by a number of groups known as “Mound Builders.” These groups created large earth mounds as burial and ceremonial sites. Remains of some of these mounds may be seen near Baraboo, just outside of the southern end of the Volk South MOA. Since its opening in 1959, Circus World Museum in Baraboo has attracted more than six million visitors. It is owned by The State Historical Society of Wisconsin.

Tribal organizations that may be interested in the proposed action include Menominee Indian Tribe of Wisconsin, Stockbridge Munsee Community of Wisconsin, Oneida Tribe of Indians of Wisconsin, and the Ho-Chunk Nation.

3.7.8 Socioeconomics

Wisconsin is widely known for its dairy industry, which produces a large part of the nation's butter and cheese. Wisconsin has been termed “America's Dairyland” with dairying and crop farming comprising a vital part in the economy. Manufacturing grew rapidly in the 20th century, becoming a dominant segment of the state's economy. The state's rich forests have also generated a thriving lumber and paper industry, while extensive water resources have been important for fishing and transportation. The water, forest, and farms combine to give the state a natural beauty, which in turn has made the state a popular destination for tourists. Public lands and recreational use provide a considerable contribution to regional economies.

Current trends in the economy indicate that the nature of employment is changing in the state. By 1993, employment on farms had decreased 26 percent from ten years before, while manufacturing employment grew 17 percent in the same period. Occupations such as nursing, restaurant serving, and computer programming have shown the largest gains. Employment breakdown in 1997 was as follows: 27 percent of the workers in service; 22 percent in wholesale or retail trade; 19 percent in manufacturing; 12 percent in federal, state, or local government, including those in the military; 7 percent in finance, insurance, or real estate; 5 percent in construction; 4 percent in transportation or public utilities; and 4 percent in farming (including agricultural services), forestry, or fishing.

Within the Falls and Volk MOAs, agriculture is an important part of the local economy, with many farms specializing in dairying. Wisconsin is a Corn Belt state, and corn is its major crop, grown chiefly for livestock feed in the southern half of the state, while hay, oats, and forage are more characteristic of north central and western Wisconsin. Potatoes, vegetables, and cranberries are raised mostly on the sandy plain of central Wisconsin. Other leading crops are soybeans, hay, sweet corn, green peas, snap beans, and oats. The eastern and southeastern counties provide fluid milk for Chicago, Milwaukee, and other large urban markets, while the central and western areas process most of their milk production into cheese and butter.

Although forestry is neither a major labor-using industry nor a leading income producer for Wisconsin, the industries based on wood are important in the nearby areas east of the Volk MOAs, with a large concentration of pulp and paper products industries around Green Bay and Appleton. Other areas in the vicinity of the MOAs near the Fox River and the Wisconsin River are large centers for paper and wood products, including Oshkosh, Eau Claire, and Wausau. The leading industry groups ranked by employment were industrial machinery and equipment, food and food products, paper products, electronic equipment, and fabricated metal products. Wisconsin's well-known cheddar cheese is produced in the east central and central sections of the state.

The estimated 2000 population of the counties within the Falls MOAs was 396,383 (Table 3-75) and the total population of the adjacent counties was 255,655 (Table 3-76). The highest-populated center in the vicinity of the Falls MOAs is the city of Eau Claire, which had a 2000 population of 61,704. It is located just outside of the western boundary of the MOA. Within the Falls MOAs, the largest population center is the city of Wisconsin Rapids (18,435). The rest of the Falls MOAs contains small towns such as Osseo (1,669), Fairchild (351), and Alma Centre (446).

The 2000 population estimate for the Volk MOAs counties was 527,439 (Table 3-77) and the total population of the adjacent counties was 1,133,809 (Table 3-78). The highest population centers within the Volk MOA are the cities of Stevens Point and Plover, which have 2000 populations of 24,551 and 10,520 respectively. However, there are moderately populated areas nearby, with the city of Wausau (38, 426) to the north, and the cities of Appleton (70,087), Oshkosh (62,916), and Fond du Lac (42,203) to the east, and the villages of Baraboo (10,711) and Portage (9,728) to the south.

TABLE 3-75
Socioeconomic Characteristics of the Falls MOA Region (Underlying Counties)

County	Area[1]	Population[2]	Density[3]	Median Household Income ($)[4]
Clark Co., WI	1,216	33,557	27.6	$30,875
Eau Claire Co., WI	638	93,142	146.0	$37,404
Jackson Co., WI	987	19,100	19.4	$31,374
La Crosse Co, WI	453	107,120	236.5	$38,523
Monroe Co., WI	901	40,899	45.4	$34,392
Trempealeau Co., WI	734	27,010	36.8	$31,799
Wood Co., WI	793	75,555	95.3	$41,762
Totals/Average	5,721	396,383	69.3	$35,161

1. US Census Bureau - Land Area, Population, and Density for States and Counties: 2000
2. US Census Bureau - Estimated population for 2000 <www.census.gov/population/estimates/county
3. Calculated - County Population divided by County Area.
4. U.S. Census Bureau – Money Income for all counties in Wisconsin 1997, www.tier2.census.gov/cgi-win/usac

TABLE 3-76
Socioeconomic Characteristics of the Falls MOA Region (Adjacent Counties)

County	Area[1]	Population[2]	Density[3]	Median Household Income ($)[4]
Taylor Co., WI	975	19,680	20.2	$33,844
Marathon Co., WI	1545	125,834	81.4	$42,120
Portage Co., WI	806	67,182	83.4	$41,782
Adams Co., WI	648	18,643	28.8	$30,299
Juneau Co., WI	768	24,316	31.7	$31,461
Total/Average	4742	255,655	53.9	$35,901

1. US Census Bureau - Land Area, Population, and Density for States and Counties: 2000
2. US Census Bureau – Estimated population for 2000. <www.census.gov/population/estimates/county
3. Calculated - County Population divided by County Area.
4. U.S. Census Bureau – Money Income for all counties in Wisconsin 1997, www.tier2.census.gov/cgi-win/usac

TABLE 3-77
Socioeconomic Characteristics of the Volk MOA Region (Underlying Counties)

County	Area[1]	Population[2]	Density[3]	Median Household Income ($)[4]
AdamsCo., WI	648	18,643	28.8	$30,299
Clark Co., WI	1,216	33,557	27.6	$30,875
Columbia Co., WI	774	52,468	67.8	$39,936
Dodge Co., WI	882	85,897	97.4	$42,443
Green Lake Co., WI	354	19,105	54.0	$36,015
Jackson Co., WI	987	19,100	19.4	$31,374
Juneau Co., WI	768	24,316	31.7	$31,461
MarquetteCo., WI	455	15,832	34.8	$29,958
Monroe Co., WI	901	40,899	45.4	$34,392
Portage Co., WI	806	67,182	83.4	$41,782
Waupaca Co., WI	751	51,731	68.9	$36,842
Waushara Co., WI	626	23,154	37.0	$30,836
Wood Co., WI	793	75,555	95.3	$41,762
Totals/Average	9,961	527,439	53.0	$35,229

1. US Census Bureau - Land Area, Population, and Density for States and Counties: 2000.
2. US Census Bureau – Estimated population for 2000 <www.census.gov/population/estimates/county
3. Calculated - County Population divided by County Area.
4. U.S. Census Bureau – Money Income for all counties in Wisconsin 1997, www.tier2.census.gov/cgi-win/usac

TABLE 3-78
Socioeconomic Characteristics of the Volk MOA Region (Adjacent Counties)

County	Area[1]	Population[2]	Density[3]	Median Household Income ($)[4]
Marathon Co., WI	1545	123,834	81.4	$42,120
Shawano Co., WI	893	40,664	45.5	$33,849
Outagamie Co., WI	640	160,971	251.5	$47,845
Winnegabo Co., WI	439	156,763	357.1	$43,937
Fond du Lac Co,, WI	723	97,296	134.6	$42,700
Washington Co., WI	431	117,493	272.6	$53,937
Jefferson Co., WI	557	74,021	132.9	$42,567
Waukesha Co., WI	556	360,767	648.9	$61,562
Total/Average	5784	1,133,809	196	$46,065

1. US Census Bureau - Land Area, Population, and Density for States and Counties: 2000
2. US Census Bureau – Estimated population for 2000 <www.census.gov/population/estimates/county/
3. Calculated - County Population divided by County Area.
4. U.S. Census Bureau – Money Income for all counties in Wisconsin 1997, www.tier2.census.gov/cgi-win/usac

3.7.9 Environmental Justice

Demographic information on race, ethnicity, and poverty status in the counties underlying the Volk and Falls MOAs are presented in Table 3-79. Statistics for the surrounding state of Wisconsin are included to provide context. (See subsection 3.3 for the definitions of minority population and poverty areas).

The percentages of total minority population in the 17 counties underlying the Volk and Falls MOAs are less than in the state of Wisconsin. A few of the counties have somewhat higher percentages of certain minority groups than the statewide average (American Indian population in Jackson County and Asian population in Eau Claire and La Crosse counties), but each group represents less than 5 percent of the population in each of these counties. None of the counties meet the definition of a poverty area.

TABLE 3-79
Demographic Statistics for the Falls and Volk MOAs

Jurisdiction	Total Persons (2000)	Percentage						
		White (2000)	Black (2000)	American Indian[1] (2000)	Asian[2] (2000)	Other (2000)	Hispanic Origin[3] (2000)	Poverty Rate[4] (1997)
Wisconsin	5,363,675	88.9	5.7	0.9	1.7	1.6	3.6	9.2
Falls 1 & 2 MOA Counties								
Clark Co., WI	33,557	98.1	0.1	0.5	0.3	0.6	1.2	11.5

TABLE 3-79
Demographic Statistics for the Falls and Volk MOAs

Jurisdiction	Total Persons (2000)	Percentage						
		White (2000)	Black (2000)	American Indian[1] (2000)	Asian [2] (2000)	Other (2000)	Hispanic Origin[3] (2000)	Poverty Rate[4] (1997)
Eau Claire Co., WI	93,142	95.0	0.5	0.5	2.5	0.3	0.9	11.0
Jackson Co., WI	19,100	89.6	2.3	6.2	0.2	1.0	1.9	11.6
La Crosse Co., WI	107,120	94.2	0.9	0.4	3.2	0.3	0.9	10.0
Monroe Co., Wi	40,899	96.5	0.5	0.9	0.5	0.8	1.8	11.2
Trempealeau Co., WI	27,010	98.8	0.1	0.2	0.1	0.3	0.9	10.5
Wood Co., WI	75,555	96.4	0.3	0.7	1.6	0.3	0.9	8.1
Volk MOA Counties								
Juneau Co., WI	24,316	96.6	0.3	1.3	0.4	0.6	1.4	10.5
Wood Co., WI	75,555	96.4	0.3	0.7	1.6	0.3	0.9	8.1
Adams Co., WI	18,643	97.6	0.3	0.6	0.3	0.3	1.4	12.9
Columbia Co., WI	52,468	96.2	0.9	0.4	0.3	0.4	1.6	6.4
Dodge Co., WI	85,897	95.3	2.5	0.4	0.3	0.9	2.5	6.1
Green Lake Co., WI	19,105	97.8	0.2	0.2	0.3	0.9	2.1	7.9
Marquette Co., WI	15,832	93.7	3.4	1.0	0.4	0.4	2.7	9.9
Portage Co., WI	67,182	95.7	0.3	0.4	2.2	0.4	1.4	9.3
Waupaca Co., WI	51,731	97.9	0.2	0.4	0.3	0.5	1.4	7.3
Waushara Co., WI	23,154	96.8	0.3	0.3	0.3	1.4	3.7	12.3
Jackson Co., WI	19,100	89.6	2.3	6.2	0.2	1.0	1.9	11.6
Monroe Co., WI	40,899	96.5	0.5	0.9	0.5	0.8	1.8	11.2
Clark Co., WI	35,557	98.1	0.1	0.5	0.3	0.6	1.2	11.5

Source: U.S. Bureau of the Census, 2000

Notes:
1. Includes Alaska native and Aleutian Islander
2. Includes Pacific Islander
3. Race refers to Census respondents' self-identification of racial background. Hispanic origin refers to ethnicity and language, not race, and may include persons whose heritage is Puerto Rican, Cuban, Mexican, and Central or South American.
4. The values shown are 1997 Census Bureau estimates of percent persons with household incomes below the poverty threshold.

3.8 Rivers

The Rivers MOA is located in the southeastern part of Oklahoma and encompasses portions of Atoka, Bryan, Choctaw, Latimer, Le Flore, McCurtain, Pittsburg, and Pushmataha counties (Figure 3-8). The affected environment consists of these counties underlying the Rivers MOA, as well as the adjacent counties of Sebastian, Scott, Polk, Sevier, and Little River in western Arkansas, and the adjacent counties of Red River and Bowie in northeastern Texas.

3.8.1 Earth Resources

Oklahoma is characterized by three physiographic regions. These consist of the Coastal Plain, Interior Highlands, and the Interior Plains. Of these, the Interior Plains cover the majority of the state, while the Coastal Plain and Interior Highlands flank these plains on the south and east, respectively. The Rivers MOA is located within the Interior Highlands physiographic region. Elevations in Oklahoma range from less than 300 ft above sea level in the southeast corner to 5,000 ft in the northwest edge of the state. The mean elevation of the state is 1,300 ft above sea level.

The topography changes dramatically in the Interior Highlands north of the Coastal Plains where peaks in the Ouachita Mountains reach as high as 2,600 ft. The Ouachita Mountains, a series of steeply folded ridges and valleys, resemble parts of the Appalachians farther to the east. The Rivers MOA is traversed by three major mountain ranges which are oriented from northeast to southwest in the northern part of the MOA. These are the Jack Fork Mountains and Kiamichi Mountains in Pushmataha County, and Pine Mountains in the southwest corner of Pittsburg County. Accordingly, several prominent mountain peaks are located in the general region of the Rivers MOA. These include Blue Mountain in Pittsburg County (elevation 1,455 ft), Black Mountain (elevation 2,406 ft) and Canaval Mountain (elevation 2,385 ft) in Le Flore County, and Hee Mountain (elevation 1,439 ft) in McCurtain County.

In general, soils in Oklahoma vary from rich black grassland soils to sterile blow sand, and a number of different soils of varying fertility. The ultisols (red and yellow podzols) are characteristic of the forested Ouachitas and Ozarks, but have been leached of much of their nutrients. The alfisols and mollisols (chernozems and chestnut soils) of the grassy prairies are known for their natural fertility, although agricultural overuse and limited precipitation restrict their natural richness. Alluvial soils are usually found along the river valleys, while loess (a wind-deposited soil) can be found on the uplands between the rivers.

3.8.2 Climate

Like many plain states, Oklahoma is known for its changeable and varied weather patterns. During the winter it is common for the south and southeast regions to experience mild springlike temperatures when other parts of the state receive up to 12 inches of snow. Depending on location, the climate varies from semiarid to humid; the area of the Rivers MOA is generally categorized as having a humid subtropical climate, with very hot, long summers and moderate, short winters.

January is usually the coldest month with an average of about 38° F and extremes from -27° F (the lowest ever recorded) to 92° F. Summers are long and hot, with temperatures in the lower 100° F range being common from May until September. The growing season varies from less than 180 days in the western Panhandle to more than 240 days in the southeastern Coastal Plain.

Oklahoma occupies a transitional precipitation zone, with a humid east and a semi-arid west. Rainfall averages from 50 inches in the Ouachita Mountains (near the Rivers MOA) to just 15 inches in the far western Panhandle. Spring is generally the wettest, but in the west this advantage is offset by the high evaporation rate. Periodic droughts are known to occur particularly in semiarid areas of western Oklahoma and tornadoes occur annually, especially during the months of April and May, moving from southwest to northeast across the state.

3.8.3 Water Resources

Oklahoma is characterized by many short, intermittent streams, and rivers which flow from northwest to southeast across the state. For the most part, the lands within the Rivers MOA drain southward to the Red River, which is a major tributary of the Mississippi River. The Canadian River traverses the lands of northern Pittsburg County, just outside the northwestern end of the MOA, and is a principal tributary of the Arkansas River. The Rivers MOA is drained by the Boggy Creek in the southeast, within the counties of Atoka and Choctaw; Kaimichi River at its central portion; and Little River in its western portion, at Pushmataha County. As with most rivers arising from the western plains and flowing eastward, the Canadian and Red River are characterized by broad, shallow, and sandy channels. In the dry season, there will generally be little surface flow, although subsurface water will flow through the rivers' sandy beds.

Most of the larger lakes in Oklahoma are artificial and more than three-fourths of them are in the eastern portion of the state, where the rainfall is greater. These reservoirs were created for flood control, navigation, water supply, power generation, and recreation. Artificial lakes include Pine Creek and Hugo Lake underlying the Rivers MOA, and Eufala Lake just outside the MOA's northern boundary. Eufala Lake was created by the US Army Corps of Engineers, the Bureau of Reclamation and the Grand River Dam Authority, and is part of the McClellan-Kerr Arkansas River Navigation System that connect Tulsa's port of Catoosa to barge traffic on the Mississippi system. Other important water bodies within the Rivers MOA are Sardis Lake in Pushmataha and Latimer County, and McGee Creek Lake in Atoka County.

3.8.4 Biological Resources

There are three broad categories of flora in Oklahoma, which are distributed according to variation in water, temperature, elevation, slope, soil, drainage, and competition among native and introduced species. The largest forested area can be found in the eastern region, where deciduous forests of oak, hickory, mixed forests of pines and hardwoods, or pure stands of southern pine are located. Woodlands and savanna cover the mid-section of the state with trees becoming less abundant toward the west. The extreme western region is dominated by short grasses, sagebrush, and eastern red cedar. The northwestern Panhandle has a piñon-juniper woodland, similar to the Rocky Mountains. Flowering plants found through most parts of the state include dogwood, redbud, sunflower, goldenrod, wild indigo, verbena, violet, primrose, anemone, and phlox. There are two federally threatened and one federally endangered plants in the state. These include the white fringed prairie orchid, eastern white fringed prairie orchid, and winged mapleleaf. The latter species has been identified as a state endangered plant.

Within the Rivers MOA, the dominant plant cover is the loblolly-shortleaf pine forest, which covers most of the central and eastern part of Pushmataha Couny. This forest stand is interspersed by patches of oak-hickory forests. The northern portion of the MOA is characterized by an oak-pine forest, particularly in the areas surrounding Sardis Lake and Kiamichi River.

Oklahoma's animal population includes jackrabbits, cottontails, coyotes, prairie dogs, mink, squirrels, racoons, and skunks. Some of the larger animals found in the state are pronghorn antelope, white-tailed and mule deer, elk, red and grey fox, bobcat and beaver. Birds commonly found are the cardinal, English sparrow, swallow, robin, meadowlark, mockingbird, quail, wild turkey, prairie chicken, mourning dove, and pheasant. There are six federal and state-listed threatened animal species, and nine federal and state-listed endangered animal species in Oklahoma. Most of the affected species within the MOA are mussels, such as the Oachita Rock Pocketbook, and reptiles, such as the alligator snapping turtle.

Tables 3-80 and 3-81 list the threatened and endangered flora and fauna in the Rivers MOA and surrounding counties. Correspondence with Oklahoma Department of Wildlife Conservation have indicated that no state-listed wildlife species would be affected by the proposed action within the Rivers MOA.

TABLE 3-80
Threatened and Endangered Flora and Fauna in the Rivers MOA (Underlying Counties)

Common Name	Scientific Name	Status
American Burying Beetle	*Nicrophorus americanus*	LE
Interior Least Tern	*Sterna antillarum*	LE
Ouachita Rock Pocketbook	*Arkansia wheeleri*	LE
Winged Mapleleaf	*Quadrula fragosa*	LE
Lepard Darter	*Percina pantherina*	LT
Bald Eagle	*Haliaeetus leucocephalus*	LT
Indiana Bat	*Myotis sodalis*	LE
Blackside Darter	*Percina maculata*	ST
American Alligator	*Alligator mississippiensis*	LT
Red-Cockaded Woodpecker	*Picoides borealis*	LE
Arkansas River Shiner	*Notropis girardi*	LT

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

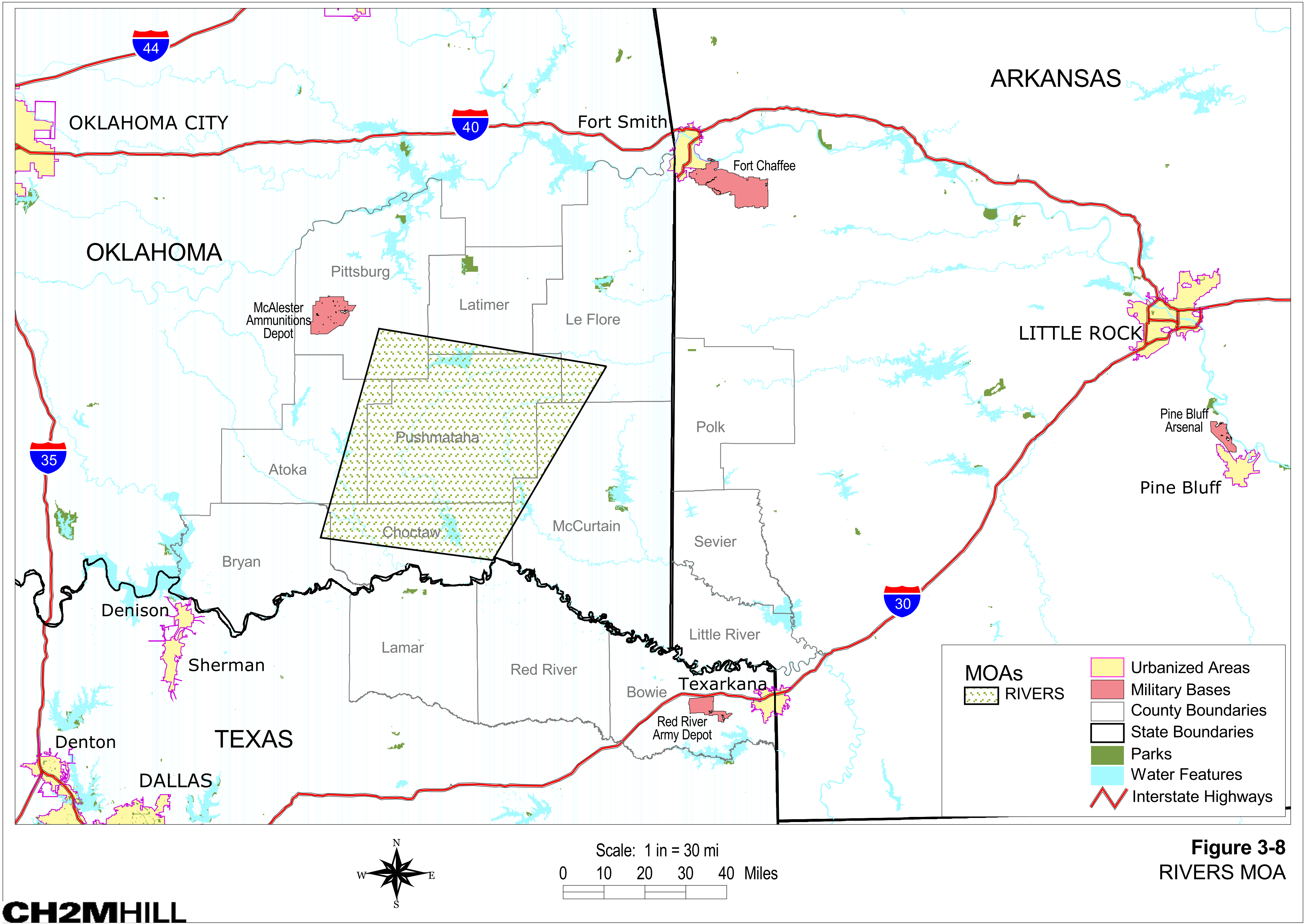

Figure 3-8
RIVERS MOA

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TABLE 3-81
Threatened and Endangered Flora and Fauna in the Rivers MOA (Adjacent Counties)

Common Name	Scientific Name	Status
Bald Eagle	*Haliaeetus leucocephalus*	LT
American Buying Beetle	*Nicrophorus americanus*	LE
Interior Least Tern	*Sterna antillarum athalassos*	LE
Red-Cockaded Woodpecker	*Picoides borealis*	LE
Harperella	*Ptilimnium nodosum*	LE
Florida Panther	*Felis concolor coryi*	LE
Arkansas Fatmucket	*Lampsilis powellii*	LT
Leopard Darter	*Percina pantherina*	LT
Ouachita Rock Pocketbook	*Arkansia wheeleri*	LE
Pink Mucket	*Lampsilis abrupta*	LE
American Peregrine Falcon	*Falco peregrinus anatum*	SE
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	ST
Bachman's Sparrow	*Aimophila aestivalis*	ST
Bald Eagle	*Haliaeetus leucocephalus*	LT
Wood Stork	*Mycteria americana*	ST
Blackside Darter	*Percina maculata*	ST
Creek Chubsucker	*Erimyzon oblongus*	ST
Paddlefish	*Polyodon spathula*	ST
Black Bear	*Ursus americanus*	ST
Alligator Snapping Turtle	*Macroclemys temminchkii*	ST
Texas Horned Lizard	*Phrynosoma comutum*	ST
Timber/Canebrake Rattlesnake	*Crotalus horridus*	ST
Eskimo Curlew	*Numenius borealis*	LE
Creek Chubsucker	*Erimyzon Oblongus*	ST
Shovelnose Sturgeon	*Scaphirhynchus platorynchus*	ST

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

3.8.5 Land Use and Visual Resources

The Rivers MOA is mountainous and contains rugged topography. Most of the lands are forested, with the Ouachita Mountains in LeFlore County as one of the principal forested areas in the state. Pines dominate the slopes and ridges of the Ouachitas and other mountainous areas, while hardwoods are found chiefly on the lower slopes and in the valleys. In the swamps and river bottoms, which are subject to floods, the cypress is common. Second-growth forests are increasing in number and about 95 percent of the forested land in the state is privately owned.

The rugged mountain areas and their swift flowing streams, and the numerous large lakes and reservoirs, attract many tourists. Scenic areas occur just outside of the eastern and northern boundary of the Rivers MOA. I-259 winds through the Ouachita National Forest and Winding Stair Mountains. Important state parks include McGee Creek, Boswell, Clayton Lake, and Raymond Gary within the MOA, and Beavers Bend, Hochatown, Bily Creek, Winding Stair, Cedar Lake, Talimena, and Robber’s Cave within adjacent counties. Robber’s Cave State Park within the San Bois Mountains was known to be a hideout for deserters during the Civil War. Wilderness areas and botanical preserves are found in the Winding Stair Mountain National Recreation Area, located in the Ouachita National Forest near Talihina. Other important attractions include Fort Towson Military Park and McAlester Army Ammunition Plant near McAlester.

The southwestern part of the Rivers MOA is primarily agricultural, where much of the local topography is more conducive to agricultural uses. Farms are relatively small, often less than 300 acres, and are generally suited for grazing. General land use patterns within the Rivers MOA and adjacent counties are shown in Tables 3-82 and 3-83.

Much of the lands in the vicinity of the Rivers MOA are underlain by high grade bituminous coal. Coal was first mined near McAlester in 1872, near the northwest corner of the MOA.

TABLE 3-82
Rivers MOA Land Use/Land Cover (Underlying Counties)

County	Total Acreage	Percent Agriculture	Percent Forest	Percent Grassland	Percent Shrub / Brushland	Percent Urban / Rural Development	Percent Water
Atoka	633,730	14.25	49.30	0.04		34.44	1.97
Bryan	603,984	68.09	5.80	2.28		19.08	4.75
Choctaw	512,547	39.23	27.19	2.60		27.73	3.25
Latimer	466,639	4.74	79.11			15.34	0.81
Le Flore	1,029,142	5.38	67.15			26.94	0.53
McCurtain	1,217,359	11.05	69.52			14.51	4.93
Pittsburg	881,902	4.75	48.82	0.14	0.08	42.01	4.19
Pushmataha	910,733	6.24	86.37			5.60	1.79

TABLE 3-83
Rivers MOA Land Use/Land Cover (Adjacent Counties)

County	Total Acreage	Percent Agriculture	Percent Forest	Percent Grassland	Percent Urban / Rural Development	Percent Water
Bowie	590,822	13.19	64.54		16.66	5.62
Lamar	596,885	53.00	19.61	6.45	18.23	2.70
Little River	361,645	30.49	53.24		12.66	3.61
Polk	552,081	0.20	92.20		7.56	0.04
Red River	676,806	23.57	48.43	0.91	26.96	0.13
Scott	574,797	0.55	89.92		9.27	0.26
Sebastian	349,581	27.02	42.17		30.38	0.43
Sevier	372,082	1.56	78.49		16.99	2.96

3.8.6 Infrastructure, Transportation, and Utilities

The Rivers MOA is traversed along its western side by Indian National Turnpike. The turnpike is a major connecting route between Tulsa and Dallas, Texas. The other major road underlying the MOA is U.S.-271, which traverses the central portion. The adjacent counties contain three major highways: namely Highway 75, U.S.-270, and U.S.-259. Oklahoma also has an extensive railroad system, with Durant and Muskogee as important railroad centers near the MOA region of influence. The primary commodities originating in the state and transported by rail are nonmetallic minerals (32 percent of total freight), chemicals (17 percent), petroleum products (10 percent), and farm products (9 percent).

There are no airports within the Rivers MOA. The closest airport is the McAlester Municipal Airport located just outside of the northwestern corner of the MOA. The Fort Smith Airport in Arkansas is within the region of influence of the Rivers MOA.

Oklahoma obtains 94 percent of its electricity from steam plants using coal or natural gas, while the remainder comes from hydroelectric facilities. Most of steam plants are located in the central and drier parts of the state, where the water supply in the lakes is not dependable enough for the generation of hydroelectric power. Near the Rivers MOA, power is generated by Denison Dam along the Red River System, which is among the largest of Oklahoma's hydroelectric dams. Most hydroelectric dams have been built since the 1940s. Tables 3-84 and 3-85 provide a listing of major suppliers of electricity in the River MOA region of influence.

TABLE 3-84
Major Power Utilities Serving the Rivers MOA Region (Underlying Counties)

Power Utility	Location (Counties, State)
Arkansas Valley Electric Cooperative Corporation	Le Flore, OK
Choctaw Electric Co-Operative, Inc	Atoka, Bryan, Choctaw, Le Flore, McCurtain, Pushmataha, OK
Cookson Hills Electric Cooperative, Inc	Latimer, Le Flore, Pittsburg, OK
Kiamichi Electric Cooperative, Inc	Atoka, Latimer, Le Flore, Pittsburg, Pushmataha, OK
Oklahoma Gas and Electric Company	Bryan, Le Flore, OK
People's Electric Cooperative	Atoka, Pittsburg, OK
Public Service Company of Oklahoma	Atoka, Choctaw, Latimer, Le Flore, McCurtain, Pittsburg, Pushmataha, OK
Rich Mountain Electric Cooperative, Inc	Le Flore, McCurtain, OK
Southeastern Electric Cooperative, Inc	Atoka, Bryan, Choctaw, OK
Southwest Arkansas Electric Cooperative Corporation	McCurtain, OK
Town of Spiro	Le Flore, OK

TABLE 3-85
Major Power Utilities Serving the Rivers MOA Region (Adjacent Counties)

Power Utility	Location (Counties, State)
Arkansas Valley Electric Cooperative Corporation	Scott, Sebastian, AR
Bowie-Cass Electric Cooperative, Inc	Red River, Bowie, TX
Entergy Arkansas, Inc	Scott, AR
Lamar County Electric Cooperative Association	Red River, TX
Oklahoma Gas and Electric Company	Scott, Sebastian, AR
Rich Mountain Electric Cooperative, Inc	Polk, Sevier, AR
Southwest Arkansas Electric Cooperative Corporation	Polk, Sevier, Little River, AR; Bowie, TX
Southwestern Electric Power Company	Sebastian, Polk, Sevier, Little River, AR; Red River, Bowie, TX
Texas-New Mexico Power Company	Red River, TX
Upshur Rural Electric Cooperative Corporation	Bowie, TX

3.8.7 Cultural Resources

While Oklahoma is rich in Native American and American Civil War history, most of the significant cultural areas are located outside of the Rivers MOA. Tuskahoma, located within the MOA boundary, is the site of the national capital of the Choctaw Native American Tribe and contains the Choctaw Council House. Another attraction is the Chief Gardner Home and Museum in McCurtain County outside the eastern boundary of the MOA.

According to the 2000 Census, there were 273,230 Native Americans in Oklahoma. This is a relatively large Native American community. Many Native Americans live in the Ouachita and Ozark regions of eastern Oklahoma, in what was originally Indian Territory. The potentially affected tribal organization within the Rivers MOA is the Choctaw Nation of Oklahoma.

3.8.8 Socioeconomics

Agriculture and livestock raising, mining and processing a variety of minerals, tourism, manufacturing, and service industries are all important sources of income in Oklahoma. The largest number of jobs, 28 percent, were provided by the services sector, which can include jobs such as dry cleaners or computer operators. Another 21 percent of jobs were in wholesale or retail trade; 17 percent in federal, state, or local government, including military service; 10 percent in manufacturing; 6 percent in farming (including agricultural services), forestry, or fishing; 6 percent in finances, insurance, or real estate; 5 percent in transportation or public utilities; 5 percent in construction; and 3 percent in mining. Oklahoma is more a producer of raw materials than of manufactured goods.

In the vicinity of the Rivers MOA, raising beef cattle is one of the major agricultural activities along the Ouachita Mountains. Forestry is also common, with large sawmills located in Wright City, Broken Bow, and Idabel near the eastern boundary of the MOA. A large wallboard plant, which uses the chips and sawdust of the Wright City sawmill, is located near Broken Bow. About 2 million acresof pine forests are used in commercial lumber and paper production in the Ouachita and Ozark regions.

Although petroleum and gas are found in almost every county in Oklahoma, the vicinity of the Rivers MOA is known for its coal deposits. Coal was first mined near McAlester in 1872, which is situated near the northwest boundary of the MOA. Meatpacking is an important industry near Ada and Durant, near the western boundary of the MOA. In addition, rubber tires are made at Ada and Ardmore, while clothing factories have been established at Coalgate and Ada, and furniture is made in factories in Atoka within the western zone of influence of the MOA.

The estimated 2000 population of the counties underlying the Rivers MOA was 212,578 persons (Table 3-86). The estimated 2000 population of the adjacent counties was 279,301. The largest population center underlying the Rivers MOA is the city of Hugo in Choctaw County (population 5,536). Most other towns within the MOA contain populations of 2,500 or less (e.g, Antlers - 2,552; Fort Towson - 611; Clayton - 719). Major population centers in the adjacent counties include include the city of Durant (13,549), McAlester (17,783), Idabel (6,952), and Poteau (7,939).

TABLE 3-86
Socioeconomic Characteristics of the Rivers MOA Region

County	Area[1]	Population[2]	Density[3]	Median Household Income ($)[4]
Underlying Counties				
Atoka Co., OK	978	13,879	14.2	$21,062
Bryan Co., OK	909	36,534	40.2	$24,270
Choctaw Co., OK	774	13,342	19.8	$19,213
Latimer Co., OK	722	10,692	14.8	$23,720
Le Flore Co., OK	1,586	48,109	30.3	$26,057
McCurtain Co., OK	1,852	34,402	18.6	$23,132
Pittsburg Co., OK	1,306	43,953	33.7	$26,665
Pushmataha Co., OK	1,397	11,667	8.4	$19,362
Total/Average	9,524	212,578	22.3	$22,935
Adjacent Counties				
Little River Co., AR	532	13,628	25.6	$28,739
Polk Co., AR	859	20,229	23.5	$23,934
Scott Co., AR	894	10,996	12.3	$24,049
Sebastian Co., AR	536	115,071	214.7	$32,360
Sevier Co., AR	564	15,757	27.9	$26,121
Bowie Co., TX	888	89,306	100.6	$32,433
Red River Co., TX	1050	14,314	13.6	$22,035
Total/Average	5323	279,301	52.5	$27,096

1. US Census Bureau – Land Area, Population, and Density for States and Counties: 2000.
2. US Census Bureau – Estimated population for 2000. <www.census.gov/population/estimates/county/
3 Calculated – County Population divided by County Area.
4 U.S. Census Bureau – Money Income for all counties in Oklahoma, Arkansas and Texas 1997, www.tier2.census.gov/cgi-win/usac

3.8.9 Environmental Justice

Demographic information on race, ethnicity, and poverty status in the counties underlying the Rivers MOA are presented in Table 3-87. Statistics for the state of Oklahoma are included to provide context. (See subsection 3.3 for the definitions of minority population and poverty areas).

The total percentages of minority population living in 5 of the 8 counties underlying the Rivers MOA are less than in the state of Oklahoma. However, Choctaw, Latimer and McCurtain counties (26.6, 21.1 and 24.4 percent) have higher total minority populations than the state (19.4 percent). In addition, all of the counties have higher American Indian populations than the statewide percentage and Choctaw and McCurtain counties have higher percentages of Black population. All of the counties, except Pittsburg County, underlying the Rivers MOA exceed the 20 percent definition for poverty areas. Although none of the counties meet the 40 percent definition of an "extreme poverty area" countywide, it is likely that some individual communities within those counties would. (Poverty areas typically have high concentrations of poor persons, but that doesn't mean that everyone living in them is poor). The state of Oklahoma as a whole also comes close to that criterion, with an overall poverty rate of 16.3 percent.

TABLE 3-87
Demographic Statistics for the Rivers MOA

Jurisdiction	Total Persons (2000)	Percentage						
		White (2000)	Black (2000)	American Indian[1] (2000)	Asian [2] (2000)	Other (2000)	Hispanic Origin[3] (2000)	Poverty Rate[4] (1997)
Oklahoma	3,3450,654	76.2	4.6	7.9	1.5	2.4	5.2	16.3
Rivers MOA Counties								
Atoka Co., OK	13,879	75.9	5.9	11.4	0.2	0.6	1.4	27.5
Bryan Co, OK	36,534	80.0	1.4	12.2	0.4	1.1	2.6	21.2
Choctaw Co., OK	15,342	68.6	10.9	15.0	0.2	0.5	1.6	29.6
Latimer Co., OK	10,692	73.0	1.0	19.4	0.2	0.5	1.5	24.1
Le Flore Co., OK	48,109	80.4	2.2	10.7	0.2	1.4	3.8	21.7
McCurtain Co., OK	34,402	70.5	9.3	13.6	0.2	1.3	3.1	26.5
Pittsburg Co. OK	43,953	77.2	4.0	12.5	0.3	0.8	2.1	19.8
Pushmataha Co., OK	11,667	78	0.8	15.6	0.2	0.3	1.6	29.2

Source: U.S. Bureau of the Census, 2000

Notes:

1. Includes Alaska native and Aleutian Islander
2. Includes Pacific Islander
3. Race refers to Census respondents' self-identification of racial background. Hispanic origin refers to ethnicity and language, not race, and may include persons whose heritage is Puerto Rican, Cuban, Mexican, and Central or South American.
4. The values shown are 1997 Census Bureau estimates of percent persons with household incomes below the poverty threshold.

3.9 Hog and Shirley

The Hog MOA is located in the west central part of Arkansas and encompasses portions of Franklin, Logan, Scott, Sebastian, Yell, Montgomery, and Polk counties, as well as a portion of Le Flore County in Oklahoma (Figure 3-8). The affected environment includes these counties and the adjacent downwind counties of Pope, Conway, Perry, Garland, Hot Spring, Clark, and Pike in central and western Arkansas.

The Shirley MOA is located in north-central Arkansas and encompasses portions of Baxter, Cleburne, Conway, Faulkner, Independence, Izard, Jackson, Newton, Pope, Searcy, Sharp, Stone, Van Buren, and White counties (Figure 3-9) The affected environment includes these underlying counties and the adjacent counties of Fulton, Randolph, Lawrence, Jackson, Woodruff, Prairie, Lonoke, and Pulaski in central and eastern Arkansas, and Ozark, Howell, and Oregon in south central Missouri.

3.9.1 Earth Resources

The Hog and Shirley MOAs are located in the Interior Highlands physiographic region of Arkansas, which includes major landforms such as the Ozark Mountains, the Ouachita Mountains, and the Arkansas River Valley. The highest mountain peak in the state, Magazine Mountain, is found in the vicinity of the MOAs. It rises abruptly from the Arkansas Valley floor to 2,753 ft above sea level. Hog MOA contains many isolated peaks, including Poteau Mountain, Rich Mountain, White Oak Mountain, and Pilot Knob of the Ouachita Mountains. The Shirley MOA lies north of the Arkansas Valley, in the region of the Ozark Mountains or Ozark Plateaus, which are composed of ancient sandstone and limestone. The remainder of the lands to the east and south of the MOAs are considered part of the Coastal Plain physiographic region in Arkansas, which extends across much of the Mississippi borderlands.

The Ouachita Mountains within the Hog MOA contain rocks of great age. The mountains were formed when rock layers were subjected to tremendous pressure (in the geologic past), and were pushed into folds that now form long, narrow ridges that run from east to west and are separated by wide basins. The Ouachitas cover a belt from 50 to 60 miles wide, extending from just west of Little Rock into Oklahoma. They rise in elevation to the west, reaching altitudes of 2,600 feet at Blue Mountain, near the Oklahoma State line.

The Ozark Mountains in the vicinity of the Shirley MOA contain many sinks, caves, and underground river channels, which were formed when limestone was dissolved by water. The southern part of the Ozark Mountains is known locally as the Boston Mountains. The Boston Mountains form the most rugged part of the Ozark Mountains, with peaks reaching more than 2,300 ft high and a heavily wooded tangle of steep sandstone ridges and jagged spurs, cut through by gorges as much as 1,400 ft deep. The Ozarks are bounded on the north by a gentle escarpment.

The soils of the Ozarks are derived mainly from limestone, while those of the Ouachitas are derived from shale and sandstone. Both of these upland areas are susceptible to soil erosion, and are suited primarily for small scale agricultural operations.

3.9.2 Climate

Summers in Arkansas are long and moderately hot, and winters are short and relatively mild. However, northward and westward from the Coastal Plain, there is a gradual change from warm winters and hot, humid summers to more clear, brisk, and dry weather and a wider range of temperatures associated with the Interior Plains. January temperature averages between 38° and 46° F throughout the state. July averages are between 78° and 82° F. Daytime high temperatures in July are frequently in the middle 90°s F. The exception to these temperature patterns occurs within the Ozark and Ouachita uplands, where temperatures vary considerably from ridge to valley and are usually in the upper 70°s F throughout the summer months.

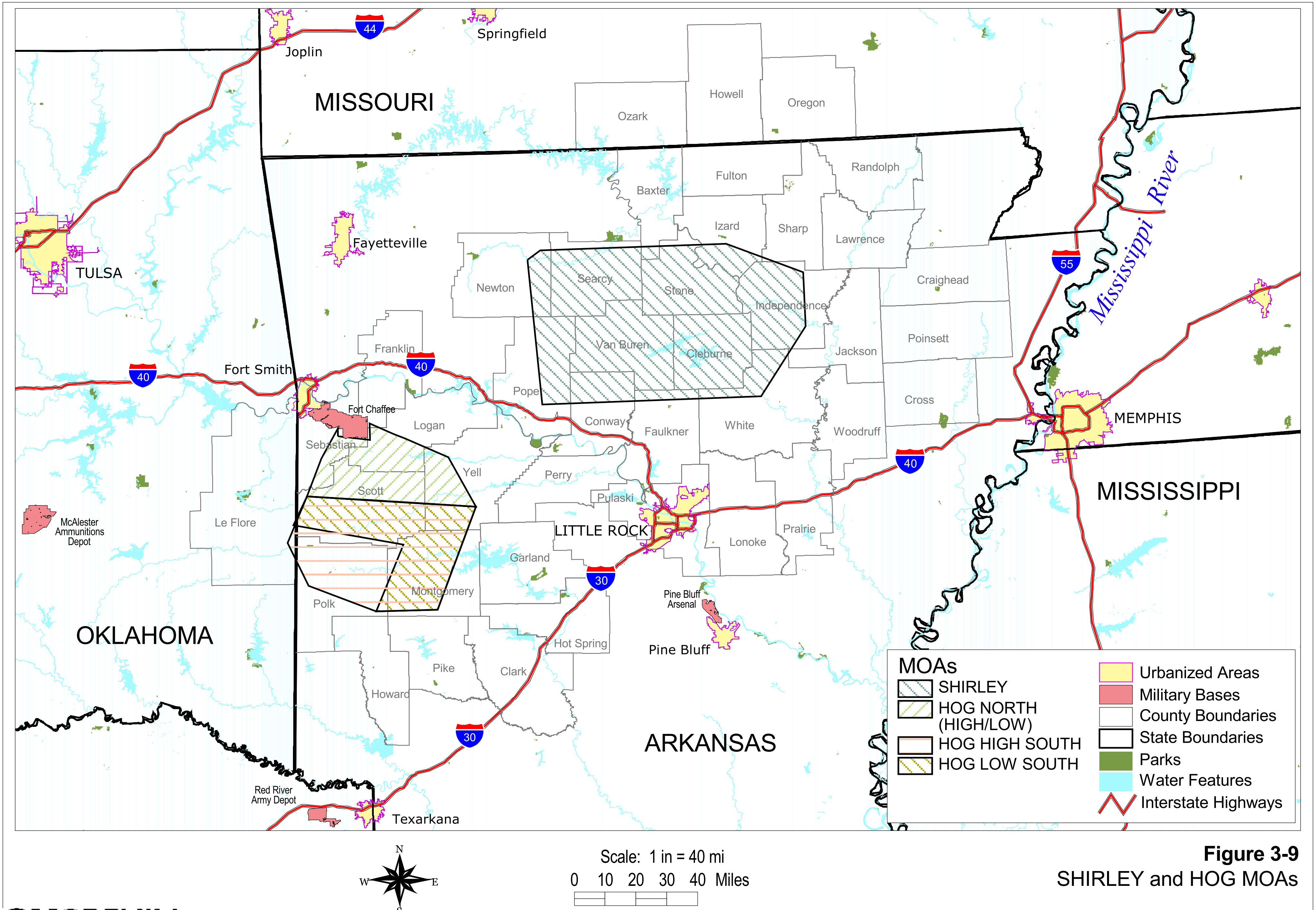

Figure 3-9
SHIRLEY and HOG MOAs

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Arkansas receives 40 to 50 inches of precipitation a year, with some areas receiving even more. Most of the rain, which can be heavy enough to cause flooding, comes during winter and spring. Snowfall rarely occurs in the south, but usually amounts to more than 10 inches per year in the mountains.

The growing season in Arkansas averages 211 days, ranging from 241 days in the lowlands to 176 days in the mountains. The last frost of winter is usually over by mid-March in the south and southeast and by late April in the northwest. In the fall, the first killing frost arrives by mid-October in the Ozark Mountain areas, but it may not be felt in the central area of Arkansas until early November.

3.9.3 Water Resources

Arkansas contains an abundance of waterbodies, which primarily drain to the southeast towards the Mississippi River. The Mississippi River forms the eastern boundary of Arkansas, where it flows across a wide floodplain. The Arkansas River is a major tributary of the Mississippi River and flows between the Hog and Shirley MOA. This river originates as a small stream in the Rocky Mountains, and becomes a great river by the time it reaches Arkansas. The water level on the river fluctuates seasonally.

Within the Hog MOA, the major river systems are the Ouachita River in Polk and Montgomery County, and the Fourche River in Scott and Yell County. They two rivers drain eastward to Ouachita Lake and Nimrod Lake, respectively. The major river systems within the Shirley MOA are the Buffalo River, located to the north of Newton and Searcy County, and the Little Red River, which also flow eastward across Searcy, Van Buren, and Cleburne County. The Little Red River is a tributary of the White River, which drains most of northern Arkansas. A section of the White River passes through the eastern part of the Shirley Moa in the counties of Independence, Stone and Izard.

There are no large natural lakes in Arkansas. The largest bodies of water are reservoirs behind dams. These include Ouachita Lake and Nimrod Lake in Hog MOA, and Greers Ferry Reservoir in Shirley MOA.

3.9.4 Biological Resources

Fifty-two percent of Arkansas is forested, with timber as one of the state's most valuable resources. Oak and hickory forests also characterize the Ozark region, where the typical oak species varies from white, red, blackjack, and post. These oak hickory forests are also interspersed with black walnut, American elm, and white ash. South of the Arkansas River, the oak-hickory forest merges into pine forest, comprised of fast growing loblolly and short-leaf pines. Within the Hog MOA, the forested cover composition is estimated to be 60 percent loblolly-shortleaf pine and 20 percent oak–pine. The loblolly-shortleaf pine forests form broad sweeping belts over much of central and southern parts of the MOA. The forest cover of the Shirley MOA is about 70 percent oak-hickory, with about 10 percent as oak-pine stands. The oak-hickory stands cover most of central and southern portion of the MOA while the oak- pine stands occur along the northeast corner. The remaining area within each of the MOAs consists of urbanized or agricultural land.

An estimated 2,470 native plants and exotics flourish in Arkansas. These include the passionflower and water lily, as well as 36 varieties of orchid, American bellflower, blue lobelia, verbena, phlox, yellow jasmine, hibiscus, aster, and wild hydrangea within the forested areas. Spring months are usually characterized by dogwood, redbud, crab apple, wild plum, locust, and many other flowering trees in full bloom.

Mammals commonly found in Arkansas are the bobcat, opossum, muskrat, weasel, rabbit, squirrel, red and gray foxes. Deer and elk thrive in state and federal game refuges. Black bear reintroduced from Minnesota are thriving in Arkansas's highlands areas. The Mississippi River and the lower valleys of its tributaries are considered one of the great flyways for birds migrating between the Gulf of Mexico and Canada. The Ozarks-Ouachita region is also the breeding ground for such species as the scarlet tanager, ovenbird, summer tanager, Carolina wren, rufous-sided towhee, and roadrunner.

The rivers, streams, and lakes of the state support a wide variety of fish, including largemouth and spotted bass, catfish, and several species of bream. Mountain waters commonly support smallmouth bass and the darters. Striped bass have been introduced to many reservoirs, and trout populations are found below dams in the White River system. Norfolk National Fish Hatchery is the largest trout hatchery in the country.

Threatened and endangered flora and fauna within the Hog and Shirley MOA regions of influences are listed in Tables 3-88 to 3-91.

TABLE 3-88
Threatened and Endangered Flora and Fauna in the Hog MOA (Underlying Counties)

Common Name	Scientific Name	Status
Bald eagle	Haliateetus leucocephalus	LT
American Burying Beetle	Nicrophorus americanus	LE
Interior Least Tern	Sterna antillarum athalassos	LE
Red Cockaded Woodpecker	Picoides borealis	LE
Florida Panther	Felis concolor coryi	LE
Arkansas Fatmucket	Lampsilis powellii	LT
Leopard darter	Percina pantherina	LT
Ouachita Rock Pocketbook	Arkansia wheeleri	LE
Winged Mapleleaf	Quadrula fragosa	LE
Indiana Bat	Myotis sodalis	LE
Geocarpon	Geocarpon minimum	LT
Magazine Mountain Shagreen	Mesodon magazinensis	LT
Harperella	Ptililimnium nodosum	LE

TABLE 3-88
Threatened and Endangered Flora and Fauna in the Hog MOA (Underlying Counties)

Common Name	Scientific Name	Status

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

TABLE 3-89
Threatened and Endangered Flora and Fauna in the Hog MOA (Adjacent Counties)

Common Name	Scientific Name	Status
Gray Bat	Myotis grisenscens	LE
Interior Least Tern	Sterna antillarum athalassos	LE
Florida Panther	Felis concolor coryi	LE
Red-Cockaded Woodpecker	Picoides borealis	LE
Bald Eagle	Haliaeetus leucocephalus	LT
Harperella	Ptilimnium nodosum	LE
Ouachita Rock Pocketbook	Arkansia wheeleri	LE
Pink Mucket	Lampsilis abrupta	LE
Arkansas Fatmucket	Lampsilis powellii	LT
Winged Mapleleaf	Quadrula fragosa	LE

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

TABLE 3-90
Threatened and Endangered Flora and Fauna in the Shirley MOA (Underlying Counties)

Common Name	Scientific Name	Status
Bald Eagle	Heliaeetus leucocephalus	LT
Pink Mucket	Lampsilis abrupta	LE
Gray Bat	Myotis grisescens	LE
Florida Panther	Felis concolor coryi	LE
Interio Least Tern	Sterna antillarum athalassos	LE
Indiana Bat	Myotis sodalis	LE

TABLE 3-90
Threatened and Endangered Flora and Fauna in the Shirley MOA (Underlying Counties)

Common Name	Scientific Name	Status
Running Buffalo Clover	Trifolium stoloniferum	LE
Missouri bladderpod	Lesquerella filiformis	LE
Pondberry	Lindera melissifolia	LE
Turgid Blossom	Epioblasma turgidula	LE
Speckled Pocketbook	Lampsilis streckeri	LE

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

TABLE 3-91
Threatened and Endangered Flora and Fauna in the Shirley MOA (Adjacent Counties)

Common Name	Scientific Name	Status
Curtis Pearlmussel	Epioblasma florentina curtisi	LE
Bald Eagle	Haliaeetus leucocephalus	LT
Pink Mucket	Lampsilis abrupta	LE
Pondberry	Lindera melissifolia	LE
Gray Bat	Myotis grisescens	LE
Red-Cockaded Woodpecker	Picoides borealis	LE
Interior Least Tern	Sterna antillarum athalassos	LE
Running Buffalo Clover	Trifolium stoloniferum	LE
Bachman's Sparrow	Aimophila aestivalis	SE
Plains Spotted Skunk	Spilogale putorius interrupta	SE
Swainson's Warbler	Limnothlypis swainsonii	SE
Decurrent False Aster	Boltonia decurrens	LT

LT- listed as threatened by the U.S. Fish and Wildlife Service
LE- listed as endangered by the U.S. Fish and Wildlife Service
ST- listed as threatened by the State jurisdiction
SE- listed as endangered by the State jurisdiction

3.9.5 Land Use and Visual Resources

In 1937, Arkansas was the first state to pass legislation that organized voluntary soil conservation districts. President Theodore Roosevelt took an active interest in conserving the state's timber resources, and he set aside the Ouachita National Forest in 1907 and the Ozark National Forest in 1908. The Hog and Shirley MOAs are located above these national forests, which are among the most extensive forested areas within the state. Agricultural activity is also widespread in the vicinity of the MOAs. There are cultivated patches in the narrow valley bottoms and on the steep slopes of the Ozark-Ouachita uplands.

As discussed, there are also large waterbodies in the vicinity of the MOAs. Dams and reservoir areas on the tributaries of the Arkansas River and the dams and locks of the McClellan-Kerr Arkansas River Navigation System (completed in 1971) near the MOAs were created to minimize the extent of flooding destruction once caused by the Arkansas River.

Land use patterns underlying the Hog and Shirley MOA regions of influence are presented in Tables 3-92 through 3-95. The pattern of land use is consistent with the rugged, mountainous terrain and the scenic beauty of the Ouachita-Ozark Mountain area, which is well known to vacationers and tourists. The Ouachita National Forest is the largest national forest in Arkansas. It offers many attractions, including Lake Ouachita and historic Caddo Gap, where Hernando De Soto (the first European to explore the region) fought Native Americans. Seven wilderness areas are preserved in the forest. Ozark National Forest is in four separate areas, three north of the Arkansas River and one south of it. It includes four national wildlife refuges, a number of state game and fish refuges, five wilderness areas, and many scenic drives.

Within the Hog MOA, there are numerous state parks, including Little Pines, Queen Wilhemina, Knoppers Ford, Jack Creek, River Bluffs, and Lake Ouachita. Other wilderness and natural areas include Dry Creek, Poteau Mountain, Upper Kiamichi, Black Fork Mountain, and Caney Creek. Near the eastern boundary of the Hog MOA, the Hot Springs National Park contains 47 hot springs used for many years for therapeutic treatments. Petit Jean State Park, located in Yell Township at Petit Jean Mountain near the Arkansas River, is the oldest and one of the more beautiful state parks. It is located just outside of the eastern boundary of the Hog MOA.

Other attractions within counties adjacent to the Hog MOA include the Fort Chaffee Military Reserve near Fort Smith, University of the Ozarks in Clarksville, and Hot Springs National Park. Magnet Cove, east of Hot Springs, is considered a geological wonder. Within only five square miles, nearly 100 different minerals can be found.

In the northern part of the Shirley MOA, the Buffalo National River is one of the few remaining free-flowing rivers in the lower 48 states. The river cuts through massive limestone bluffs on its course through the Ozark Mountains. In addition, the underground caverns within the MOA attract many visitors every year. One of the most popular is known as the Blanchard Springs Caverns. Located near Mountain View, the Blanchard Springs Caverns contain miles of explored passages. Hurricane River Cave and Diamond Cave are also frequently visited. Other wilderness and natural areas in the region are East Fork, Richland Creek, and Leatherwood Wilderness. Important attractions in counties adjacent to the Shirley MOA region of influence are Mystic Cavern, University of Central Arkansas, Central Baptist College, Plantation Agriculture Museum, Toltec Mounds, Harding University, and Lyon College.

TABLE 3-92
Hog MOA Land Use and Cover (Underlying Counties)

County	Total Acreage	Percent Agriculture	Percent Forest	Percent Urban / Rural Development	Percent Water
Franklin	396,603	30.67	49.06	16.65	3.62
Logan	468,158	10.46	61.24	25.68	2.62
Montgomery	512,233	0.09	87.32	3.49	9.11
Polk	552,081	0.20	92.20	7.56	0.04
Yell	607,274	4.97	69.78	24.14	1.10

TABLE 3-93
Hog MOA Land Use and Cover (Adjacent Counties)

County	Total Acreage	Percent Agriculture	Percent Forest	Percent Urban / Rural Development	Percent Water
Clark	565,074	4.45	81.48	11.59	2.47
Conway	362,661	17.88	45.06	36.22	0.83
Garland	470,223	1.80	78.82	2.87	16.50
Hot Spring	398,253	2.89	85.40	7.08	4.62
Howard	381,006	2.69	71.07	23.32	2.91
Perry	358,787	7.56	81.89	9.67	0.88
Pike	392,971	1.21	87.59	8.75	2.45
Pope	531,715	14.17	59.73	22.62	3.48

TABLE 3-94
Shirley MOA Land Use and Cover (Underlying Counties)

County	Total Acreage	Percent Agriculture	Percent Forest	Percent Grassland	Percent Urban / Rural Development	Percent Water
Baxter	375,433	3.69	68.85		19.56	7.90
Cleburne	378,824	1.11	59.58		26.59	12.72
Conway	362,661	17.88	45.06		36.22	0.83
Faulkner	425,001	17.44	29.14		51.38	2.03

TABLE 3-94
Shirley MOA Land Use and Cover (Underlying Counties)

County	Total Acreage	Percent Agriculture	Percent Forest	Percent Grassland	Percent Urban / Rural Development	Percent Water
Independence	493,633	22.11	32.32	0.10	45.46	
Izard	373,726	5.76	73.02		21.16	0.07
Jackson	410,569	89.82	2.69	0.18	7.31	
Newton	526,749		93.44		6.56	
Pope	531,715	14.17	59.73		22.62	3.48
Searcy	427,747	0.03	68.85		31.12	
Sharp	388,007	4.60	70.59		24.76	0.06
Stone	389,980		82.94		17.06	
Van Buren	463,539	0.43	78.49		16.56	4.53
White	667,071	44.89	17.87		37.24	

TABLE 3-95
Shirley MOA Land Use and Cover (Adjacent Counties)

County	Total Acreage	Percent Agriculture	Percent Forest	Percent Grassland	Percent Urban / Rural Development	Percent Water	Percent Wetlands
Craighead	456,296	88.89	2.15	0.16	8.74		0.05
Cross	398,401	83.39	2.05	0.25	14.32		
Fulton	396,924	8.83	41.75		48.93	0.49	
Howell	593,950	5.10	40.58	0.21	54.11		
Jackson	410,569	89.82	2.69	0.18	7.31		
Johnson	436,927	10.09	68.74		14.09	7.09	
Lawrence	379,056	63.25	14.12	0.26	22.11	0.26	
Lonoke	513,705	79.41	3.45	0.34	16.32	0.43	0.05
Oregon	506,486	0.39	66.76	0.49	32.37		
Ozark	483,100	4.08	49.92		45.10	0.89	
Poinsett	488,437	89.76	1.73	0.05	8.41	0.05	
Prairie	432,548	78.98	9.12		11.27	0.63	
Pulaski	517,136	40.80	41.82		13.94	3.44	
Randolph	419,695	26.65	44.09		29.27		
Woodruff	380,120	87.65	2.43	0.59	9.34		

3.9.6 Infrastructure, Transportation, and Utilities

The steamboat was the primary means of transportation in central Arkansas until the development of the railroad system in the 1870s. Roads were slow to develop within the dense forested uplands, with the Southwest Trail (along the edge of the Ozarks and Ouachitas) as the best known of Arkansas's early roads. Currently, the road networks within the Hog and Shirley MOAs provide a secondary road connection between the population centers of Little Rock , Hot Springs, Fort Smith, and Fayetteville. The primary road system, I-40, runs east-west from Little Rock to Fort Smith, along the Arkansas River lowlands between the Hog and Shirley MOAs.

The major roads within the Hog MOA are U.S. Highway 270 and U.S. Highway 71, which run primarily east-west between scenic mountain peaks along the Ouachita Mountains. The major roads within the Shirley MOA are U.S. Highway 65 and State Highway 167, which are oriented in a north-south direction. Although the road system near Little Rock is currently well developed, the completion of the McClellan-Kerr Arkansas River Navigation System in 1971 has made the Arkansas River an important part of the nation's inland waterways, by connecting it to the Mississippi River-Gulf Intracoastal Waterway. Little Rock and Fort Smith are major ports near the Hog and Shirley MOAs.

Potentially affected airports in the region of influence of the Hog MOA are Fort Smith Regional, in Sebastian County, and Hot Springs Airport, in Garland County. Potentially affected airports in the region of influence of the Shirley MOA are the Harrison Airport in Boone County, Jonesboro Airport in Craighead County, and Little Rock Airport in Pulaski County.

Electrical power in Arkansas comes from conventional steam-powered plants fueled by coal (62 percent), nuclear power plants (30 percent), and the remainder from hydroelectric facilities. The federal government has developed hydroelectric power in the Arkansas, White, and Ouachita river basins. The largest and most famous of the dams is Bull Shoals on the White River, just a short distance north of the Shirley MOA. Additional dams, built as part of the Arkansas River Navigation Project, provide for improved flood control as well as expanded power production. Major power utilites in the Hog and Shirley MOAs regions of influence are listed in Tables 3-96 through 3-99.

TABLE 3-96
Major Power Utilities Serving the Hog MOA Region (Underlying Counties)

Power Utility	Location (Counties, State)
Arkansas Valley Electric Cooperative Corporation	Franklin, Logan, Scott, Sebastian, Yell, AR; Le Flore, OK
Choctaw Electric Co-Operative, Inc	Le Flore, OK
City of Paris	Logan, AR
Cookson Hills Electric Cooperative, Inc	Le Flore, OK
Entergy Arkansas, Inc	Scott, AR
Entergy Arkansas, Inc	Yell, AR
First Electric Cooperative Corporation	Yell, AR
Kiamichi Electric Cooperative, Inc	Le Flore, OK

TABLE 3-96
Major Power Utilities Serving the Hog MOA Region (Underlying Counties)

Power Utility	Location (Counties, State)
Oklahoma Gas and Electric Company	Franklin, Logan, Scott, Sebastian, AR; Le Flore, OK
Ozarks Electric Cooperative Corporation	Franklin, AR
Public Service Company of Oklahoma	Le Flore, OK
Rich Mountain Electric Cooperative, Inc	Montgomery, Polk, AR; Le Flore, OK
South Central Arkansas Electric Cooperative, Inc	Montgomery, AR
Southwest Arkansas Electric Cooperative Corporation	Polk, AR
Southwestern Electric Power Company	Franklin, Logan, Polk, Scott, Sebastian, Yell, AR
Town of Spiro	Le Flore, OK

TABLE 3-97
Major Power Utilities Serving the Hog MOA Region (Adjacent Counties)

Power Utility	Location (Counties, State)
Arkansas Valley Electric Cooperative Corporation	Pope, AR
Carroll Electric Cooperative Corporation	Pope, AR
First Electric Cooperative Corporation	Conway, Perry, AR
Petit Jean Electric Cooperative Corporation	Pope, Conway, AR
South Central Arkansas Electric Cooperative, Inc	Hot Spring, Clark, Pike, AR
Southwestern Electric Power Company	Pike, AR

TABLE 3-98
Major Power Utilities Serving the Shirley MOA Region (Underlying Counties)

Power Utility	Location (Counties, State)
Arkansas Valley Electric Cooperative Corporation	Newton, Pope, AR
Carroll Electric Cooperative Corporation	Newton, Pope, AR
Clay County Electric Coop Corporation	Sharp, AR
Conway Corporation	Faulkner, AR
Craighead Electric Coop Corporation	Independence, Sharp, AR
Entergy Arkansas, Inc	Searcy, Sharp, Stone, Van Buren, White, AR
Farmers Electric Cooperative Corporation	Independence, Jackson, AR
First Electric Cooperative Corporation	Cleburne, Conway, Faulkner, Independence, Stone, White, AR
North Arkansas Electric Cooperative, Inc	Baxter, Izard, Sharp, Stone, AR
Petit Jean Electric Cooperative Corporation	Cleburne, Conway, Newton, Pope, Searcy, Stone, Van Buren, AR

TABLE 3-99
Major Power Utilities Serving the Shirley MOA Region (Adjacent Counties)

Power Utility	Location (Counties, State)
City of Augusta	Woodruff, AR
City of Mountain View	Howell, MO
City of North Little Rock	Pulaski, AR
City of Thayer	Oregon, MO
City of West Plains	Howell, MO
City of Willow Springs	Howell, MO
Clay County Electric Coop Corporation	Randolph, Lawrence, AR; Oregon, MO
Craighead Electric Coop Corporation	Randolph, Lawrence, AR
Entergy Arkansas, Inc	Randolph, Woodruff, Pulaski, AR
Farmers Electric Cooperative Corporation	Jackson, Woodruff, AR
First Electric Cooperative Corporation	Prairie, Lonoke, Pulaski, AR
Howell-Oregon Electric Cooperative, Inc	Ozark, Howell, Oregon, MO
North Arkansas Electric Cooperative, Inc	Fulton, AR
Ozark Border Electric Cooperative	Oregon, MO
White River Valley Electric Cooperative, Inc	Ozark, MO
Woodruff Electric Cooperative Corporation	Woodruff, Prairie, AR

3.9.7 Cultural Resources

The areas in the region of the Hog and Shirley MOAs have played an important role in the Arkansas’s early history, due in part to the significance of the major water systems to exploration. Aside from the waterway areas, important cultural areas are located outside of the MOA boundaries, and are centered within the nearby areas of Fort Smith and Little Rock. Fort Smith National Historic Site at Fort Smith was one of the first US military posts in the Louisiana Territory, where government policy toward Native Americans was enforced. Russellville, located just outside of the western boundary of the Shirley MOA, was the site of the first Protestant missionary school.

Arkansas's First State Capitol (the Old State House) at Little Rock, a Greek Revival building that served as the capitol until 1911, houses a historical museum. Also in Little Rock are the Arkansas Museum of Science and History, housed in the former Little Rock Arsenal (the birthplace of General Douglas MacArthur), and the Arkansas Arts Center museum. The mound complex in Toltec State Park just outside of Little Rock is an important historical cultural artifact, and was apparently used for ceremonies by Native Americans.

Annual cultural events in the vicinity of the MOAs include the Oaklawn Horse Racing Season in Hot Springs; the Arkansas Folk Festival in Mountain View, the Old Fort Days Rodeo and River Festival in Fort Smith, the Quapaw Quarter tour of historic homes, and the Arkansas State Fair and Livestock Exposition in Little Rock.

The Hog MOA region includes the Native American tribal organization of the Choctaw Nation of Oklahoma. No tribal organizations were identified within the Shirley MOA. There are currently no Native American reservations within the Hog and Shirley MOAs.

3.9.8 Socioeconomics

Arkansas had a work force of 1,222,000 people in 1999. The largest share of those, 24 percent, worked in the diverse services sector. This includes occupations such as health care workers and automobile mechanics. Another 21 percent were employed in wholesale or retail trade; 18 percent in manufacturing; 14 percent in federal, state, or local government, including those in the military; 6 percent in farming (including agricultural services), forestry, or fishing; 6 percent in transportation or public utilities; 6 percent in construction; 5 percent in finance, insurance, or real estate; and 0.4 percent in mining

The 2000 population of the counties within the Hog MOA was 265,046 persons (Table 3-100). The estimated 2000 population of adjacent counties was 150,246 persons (Table 3-101). The principal population center within the Hog MOA is the Town of Mena, located in Polk County (population 5,637). Most other towns within the MOA contain populations of less than 4,000 persons (e.g., Waldron - 3,508; Mansfield - 1,097 ; Mount Ida - 981; Oden - 220; and Black Springs - 114).

The 2000 population of the counties within Shirley MOA was 418,025 persons (Table 102). The population estimate for adjacent counties was 555,735 (Table 103). The principal population centers within the Shirley MOA are the city of Batesville in Independence County (population 9,445) and Heber Springs in Cleburne County (6,432). Most other towns in the MOA contain populations of less than 4,000 (e.g., Mountain View – 2,876; Greers Ferry - 930; and Leslie - 482 persons).

The principal cities in the counties adjacent to both the Hog and Shirley MOAs are Little Rock (with a 2000 population of 183,133), the state capital and chief commercial center; the industrial center of Fort Smith (population 80,268); the industrial center of North Little Rock (population 60,433); and Hot Springs (population 35,750), a resort and spa in the Ouachita Mountains.

In the vicinity of the MOAs, a number of historic economic advances occurred in the first quarter of the 20th century. In 1901, natural gas was first exploited in the Fort Smith area. In 1907 and 1908 the Ouachita and Ozark national forests were established and tourists began to take an interest in the hill country. In 1909 lumbering reached an all-time peak. The state's first large hydroelectric dam, on the Ouachita River, was completed in 1924.

Within the MOAs, lumbering is a major part of the local economy. The vast coniferous forests of loblolly and shortleaf pine supply saw mills within the Ouachitas. In the Ozarks, oak and hickory forests once formed the basis of a thriving woodworking industry. Wood processing and furniture making are important in central and western Arkansas, notably in Fort Smith and in many Ozark towns. The production of lumber, wood products, and the milling of paper are located at principal industrial centers of Little Rock, Fort Smith, and the Fayetteville-Springdale area.

Development of rich mineral resources has helped to bring industrial growth, with vast deposits of high quality bituminous and semianthracite coal occupying about 1,600 sq mi of the Arkansas River valley in the general region of influence of the MOAs. There are also vast deposits of lignite in central and southwest Arkansas, whose uses were explored in the 1980s. Natural gas occurs in the upper western Arkansas River valley, and it also flows in great quantities from oil wells in southwestern Arkansas. In addition to coal and gas, there also important deposits of building stone found in the Ozark Mountains. Also mined in Arkansas are significant quantities of limestone, barite, and silica. Bauxite deposits, which are concentrated in central Arkansas, are no longer mined commercially.

Although lumbering is an important part of the local economy, the processing of food products, particularly the preparation of meat and the packaging of fruits and vegetables, far exceeds any other industrial activity in value. Many food processing plants have been built to accommodate poultry production. These plants are located in the small- to medium-sized towns in the Ozarks, along the Arkansas River valley, and in western Arkansas. The economy of the Ozarks and Ouachitas has been transformed by the rise of mass-production chicken farming, pioneered by Tyson Foods, and the enormous growth of Sam Walton's Wal-Mart discount chain stores. Finally, the numerous state parks situated in the vicinity of the Ozark and the Ouachita mountains are the focal point of a thriving tourism industry within the MOA.

TABLE 3-100
Socioeconomic Characteristics of the Hog MOA Region (Underlying Counties)

County	Area[1]	Population[2]	Density[3]	Median Household Income ($)[4]
Franklin Co., AR	610	17,771	29.1	27,300
Logan Co., AR	710	22,486	31.7	26,233
Montgomery Co., AR	781	9,245	11.8	23,928
Polk Co., AR	859	20,229	23.5	23,939
Scott Co., AR	894	10,996	12.3	24,049
Sebastian Co., AR	536	115,071	214.7	32,360
Yell Co., AR	928	21,139	22.8	25,751
Le Flore Co., OK	1,586	48,109	30.3	26,057
Total/Average	6,904	265,046	38.4	26,202

1. US Census Bureau - Land Area, Population, and Density for States and Counties, 2000
2. US Census Bureau - Estimated population for 2000 <www.census.gov/population/estimates/county/
3 Calculated - County Population divided by County Area.
4 U.S. Census Bureau – Money Income for all counties in Arkansas and Oklahoma 1997, www.tier2.census.gov/cgi-win/usac

TABLE 3-101
Socioeconomic Characteristics of the Hog MOA Region (Adjacent Counties)

County	Area[1]	Population[2]	Density[3]	Median Household Income ($)[4]
Clark Co., AR	865	23,546	27.2	26.783
Conway Co., AR	556	20,366	36.6	28,503
Hot Spring Co., AR	615	30,353	49.4	27,757
Perry Co., AR	551	10,209	18.5	26,507
Pike Co., AR	603	11,303	18.7	26,974
Pope Co., AR	812	54,469	67.1	31,290
Total/Average	4002	150,246	37.5	27,969

1. US Census Bureau - Land Area, Population, and Density for States and Counties, 2000
2. US Census Bureau - Estimated population for 2000 <www.census.gov/population/estimates/county/
3 Calculated - County Population divided by County Area.
4 U.S. Census Bureau – Money Income for all counties in Arkansas 1997, www.tier2.census.gov/cgi-win/usac

TABLE 3-102
Socioeconomic Characteristics of the Shirley MOA Region (Underlying Counties)

County	Area[1]	Population[2]	Density[3]	Median Household Income ($)[4]
Baxter Co., AR	554	38,386	69.3	26,352
Cleburne Co., AR	553	24,046	43.5	27,223
Conway Co., AR	556	20,366	36.6	28,503
Faulkner Co., AR	647	86,014	132.9	35,722
Independence Co., AR	764	34,233	44.8	28,864
Izard Co., AR	581	13,249	22.8	22,868
Jackson Co., AR	634	18,418	29.1	23,942
Newton Co., AR	823	8,608	10.5	21,621
Pope Co., AR	812	54,469	67.1	31,290
Searcy Co., AR	667	8,261	12.4	19,091
Sharp Co., AR	604	17,119	28.3	22,433
Stone Co., AR	607	11,499	18.9	21,846
Van Buren Co., AR	712	16,192	22.7	23,828
White Co., AR	1,034	67,165	65	28,513
Total/Average	9,548	418,025	43.8	25,864

TABLE 3-102
Socioeconomic Characteristics of the Shirley MOA Region (Underlying Counties)

County	Area[1]	Population[2]	Density[3]	Median Household Income ($)[4]

1. US Census Bureau - Land Area, Population, and Density for States and Counties, 2000
2. US Census Bureau - Estimated population for 2000 <www.census.gov/population/estimates/county/
3. Calculated - County Population divided by County Area.
4. U.S. Census Bureau – Money Income for all counties in Arkansas 1997, www.tier2.census.gov/cgi-win/usac

TABLE 3-103
Socioeconomic Characteristics of the Shirley MOA Region (Adjacent Counties)

County	Area[1]	Population[2]	Density[3]	Median Household Income ($)[4]
Fulton Co., AR	618	11,642	18.8	20,848
Jackson Co., AR	634	18,418	29.1	23,942
Lawrence Co., AR	587	17,774	30.3	23,133
Lonoke Co., AR	766	52,828	69.0	35,825
Prairie Co., AR	646	9,539	14.8	26,039
Pulaski Co., AR	771	361,474	468.8	34,727
Randolph Co., AR	652	18,195	27.9	24,454
Woodruff Co., AR	587	8,741	14.9	20,623
Howell Co., MO	928	37,238	40.1	23,423
Oregon Co., MO	791	10,344	13.1	19,847
Ozark Co., MO	742	9,542	12.9	21,345
Total/Average	7722	555,735	72.0	24,928

1. US Census Bureau - Land Area, Population, and Density for States and Counties, 2000
2. 2. US Census Bureau - Estimated population for 2000 <www.census.gov/population/estimates/county/
3. Calculated - County Population divided by County Area.
4. U.S. Census Bureau – Money Income for all counties in Arkansas and Missouri 1997, www.tier2.census.gov/cgi-win/usac

3.9.9 Environmental Justice

Demographic information on race, ethnicity, and poverty status in the counties underlying the Hog and Shirley MOAs are presented in Table 3-104. Statistics for the surrounding states of Arkansas and Oklahoma are included to provide context. (See subsection 3.3 for the definitions of minority population and poverty areas).

The total percentages of minority population in all of the 14 counties underlying the Shirley MOA and the 8 counties underlying the Hog MOAs are less than the percentages for the states of Arkansas and Oklahoma. However, Le Flore County in Oklahoma (Hog MOA) has a somewhat higher American Indian population (10.7 percent) than in the state of Oklahoma as a whole (7.9 percent). Sebastian and Yell counties (Hog MOAs) have slightly higher Hispanic populations (6.7 and 12.7 percent) than elsewhere in Arkansas (3.2 percent).

In the Shirley MOA region, 7 out of 14 counties (Izard, Jackson, Newton, Searcy, Sharp, Stone, and Van Buren counties in Arkansas) meet the 20 percent definition for poverty areas, while 4 of the 8 counties underlying the Hog MOAs (Scott, Montgomery and Polk Counties in Arkansas, and Le Flore County in Oklahoma) meet the definition of poverty areas. Both of the states of Arkansas and Oklahoma come close to a 20 percent poverty rate, statewide.

TABLE 3-104
Demographic Statistics for the Shirley and Hog MOAs

Jurisdiction	Total Persons (1997)	Percentage						
		White (1996)	Black (1996)	American Indian[1] (1996)	Asian [2] (1996)	Other (1996)	Hispanic Origin[3] (1996)	Poverty Rate[4] (1993)
Arkansas	2,673,400	80.0	15.7	0.7	0.9	1.5	3.2	17.5
Oklahoma	3,450,654	76.2	7.6	7.9	1.5	2.4	5.2	16.3
Shirley MOA Counties								
Baxter County, AR	38,386	97.8	0.1	0.5	0.3	0.2	1.0	14.6
Cleburne Co., AR	24,046	98.2	0.1	0.5	0.1	0.1	1.2	15.8
Conway Co., AR	20,336	84.3	13.1	0.5	0.2	0.7	1.8	17.1
Faulkner Co. AR	86,014	88.3	8.5	0.5	0.7	0.7	1.8	10.9
Independence Co., AR	34,233	94.9	2.0	0.5	0.6	0.6	1.5	16.7
Izard Co., AR	13,249	96.4	1.4	0.6	0.1	0.3	1.0	22.4
Jackson Co., AR	18,418	80.6	17.6	0.3	0.2	0.4	1.3	23.6
Newton Co., AR	8,608	97.4	0.1	0.6	0.2	0.4	1.1	25.2
Pope Co., AR	54,469	93.7	2.6	0.7	0.6	0.9	2.1	15.7
Searcy Co., AR	8,261	97.3	(Z)	0.8	0.1	0.4	1.0	27.4
Sharp Co., AR	17,119	97.1	0.5	0.7	0.1	0.2	1.0	21.2
Stone Co., AR	11,499	97.3	0.1	0.8	0.1	0.1	1.1	23.2
Van Buren., AR	16,192	96.8	0.3	0.8	0.2	0.4	1.3	20.1
White Co., AR	67,165	93.5	.6	0.4	0.3	0.8	1.9	17.4
Hog MOA Counties								
Franklin Co. AR	17,771	96.2	0.6	0.8	0.4	0.7	1.7	17.3
Logan Co., AR	22,486	96.5	1.0	0.7	0.1	0.4	1.2	18.4
Scott Co., AR	10,996	93.5	0.2	1.4	1.0	2.6	5.7	22.4

TABLE 3-104
Demographic Statistics for the Shirley and Hog MOAs

Jurisdiction	Total Persons (1997)	Percentage						
		White (1996)	Black (1996)	American Indian[1] (1996)	Asian [2] (1996)	Other (1996)	Hispanic Origin[3] (1996)	Poverty Rate[4] (1993)
Sebastian Co., AR	115,071	82.3	6.2	1.6	3.5	3.7	6.7	14.4
Yell Co., AR	21,139	86.6	1.5	0.6	0.7	9.0	12.7	16.8
Montgomery Co., AR	9,245	95.4	0.3	1.1	0.4	1.6	2.5	21.3
Polk Co., AR	20,229	94.7	0.2	1.5	0.3	1.7	3.5	21.1
Le Flore Co., OK	48,109	80.4	2.2	10.7	0.2	1.4	3.8	21.7

Source: U.S. Bureau of the Census, 2000

Notes:

1. Includes Alaska native and Aleutian Islander

2. Includes Pacific Islander

3. Race refers to Census respondents' self-identification of racial background. Hispanic origin refers to ethnicity and language, not race, and may include persons whose heritage is Puerto Rican, Cuban, Mexican, and Central or South American.

4. The values shown are 1997 Census Bureau estimates of percent persons with household incomes below the poverty threshold.

(Z) values are greater than zero but less than half unit of measure shown

4 Environmental Conditions and Consequences

4.1 Introduction

This section discusses environmental conditions and evaluates the potential environmental consequences, or impacts, related to the proposed use of chaff and flares during training missions in the 15 ANG-managed MOAs that are described in Sections 1 through 3.

Resource areas and issues evaluated in the following subsections are air quality, noise, fire risk, safety, human health, biological resources, hazardous and solid waste, land use and visual resources, cultural resources, socioeconomics, and environmental justice; physical (soil and water) resources are evaluated in the context of biological resources (terrestrial and aquatic habitats). Those issues that are not meaningful in the context of the proposed action are identified and eliminated from detailed study, narrowing the discussion of these issues to a brief presentation of why they will not have a significant impact on the environment.

4.2 Studies Incorporated by Reference

The Air Combat Command (ACC) August 1997 technical report, titled *Environmental Effects of Self-Protection Chaff and Flares*, presented a summary of an in-depth study of the environmental effects of chaff and flares used within ACC-controlled airspace. Based on the findings of this study, the ACC developed guidelines to assist in the assessment of environmental impacts of proposals involving use of chaff or flares and to prepare NEPA documents. The guidelines address the major issues for potential effects on health, safety, air quality, physical resources, biological resources, land use and visual resources, cultural resources, and fire risk. Table 4-1 presents the conclusions reached by the ACC study regarding the potential for impacts to various resource areas. The findings of the 1997 ACC technical report are incorporated by reference into this EA.

In August 1999, the Naval Research Laboratory (NRL) sponsored a second report, titled *Effects of RF Chaff — A Select Panel Report to the Undersecretary of Defense for Environmental Security*, that further assesses the environmental and human health effects specific to radio-frequency (RF) chaff. A select panel of eight university-based research scientists, each with published expertise in a relevant field, prepared the findings of that report. The select panel operated independently from the military services in analyzing the data and reaching their conclusions.

The analytical approach used in that report was to use models from environmental toxicology and related disciplines "using 'upper bounds'(or worst-case) estimates based on the amounts and areas of chaff use, analysis of data from known literature related to the effects of chaff, and reasonable, prudent extrapolations and derivations from these data" (NRL, 1999). The select panel concluded that:

Table 4-1
Potential for Impacts from Chaff and Flare Use

Resource/Issue	No Significant Impact		Site-Specific Analysis		Conditions Needing Analysis
	Chaff	Flares	Chaff	Flares	
Safety					
Interference with communications/tracking systems	X	N/A	-	N/A	
Disruption or interference with FAA or other radars	–	N/A	X	N/A	All areas not already approved.
Damage to or disruption of electrical power distribution system	X	N/A	-	N/A	
Pilot distracted by chaff deployment from other aircraft	X	N/A	-	N/A	
Damage to aircraft from chaff system malfunction	X	N/A	-	N/A	
Injury to person or property from falling chaff or flare debris	X	X	-	-	
Injury from dud flare during handling or disposal	N/A	-	N/A	X	Non-DoD land areas with public access.
Injury to personnel or damage to equipment from flare system malfunction	N/A	X	N/A	-	
Fire Risk					
Effect of quantity of flares used on fire risk	N/A	-	N/A	X	All non-DoD land areas with low-altitude airspace (flare use only).
Effect of weather on fire risk	N/A	-	N/A	X	
Effect of topography on fire risk	N/A	-	N/A	X	
Effect of vegetation on fire risk	N/A	-	N/A	X	
Effect of fire management capabilities on fire risk	N/A	-	N/A	X	
Effectiveness of minimum flare release altitudes on fire risk	N/A	-	N/A	X	
Air Quality					
Non-compliance with NAAQS	X	X	-	-	
Health effects from hazardous air pollutant emissions	X	X	-	X	Very high use of flares in small areas.
Visibility impairment in PSD Class I areas	X	X	-	-	
Physical Resources					
Effects of chaff and flare deposition on soil chemistry	X	X	-	-	
Potential for chaff or flare ash to leach toxic chemicals or change chemical composition of water	-	-	X	X	Small, confined freshwater aquatic environments with sensitive species.
Effects of chaff or flares on drinking water sources and systems	X	X	-	-	

Table 4-1
Potential for Impacts from Chaff and Flare Use (continued)

Resource/Issue	No Significant Impact		Site-Specific Analysis		Conditions Needing Analysis
	Chaff	Flares	Chaff	Flares	
Biological Resources					
Startle effect on birds and other wildlife	X	X	-	-	
Ingestion effects on wildlife	X	N/A	-	N/A	Water bodies with significant waterfowl use or protected species.
Inhalation effects on wildlife	X	N/A	-	N/A	
Impacts on waterfowl and aquatic organisms	–	-	X	X	
Physical effects of chaff from external contact	X	N/A	-	N/A	
Interference with wildlife activities	X	N/A	-	-	
Chemical effects on plants through soil	X	X	-	-	
Alteration of habitat through fire	N/A	-	N/A	X	Areas with high or extreme fire risk and sensitive species or critical habitat (flare use only).
Land Use and Visual Resources					
Effects of accumulation of chaff fibers on land use	X	N/A	-	N/A	
Effects of accumulation of chaff and flare debris on land use	-	-	X	X	Wilderness Areas, Wild and Scenic Rivers, parks, coastal zones, outstanding visual resources.
Effects of accumulation of chaff and flare debris on visal resources	X	X	-	-	
Effect of dud flare hazard on land use	N/A	-	N/A	X	Residential areas and areas with concentrated use (flare use only)
Effect of burning flares at night on sensitive visual resources	N/A	-	N/A	X	Recreational areas and Wildlerness areas (flare use olny)
Effects of fire on land use	N/A	-	N/A	X	Areas with high or extreme fire risk (flare use only)
Cultural Resources					
Effect of accumulation of chaff and flare debris on cultural sites	X	X	-	-	
Potential for chaff to physically or chemically damage cultural resources	X	N/A	-	N/A	
Effects of chaff and flare use on traditional Native American properties and land uses	-	-	X	X	Native American traditional use areas.
Effects of fires on cultural resources	N/A	-	N/A	X	Areas with high or extreme fire risk (flare use only).
Impacts from fire suppression and rehabilitation activities	N/A	-	N/A	X	
Effects of smoke on historic structures and rock art	N/A	-	N/A	X	

Source: ACC 1997
N/A – Not Applicable.

"… widespread environmental, human, and agricultural impacts of RF chaff as currently used in training are negligible, and far less than those from other man-made emissions, based on the available data, analyses, estimations and related information. Empirical information is lacking concerning the extent to which chaff abrades and is resuspended to the atmosphere and actual exposure in populated areas near release. However, upper limit calculations suggest that those impacts are also negligible."

The 1999 Select Panel report to NRL is also incorporated into this EA by reference and is attached as Appendix E.

The following subsections summarize the relevant findings of these two studies and provide additional evaluation of issues requiring site-specific information or further analysis.

4.3 Noise

4.3.1 Environmental Conditions

The acoustic environment is a combination of the sounds associated with the natural and human surroundings of a specific location. Noise is defined as unwanted sound that interferes with normal activities or otherwise diminishes the quality of the environment. Noise may be associated with stationary sources such as industrial activities or with mobile sources such as vehicles and aircraft. It may be continuous or of relatively long duration, as with operation of certain equipment, or intermittent, as with vehicles and traffic.

Jet engine noise is associated with all ANG training flights over the MOAs. Whether or not the noise is audible to persons on the ground is largely a function of the types of aircraft and operating altitudes.

4.3.2 Environmental Consequences

Relative to engine noise, the additional noise generated by the actual release of chaff and flares is insignificant. The sound associated with the release of either chaff or flares would be inaudible to persons on the ground. Because the proposed action does not generate audible, unwanted sound, there would be no adverse effects on noise receptors (e.g., people and wildlife).

4.4 Air Quality

4.4.1 Environmental Conditions

Pursuant to the federal Clean Air Act, as amended (CAA)[1], EPA has established National Ambient Air Quality Standards (NAAQS) for six major air pollutants, commonly referred to as "criteria" pollutants. They are ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur oxides (SO_2), PM_{10} (particulate matter smaller than 10 micrometers), and lead. Specific numerical limits have been established for concentrations of these pollutants in the ambient air. The CAA has also established National Emission Standards for Hazardous Air

[1] Air Pollution Control Act of 1955, Clean Air Act of 1963, Air Quality Act of 1967, CAA Amendments of 1970, CAA Amendments of 1977, and CAA Amendments of 1990

Pollutants (NESHAPs). With regard to visibility impairment, the CAA states that it is a national goal to prevent any further impairment of visibility from manmade sources of air pollution within a federally mandated Prevention of Significant Deterioration (PSD) Class I area.

EPA designates locales within the US as either attainment or non-attainment areas, depending on whether those areas comply with the NAAQS. Depending on the pollutant and severity of violation, there can be several classifications of non-attainment. Areas having been recently redesignated as attainment areas are further classified as maintenance areas. Under the CAA, states with non-attainment areas must submit State Implementation Plans (SIPs) to EPA demonstrating how they plan to attain NAAQS in those areas. SIPs are required for each non-attainment pollutant and must include emissions budgets, enforce-able emissions reduction measures, and schedules for achieving attainment.

There are several concerns regarding how the release of chaff and flares may impact air quality. These include the potential for chaff to degrade to particle sizes that may be respirable, the hazardous emissions from flares, the potential for the release of chaff and flares to result in the violations of air quality standards, and the potential for the release of chaff and flares to inhibit visibility.

In the year 2000, about 220,000 bundles of chaff are expected to be used in the 14 existing MOAs considered in this EA (see Table 2-3 in subsection 2.1). A typical bundle of chaff contains 5 million fibers, each 25 µm in diameter and typically 1 to 2 cm in length. Chaff is typically composed of glass silicate with an aluminum coating (NRL, 1999). Chaff emissions consist of particulates greater than 10 µm in size. Particulates equal to or smaller than 10 µm (PM_{10} and $PM_{2.5}$) are considered respirable (EPA, 1997). A description of the composition of chaff is attached in Appendix C.

In the same set of MOAs, about 137,000 flares were used in 1998. Flares consist primarily of magnesium, which is not highly toxic. The impulse cartridges and initiators contain some chromium and lead (ACC, 1997). Although these inorganics are generally considered to be more toxic than magnesium, they are released in very small quantities. A description of the composition of typical flares is attached in Appendix C.

The USAF conducted a study to develop more comprehensive scientific data on the employment of chaff and flares in training and the associated environmental impacts (ACC, 1997). A regulatory review, literature review, particulate test for chaff, and screening human health risk assessment for flares were completed as part of the ACC study.

The ACC study's regulatory review consisted of reviewing the CAA, including NAAQS and PSD. Chaff and flare emissions are viewed as stationary source emissions. In non-attainment areas, permits are needed for stationary sources that emit more than a specified amount of the criteria pollutants (ranging from 25 to 250 tons/year). The report determined that the emissions from chaff bundles, flares, and their dispensers are well below the thresholds for requiring a permit.

The ACC study's literature review consisted of reviewing environmental studies conducted by Science and Engineering Associates, Inc. for the Strategic Air Command and the National Guard Bureau (SEA, 1989; 1990) and a data search using the DIALOG Information Retrieval Service databases. The literature review revealed some inconsistencies in the current, available information on dipole diameter size. However, it was clear that consideration of the diameter size (which ranges from 18 to 25 µm) is important from an air impact perspective due to the potential for formation of respirable particles.

The literature review for flare usage found that a limited number of studies have been performed related to environmental impact. The review indicated that flare debris consists of a plastic end cap and portion of the plastic piston, slide assembly, and felt spacers. The plastic and metal flare debris remains intact and is essentially non-biodegradable. Flares also emit a small quantity of visible smoke when ignited. The 1997 ACC study concluded that the smoke release does not cause significant impacts due the small quantity and because flare releases occur over large areas.

The 1997 ACC study also provides information on a particulate test with chaff. The purpose of the test was to determine whether aluminum-coated glass fiber chaff dipoles have the potential for breaking up into respirable particles when they are ejected from aircraft. Chaff was released within a test facility. The air was subsequently filtered. Compared to background levels of particulates in the test facility, there was a statistically significant increase in the levels of PM_{10}. However, microscopic operations of filters exposed during the chaff tests revealed that there were very few chaff dipoles and no dipole fragments collected on those filters. The study concluded that the chaff material was not a source of the increased levels of PM_{10} particulates measured during the chaff releases. Chaff dipoles also settled quickly during the test, suggesting that the dipoles would not impair visibility.

The purpose of the ACC study's screening human health risk assessment was to estimate, through quantitative analysis, whether the emission levels of chromium and lead from flare use could cause significant long-term or short-term health impacts (ACC, 1997). Emission rates were based on weight estimates of lead and chromium compounds. A series of emission release scenarios were developed to account for the variability in altitude and size of the areas where flares are used.

The worst case scenario evaluated by the ACC study involved the use of 85,000 flares in one year at one MOA. This would result in about 5 lbs of chromium discharged per year (ACC, 1997). The results of the risk assessment indicated that, using the EPA cancer risk potency values and the quantity of chromium in the first fire mix and impulse cartridges, emission thresholds for causing significant increased cancer risk are unlikely to be exceeded under typical military flight exercises during a given year. For lead, the analyses indicated that up to 67,000 flares could be used in an hour without significantly increasing the cancer risk for lead. On a yearly basis, up to 1.6 million flares could be used without significantly increasing the cancer risk from lead.

Following the 1997 ACC efforts, a select panel of non-government scientists were brought together by the Naval Research Laboratory, to review the environmental effects of chaff used by the US military in training exercises and to make recommendations to decrease scientific uncertainty where significant environmental effects of chaff are possible (NRL, 1999). The panel concluded that chaff fibers experience little breakup before reaching the ground, based on the fact that breakup of fibers would degrade the effectiveness of chaff. Because ejection of chaff appears to subject the fibers to much larger forces than would atmospheric turbulence, it is unlikely that fibers that survive ejection intact subsequently break up during their fall to earth.

In conclusion, available studies indicate that the release of chaff and flares does not result in the violation of air quality standards during typical training exercises, chaff does not degrade to particles of respirable size in the atmosphere, and that chaff is unlikely to impair visibility. In addition, the screening human health risk assessment indicated that emissions from flares do not pose risks to human health.

4.4.2 Environmental Consequences

This section evaluates the effects of chaff and flare emissions on air quality within the MOAs under consideration in this EA. Emissions resulting from the use of chaff and flares are compared to NAAQS and HAPs. The same emissions are considered in a Conformity Analysis, and the potential for impacts to PSD Class I areas are discussed.

4.4.2.1 National Ambient Air Quality Standards

The NAAQS are two-tiered: primary, to protect public health; and secondary, to prevent degradation to the environment (e.g., impairment of visibility, damage to vegetation and property, etc.). Because states generally adopt the NAAQS and the MOAs cover multiple states, federal standards were used in the evaluation (Table 4-2).

TABLE 4-2
Federal Ambient Air Quality Standards

Pollutant	Averaging Time	Federal (State) Standards[a, b]	
		Primary	Secondary
Ozone (O_3)[c]	1-hour	0.12 ppm (235 µg/m^3)	0.12 ppm (235 µg/m^3)
PM_{10} [c,d]	24-hour	150 µg/m^3	150 µg/m^3
	Annual Arithmetic Mean	50 µg/m^3	50 µg/m^3
CO	1-hour	35 ppm (40 mg/m^3)	-
	8-hour	9 ppm (10 mg/m^3)	-
NO_2	Annual Arithmetic Mean	0.053 ppm (100 mg/m^3)	0.053 ppm (100 mg/m^3)
Lead	Calendar Quarter	1.5 µg/m^3	1.5 µg/m^3
Sulfur Dioxide (SO_2)	3-hour	-	0.5 ppm (1,300 µg/m^3)
	24-hour	0.14 ppm (365 µg/m^3)	-
	Annual Arithmetic Mean	0.03 ppm (80 µg/m^3)	-

ppm = parts per million
µg/m^3 = micrograms per cubic meter
mg/ m^3 = milligrams per cubic meter
[a]Gaseous concentrations are corrected to a reference temperature of 25°C and to a reference pressure of 760 millimeters mercury.
[B]National standards (other than O_3, PM_{10}, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once per year. For PM_{10}, the 24-hour standard is attained when 99 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard.
[c]In July of 1997, EPA promulgated two revised NAAQS—a new standard for ozone based on an 8-hour average, and a new standard for $PM_{2.5}$ (particulate matter with aerodynamic diameter less than or equal to 2.5 micrometers). These two revised standards were challenged, and in May of 1999, a decision by the U. S. Court of Appeals for the D. C. Circuit blocked EPA's authority to implement the standards. EPA is appealing the court's decision, but resolution of the appeal is expected to take as long as 2 years.
[d] Particles with aerodynamic diameter less than or equal to a nominal 10 µm.
Source: EPA National Ambient Air Quality Standards

PM_{10} and CO are the only criteria pollutants associated with chaff and flares. In developing a worst-case model for PM_{10}, NRL (1999) assumed that all chaff released within one year (i.e., 500 tons) would abrade to 10 µm or less, remain suspended within the borders of the continental US, would be released at 5,000 m above ground level, and mix evenly throughout the airspace. Under these assumptions, the annual average concentration of PM_{10} was calculated to be 0.01 $\mu g/m^3$ for the entire continental US (NRL, 1999). As shown in Table 4-2, this concentration is far lower than the annual average NAAQS for particulate matter.

There is about 0.00044 lbs of CO in a flare (ACC, 1997). Based on the number of flares anticipated to be used annually in the 15 existing MOAs considered in this EA (106,000), the amount of CO emitted would be about 47 lbs per year or 0.02 ton per year across the entire US. Using the total area of the 14 pre-existing MOAs (54,632 square miles excluding Dolphin and Goose South, which results in a more conservative concentration estimate for Goose, Juniper and Hart MOAs) and a 5,000-meter release height, the annual average CO concentration would be less than 0.00006 $\mu g/m^3$ which is far less than the NAAQS for CO.

4.4.2.2 Federal Hazardous Air Pollutants

Section 112 of the CAA relates to the release of hazardous air pollutants. Section 112 (d-j) of the CAA specifies that a National Emission Standards for Hazardous Air Pollutants (NESHAPs) be promulgated for numerous source categories. There is no source category listed for chaff and flares. Therefore, a risk assessment of any hazardous air pollutants from the chaff and flares would need to be completed. There are no hazardous air pollutants emitted from chaff. However, some flares emit chromium and lead, which are considered hazardous. A risk assessment for these air pollutants has been performed (ACC, 1997).

For a range of release ground areas and release altitudes, Table 4-3 presents the chromium emission thresholds and corresponding flare quantities that could be used in a year without significantly increasing the cancer risk. These threshold values were originally presented in ACC (1997).

TABLE 4-3
Summary of Annual Chromium Emission Thresholds

Scenario	Assumed Underlying Ground Area of Release (acres)	Release Altitude (feet agl)	Annual Emission Threshold (lbs./year)*	Annual Flare Threshold (flares/year)**
Target Area	10,000	400	137	220,000
		900	152	240,000
Small Range/MOA	490,000	400	992	1.6 million
		50,000	2.8 million	4.5 billion
Large Airspace	1.6 million	400	1,830	2.9 million
		50,000	5.2 million	9.2 billion

TABLE 4-3
Summary of Annual Chromium Emission Thresholds

Scenario	Assumed Underlying Ground Area of Release (acres)	Release Altitude (feet agl)	Annual Emission Threshold (lbs./year)*	Annual Flare Threshold (flares/year)**

Source: *Environmental Effects of Self-Protection Chaff and Flares*: Final Report, U.S. Air Force Combat Command, August 1997

* Assuming a cancer risk significance level of 1.0 x 10^{-6}, or one in one million.

** Assuming a hexavalent chromium content of 0.287 grams/flare.

Of the MOAs considered in the EA, the greatest number of flares (45,763 per year) were used in the Volk MOAs (see Table 2-4). The MOA with the smallest land area is the current Goose MOA (1,520 square miles or 972,800 acres; see Table 2-5). Comparing a hypothetical "worst-case" scenario in which 45,763 flares are used in a year over 972,800 acres (i.e., if the highest recorded flare usage were to occur in the smallest MOA) against the thresholds shown in Table 4-3 indicates that cancer risk will not increase as a result of the proposed action.

Lead emissions in excess of 0.734 lbs per hour may result in a significant acute health hazard (ACC, 1997). At a release altitude of 3,400 feet above ground level, this emission rate would be achieved using 67,000 flares per hour (ACC, 1997). The ANG could not use this many flares within an hour in a concentrated area.

4.4.2.3 Conformity Analysis

The CAA states that the federal government is prohibited from engaging in, supporting, providing financial assistance for, licensing, permitting, or approving any activity that does not conform to an applicable implementation plan. For many federal actions, it is required that proposed plans conform with state plans to comply with the NAAQS in non-attainment and maintenance areas. Activities that will result in emissions that do not exceed *de minimis* standards set for the pollutants of concern in the region of influence are presumed to conform.

All counties in the US have been designated either as attainment or non-attainment and are listed in 40 CFR 81. The particulate matter (PM_{10}) and carbon monoxide (CO) status of each of the counties within the MOA regions of influence were obtained. These are the pollutants of concern for chaff and flares, respectively (Table 4-4).

Given that there are numerous counties potentially affected by the proposed action, the county with the most stringent attainment status was used for the conformity analysis in this EA. The attainment status of the most stringent counties (Washoe, NV; Josephine, OR; and Klamath, OR) was moderate non-attainment for both CO and PM_{10}.

In the year 2000, about 220,000 bundles of chaff (about 36 tons) are expected to be used in the 14 existing MOAs considered in this EA (Table 2-3). These MOAs cover about 1.5% of the US. Using the ultra-conservative assumption that all the chaff released were PM_{10} (i.e., that all the chaff abraded completely into respirable particles), the *de minimis* levels presented in Table 4-4 for the most stringent counties (moderate non-attainment) (100 tons) would still not be exceeded.

As discussed above, a very small amount of CO is found in flares (ACC, 1997). In 1998, CO emissions attributable to flare use in the 14 existing MOAs addressed in this EA was about 60 pounds per year. This amount is insignificant relative to the *de minimis* standard for CO (100 tons).

4.4.2.4 Class I Visibility

The CAA states that it is a national goal to prevent any further impairment of visibility within a federally mandated PSD Class I area. Chaff dipoles settled quickly during a particulate test conducted by the ACC (ACC, 1997). This suggests that chaff dipoles do not remain in the air column for long periods of time and therefore would not impair visibility. Flares emit a small quantity of visible smoke when ignited (ACC, 1997). However, the effect of this smoke on visibility would be insignificant, because such a small quantity is released and when multiple flares are used they are dispensed over large areas. These observations strongly suggest that chaff and flares will not have a significant adverse impact on visibility. This conclusion is supported by the fact that evidence to the contrary has not been gathered by the military or the public.

TABLE 4-4
De Minimis Levels for Non-Attainment Areas

Non-Attainment Status	Tons/Year	
	CO	PM_{10}
Extreme	N/A	N/A
Severe	N/A	N/A
Serious	100	70
Marginal (inside an ozone transport region)	N/A	N/A
Marginal (outside an ozone transport region)	N/A	N/A
Moderate (inside an ozone transport region)	**100**	**100**
Moderate (outside an ozone transport region)	**100**	**100**
Maintenance (inside an ozone transport region)	100	100
Maintenance (outside an ozone transport region)	100	100

4.4.2.5 Conclusion

The evaluations in this section indicate that chaff and flare use within the MOAs considered in this EA will not result in exceedances of air quality thresholds. In addition, the evaluations demonstrate conformity and strongly suggest that chaff and flare use will not adversely affect visibility. Overall, the conclusion is that the proposed action will not have a significant adverse impact on air quality.

4.5 Fire Risk

4.5.1 Environmental Conditions

Self-protection flares are released over MOAs during military training operations. Existing military regulations (FAR 91.15 and AFI 11-206) require precautions to be taken to avoid injury or damage to persons or objects. This includes precautions for activities that increase the potential for fires, such as the release of flares. The risk of fire due to the release of flares involves environmental, procedural, and operating factors. Assessing the probability of a fire starting due to a burning item landing on the ground is difficult because of the many variables involved. These variables include fuel type, abundance of fuel, fuel moisture, residual energy of the burning item, and environmental conditions (e.g., wind and rainfall).

AFI 11-206 provides procedures to ensure different types of flares completely burn out before reaching the ground. This may include altitude restrictions or seasonal limits. Based on information reported in ACC (1997), fires are rare when release altitude and restrictions are based on site-specific conditions. For example, for MOAs located in Idaho, release of flares is restricted to minimum level of 2,000 feet above the ground when there is a high fire risk. Once started, the potential for a fire to burn out of control relates to environmental factors and availability of on-site fire suppression services.

ACC (1997) concluded, based on interviews with ranges and airspace areas, that information relating flare use to fires is not sufficient; fire occurrence data for DoD lands are not systematically reported to national fire occurrence databases; categories used for the national fire occurrence database cannot differentiate fires caused by flares; and flare-caused fires cannot be evaluated based on flare type. Also, procedures currently used (altitude restrictions and suspension during fire seasons) to help reduce the risk of fire and existing fire management procedures and resources provide ACC units a framework to gauge fire risks.

4.5.2 Environmental Consequences

A study was conducted to quantitatively assess the ignition potential associated with the airborne releases of self-protection flares over the 14 existing and 1 proposed MOAs considered in this EA (Air Sciences, 2000). Current fuels information and up to 20 years of historical fire weather data were collected and analyzed to assess the ignition potential. The weather and fuels data were modeled with the fire danger rating calculations in the FireFamily+ model to reveal the expected probability of fire ignition resulting from the use of military flares within each MOA. These results are summarized in the report (see Appendix F).

The ignition potential in MOAs was assessed using elements of the National Fire Danger Rating System (NFDRS), which is currently used to assess wildland fire danger by most state and federal agencies. Two NFDRS indices were used to assess the ignition potential in the MOAs. They are: Probability of Ignition (P(I)) and Ignition Component (IC). P(I) is the probability that a firebrand will start a fire (reportable or not) after landing on receptive fuels. This differs from the IC, which incorporates burning conditions and the spread rate of a fire to estimate the probability (actually, an index value) of a firebrand becoming a reportable fire (nominally, ¼ acre or larger).

The 50^{th}, 93^{rd}, and 100^{th} percentile P(I) and IC values were computed for each month of the year for each MOA. A subjective rating of each area's ignition potential was then assigned based on the 50^{th} percentile IC values. The subjective rating was based on the State of Minnesota Department of Environmental Quality (DEQ)'s fire danger rating system. The Minnesota DEQ recognizes five fire danger rating classes based on IC. They are:

- Low: $0 \leq IC < 10$
- Moderate: $11 \leq IC < 20$
- High: $21 \leq IC < 30$
- Very high: $31 \leq IC < 40$
- Extreme: $41+ \leq IC$

Using this system of classification, the ignition potential of the 15 MOAs were characterized as follows:

- Low: Steelhead MOA
- Moderate: Beaver, Snoopy, Rivers, Hog, Lake Andes, Falls, Volk, Pike, Shirley, and Crypt MOAs
- Very high: Dolphin, Juniper, and Goose MOAs
- Extreme: Hart MOA

The MOAs with the greatest risk of fire are Dolphin, Juniper, Goose, and Hart. For these MOAs, months with high to extreme IC potentials are:

- Dolphin – July, August, September, and October
- Juniper – July, August, and September
- Goose – July, August, September, and October
- Hart – June, July, August, September, and October

As mentioned above, procedures are established for use by ANG units to help reduce the risk of fire, especially for MOAs in the low to middle altitude ranges. At the Operations Group Commander's discretion, the minimum altitude for flare use in any MOA can be raised during the fire season, or the use of flares can be temporarily suspended. Under normal conditions, the minimum altitude for flare use in a MOA is 2,000 feet AGL, to ensure complete burnout before reaching the ground. Of the seasonally high-risk MOAs mentioned above, only Juniper Low encompasses airspace less than 3,000 feet AGL. The base altitude for Goose is 3,000 AGL; for Dolphin, Hart and Juniper North/South base altitude is 11,000 MSL.

4.6 Safety

4.6.1 Environmental Conditions

Safety risks are faced by military personnel on all missions and the people that live in the vicinity of a base or a military mission. Chaff and flares, which have been used for more than fifty years as a defensive mechanism, pose some level of risk to safety.

Potential safety issues that have been evaluated for chaff include interference with communication and tracking systems, weather radar, and power distribution systems. Potential for impacts to aircraft, aircraft engines, aircraft pilots, and persons on the ground have also been evaluated. Issues evaluated for flares include risk of fire, flare system malfunction, and harm to persons on the ground.

4.6.1.1 Chaff

Current United States Air Force (USAF) policy on the use of chaff and flares was established by the Airspace Subgroup of HQ Air Force Flight Standards Agency (AFFSA) in 1993. It requires units to obtain a frequency clearance from the USAF Frequency Management Center and HQ FAA prior to using chaff, to ensure training with chaff is conducted on a basis of noninterference with civilian radar. This requirement ensures electromagnetic compatibility between the FAA, the Federal Communications Commission, and DOD agencies. USAF does not place any restrictions on use of chaff, provided those conditions are met.

In October 1998, DOD updated certain controls over the use of chaff, in Section 3212.02 of the Chairman of the Joint Chiefs of Staff manual (*Performing Electronic Attack in the United States and Canada for Tests, Training, and Exercises,* CJCSM 3212.02, October 1998). This section set procedures for controlling the types of chaff used, areas where it can be used, and altitudes at which it can be released (GAO, 1998).

For many of the chaff safety issues discussed in the following subsection, the USAF has developed Hazard Risk Indices (HRI) based on an evaluation process defined in AFI 91-204, Safety Investigations and Reports, October 1995 (ACC, 1997). The HRIs are based on the likely frequency of occurrence and the severity of the effect/event, should it occur (Table 4-5). Each HRI is associated with a rating (e.g., unacceptable) and an associated level of action required (Table 4-6).

The HRIs, ratings, probabilities, and frequencies for chaff-related safety effects or events are provided in Table 4-7. Mishap classes corresponded to the hazard severity categories. Severity designations associated with mishap classes A, B, C/D, and HAP are catastrophic, critical, marginal, and negligible, respectively. The probability that any of these effects or events will occur is low.

TABLE 4-5
Hazard Risk Index Matrix

Frequency of Occurrence	Hazard Severity Categories			
	Catastrophic (1)	Critical (2)	Marginal (3)	Negligible (4)
Frequent (A)	1A	2A	3A	4A
Probable (B)	1B	2B	3B	4B
Occasional (C)	1C	2C	3C	4C
Remote (D)	1D	2D	3D	4D
Improbable (E)	1E	2E	3E	4E

TABLE 4-6
Hazard Risk Response

Hazard Risk Index	Rating – Action Required
1A, 1B, 1C, 2A, 2B, 3A	Unacceptable – Immediate corrective action required.
1D, 2C, 2D, 3B, 3C, 3D	Undesirable – Reduced priority, corrective action required.
1E, 2E, 3E, 4A, 4B	Acceptable – Low priority for corrective action, may not warrant action.
4C, 4D, 4E	Acceptable – Correction action not required.

TABLE 4-7
Probability of Chaff Safety Events and Action Required

Event/Effect	HRI	Rating	Action Required	Probability	Frequency (per year)
Inadvertent release or cloud drift clutters FAA radar	4E	Acceptable	None Required	1×10^{-6}	< 1
Inadvertent release or cloud drift clutters airborne radar	3E	Acceptable	Low Priority	1×10^{-6}	< 1
Inadvertent release or cloud drift clutters satellite tracking	4E	Acceptable	None Required	1×10^{-6}	< 1
Power line arcing	3E	Acceptable	Low Priority	2×10^{-7}	0.2
Aircraft ingests chaff and affects engine efficiency	4E	Acceptable	None Required	1×10^{-7}	0.1
Chaff deployed near another aircraft, distracting pilot	4E	Acceptable	None Required	1×10^{-6}	1
Class D Mishap from system malfunction (non-aircraft).	3E	Acceptable	Low Priority	5×10^{-7}	0.5
High Accident Potential from system malfunction (non-aircraft)	4D	Acceptable	None Required	4.2×10^{-6}	4.2
High Accident Potential from system malfunction (aircraft)	4D	Acceptable	None Required	5.3×10^{-6}	5.3
Injury from falling debris	1E/2E	Acceptable	Low Priority	1×10^{-8}	0.01

Source: ACC (1997)

FAA Air Traffic Systems. The FAA places restrictions on the use of any type of chaff that operates within the frequency bands used by air traffic control radar and navigational systems. In taking a conservative approach to air traffic control and flight safety, FAA has limited or placed restrictions on the locations, altitudes, and/or time periods within which specific types of chaff can be employed. Incidents have been reported at Phoenix and some other locations where chaff may have caused interference with FAA radar systems. However, ACC (1997) found, through discussions with ACC flying units and staff members and Air Force representatives at the FAA Regional Headquarters, that very few reported occurrences of such interference could be clearly connected to known chaff operations.

Military requests for chaff use are forwarded for approval to the Spectrum Management Office (ASM-500) at FAA Headquarters in Washington, D.C. The Spectrum Management Office reviews the types of chaff to be used, requested areas and altitudes, dates and times, and other operational data that accompany the military request. After considering the potential to interfere with air traffic control equipment, Spectrum Management Office either approves the request, denies it, or approves it with restrictions. Once a request has been approved, with or without restrictions, a copy is provided to Air Traffic Management (ATM-400) for coordination and appropriate action by the potentially-affected air traffic control facility. In some cases, Notice to Airmen (NOTAM) may be required to advise the flying public that certain air traffic control equipment or services may be affected during a specific period of time by chaff operations. Restrictions and NOTAM are not necessary when RR-188 chaff is used, because it does not interfere with the frequency bands used by air traffic control radar and navigational systems (ACC, 1997).

If a chaff cloud drifts outside designated airspace, ACC (1997) indicates potential effects include cluttering radar and interference with satellite tracking. Inadvertent releases of chaff, due to release system electro-mechanical malfunctions, human error or mechanical system degradation, are possible and recognized as a safety concern.

NOAA Weather Surveillance Radar. NOAA weather surveillance radar (WSR-88D) are located throughout the US. The WSR-88D (also known as NEXRAD) is a doppler radar system designed to observe the presence and calculate the speed and direction of severe weather elements such as violent thunderstorms and tornadoes. It also has the capability of providing precipitation data for the unit's coverage area. Table 4-8 lists WSR-88D radar systems located in or near the MOAs that are considered in this EA.

Several reports have documented radar detection of chaff being interpreted as weather phenomena (GAO, 1998; NOAA, 1995; 1997; 1998). False readings can lead to inaccurate weather warnings. This presents a safety hazard because false weather reports can lead to misleading instructions being provided to aircraft pilots, both domestic and military.

TABLE 4-8
Summary of WSR-88D Radar Systems in the Vicinity of the MOAs

State	WSR-88D Radar Location	Nearest MOAs
Arkansas	Western Arkansas Radar	Hog, Shirley, Rivers
California	Eureka	Dolphin
Iowa	Des Moines	Crypt
Michigan	North Central Lower Michigan Radar	Pike, Steelhead
Michigan	Detroit	Pike, Steelhead
Michigan	Grand Rapids	Volk
Minnesota	Duluth	Beaver, Snoopy
Minnesota	Minneapolis	Falls 1 & 2, Volk
Nebraska	North Platte	Lake Andes
Nevada	Reno	Juniper, Hart, Goose
North Dakota	Eastern North Dakota Radar	Beaver
Oklahoma	Oklahoma Radar	Rivers, Hog

TABLE 4-8
Summary of WSR-88D Radar Systems in the Vicinity of the MOAs

State	WSR-88D Radar Location	Nearest MOAs
Oklahoma	Norman	Rivers, Hog, Shirley
Oklahoma	Tulsa	Rivers, Hog
Oregon	Medford	Dolphin, Juniper, Hart, Goose
Oregon	Portland	Juniper, Hart, Goose
Oregon	Pendleton	Juniper, Hart, Goose
South Dakota	Sioux Falls	Lake Andes, Crypt
Wisconsin	La Crosse	Falls 1 & 2, Volk
Wisconsin	Milwaukee	Falls 1 & 2, Volk
Wisconsin	Green Bay	Falls 1 & 2, Volk

Efforts have been and are continuing to be made to reduce the number of occurrences where chaff is mistaken for a weather event. NOAA (1995; 1997; 1998) describe methods that radar operators can use to differentiate chaff radar returns from weather returns. These include:

- **Band Structure**: Chaff's distinctive band structure is roughly parallel to the wind direction and moves with the wind. It also is narrow and only seen in one or two elevation angles.
- **Measurement of the Terminal Velocity**: Chaff falls at about 3,000 ft/minute and spreads due to tumbling and turbulence.
- **Time Lapse Monitoring:** Chaff appears as a point release on radar time lapse. Also, during the first 30 minutes, if there is a rapid increase in the areal coverage of returns without an increase in the maximum reflectivity associated with a thunderstorm, then the echoes may be chaff.
- **Visual confirmation:** Confirm with visual satellite imagery. Are clouds consistent with the echoes? Images are available on a near real time basis (6 to 8 min).
- **Echo Vertical Tilt:** If the vertical tilt of the echo is excessive or very different from most other echoes, then the echo is probably chaff.

Power Distribution System. GAO (1998) reported two 1985 incidents where chaff caused power outages. One case was attributed to unexpected winds. The second case was attributed to pilot error. ACC (1997) suggests that a chaff-related power outage is unlikely now because the type of chaff that could cause an outage is no longer used.

Aircraft. ACC (1997) reported that damage to aircraft could occur if the chaff dispensing system malfunctions. During a ten-year period (1983-1993) the USAF reported there were no catastrophic, critical, or marginal chaff dispensing system mishaps. During the same period, 53 High Accident Potential (HAP) occurrences were reported (i.e., 53 incidents of negligible severity). Based on USAF hazard severity categories, there were no mishaps that resulted in death, system loss, severe injury, occupational illness, major system damage, minor injury, occupational illness, or minor system damage.

Aircraft Engines. One of the potential issues with aircraft is the intake of chaff into the engines. If two planes are flying in close proximity, it is possible for the engines of one plane to intake chaff released by the other. ACC (1997) reports that chaff intake can result in loss of engine efficiency but not failure.

Aircraft Pilots. ACC (1997) evaluated the potential for the discharge of chaff rounds to distract pilots and lead to "over-controlling" of the aircraft. There were no reported mishaps of this type.

Falling Debris. If chaff failed to dispense, it is possible the dud chaff round could hit a person and cause personal injury. ACC (1997) indicates calculating the probability of a chaff round hitting a person on the ground is difficult because of the number of variables involved. ACC (1997) determined that, given a set of assumptions about reliability rate, aircraft speed, aircraft height above ground, and the behavior of the chaff box after release, the probability of a chaff box hitting a person in an area with a population density of 100 persons per square mile is 1 in 185,000 (5.4×10^{-6}).

Conclusion. Based on historical data and the calculations made in ACC (1997), the probability that any of the potential chaff-related safety impacts discussed in this section will occur is low (Table 4-7). Safety measures have been put into place to minimize the chance that public safety will be significantly affected by training exercises involving chaff.

4.6.1.2 Flares

Regulations restrict the use of flares to government-controlled land or military-owned land, and the deployment altitude over non-government property at 2,000 feet above ground level (ACC 1997). Additionally, flare use over MOAs and Military Training Routes (MTRs) is permitted only when an environmental analysis is complete. Although these safety regulations are in place, handling, maintenance and use of flares and their pyrotechnic components carries some safety risk. Issues that have been evaluated for flares include risk of fire, flare system malfunction, and risk of harm to persons on the ground. ACC (1997) HRIs, ratings, probabilities, and frequencies for flare-related safety effects/events are provided in Table 5.

Fire Risk. Fire risk for the 15 MOAs considered in this EA is addressed in subsection 4.3.

Flare System Malfunction. The probabilities of flare system malfunction are low. The only events identified with an undesirable HRI rating were non-aircraft-related Class C and D mishaps. These mishaps would involve military personnel that handle, store, or test flares. The risk associated with these job functions are manageable though corrective actions.

Harm to Persons on the Ground. If a flare fails to ignite upon ejection, it is possible that the dud flare could hit a person. Given a set of assumptions regarding reliability rate, aircraft speed, aircraft height above ground, and behavior of the flare after release, ACC (1997) calculated the probability of a dud flare hitting a person in an area with a population density of 100 persons per square mile would be 1 in 5.8 million (1.7×10^{-7}).

ACC (1997) did not develop an HRI for picking up and handling a dud flare on the ground. However, evidence suggests that there is little risk. The vast majority of flares used by ACC units are released over DoD ranges and duds are recovered by Explosive Ordnance Disposal (EOD) personnel. The ACC investigation uncovered only one incidence of injury from a dud flare. Although indications are that there is little risk, ACC (1997) recommended that the potential for a dud flare to be picked up should be considered over non-DoD lands.

Conclusion. Based on historical data and the calculations made in ACC (1997), the probability that any of the potential flared-related safety impacts discussed in this section will occur is low (Table 4-9). Safety measures, such as the 2,000 feet AGL minimum altitude for deployment, have been put into place to minimize the chance that public safety will be significantly affected by training exercises involving flares. There may be a safety issue associated with the public picking up dud flares over non-DoD lands.

4.6.2 Environmental Consequences

4.6.2.1 Chaff

As indicated in Section 4.4.1, the probability that any of the potential chaff-related safety impacts will occur is low (Table 4-7). Procedures have been put into place to minimize the chance that public safety will be significantly affected by training exercises involving chaff. Although chaff is unlikely to cause impacts to pubic safety, additional evaluation was conducted for this EA, to confirm some of the ACC conclusions on a MOA-specific basis.

The modeling conducted by ACC (1997) to estimate the probability of an unopened chaff box hitting a person was based on a population density of 100 persons per square mile. Keeping all other variables constant between the modeling effort and a real training exercise, it is possible to compare the population densities within the MOAs considered in this EA to the modeling value of 100 persons per square mile to determine if the probability is higher for areas considered here. Population densities for counties underlying MOAs ranged from 4.5 to 69.3 persons per square mile (Table 4-10). Because they are lower than modeling value of 100 person per square mile, the probability of an unopened chaff box impacting a person as it falls to the ground is even less than 1 in 185,000 (5.4×10^{-6}).

TABLE 4-9
Probability of Flare Safety Events and Action Required

Event/Effect	HRI	Rating	Action Required	Probability	Frequency (per year)
Flare system malfunction (non-aircraft related) Class B Mishap	2E	Acceptable	Low Priority	5.26×10^{-7}	0.2
Flare system malfunction (non-aircraft related) Class C Mishap	3D	Undesirable	Corrective Action	5.53×10^{-6}	2.1
Flare system malfunction (non-aircraft related) Class D Mishap	3D	Undesirable	Corrective Action	6.84×10^{-6}	2.6
Flare system malfunction (non-aircraft related) Class HAP Mishap	4D	Acceptable	None Required	2.82×10^{-5}	10.7
Flare system malfunction (aircraft related) Class A	1E	Acceptable	Low Priority	2.37×10^{-7}	0.08
Flare system malfunction (aircraft related) Class C	3E	Acceptable	Low Priority	7.89×10^{-7}	0.3

TABLE 4-9
Probability of Flare Safety Events and Action Required

Event/Effect	HRI	Rating	Action Required	Probability	Frequency (per year)
Flare system malfunction (aircraft related) HAP	4D	Acceptable	None Required	2.66×10^{-7}	10.1
Dud flare lands on ground resulting in personnel injury	1E	Acceptable	Low Priority	1.17×10^{-7}	0.0003

TABLE 4-10
Population Density of Counties Underlying the MOAs

MOA	Area of Underlying Counties (sq. miles) [1]	Population of Underlying Counties [2]	Population Density of Underlying Counties (persons/sq. mile) [3]
Beaver	14,503	102,519	7.1
Crypt	12,966	425,480	32.8
Dolphin	26,981	903,958	33.5
Falls	5,721	396,383	69.3
Goose (pre-existing area)	18,024	80,646	4.5
Goose (2002 expanded area)	22,581	114,474	5.1
Hart	28,556	363,966	12.7
Hog	6,904	265,046	38.4
Juniper	24,267	149,580	6.2
Lake Andes	12,867	85,395	6.6
Pike	4,134	126,161	30.5
Rivers	9,524	212,578	22.3
Shirley	9,548	418,025	43.8
Snoopy	9,776	216,754	22.2
Steelhead	3,530	179,404	50.8
Volk	9,961	527,439	53.0

1. US Census Bureau - Land Area, Population, and Density for States and Counties: 1990, issued 3/12/1996.
2. US Census Bureau - Census 2000 total population <www.census.gov/population/estimates/county/>
3. Calculated - Population divided by Area.

In addition to the MOA-specific evaluations for harm to persons on the ground, about 10% of the almost 300 electric utilities that provide service to the MOA regions of influence were contacted and asked about chaff-related power outages. Of those that responded, none were aware of any chaff-related service failures.

In summary, use of chaff during training exercises in the MOAs evaluated by this EA is unlikely to significantly impact public safety.

4.6.2.2 Flares

As indicated in Section 4.4.1, the probability that any of the potential flare-related safety impacts will occur is low (Table 4-9). Procedures have been put into place to minimize the chance that public safety will be significantly affected by training exercises involving flares. Although flare use is unlikely to cause impacts to pubic safety, additional evaluation was conducted as part of this EA to confirm some of the ACC conclusions on a MOA-specific basis. Fire risk is discussed in subsection 4.3.

The modeling conducted by ACC (1997) to estimate the probability of a dud flare hitting a person was based on a population density of 100 persons per square mile. Keeping all other variables constant between the modeling effort and a real training exercise, it is possible to compare the population densities within the MOAs considered in this EA to the modeling value of 100 persons per square mile, to determine if the probability is higher for areas considered here. Population densities for counties underlying MOAs ranged from 4.5 to 69.3 persons per square mile (Table 4-10). Because those densities are lower than the modeling value of 100 persons per square mile, the probability of a dud flare impacting a person as it falls to the ground is even less than 1 in 5.8 million (1.7×10^{-7}).

The ACC (1997) evaluation indicated there may be a public safety concern associated with individuals picking up dud flares on non-DoD lands. Without factoring in DoD versus non-DoD land within MOAs, Table 4-11 shows the predicted density of dud flares per square mile. Densities range from 0.003 to 0.12, with the highest in the Volk (0.12) and Falls (0.12) MOAs. The remainder were a half to a full order of magnitude below 0.12. A density of 0.12 equates to a one dud flare per year in 8.3 square miles, assuming an even distribution of randomly dispersed flares. However, in some MOAs, including Volk, dud flare density would be even lower in populated areas due to the presence of a bombing range, which receives a greater proportion of flares compared to areas of even distribution. Because more flares are deployed over Hardwood Bombing Range than over other portions of Volk MOA, the dud flare density would be higher on the range but much lower in the surrounding, populated areas.

Although the Volk and Falls MOAs have the highest population densities (53 and 69.3 persons per square mile, respectively; see Table 4-10), the likelihood is low that an individual would find a dud flare, pick it up, and be injured (if the dud flare somehow was ignited).

In summary, use of flares in training exercises is unlikely to significantly impact public safety.

TABLE 4-11
MOA-Specific Data on Flare Use and Estimated Dud Flare Density

MOA	Flares Dispensed per Year [1]	Estimated Number of Duds [2]	MOA Area (sq. mi.) [3]	Density of Dud Flares (duds/sq. mile) [4]
Beaver	1,500	15.0	3,305	0.0045
Crypt	2,100	21.0	6,067	0.0035
Falls	22,241	222.4	1,798	0.1237
Goose (current)	2,904	29.0	1,520	0.0191
Hart	2,948	29.5	3,291	0.0090
Hog	3,980	39.8	2,623	0.0152
Juniper	2,948	29.5	4,453	0.0066
Lake Andes	2,000	20.0	4,637	0.0043
Pike	31,200	312.0	8,458	0.0369
Rivers	750	7.5	2,560	0.0029
Shirley	2,000	20.0	4,067	0.0049
Snoopy	1,500	15.0	5,094	0.0029
Steelhead/Pike	15,600	156.0	11388	0.0136
Volk	45,765	457.7	3,829	0.1195

1. See Table 2-4
2. One percent failure rate assumed (ACC, 1997).
3. See Table 2-5
4. Calculated - estimated # of duds divided by MOA area.

4.7 Human Health

4.7.1 Environmental Conditions

Humans may be exposed to chemicals emitted into the air or deposited onto the land surface. Chemicals are emitted into the air through a number of industrial processes, including automobile emissions and stack emissions (i.e., from coal-fueled power plants), and natural processes such as volcanic eruptions. Human receptors may inhale airborne chemicals if particles are a respirable size, or they may ingest particles that are inhaled into the mouth but are too large to be inhaled into the lungs. Inhalation of chemicals may result in effects ranging from nasal or lung irritation to lung cancer, depending on the toxicity of the specific chemicals. Humans can contact chemicals in soil and water through incidental ingestion and dermal (skin) contact. Ingestion and dermal contact with chemicals in the soil and water may result in effects ranging from skin irritation and effects on organs (liver, kidney, etc.) to cancer.

Chaff and flares are discharged from aircraft. Chaff, which is primarily composed of aluminum coated glass fibers, will eventually fall to the ground. Flares, which are mostly magnesium, generally burn completely in the air. Potential human receptors may inhale the air in the areas where chaff and flares are discharged, and may incidentally ingest and dermally contact the soil and water in these areas. Therefore, human receptors have the potential to contact materials associated with the use of chaff and flares.

Each year, about 500 tons of chaff (2.3 million bundles of chaff) are released by the military worldwide for operational and training purposes (NRL, 1999). This quantity is similar to the primary particle emissions from a single coal-powered generating station. Viewed in this context, the release of chaff is a minor component of total air emissions.

Chaff is composed of glass silicate with an aluminum coating. Therefore, the primary components of chaff are silica and aluminum. These two constituents occur naturally at relative high percentages in the earth's environment. Windblown desert dusts typically are 50 to 60 percent silicon dioxide, which is similar to the content of silica in the glass fibers of chaff (NRL, 1999). Aluminum is a very common metal in the earth's crust and part of the natural soil layer. Chaff introduces only 1/50,000 and 1/5,000 the amounts of silicon dioxide and aluminum oxide in the top 2 cm of soil in areas where it is deposited (NRL, 1999).

Silica is practically nontoxic if ingested (Gosselin et al., 1976). Epidemiological studies have been conducted for workers involved in the manufacture of fibrous glass products. These workers may inhale glass fibers. The majority of the studies showed no significant differences between glass workers and non-exposed control groups, and no differences between mildly and severely exposed glass workers (NRL, 1999). However, in one study, an excess number of glass workers dying of "nonmalignant respiratory disease" was noted (Bayliss et al., 1976). The precise nature of the diseases was not stated, and exposure to other dusts in other occupations was not excluded, nor was cigarette use. A more recent study states fibrous glass is not associated with an excess death from nonmalignant lung disease (Ameille et al., 1998). Additional studies support Ameille's finding. It should also be noted that all of the studies were done on humans exposed to glass fibers of respirable size, over long periods in enclosed areas, at concentrations exceeding those that are possible in the open air. The effects of this intense exposure were insignificant (NRL, 1999).

Nearly two million people in the US are exposed to aluminum due to their occupation (Nemery, 1998). Lung disease due to aluminum is controversial. Some studies indicate that inhalation of aluminum does not cause lung disease (fibrosis), while others claim to have seen rare examples of lung disease due to inhalation of aluminum (NRL, 1999). A few of these reported cases appear to have been associated with heavy exposures to respirable-sized particles during manufacturing, an exposure that should not have occurred (NRL, 1999). Exposure to aluminum in the open air, as from chaff, would not result in disease because the concentration of particles is so low, much lower than those in the studies discussed above (NRL, 1999).

Other constituents present in chaff, in much lower amounts than the silicon and aluminum, are boron, calcium, copper, iron, manganese, magnesium, potassium, sodium, titanium, vanadium, and zinc. These materials are generally nontoxic except in quantities significantly larger than those any human could reasonably be exposed to from chaff use (ACC, 1997).

Another important consideration in evaluating the human health risks associated with inhalation of chaff is particle size. Each fiber of chaff is about 25 micrometers (μm) in diameter and 1 to 2 centimeters (cm) in length. Particles that are inhalable have diameters that are less than or equal to 10 µm (PM_{10}) (EPA, 1997). Inhalable particles have dimensions that are capable of being transported through the upper respiratory tract into the alveolar tissues of the lung. Most particles larger than 10 µm are removed in the mouth or nose prior to entering the body. Total PM_{10} and $PM_{2.5}$ particulate emissions are monitored by the EPA. Virtually all RF chaff is 10-100 times larger than PM_{10} and $PM_{2.5,}$ particulates of concern for public health (NRL, 1999). In addition, even if all RF chaff emitted were these sizes, it would still be only 0.006-0.0016% of those particulates emitted annually in the US (NRL, 1999).

Additionally, chaff fibers do not break up during ejection. Because ejection of chaff appears to subject the fibers to much greater forces than would atmospheric turbulence, it is unlikely that fibers would survive ejection and then break up during their fall to earth (NRL, 1999). Extreme abrasion would be needed to reduce the diameter of the chaff dipole. The most probable breakup of a dipole would be perpendicular to its length, with remaining particles having a diameter similar to the dipole. Therefore, as chaff particles fall to the ground, and land on the ground surface, they do not form particles with smaller diameters that are considered inhalable (NRL, 1999). Even if abraded chaff particles reached the human lung, the fraction would be small compared to inhaled dust from other sources and disease would not likely result (NRL, 1999). Additionally, fibrous glass and aluminum oxide are relatively nontoxic.

The primary material in flares, magnesium, is not highly toxic, and it is highly unlikely that humans would ingest flare material. Although magnesium is an essential nutrient, excessive ingestion of magnesium can cause neuromuscular irritability, cardiac and renal damage, and calcification (HSDB, 1993). Acute exposure can result in nausea and cardiovascular and central nervous disorders at high concentrations (HSDB, 1993). However, the amount of magnesium released from flares is too small to result in exposure levels that would be associated with these effects (ACC, 1997).

Impulse cartridges and initiators used with some flares contain chromium, and sometimes lead. A screening level risk assessment was conducted to evaluate the potential health risks associated with the use of these impulse cartridges (ACC, 1997). Air dispersion modeling and risk modeling were used to estimate the emission levels that could cause significant short- and long-term health impacts. Modeled concentrations were compared to national standards for Unit Risk Factors accepted by the EPA. The risk assessment model developed by the State of California as part of its air toxics legislation was used in this assessment. Exposure through inhalation, soil ingestion, and dermal contact were evaluated. The SCREEN2 Model and PUFF screening model were used to calculate downwind ground-level concentrations of lead and chromium under three release scenarios. Worst-case meteorological conditions were assumed for all runs. The study indicated that the emission thresholds for causing significant increased risk, under all release scenarios, are unlikely to occur under typical military flight exercises during a given year (ACC, 1997).

In summary, studies conducted to date suggest that the release of chaff and flares does not pose a significant health risk to humans. This includes consideration of exposure through inhalation, ingestion, and dermal contact.

4.7.2 Environmental Consequences

A number of studies have been conducted to address the concerns associated with the use of chaff and flares by the US military. These studies have included the evaluation of potential human exposure and subsequent effects of exposure to materials in the chaff and flares. The studies have demonstrated that there are no significant human exposures or health risks associated with the use of chaff and flares, for the following reasons:

- Estimated total annual emissions of chaff by the military worldwide for operational and training purposes is similar to the annual primary particle emissions from a single coal-powered generating station (NRL, 1999).
- The risk of exposure to chaff for humans through inhalation is considered negligible, because chaff fibers are too large to be inhaled (NRL, 1999).
- Chaff particles do not break down to respirable sizes. Even if they did break down to respirable sizes, inhalation would not be a concern because the aluminum and silicon that make up the chaff particles are not very toxic when inhaled (NRL, 1999).
- The risk of exposure of chaff for humans through ingestion is considered negligible since the main components of chaff have low toxicity (NRL, 1999).
- The risk of exposure for humans to materials in flares is considered negligible because the primary component of flares, magnesium, is not very toxic. Additionally, the majority of the magnesium burns up before it reaches ground surface (ACC, 1997).

Some activities of the DOD retain lead-based chaff in their inventory, although it has not been manufactured since 1987 and there are no plans to use it. The ANG does not use lead-based chaff for training and has no plans to use this chaff.

Based on all the analyses that have been conducted, the proposed action will not impact the health of people living within and in the vicinity of the MOAs where chaff and flares are used.

4.8 Biological Resources

4.8.1 Environmental Conditions

This section summarizes the available information on the ecological toxicity and environmental fate of chaff and flare components in terrestrial and aquatic environments. Biological resources within each of the MOAs are described in Section 3. The potential issues related to the use of chaff and flares, as they might potentially impact biological resources present in the MOAs, are summarized in Table 4-12.

4.8.1.1 Chaff

A typical bundle of training chaff contains about 5 million fibers, each 25 µm in diameter and 1 to 2 cm in length. There is approximately 150 g of chaff in each bundle (NRL, 1999). The chaff fibers (dipoles) are composed of silica glass (made primarily of silicon dioxide) with a coating of aluminum. Stearic acid (a natural fat) is used in small quantities to bond the chaff components (ACC, 1997); stearic acid is essentially non-toxic and is readily degraded in the environment (ACC, 1997). Other trace elements present include boron, calcium, copper, iron, magnesium, manganese, potassium, sodium, titanium, vanadium, and zinc (ACC, 1997; NRL, 1999). By weight, chaff is about 44 percent aluminum (NRL, 1999). In the past, chaff contained significant amounts of lead, but this chaff formulation is no longer in use (ACC, 1997).

TABLE 4-12
Potential Biological Issues Related to Chaff and Flare Use

Potential Issues	Chaff	Flares
Release/Air Pathways		
Startle effects on wildlife at release	X	X
Inhalation	X	Combustion products
Direct effects on flying birds	X	X
Direct effects on flying bats	X	X
Falling debris	X	X
Terrestrial Habitats		
Habitat alteration from fire		X
Direct ingestion by wildlife	X	
Dermal contact by wildlife	X	
Direct toxicity to plants and soil fauna	X	
Toxicity to plants and soil fauna from mobilized components	X	X
Wildlife ingestion of mobilized components (food chain)	X	X
Inhalation of resuspended particulates	X	
Wetland/Aquatic Habitats		
Direct ingestion by fish and wildlife	X	
Direct toxicity to aquatic organisms	X	
Toxicity to aquatic life from mobilized components	X	X
Ingestion of mobilized components (food chain)	X	X

In the year 2000, about 220,000 bundles of chaff are expected to be used in the 14 existing MOAs considered in this EA (see Table 2-3 in subsection 2.1). GAO (1998) estimates that about 2.3 million bundles of chaff are released each year worldwide by all of the service branches during operations and training. This translates to about 500 tons per year (NRL, 1999).

4.8.1.1.1 Air Pathways

Chaff released from an airplane quickly disperses into a large spherical cloud. Atmospheric residence times vary depending upon atmospheric conditions and the altitude at which the chaff is released. Conservative estimates indicate atmospheric residence times of about 10 minutes for the majority of chaff dipoles released at an altitude of 100 meters above ground level, to about 10 hours for chaff released at 10,000 meters above ground level (NRL, 1999). These calculated residence times are generally longer than those observed on radar following chaff release (NRL, 1999).

Possible biological impacts of chaff release into the air include startle effects on wildlife, direct effects to flying birds and bats, and inhalation exposures to wildlife species (Table 4.6-1). The flight of military airplanes can elicit startle responses in a number of wildlife species (Manci et al., 1988), especially during supersonic flight. These effects are due primarily to the noise (especially sonic booms) of the aircraft. Any potential startle effects from chaff deployment would be minimal relative to the noise of the aircraft.

Birds and bats that fly through a cloud of chaff could possibly experience a brief period of disorientation (especially bats who rely on echolocation during foraging flights), but would not likely be injured due to the low mass and diffuse nature of the chaff cloud. Also, the low residence times of chaff in the air and the localized nature of an individual chaff release suggest that such interactions would be inconsequential. Due to the light weight of the released materials, potential direct impacts from falling debris due to chaff release are unlikely.

Particulates smaller than 10 µm (PM_{10} and $PM_{2.5}$) are considered respirable by humans and are monitored by the EPA. Virtually all chaff is 10-100 times larger than PM_{10} and $PM_{2.5}$ (NRL, 1999), and thus would not be respirable by humans and, by extrapolation, by other species of mammals and birds. Studies have shown that chaff does not break up into respirable particles during ejection from an aircraft (ACC, 1997). In addition, even assuming that chaff particles were inhalable, the total amount of chaff released annually on a worldwide basis is equal to the particulate output of a single coal-fired power plant and many orders of magnitude less than estimated annual nationwide releases of dust (which is broadly similar in composition to chaff fibers) from such sources as unpaved roads, agricultural fields, and construction sites (NRL, 1999). Although no data on the toxicity of chaff via inhalation pathways are available, studies with humans (mostly occupational exposures at concentrations much higher than would be expected from exposure to chaff) and laboratory animals with fibrous glass and aluminum indicate that these components do not have any proven fibrogenic or carcinogenic potential (NRL, 1999).

4.8.1.1.2 Terrestrial Habitats

There are relatively little direct data on the potential effects of chaff deposited in terrestrial habitats, although much can be inferred from the available information on the principal components of chaff (aluminum and silicon dioxide). Little is known about the environmental fate of chaff, although available data (e.g., Farrell, 1998) indicate that aluminum-coated chaff fibers are very slow to degrade in terrestrial environments. Chaff will weather, based on observations of field collected samples from the Nellis and Townsend ranges (ACC, 1997), but at an unknown rate. Since the solubility of aluminum (which coats the chaff) is highest in acid and alkaline environments, degradation rates are likely to be dependent on the pH of the soil as well as other factors, such as vegetative cover and wind patterns (which would affect the rate of abrasion of chaff particles).

Chaff is comprised, by weight, of approximately 40% aluminum and 60% silicon, the two most common elements in the Earth's crust (NRL, 1999). The composition of chaff fibers (including trace elements) is very similar to that of desert soil (NRL, 1999). Silica (silicon dioxide) belongs to the most common mineral group, silicate minerals, and is essentially inert in the environment (ACC, 1997). Aluminum is the most commonly occurring metallic element, comprising approximately eight percent of the earth's crust. It is a major component of almost all common inorganic soil particles. The typical range of aluminum in soils is 1 to 30 percent (10,000 to 300,000 mg/kg), with naturally occurring concentrations varying over several orders of magnitude (EPA, 2000). Background concentrations of aluminum in soil are typically over 10,000 mg/kg, averaging 72,000 mg/kg nationwide (ACC, 1997; EPA, 2000). Aluminum concentrations in soils tend to be higher in western states than in states east of the Mississippi River (EPA, 2000).

Based on estimated and empirically-derived chaff deposition rates ranging from 2.8 to 30 g/ha/year, annual chaff deposition introduces only an estimated 1/50,000 (0.002%) to 1/5,000 (0.02%) of the silicon dioxide and aluminum oxide in the top 2 cm of soil in areas where it is deposited (NRL, 1999). These estimated rates are consistent with typical chaff concentrations found in soil samples collected from the Nellis and Townsend ranges (USAF, 1994a).

Data on the potential toxicity of chaff to plants and soil organisms are limited. In studies with a "degradable" form of chaff (EcoChaff™), it was concluded that coated and uncoated chaff did not pose any serious threat to the terrestrial environment (Farrell, 1998). Chaff did not significantly affect gross microbial activity, but some phytotoxic effects (on seed germination and root elongation) were observed in salt-sensitive plants. These adverse effects were attributed to salinity changes in the soil from sodium released during fiber degradation, but were considered unlikely to be manifested in natural soils due to the low concentrations of chaff actually expected (relative to the concentrations that were tested).

More is known on the toxicity of chaff components. Silica is inert and would not be expected to exhibit toxic effects in terrestrial environments. Trace elements, other than aluminum, are not present in significant enough quantities in chaff to be of potential concern. Total aluminum in soil is not correlated with toxicity to plants and soil invertebrates; such toxicity is associated with soluble aluminum. Uptake and bioaccumulation in these organisms is also correlated with soluble, not total, aluminum (EPA, 2000).

The bioavailability and toxicity of aluminum in soils to plants is correlated with pH since aluminum is soluble and biologically available in acidic (pH <5.5) soils and waters, but is biologically inactive under near neutral conditions (pH 5.5 to 8.0). Under alkaline conditions (pH > 8.0), the solubility of aluminum begins to increase again but its bioavailability and toxicity under such conditions is poorly understood (EPA, 2000). The toxic effects of aluminum on terrestrial plants are typically associated with soluble aluminum (Al^{+3}). Effects include decreased yields, decreased plant and root growth, and decreased ability to uptake essential nutrients such as phosphorus and calcium (EPA, 2000). There is considerable variability in the tolerance to aluminum among different species of plants, with sensitive species adversely affected at (soluble) concentrations (in nutrient solutions) of 1 to 2 parts per million (ppm) while less sensitive plants can tolerate over 100 ppm with little or no adverse effects (EPA, 2000). Few data are available on the toxicity of aluminum to soil invertebrates. As for plants, the toxicity is correlated with pH (EPA, 2000). Since soluble forms of aluminum are typically only present in soils at relevant concentrations at low pH, aluminum is usually only of potential concern when soil pH is less than 5.5 (EPA, 2000).

Possible effects of chaff ingestion include direct toxicity, physical effects (abrasion or choking hazards), and the leaching of toxic materials (e.g., aluminum) from the chaff during passage through the digestive system. Although no data on the effects of chaff ingestion by wildlife species are available, several studies of chaff ingestion with various species of livestock have been conducted. In feeding studies with cattle and goats, the animals refused to ingest intact chaff. The chaff was not consumed by calves until it was scattered evenly throughout the grain ration and thoroughly mixed with molasses. When ingested at doses up to 7 g/day for up to 39 days, no adverse effects were observed in beef calves. Another study with dairy calves indicated no adverse effects at doses of 1.8 kg/day (NRL, 1999). Grazing animals and many wildlife species consume relatively large amounts of soil either directly (as a mineral source or to aid digestion) or incidentally to feeding without adverse effects. As indicated previously, the composition of chaff is generally similar to that of many soils present in the US.

The National Research Council (NRC) recommends a dietary maximum tolerance level for soluble aluminum salts of 1,000 mg/kg for ruminants (e.g., cattle and sheep) and 200 mg/kg for non-ruminants (e.g., turkeys and chickens) (NRL, 1999). The toxicity of ingested aluminum to animals (e.g., birds and mammals) is dependent on the chemical form of the ingested aluminum. Insoluble forms of aluminum (such as aluminum oxides) are considerable less toxic than soluble forms (such as aluminum chloride) (EPA, 2000). As indicated, soluble aluminum is usually only a potential concern when soil pH is less than 5.5 (EPA, 2000). Aluminum is not expected to bioconcentrate significantly in terrestrial organisms and is not known to biomagnify in terrestrial food chains (Wren et al., 1983).

Glass fibers can be irritating to the skin (NRL, 1999). Due to its flexible nature and softness, dermal contact with chaff fibers present in soils would not be expected to adversely affect wildlife, especially at the very low concentrations expected in the environment. Most species of wildlife are covered by hair or feathers, minimizing direct skin contact, although some species (such as amphibians and reptiles) and young animals lack these protective coverings. If chaff is incorporated into nests or burrow linings, exposure of young animals could possibly occur. In qualitative field studies at the Nellis and Townsend ranges (USAF, 1994a), no visible chaff was found in nests and burrows located during the survey, although evidence of chaff and chaff debris was observed in scattered locations, especially on the Nellis range area.

4.8.1.1.3 Wetland/Aquatic Habitats

4.8.1.1.3.1 General Information

Chaff deposited to wetland or aquatic systems would either float on the water surface or sink to the bottom sediments. Individual chaff fibers and intact (dud) chaff bundles would tend to sink quickly but clumps of chaff fibers may trap air and float on the water surface. Chaff itself is insoluble in water (ACC, 1997) and would unlikely remain in the water column for appreciable periods before settling to the sediment surface.

In 13-day studies with chaff in salt water, no appreciable quantities of metals were leached from the chaff fibers (ACC, 1997). In 21-day studies with chaff in fresh water of varying pH and hardness, and in salt water, total aluminum was not detected in soft fresh water, was generally at about 1 mg/L in hard fresh water, and was approximately 2 mg/L in salt water (Haley and Kurnas, 1992). Levels of soluble metals remained below detection limits throughout the test period.

In modified leaching tests with chaff in fresh water (at low, neutral, and high pH) and synthetic sea water (pH of 7.8), aluminum and several trace metals were present at concentrations above detectable levels (USAF, 1994b). In sea water, low concentrations of aluminum (0.3 mg/L), zinc (0.04 mg/L), and boron (0.8 mg/L) were detected. In freshwater, concentrations were related to pH with the highest concentrations of aluminum (170 mg/L), magnesium (0.24 mg/L), zinc (0.4 mg/L), and boron (1.5 mg/L) found at pH 4. It should be noted that these tests used a high chaff to water ratio of 1:20, which would result in much higher concentrations than would occur under normal environmental conditions. Assuming a 100 g sample (the standard sample weight for this type of test), only about 0.75% of the aluminum in the chaff was leached at pH 4. At neutral (7) and high (10) pH, aluminum concentrations were much lower (0.3 and 3.0 mg/L, respectively).

Equilibrium partitioning between the particulate-associated and dissolved forms of aluminum in surface water determines the amount of dissolved aluminum. The dissolved fraction is the bioavailable fraction. At neutral pH, aluminum is relatively insoluble in water but the lower the pH of the water, the more aluminum will be present in dissolved form (HSDB, 1997).

Chaff deposited to wetland or aquatic systems (fresh or marine) could potentially impact these communities directly (through the chaff particles or intact (dud) chaff bundles themselves) or indirectly through the leaching of potentially toxic components (e.g., aluminum) from the chaff into surface water or sediment where organisms could be exposed to them directly or could uptake them and thus expose other organisms which consume them (food chain effects).

Several studies have evaluated the potential effects of chaff on aquatic organisms. In short-term exposures to 1,000 mg/L of chaff in water, freshwater fleas (*Daphnia magna*) and marine shrimp (*Mysidopsis bahia*) showed no adverse effects, although the organisms were not directly exposed to the fibers (they were exposed to a supernatant of the chaff/water mixture). Sheepshead minnows, a small marine fish, were directly exposed for short periods to the chaff fibers at concentrations of 1,000 mg/L without adverse effects (Haley and Kurnas, 1992).

In another series of tests, Chesapeake Bay organisms, including oysters, blue mussels, blue crabs, polycheate worms, menhaden, and killifish, were exposed directly to chaff fibers (Systems Consultants, 1977). Blue crabs, menhaden, and killifish were force-fed whole and broken chaff fibers for several weeks at concentrations up to 1,000 times those expected to occur in the bay. No adverse effects were observed. There were no significant adverse effects at 10 times the expected environmental concentration (the highest concentration tested) in one-day old oyster larvae, nor were adverse effects observed in 10-day old oyster larvae at 100 times the expected environmental concentration, although a small effect was observed on larval size at 1,000 times the expected environmental concentration. Polycheates were tested at 10 times the expected environmental concentration and no adverse effects were observed, although some of the test worms used the chaff in their burrows.

In summary, these tests indicate that adverse effects from chaff use at exposure levels in excess of expected do not result in adverse effects to aquatic organisms. Adverse effects from chaff components (principally silicon dioxide and aluminum) are also unlikely. Silicon dioxide is relatively insoluble, is mostly inert, and has very low toxicity (HSDB, 1997). In addition, the non-coating portion of chaff particles (silica glass) are similar in size and composition to some naturally occurring silicon-based particles present in aquatic systems. For example, many species of sponges contain spicules composed mostly of silicon dioxide which are similar in diameter to chaff particles (NRL, 1999). Diatoms, which are common aquatic organisms and important components of both marine and freshwater food webs, contain appreciable quantities of silicon in their cell walls (NRL, 1999). Many species of aquatic organisms consume sponges and diatoms without harmful effects, with the bulk of the silica passing directly through the digestive system (NRL, 1999).

The direct toxic potential of aluminum in aquatic systems is relatively low compared to that of many other metals (Scheuhammer, 1987). In aquatic systems, the toxicity of aluminum has been shown to vary with water hardness and pH (Ingersoll et al., 1990a, 1990b; Woodard et al., 1989), with toxicity increasing at lower pH. The chronic freshwater ambient water quality criteria value for aluminum is 87 μg/L and the acute value is 750 μg/L for a pH range of 6.5 to 9.0 (EPA, 1999). Although little data on the toxicity of aluminum in marine surface water are available, toxicity is not likely to be higher than in freshwater systems given the pH of sea water (about 7.8). In addition, the large size of a typical marine water body would result in significant dilution of any leached aluminum. In smaller, isolated fresh water bodies, this dilution would be much lower. The potential for impact in small water bodies is unknown.

The bioconcentration of aluminum in fish is a function of pH and total organic carbon content (ATSDR, 1990). Aluminum is not expected to bioconcentrate significantly in aquatic organisms and is not known to biomagnify in aquatic food chains (Wren et al., 1983).

4.8.1.1.3.2 Whooping Cranes

While individual chaff particles deposited in wetland or aquatic systems are unlikely to be noticed by wildlife such as waterfowl before sinking to the bottom of the water body, the shiny metallic appearance of dud chaff bundles could attract such birds, which might think the dud is a fish. Some species of waterfowl are known to be attracted to shiny metallic objects. One example is the whooping crane (*Grus americana*). The tendency of this species to pick up and ingest shiny metallic objects found laying on the ground has been noted in captive breeding flocks (Olsen and Wise, 2001). Because the whooping crane is found in an experimental population in the Necedah National Wildlife Refuge in Volk MOA, the potential presence of dud chaff bundles in whooping crane habitat is an issue that warrants additional discussion.

The failure rate of chaff is approximately 1.5 percent (ACC, 1997). For Volk MOA, that would translate into an average of 0.4 dud chaff bundles per square mile per year. At approximately 44,000 acres (70 square miles), the maximum anticipated exposure of the Necedah NWF Refuge to dud chaff bundles would be only 28 per year (70 x 0.4). In order for a whooping crane to come into contact with a dud bundle, two conditions would need to be met. First, the dud chaff bundle would need to fall into whooping crane habitat. Second, the dud bundle would need to be visible to the crane. If a dud bundle were to land in crane habitat with overlying water, it is likely that the force of impact would plunge an intact dud chaff bundle into the sediment and bury it. The potential for a crane to find a dud bundle is also lowered due to the fact that the area of their preferred habitat that is not covered by surface water constitutes a low percentage of the Volk MOA. Overall, the probability of a whooping crane, or other similar bird, finding and ingesting an intact dud chaff bundle is very low and most likely far below the probability of ingesting other types of existing shiny debris, such as fishing lures and various types of aluminum litter.

4.8.1.1.4 Conclusions

Biological impacts of chaff use at anticipated levels is not likely to be significant for the following reasons:

- Any potential startle effects from chaff deployment would be minimal relative to the noise of the aircraft.
- Birds and bats that fly through a cloud of chaff could possibly experience a brief period of disorientation but would not likely be injured due to the low mass and diffuse nature of the chaff cloud. Also, the low residence times of chaff in the air and the localized nature of an individual chaff release suggest that such interactions would be inconsequential.
- Due to the light weight of the released materials, potential direct impacts from falling debris due to chaff release are unlikely.
- Chaff particles are too large to be respirable and do not undergo significant break up during deployment.
- Chaff deposition to surface soils will not result in a significant increase in background soil concentrations of major chaff components (silicon dioxide and aluminum).
- Chaff and chaff components are not toxic to plants and soil fauna at expected levels of chaff deposition.
- Chaff ingestion is likely to be avoided by animals, based on feeding trials with domestic livestock, the lack of similarity in appearance to typical food items (for most species), and the low probability of an animal finding a dud chaff bundle. Species such as ducks may ingest chaff deposited to surface sediments while foraging, however, because it would be difficult to distinguish and avoid chaff fibers in this situation. However, chaff is not toxic to livestock when directly consumed (the only available data). Based on field studies, the density of chaff in sediments is likely to be very low and thus potential direct ingestion exposure would also be low. Thus, the incidence of any adverse effects, should they occur, would likely affect only a few individuals and would be insignificant at a population level relative to other mortality factors (such as duck hunting).
- Major chaff components (silicon dioxide and aluminum) generally have low toxicity in the chemical forms typically found in the environment and are not known to accumulate or magnify in food webs.
- Although glass fibers can be irritating to the skin, the flexible nature and softness of chaff fibers suggest that dermal contact with chaff fibers present in soils would not adversely affect wildlife, especially at the very low concentrations expected in the environment.

- Based on the results of studies with both fresh and marine aquatic organisms, chaff is not expected to adversely impact aquatic life.

The potential for aquatic organisms to be impacted by aluminum leached from chaff in small, isolated fresh water bodies is unknown. This issue is addressed further in Section 4.6.2.

4.8.1.2 Flares

Self-protection flares consist of magnesium and Teflon pellets that, when ignited, burn for a short period of time (less than 10 seconds) at high temperatures. The impulse cartridges and initiators (the other combustible components of the flare) also contain small quantities of other metals including chromium, lead, barium, and boron (ACC, 1997). Although these other metals are generally considered to be more toxic than magnesium, they are released in very small quantities. Also ejected, but not burned, is a flare assemblage made up of components such as aluminum wrap and plastic caps; these components fall to the ground as debris.

When deployed correctly and functioning properly, the flare burns out completely before reaching the ground. Combustion products that may enter the air include magnesium oxide, magnesium chloride, and magnesium fluoride, and small quantities of boron oxide, potassium oxide, chromium oxide, and lead (ACC, 1997).

In the year 2000, about 106,000 flares are anticipated to be used within the 14 existing MOAs considered in this EA (see Table 2-4 in subsection 2.1).

4.8.1.2.1 Air Pathways

Flares released from an airplane burn brightly for about 10 seconds and then fall to the ground. Dud flares do not ignite and fall to the ground.

Possible biological impacts of flare releases include startle effects on wildlife, direct effects to flying birds and bats, inhalation exposures of combustion products to wildlife species, and direct impacts from falling debris (see Table 4-12 in previous subsection). The flight of military airplanes can elicit startle responses in a number of wildlife species (Manci et al., 1988), especially during supersonic flight. These effects are due to the noise (especially sonic booms) of the aircraft. Any potential startle effects from flare deployment, especially at night when the flares would be most visible, would be brief (given the burn time of the flare) and minimal relative to the noise of the aircraft.

Birds and bats are unlikely to be struck in flight by deployed flares and debris given the small amount of material ejected and the visibility of the flare. The probability of a dud flare or flare debris striking and injuring an animal on the ground is considered remote.

Adverse effects from inhaling flare combustion products are not likely to be significant. As described in Section 4.5.1, adverse effects via the inhalation pathway are not anticipated based on a human health assessment. The results of this assessment would likely be applicable to other species of animals.

4.8.1.2.2 Terrestrial Habitats

The primary component of flares, magnesium, is an essential nutrient with low toxicity. The amount of magnesium deposited on terrestrial soils from flare use is likely to be very low relative to background concentrations (mean of 9,200 mg/kg in the US; Shacklette et al., 1971). Munk (1994) estimates that it would take the residue from approximately 15,000 flares per acre to raise the level of magnesium in soils to phytotoxic concentrations. Similarly, it would take about 500 and 15,000 flares, respectively, per acre to contribute levels of boron and barium (the other major components detected in leach tests with flare ash; see Section 4.6.4.3) comparable to background soil concentrations (Munk, 1994). Since dud flares are relatively uncommon, the contribution of unburned flare pellets to soil concentrations is likely to be inconsequential.

The primary potential biological impact of flare use is the risk of flare-related fires. Although fire is a natural and regular component of many ecosystems, especially in the western United States, fires have a number of potential direct and indirect effects. The potential impacts of any particular fire are difficult to predict since they depend upon the extent and intensity of the fire, the time of year it occurs, and the habitats affected. Some habitat types are dependent upon periodic fires to perpetuate the type and structure of the vegetation (e.g., the cones of some species of pine trees will only release their seeds when stimulated by fire). In such ecosystems, fire is a critical and necessary component.

Some of the generic direct biological impacts of fire include: (1) direct mortality of surface vegetation (although root mass and seeds typically survive many fires); (2) direct mortality of sessile organisms (such as non-flying insects) and young animals (e.g., in open nests); and (3) effects from inhaling smoke. Indirect effects may include: (1) mortality of vegetation, thereby reducing food and cover for some wildlife species; (2) increased erosion due to loss of plant cover, resulting in soil loss and sedimentation of streams; and (3) altered patterns of ecological succession, resulting in changes in the community of plants and animals that may occur in the affected area. Potential for flare-related fire in each of the MOAs is addressed in subsection 4.3.

4.8.1.2.3 Wetland/Aquatic Habitats

4.8.1.2.3.1 General Information

The primary potential biological impact of flare use on wetland and aquatic habitats is the deposition of flare components. Although fire may directly affect some wetland systems and indirectly affect aquatic systems (primarily through deposition of ash from smoke and of soil from increased erosion), fire effects to these systems are likely to be low relative to those described for terrestrial habitats.

In modified leaching tests with flare pellets (from unburned or partially burned flares) in fresh water (at low, neutral, and high pH) and synthetic sea water (pH of 7.8), magnesium and several trace metals were present at concentrations above detectable levels (USAF, 1994b). In sea water, moderate concentrations of magnesium (640 mg/L) and low concentrations of barium (2.6 mg/L) were detected. In freshwater, concentrations were related to pH with the highest concentrations of magnesium (2,945 mg/L), barium (3.0 mg/L), and chromium (0.29 mg/L) found at pH 4. At neutral (7) and high (10) pH, magnesium concentrations were much lower (4.4 and 2.4 mg/L, respectively). The pellet material also raised the pH of the solution but the volume of solution was low relative to that expected in the environment (i.e., in a water body). It should be noted that these tests used a high pellet to water ratio of 1:20, which would result in much higher water concentrations than would occur under normal environmental conditions.

Similar modified leaching tests were conducted with flare ash in fresh water (at low, neutral, and high pH) and synthetic sea water (pH of 7.8). Magnesium and several trace metals were present at concentrations above detectable levels (USAF, 1994b). In sea water, moderate concentrations of magnesium (948 mg/L) and boron (68 mg/L), and low concentrations of chromium (0.03 mg/L) were detected. In freshwater, concentrations were related to pH with the highest concentrations of magnesium (857 mg/L) and barium (185 mg/L) found at pH 4. The highest concentrations of boron (89 mg/L), however, were found at pH 10. At neutral (7) and high (10) pH, magnesium concentrations were lower (186 and 202 mg/L, respectively). Ammonia was also detected at concentrations ranging from 2.8 to 3.2 mg/L in freshwater tests and at 3.5 mg/L in tests with synthetic sea water. The ash also raised the pH of the solution but the volume of solution was low relative to that expected in the environment (i.e., in a water body). It should be noted that these tests used a high ash to water ratio of 1:20, which would result in much higher water concentrations than would occur under normal environmental conditions.

Leached metals from flare ash and flare-related ammonia are unlikely to impact aquatic organisms in marine water bodies due to the large dilution effect. However, in smaller, isolated fresh water bodies, the dilution would be much lower. The potential for impact from metals in small water bodies is unknown. Based on results of the leaching tests described above, ammonia is not likely to impact aquatic organisms in small, fresh water bodies. The EPA chronic criterion for ammonia ranges from 3.28 to 3.48 mg/L from pH of 6.5 to 6.8, respectively (EPA, 1998). These concentrations are lower than the ammonia concentrations observed in leaching tests that used a high ash to water ratio of 1:20.

Potential impacts to higher level organisms (such as birds and mammals) are negligible since none of these metals are expected to accumulate in aquatic food webs, and flare-related concentrations in the environment are expected to be very low.

4.8.1.2.3.2 Whooping Cranes

While flare ash deposited in wetland or aquatic systems would not likely be detected by wildlife, a dud flare would be more conspicuous and might attract the attention of some species. As discussed, the whooping crane (*Grus americana*) is a species that, in captive breeding flocks, has been found to ingest foreign objects. As with dud chaff bundles, the probability of a crane finding and consuming a flare is very low. The average dud flare density in Volk MOA would be 0.1 flares per square mile, based on a failure rate of approximately 1 percent (ACC, 1997). Even if flare density was higher due to biased use over weapons-release points, it is likely that dud flares would be difficult for cranes to find, given that their preferred habitats are aquatic systems, and many of the dud flares would fall into the water and likely be buried in the sediment.

4.8.1.2.4 Conclusions

Biological impacts of flare use at anticipated levels is not likely to be significant for the following reasons:

- Any potential startle effects from flare deployment, especially at night when the flares would be most visible, would be brief (given the burn time of the flare) and minimal relative to the noise of the aircraft.

- Birds and bats are unlikely to be struck in flight by deployed flares and debris given the small amount of material ejected and the visibility of the flare. The probability of a dud flare or flare debris striking and injuring an animal on the ground is considered remote.
- Adverse effects from inhaling flare combustion products are not likely to be significant based on the results of a human health assessment, which would likely be applicable to other species of animals.
- The primary component of flares, magnesium, is an essential nutrient with low toxicity. The amount of magnesium deposited on terrestrial soils from flare use is estimated to be very low relative to background concentrations and to concentrations known to cause adverse effects to terrestrial organisms.
- The number of flares needed per acre to contribute levels of other flare ash constituents (e.g., boron and barium) comparable to background soil concentrations are much higher than actual or anticipated use rates.

There are two potential exceptions where flare use may cause significant impacts to biological resources. The first is fire. The potential for flare-induced fires in each of the MOAs is discussed in subsection 4.3. The second is the potential for aquatic organisms to be impacted by metals leached from flare ash in small, isolated fresh water bodies. This issue is addressed further in subsection 4.6.2.

4.8.2 Environmental Consequences

4.8.2.1 Chaff

To evaluate the potential effect of chaff on aquatic organisms in small, isolated fresh water bodies, aluminum concentrations in the water column of several small, hypothetical fresh water bodies were modeled using the maximum chaff deposition rate among the 14 existing MOAs (Table 4-13). The model assumes that chaff is randomly dispersed (evenly distributed) throughout the MOA. This is a realistic assumption because aircraft fly throughout the airspace of each MOA, and chaff released at altitude disperses into a cloud and falls to the ground over a wide area. The maximum chaff deposition rate is in Falls 1 and 2 MOA.

The expansion of Goose MOA and the new Dolphin MOA (previously an air refueling track), effective April 2002, were not included in the evaluation. In future use of the expanded Goose MOA, new Dolphin MOA and (unchanged) Hart and Juniper MOAs, overall levels of chaff and flare use will remain the same and the site-specific use will be reduced in the existing Juniper and Hart MOAs. This is because the same number of missions will be flown in the Dolphin, Juniper and Hart MOAs as were previously flow in the Hart and Juniper MOAs. Likewise, the same number of missions will be flown in the expanded Goose MOA as would otherwise have been flown in the existing Goose MOA. The evaluation is conservative, in that the inclusion of upcoming Goose and Dolphin changes would only have reduced the estimated deposition rates in the existing MOAs.

Assuming that, in a single year, all of the aluminum in the deposited chaff went into the water column and was bioavailable, modeled surface water concentrations are less than two percent of the chronic ambient water quality criterion (Table 4-14) at the maximum deposition rate among the MOAs (15 g/ha/year). For the water quality criterion to be exceeded, chaff deposition rates would need to be more than 50 times greater. This analysis assumes that the deposited aluminum is eventually sequestered in the sediments, the typical fate of most aluminum in aquatic systems. Once present in the sediments, aluminum has very low toxicity to aquatic organisms. Screening values for potential effects are 25,500 mg/kg in fresh water and 18,000 mg/kg in salt water (Buchman, 1999).

There is also the potential for dud chaff bundles to land in small, isolated fresh water bodies. The failure rate of chaff is approximately 1.5 percent (ACC, 1997). For example, in a "worst-case scenario," 1,408 dud chaff bundles could reach the ground in Volk MOA; this is approximately 0.4 dud chaff bundles per square mile per year.

The same model was used to evaluate the potential water quality impact from one dud chaff bundle hitting a small fresh water body. The model assumed that all of the aluminum in the dud chaff bundle would be bioavailable in the water column, an extremely conservative assumption (see Section 4.2.1). Only in the case of the smallest, shallowest water body (0.1 ha and 0.5 m) would the hazard quotient slightly exceed 1 (i.e., 1.5, meaning the concentration of aluminum would be 1.5 times the water quality criterion). There are two reasons why it is highly unlikely that this would occur in nature. First, the probability that a dud chaff bundle would land in this particular type of water body is low. Second, it is reasonable to assume that the force of impact will plunge an unopened chaff box into the sediment, burying it and making it unavailable. Even if a dud bundle were to land in a 0.1 ha, 0.5 m water body and not be buried in the sediment, the probability of the aluminum contained within it becoming completely bioavailable is very low.

Based on this conservative deposition modeling for chaff and dud chaff bundles, the key component of chaff (aluminum) is not likely to adversely impact aquatic life.

TABLE 4-13
Estimates of Chaff and Flare Use and Deposition Rates in the MOAs

MOA	MOA Area		Chaff Rounds (per year)	Chaff Mass (g/round)	Chaff Deposition (g/ha/year)	Total Flares (per year)	Flare Deposition (#/ha/year)
	(sq miles)	(ha)					
Goose (current)	1,520	393,680	5,816	150	2.22	2,904	0.0074
Hart	3,291	852,369	5,904	150	1.04	2,948	0.0035
Juniper	4,453	1,153,327	5,904	150	0.77	2,948	0.0026
Crypt	6,067	1,571,353	21,300	150	2.03	2,100	0.0013
Lake Andes	4,637	1,200,983	8,000	150	1.00	2,000	0.0017
Beaver	3,305	855,995	3,000	150	0.53	1,500	0.0018
Snoopy	5,094	1,319,346	3,000	150	0.34	1,500	0.0011
Steelhead/Pike	11,388	2,949,492	15,600	150	0.79	15,600	0.0053
Volk	3,829	991,711	93,838	150	14.19	45,763	0.0461
Falls 1 and 2	1,798	465,682	46,503	150	14.98	22,241	0.0478
Rivers	2,560	663,040	2,000	150	0.45	750	0.0011

TABLE 4-13
Estimates of Chaff and Flare Use and Deposition Rates in the MOAs

MOA	MOA Area		Chaff Rounds (per year)	Chaff Mass (g/round)	Chaff Deposition (g/ha/year)	Total Flares (per year)	Flare Deposition (#/ha/year)
	(sq miles)	(ha)					
Hog	2,623	679,357	1,990	150	0.44	3,980	0.0059
Shirley	4,067	1,053,353	2,000	150	0.28	2,000	0.0019
Average					**2.82**		**0.01**

* MOA area is estimated

4.8.2.2 Flares

To evaluate the potential effect of flare-related magnesium and boron deposition on aquatic organisms in small, isolated fresh water bodies, modeling was conducted using similar procedures as were used to evaluate aluminum deposition from chaff use. Magnesium and boron concentrations in the water column of several small, hypothetical water bodies were modeled using the maximum deposition rate among the 14 MOAs (Table 4-13). The maximum flare deposition rate is shown in Falls 1 and 2 MOA. As previously discussed for chaff, the Goose expansion and new Dolphin MOA were not included in the evaluation, resulting in a more conservative deposition rate for Goose, Juniper and Hart MOAs.

Since dud flares are rare events, the evaluation focused solely on deposition of flare ash. Assuming that, in a single year, all of the magnesium or boron in the deposited ash went into the water column and was bioavailable, modeled surface water concentrations are less than 0.03 percent of the chronic freshwater values (Tables 4-15 and 4-16) at maximum annual deposition rates. For the water quality criterion to be exceeded, flare deposition rates would need to be more than 1,000 times greater. This analysis assumes that the deposited metals in flare ash are eventually sequestered in the sediments, the typical fate of most metals in aquatic systems. Barium, which was also detected in flare ash samples, has similar aquatic toxicity and estimated deposition rates as boron. It was not modeled since it was not detected in combustion sample (ACC, 1997).

While chaff is likely to be randomly distributed throughout the MOA, flare use may be more concentrated around weapons-release points. However, even with a 1,000-fold bias in flare deployment over particular portions of a MOA, hazard quotients calculated by the model would still be less than 1.

There is also the potential for dud flares to land in small, isolated fresh water bodies. The failure rate of flares is approximately 1 percent (ACC, 1997). For example, in a “worst-case scenario,” 458 dud flares could reach the ground in Volk MOA; this is approximately 0.1 dud flares per square mile per year.

The same model was used to evaluate the potential water quality impact from one dud flare hitting a small fresh water body. Again, the model assumed that all of the magnesium and boron in the flare would be bioavailable in the water column. Using these conservative assumptions, hazard quotients for both components were less than 0.1.

Based on this conservative deposition modeling for flares and dud flares, the key components of flares are not likely to adversely impact aquatic life.

4.9 Hazardous and Solid Waste

4.9.1 Environmental Conditions

RCRA regulates the generation, transportation, treatment, storage and disposal of solid and hazardous waste. Hazardous waste generators are subject to regulations for waste handling and accumulation. Hazardous waste treatment, storage, and disposal facilities (TSDFs) are required to obtain a permit under RCRA for their activities. Under RCRA, a material must first be defined as a solid waste before it can be defined as a hazardous waste. Once a material is determined to be a solid waste, the generator must then determine if it is a hazardous waste.

A solid waste is any discarded material, which includes abandoned (disposed, burned or accumulated), recycled, inherently waste-like, or specific activities associated with unused military munitions. The term includes solids, semi-solids, liquids, or gaseous material.

A hazardous waste is a solid waste that displays a specific characteristic or is specifically listed as a hazardous waste. There are four hazardous waste characteristics:

1. Toxicity – a solid waste exhibits the characteristic of toxicity if it fails the Toxicity Characteristic Leaching Procedure (TCLP) test for any one of 40 contaminates (organics and metals)
2. Corrosivity – a solid waste exhibits the characteristic of corrosivity if it is aqueous with a pH less than or equal to 2 or greater than or equal to 12.5 or is a liquid and corrodes steel at a certain rate
3. Reactivity – a solid waste exhibits the characteristic of reactivity if:
    - It is normally unstable and readily undergoes violent change without detonating.
    - It reacts violently with water or forms potentially explosive mixtures with water.
    - When mixed with water, it generates toxic gases, vapors or fumes in a quantity sufficient to present a danger to human health or the environment.
    - It is a cyanide or sulfide bearing waste which, when exposed to pH conditions between 2 and 12.5, can generate toxic gases, vapors or fumes in a quantity sufficient to present a danger to human health or the environment.
    - It is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement.
    - It is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure.
    - It is a forbidden explosive
4. Ignitability - a solid waste exhibits the characteristic of ignitability if:

TABLE 4-14
Estimated Aluminum Toxicity to Aquatic Life From Maximum Chaff Deposition (Hypothetical Fresh Water Bodies)

Maximum Chaff Deposition Rate (g/ha/yr)	Al Deposition Rate (g/ha/yr)a	Water Body Size (ha)	Depth (meters)	Volume (liters)	Al Deposition (mg/yr)	Al conc (mg/L)	Chronic AWQC (mg/L)	Acute AWQC (mg/L)	Chronic Ratio	Acute Ratio
15	6.60	1	2	20,000,000	6,600	0.00033	0.087	0.75	0.0038	0.0004
15	6.60	1	1	10,000,000	6,600	0.00066	0.087	0.75	0.0076	0.0009
15	6.60	1	0.5	5,000,000	6,600	0.00132	0.087	0.75	0.0152	0.0018
15	6.60	0.5	2	10,000,000	3,300	0.00033	0.087	0.75	0.0038	0.0004
15	6.60	0.5	1	5,000,000	3,300	0.00066	0.087	0.75	0.0076	0.0009
15	6.60	0.5	0.5	2,500,000	3,300	0.00132	0.087	0.75	0.0152	0.0018
15	6.60	0.1	2	2,000,000	660	0.00033	0.087	0.75	0.0038	0.0004
15	6.60	0.1	1	1,000,000	660	0.00066	0.087	0.75	0.0076	0.0009
15	6.60	0.1	0.5	500,000	660	0.00132	0.087	0.75	0.0152	0.0018

a. Assumes chaff is 44% aluminum by weight.

TABLE 4-15
Estimated Magnesium Toxicity to Aquatic Life From Maximum Flare Ash Deposition (Hypothetical Fresh Water Bodies)

Maximum Flare Deposition Rate (#/ha/yr)	Mg Deposition Rate (g/ha/yr)a	Water Body size (ha)	Depth (meters)	Volume (liters)	Mg Deposition (mg/yr)	Mg conc (mg/L)	Chronic Value (mg/L)b	Chronic Ratio
0.05	32.00	1	2	20,000,000	32,000	0.0016	82	0.000020
0.05	32.00	1	1	10,000,000	32,000	0.0032	82	0.000039
0.05	32.00	1	0.5	5,000,000	32,000	0.0064	82	0.000078
0.05	32.00	0.5	2	10,000,000	16,000	0.0016	82	0.000020
0.05	32.00	0.5	1	5,000,000	16,000	0.0032	82	0.000039
0.05	32.00	0.5	0.5	2,500,000	16,000	0.0064	82	0.000078
0.05	32.00	0.1	2	2,000,000	3,200	0.0016	82	0.000020
0.05	32.00	0.1	1	1,000,000	3,200	0.0032	82	0.000039
0.05	32.00	0.1	0.5	500,000	3,200	0.0064	82	0.000078

a. Assumes a flare contains 640 g of magnesium (ACC, 1997)

b. Lowest chronic value for daphnids (Suter and Tsao, 1996)

TABLE 4-16
Estimated Boron Toxicity to Aquatic Life From Maximum Flare Ash Deposition (Hypothetical Fresh Water Bodies)

Maximum Flare Deposition Rate (#/ha/yr)	B Deposition Rate (g/ha/yr)a	Water Body Size (ha)	Depth (meters)	Volume (liters)	B Deposition (mg/yr)	B conc (mg/L)	Chronic Value (mg/L)b	Chronic Ratio
0.05	0.0025	1	2	20,000,000	2.50	1.25E-07	0.0016	0.000078
0.05	0.0025	1	1	10,000,000	2.50	2.50E-07	0.0016	0.000156
0.05	0.0025	1	0.5	5,000,000	2.50	5.00E-07	0.0016	0.000313
0.05	0.0025	0.5	2	10,000,000	1.25	1.25E-07	0.0016	0.000078
0.05	0.0025	0.5	1	5,000,000	1.25	2.50E-07	0.0016	0.000156
0.05	0.0025	0.5	0.5	2,500,000	1.25	5.00E-07	0.0016	0.000313
0.05	0.0025	0.1	2	2,000,000	0.25	1.25E-07	0.0016	0.000078
0.05	0.0025	0.1	1	1,000,000	0.25	2.50E-07	0.0016	0.000156
0.05	0.0025	0.1	0.5	500,000	0.25	5.00E-07	0.0016	0.000313

a. Assumes a flare contains 0.05 g of boron, based on analysis of combustion products (ACC, 1997)

b. Secondary chronic value (Suter and Tsao, 1996)

- It is a liquid, and has flash point less than 60°C (140°F)
- It is not a liquid and is capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard.
- It is an ignitable compressed gas or it is an oxidizer

There are four types of hazardous waste listings:

- **F**- hazardous wastes from non-specific sources
- **K**- hazardous wastes from specific sources
- **P**- discarded commercial chemical products and off-specification species
- **U** - discarded commercial chemical products and off-specification species (acutely toxic)

The generator must examine the specific hazardous waste listing descriptions compared to the waste they generate to determine if the waste meets a listing. There is no specific test for listing determination. If the waste meets the description, it is listed.

4.9.2 Environmental Consequences

In evaluating RCRA applicability, state and federal regulators were contacted. No state or federal agency had specific existing interpretive guidance on chaff and flares under the conditions of intended use in training missions.

The intended use of chaff and flare products is to be ejected from an aircraft to provide a “smoke screen” or missile decoy, respectively. As part of normal use of the product, it is expected that the expended chaff and flares will fall to the land. Based on this intended use of the product, the expended chaff and flares would not be considered a solid waste. The definition of solid waste excludes commercial chemical products where their intended or ordinary use results in application to the ground or land. (An example of this definition is the normal application of pesticides.) Therefore, if the expended chaff and flares reach the ground and are not recovered (picked up from the ground), RCRA regulations have not been triggered.

If the expended chaff and flares are recovered and are destined for disposal, reuse, or recycling, or if excess or unusable stocks of chaff or flares are decommissioned and disposed of, then they become a solid waste and must be evaluated for hazardous waste classification. The point of generation for the wastes (and when a hazardous waste determination must be made) is when the material is recovered and intended for disposal or recycling. The ANG or other organization that recovers or decommissions the material will become the generator of the waste and should comply with RCRA regulations for accumulation, transportation, treatment, and disposal of the waste.

Spent chaff and flare debris that is left on the ground could possibly fall under RCRA jurisdiction for remediation using statutory authorities (RCRA 70003 and Corrective Action), if it meets the definition of a hazardous waste and is present in sufficient quantity or concentrations. However, that is unlikely due to the nature of the materials and the large land areas over which they are dispensed.

Chaff is not likely to meet the definition of a hazardous waste. Aluminum is not on the toxic list of constituents nor does it seem, based on the properties of the chaff, that the spent chaff will be considered an ignitable, reactive, or corrosive waste. Chaff does not meet any of the hazardous waste F, K, P, and U listing descriptions.

The flare debris has the potential to meet the definition of a hazardous waste. If the flare canister is still burning, or the canister has magnesium residue, or was a dud (unexploded), the flare debris could potentially be considered an ignitable or reactive waste. If this is the case, then the flare debris must be managed in accordance with all RCRA regulations. Magnesium is not on the list of toxic constituents nor does it seem, based on the properties of the flare, that the flare debris will be considered a corrosive waste. The flare debris does not meet any of the hazardous waste F, K, P, and U listing descriptions, with the possible exception of dud (unburned) flares with first fire mixtures, which could display a TCLP (RCRA hazardous waste characteristic) for Chromium.

Neither scenario presented above, leaving the chaff and flare on the ground or recovery, subjects the ANG to the requirement to obtain a RCRA permit for hazardous waste disposal. ANG units have the potential to become generators of hazardous waste and as such are subject to specific regulations, but are not subject to a RCRA permit if all applicable generator requirements are met.

4.10 Land Use and Visual Resources

4.10.1 Environmental Conditions

Land use refers to real property classifications that denote either natural conditions or the types of human activity occurring on a parcel of land. The purpose of land use planning is to promote orderly growth and compatible uses among adjoining parcels or areas in a given jurisdiction (municipality, county or region).

The locations and extent of proposed federal actions typically should be evaluated for their possible effects both on the project site and on adjacent land uses. For the proposed action evaluated in this EA, which involves activities only within designated special use airspace, that consideration does not apply; the special use designation by the FAA serves a similar purpose. Instead, the measure of impact on land use for the proposed action would be the degree to which chaff and flares and associated debris might accumulate and alter the attributes of land or interfere with its management or use. In addition, the risk of fire associated with flares could impact land use.

Visual resources are affected by changes in the natural or built environment that detract from a viewshed or personal perceptions of a place. Places that are highly valued for their aesthetic quality are considered important visual resources.

Impacts by chaff on land use and visual resources are directly related to the visibility and accumulation of chaff debris. In highly sensitive areas, the public can be expected to react if visual qualities are impaired. Concerns are typically the greatest in areas where the views are rare, unique, or otherwise special to the region or locale, especially those areas which are remote or pristine and where present-day human influence is not readily apparent.

The USAF conducted studies to examine the effects of chaff use on land use and visual resources. The studies included: reviewing applicable laws for the protection of land use areas and resources, literature and database review, and a field study to determine the visibility of chaff debris in various settings (ACC, 1997). A review of applicable laws for the protection of land use areas and resources suggest that chaff use may not be consistent with all policies of state and federal environmental management programs. The literature and database review indicated that no previous studies were conducted on the effects of chaff on land use or visual resources.

Field studies conducted by the USAF (1994), were conducted in temperate and arid environments and in both high-use and low-use areas. Two methods were used during field investigations: an *in situ* method and a "placed" method. The *in situ* method consisted of walking though selected areas to count the number of sightings of chaff debris and filaments, and to observe factors affecting their visibility in the natural environment. The "placed" method consisted of placing chaff debris items in different natural contexts, and evaluating at what distances the items were visible and whether visibility was affected by the context (USAF, 1994).

The field study of the visibility of chaff and incidental debris in different environmental contexts concluded that significant aesthetic effects are unlikely (ACC, 1997). Overall, chaff debris has low visibility and little effect on the aesthetic quality of the environment. Chaff debris does not accumulate in quantities that make it objectionable, or even noticeable to most persons in low-use areas. Chaff debris is only visible in fairly open contexts where vegetation is sparse, along a road or pathway, or in cleared and maintained areas. Even if chaff or flare debris were to accumulate in noticeable quantities, it is unlikely to reduce the value of the land for residential, commercial, agricultural or industrial land uses.

The field study did, however, indicate that the use of chaff over, or immediately adjacent to, highly sensitive areas such as Wilderness Areas, Wild and Scenic Rivers, National Parks and Monuments, and other pristine natural areas might conflict with the land use management objectives for those areas (ACC, 1997). Public and land managers could perceive chaff debris as undesirable and unattractive, if it conflicts with expectations of primeval character and management objectives to preserve naturalness. A summary of the major wilderness and natural areas and surface water bodies in or near each MOA is provided in Section 3. Four of the fourteen MOAs (Crypt, Beaver, Steelhead, and Rivers) do not have any associated Wilderness Areas or Natural Areas.

Initiatives between the Department of Defense (DOD) and the Department of Interior agencies are helping to identify and minimize the effects of chaff on public lands (GAO, 1998). The Fish and Wildlife Service (FWS) and the Bureau of Land Management (BLM) have signed agreements with individual military services to control chaff use over wildlife refuges, Native American reservations, and public lands near military training grounds. Many military installations have local procedures to restrict the use of chaff near environmentally sensitive areas or population centers. The Navy has entered into several limited agreements to restrict chaff use over wildlife refuges and public lands, where concern was expressed over possible impacts on sensitive species (GAO, 1998).

4.10.2 Environmental Consequences

Impacts on land use and visual resources of use of chaff and flares at anticipated levels are not expected to be significant, for the following reasons:

- Chaff has low visibility, is similar in chemical composition to desert dust, and has little effect on the aesthetic quality of the environment. Chaff debris does not accumulate in quantities that make it objectionable, or even noticeable to most persons in large, low-use areas such as MOAs. Even in open areas, impacts from chaff debris are minor when compared to accumulated roadside trash or other more common visual intrusions.
- Similarly, flare debris represents, at most, a minor visual intrusion.
- If site-specific concerns should arise, resource agencies and individual military entities can enact local agreements to limit the use of chaff or flares near environmentally sensitive areas such as wildlife refuges and public lands, or Native American reservations and population centers.
- The only serious potential for impact on land use is related to accidental fires. Although unlikely (given the altitudes at which flares are normally deployed and the short burn time), there is some risk of a flare not completely burning out before reaching the ground and starting a wildfire. Fire damage can cause adverse effects on all types of land use, related to both ecological and property damage. Fire risk for the MOAs considered in this EA is addressed in subsection 4.3.

4.11 Cultural Resources

4.11.1 Environmental Conditions

Cultural resources include archeological sites from prehistoric and historic periods, structures, districts, artifacts, and other physical evidence of human activities considered important to a culture, subculture or community for scientific, traditional, religious or other reasons. Such resources may be considered significant historic properties if they meet the criteria, established by the regulations issued by the Secretary of the Interior, that make them eligible for listing on the National Register of Historic Places. In addition, sites, structures, prominent topographic features, habitats, plants, animals and minerals that have played an important role in traditional lifeways can be considered traditional cultural resources, where Native Americans or other groups consider them essential for the preservation of their traditional culture.

Under Section 106 of the National Historic Preservation Act (NHPA), the proponent of a federal undertaking must determine whether the undertaking has the potential to affect historic properties. When a federal undertaking will have an adverse effect on historic properties eligible for or listed on the National Register, the proponent must consult with the State Historic Preservation Officer (SHPO), the Advisory Council on Historic Preservation (ACHP) and other interested parties.

A wide range of prehistoric and historic resources exist within the areas underlying the MOAs scheduled by the ANG. As indicated in Section 3.0, a number of Native American reservations and tribal lands are located in some of the MOAs. Because the MOAs are such large areas of airspace, each one overlying several thousand square miles of land that are largely not DOD-controlled, it is not practicable or useful to provide detailed listings or descriptions of individual historic properties in these large areas.

4.11.2 Environmental Consequences

The proposed action has little potential to directly affect historic properties. Use of chaff and flares during training missions in special use airspace does not involve any ground disturbance or alteration of historic structures; any effects on historic properties and other cultural resources would be indirect and incidental.

Chaff debris has low visibility and is similar in chemical composition to desert dust. The 1997 ACC study concluded that there is little potential for chaff to have direct physical or chemical effects on cultural resources. Field studies conducted during that study found that, in low-use areas such as MOAs, chaff and chaff debris are rarely found or are not easily discernible from other types of litter or natural materials (ACC, 1997). It is unlikely that chaff debris would accumulate in sufficiently objectionable quantities to impair the appreciation or use of cultural resources, such as national monuments, historic landmarks or Native American traditional use areas. Even infrequent worst-case incidents, such as a bundle of chaff not properly dispersing and falling to the ground more or less intact, would result in minimal effects when compared to the more common intrusion of roadside litter.

Correspondence received from the SHPOs in Oregon and Oklahoma (the only SHPOs that responded during the scoping comment period for this EA) confirmed that the deployment of chaff and flares during ANG training missions will have no effect on historic properties. In addition, a scoping response from the White Earth Band of Minnesota Chippewa (the only Native American government that responded during scoping) stated that possible impacts on cultural resources and potential environmental consequences would have no effect on the White Earth Reservation or its members (Appendix A).

An unlikely, but potentially serious, indirect impact is the possibility of incidental damage to historic properties as a result of fire. Although existing procedures require deployment of flares at or above altitudes selected to ensure complete burnout of flares before they can contact the ground, it is still possible that inadvertent low releases of flares could, under certain conditions, start a fire. Cultural resources could be damaged by fire, smoke, fire suppression activities or rehabilitation of burned areas after a fire.

The likelihood of such flare-related effects on cultural resources in a specific location is related to the overall risk of unintended fires. MOAs located in areas of high and extreme seasonal fire risk are identified in subsection 4.3. The possibility of fire-related damage to cultural resources, along with all the other resources that could be damaged by fires, can be minimized by taking the necessary precautions to control fire risk (see subsection 4.3).

4.12 Socioeconomics

4.12.1 Environmental Conditions

Socioeconomic resources are the basic attributes associated with human activity, specifically population and economic activity. Population in a given region is affected by regional birth and death rates and by immigration from or emigration to other regions. Economic activity includes employment, personal income, sales volume, and industrial or business growth. Changes in population or economic activity (especially if they exceed average fluctuations over time in a given region) can induce changes in community resources, including housing availability, recreation, retail establishments, medical facilities, and the provision of public services such as schools or fire and police protection.

4.12.2 Environmental Consequences

The proposed action will not change population or levels of economic activity and thus does not have the potential to significantly affect socioeconomic resources.

The main potential impact on the local or regional economies of the region of influence is related to the risk of accidental fires. Although unlikely, given the altitudes at which flares are normally deployed and the short burn time, there is some risk of a flare not completely burning out before reaching the ground and starting a wildfire. As wildfires in several regions of the U.S. this year have shown, fires can have serious social and economic consequences, including displacement of residents, loss of timber, lost seasonal tourism in parks and public lands, the cost of fire suppression, injuries, smoke-related aggravation of health problems (e.g., asthma), and the cost of rebuilding homes, businesses and infrastructure damaged by fires (or some fire-fighting measures). Subsection 4.3 addresses the risk of fire for the individual MOAs evaluated in this EA.

4.13 Environmental Justice

4.13.1 Environmental Conditions

On February 11, 1994, President Clinton signed Executive Order No. 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations.” The purpose of this order is to require each federal agency to identify and address any disproportionately high and adverse environmental effects that its programs and policies might have on minority or low-income populations.

Environmental Justice: Guidance Under the National Environmental Policy Act (CEQ, 1997) defines minorities as members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black (not of Hispanic origin); or Hispanic origin. A minority population should be identified where either the minority population of the affected area exceeds 50 percent or is meaningfully greater than the minority population percentage in the general population. Low-income populations are identified using the Census Bureau's statistical poverty threshold. The Census Bureau defines a “poverty area” as a Census tract where 20 percent or more of the residents have incomes below the poverty threshold and an “extreme poverty area” as one with 40 percent or more below the poverty level (US Census Bureau, 1995).

In compliance with Executive Order No. 12898, Section 3.0 includes demographic statistics on race, ethnicity, and poverty status, for the counties underlying the 15 MOAs where the ANG proposes to use chaff and flares during ongoing training missions, in order to provide a baseline against which any such impacts can be identified and analyzed. Statistics for the surrounding states are also presented to provide context. Some of the affected counties were found to have higher percentages of minority population than the surrounding states, although none of them exceed 50 percent. A number of the counties, as well as several of the states, contain areas of poverty.

4.13.2 Environmental Consequences

Analysis of the proposed action has not indicated the potential for any disproportionately adverse effects on minority or low-income populations. The MOAs controlled by the ANG are very large areas of airspace, each one comprising thousands of square miles of land underneath. Training missions and deployment of chaff and flares can occur anywhere within a given MOA (or group of related MOAs). Because the MOAs are largely over rural areas with low population densities, the number of people potentially affected are less than if the MOAs were located over more urbanized areas.

Although minority and low-income populations exist in some of the underlying counties, there is no indication that specific minority or low-income communities within those counties are disproportionately affected by the proposed action, in comparison to non-minority or higher-income communities located in the same or adjacent counties. In addition, because no significantly adverse human health or ecological impacts have been identified for the proposed action (see particularly the discussions in subsections 4.2 Air Quality, 4.4 Safety, 4.5 Human Health and 4.6 Biological Resources), environmental justice issues are not pertinent and further site-specific analysis or mitigation related specifically to environmental justice is not warranted.

5 Findings and Conclusions

5.1 Evaluation of Alternatives

5.1.1 Alternative 1—Normal Operations

Alternative 1 is the Proposed Action, which is continue the current use of chaff and/or flares in all MOAs, to resume the use of chaff and flares in those MOAs where use was suspended pending EIAP, and to allow the use of chaff and/or flares in newly established or expanded MOAs; the specific MOAs are evaluated in this EA. ANG units and other aircraft using these MOAs would maintain current training methods with no reduction in combat readiness for individual pilots. Findings and conclusions related to the Proposed Action are discussed in subsection 5.3, following a discussion of the other alternatives, and cumulative effects.

5.1.2 Alternative 2—Minimize Number of MOAs Available

Under Alternative 2, the airspace available to an ANG unit where the use of chaff or flares is authorized would be limited. (For example, use of chaff or flares by the 148 FW could be authorized in Beaver MOA, but not in Snoopy East/West MOA.) This alternative would tend to limit the number of sorties in which training in the use of chaff or flares is available. Such a reduced level of training could degrade the level of readiness of the affected units and could result in damage to ANG property and injury or possibly death to ANG personnel in actual combat missions.

The potential effects on each of the resource area discussed in Section 4 would be similar to those assessed for the Proposed Action. No significant adverse impacts are anticipated. However, the deposition of chaff or flare material would be concentrated within a smaller area, which could increase the level of impact to specific resources.

5.1.3 Alternative 3—Increase Minimum Altitude for Flare Use

Under Alternative 3, the minimum altitude authorized for flare use would be increased in specific MOAs. (For example, flare use could be authorized only higher than 2,000 feet AGL in MOAs in low altitude class, such as Hog Low or Falls 1 and 2.) This alternative would reduce the level of readiness for certain types of training, such as bomber aircrew training missions that require low ordnance deliveries and the use of flares to defeat ground-based defense systems.

The potential effects on each of the resource area would be similar to those assessed for the Proposed Action. No significant adverse impacts are anticipated. Implementing Alternative 3 could reduce the risk of accidental fire (if a flare does not completely burn out in the air) in MOAs where there is a high general risk of fire due to climate and vegetation. In practice, the Operations Manager has the authority to

Alternative 3 also could reduce the potential startle effect on wildlife associated with nighttime deployment of flares, but it would not reduce the greater startle affect associated with aircraft noise.

5.1.4 Alternative 4—Limit Use to Certain Times of Year

Under Alternative 4 , the use of chaff or flares would not be authorized during certain times of the year, such as times of seasonal high fire risk. This alternative would limit the number of sorties in which training in the use of chaff or flares is available, which could degrade the level of readiness of the affected units

The potential effects on each of the resource area would be similar to those assessed for the Proposed Action. No significantly adverse impacts are anticipated. Implementing Alternative 4 during the dry season in certain MOAs (such as Hart from June-October and Dolphin, Juniper and Goose from July-October) would reduce the risk of accidental fire.

5.1.5 No-Action Alternative

The No-Action Alternative is essentially the same as Alternative 1 – Current Operations, except for select MOAs where the use of chaff and flares has been suspended (Volk and Falls – Alpena CRTC) or not yet introduced (Dolphin and Goose South - 173 FW). For the 173 FW, this alternative would limit the number of sorties in which training in the use of chaff or flares is available and for Alpena CRTC would continue to severely limit full and realistic pilot training. Such a reduced level of training could degrade the level of combat readiness of the affected units and could result in damage to ANG property and injury or possibly death to ANG personnel in actual combat missions.

5.2 Cumulative Effects

Cumulative effects are defined as effects on the environment that result from the incremental effect of the proposed action when added to past, present and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Due to the large size of the MOAs evaluated in this EA, there are numerous ongoing and proposed actions that could potentially result in cumulative effects. Examples include existing and new commercial air traffic, public and private land development, etc. However, the incremental contribution of the proposed action (continued or introduced use of chaff and flares in MOAs with ongoing training exercises) is expected to be minor in the context of all other activities in these large areas.

5.3 Findings and Conclusions Related to the Proposed Action

This EA was prepared to evaluate the potential effects of the use of chaff and flares in ANG training missions in 15 MOAs and alternatives to the proposed action.

5.3.1 Findings

Findings of the EA, summarized in this subsection, indicate that potential minor impacts are expected to result from implementation of the proposed action or alternatives. No significantly adverse impacts are anticipated. Specific operating procedures that could be used to minimize impacts are identified.

No significant impacts on air quality are expected. Chaff and flare use within the MOAs considered in this EA will not result in exceedances of air quality thresholds or adversely affect visibility. Chaff dipoles are greater than 10 μm in size. Even under a worst-case assumption, in which all chaff released within one year would abrade to 10 μm or less and remain suspended within the airspace of the continental US, the annual average concentration of PM_{10} is far lower than the annual average NAAQS for particulate matter. Emissions attributable to chaff and flares are insignificant relative to *de minimis* standards for PM_{10} and CO, even in the affected counties with the most stringent air rules.

Fires associated with flares could indirectly result in a variety of adverse impacts on natural, cultural and socioeconomic resources. Such fires are rare when release altitudes and other restrictions are based on site-specific conditions. A study was conducted to quantitatively assess the fire ignition potential associated with the airborne releases of self-protection flares over each of the MOAs considered in this EA. The ignition potential (during the season of highest fire risk, generally June - October) was characterized as "Extreme" for Hart MOA; "Very high" for Dolphin, Juniper, and Goose MOAs; "Low" for Steelhead MOA; and "Moderate" for the remaining MOAs.

Procedures currently used to help reduce the risk of fire and existing fire management procedures provide ANG units with the means to minimize potential impacts. At the Operations Group Commander's discretion, the minimum altitude for flare use in any MOA can be raised during the fire season or the use of flares can be temporarily suspended. Under "Extreme" and "Very High" seasonal fire hazard conditions, the use of flares should be coordinated with local range or land managers if applicable, strictly limited as to location and altitude of release, or suspended.

No significant impacts to the safety of ANG personnel or the public are expected. Chaff released within special use airspace has the potential to interfere with FAA radar systems and navigational systems, except for RR-188 chaff which is non-interfering. All military requests for chaff use must be reviewed and approved by the Spectrum Management Office of FAA. None of the electric utilities serving the MOAs that responded to queries were aware of any chaff-related electrical service failures. The probability of an unopened chaff box or dud flare hitting and injuring a person on the ground was examined on a MOA-specific basis and found to be very low. One potential public safety concern is associated with individuals picking up and being injured by dud flares on non-DoD lands. On a MOA-specific basis, the highest predicted density of dud flares (in the Volk and Falls MOAs) was found to be 0.12, or one dud flare per year in 8.3 square miles. Although the likelihood of such injury is low, it could be further reduced by a public information program in the areas near population centers.

No significant impacts to human health are expected. Chaff particles are not expected to break down to respirable sizes in any appreciable quantities and the aluminum and silicon that make up chaff particles have low toxicity when either inhaled or ingested. Estimated total annual emissions of chaff by the military, worldwide, for both operational and training purposes is similar to the annual primary particle emissions from a single coal-powered generating station. The risk of exposure for humans to materials in flares is considered negligible because the primary component, magnesium, is not very toxic and the majority of the magnesium burns up before it reaches the ground.

Biological impacts of chaff and flare use at anticipated levels is not likely to be significant. Any potential startle effects from chaff or flare deployment would be minimal relative to the noise of the aircraft. Due to the light weight and the low residence times of chaff in the air, and the small amount of material ejected and the visibility of flares, there is little potential for direct impacts on birds or bats from chaff clouds, falling chaff, or flare debris. Chaff particles are too large to be respirable and do not undergo significant breakup during deployment. Ingestion is likely to be avoided by animals and the incidence of any adverse effects of accidental ingestion would be insignificant at a population level relative to other mortality factors. Major chaff components (silicon dioxide and aluminum) generally have low toxicity in the chemical forms typically found in the environment and are not known to accumulate or magnify in food webs. The primary component of flares (magnesium) is an essential nutrient with low toxicity and the amount deposited on terrestrial soils from flare use is estimated to be very low relative to background concentrations. Based on conservative deposition modeling for the MOAs evaluated in this EA, the key components of chaff (aluminum) and flares (magnesium or boron) is not likely to adversely impact aquatic life based on realistic estimates of deposition rates to small, isolated fresh water bodies.

Chaff is not expected to meet the definition of a hazardous waste. Aluminum is not on the toxic list of constituents nor would spent chaff be considered an ignitable, reactive, or corrosive waste. Flare debris has the potential to meet the definition of a hazardous waste, but only if the flare is still burning, has magnesium residue when it reaches the ground, or is a dud (unexploded). As part of normal use of the product, it is expected that the expended chaff and flares will fall to the land. Based on this intended use of the product and discussions with state and federal regulators, expended chaff and flares would not be considered a solid waste and RCRA regulations would not be triggered, unless the materials are recovered or excess stocks are disposed. Neither leaving spent chaff and flares on the ground nor recovery is likely to require the ANG to obtain a RCRA permit for hazardous waste disposal.

Effects on land use and visual or cultural resources are not expected to be significant. Chaff has low visibility and little effect on the aesthetic quality of the environment. Chaff and flare debris does not normally accumulate in quantities that make it objectionable, or even noticeable to most persons in large, low-use areas such as MOAs. The primary potential for indirect adverse effects on land use and visual or cultural resources are associated with the risk of accidental fire, discussed above.

No direct effect on socioeconomic resources is anticipated. As for other resources, the primary potential for indirect adverse effects on socioecomomics is associated with the risk of accidental fire.

5.3.2 Conclusions

The analyses performed in this EA lead to the conclusion that implementation of the proposed action in the MOAs that were evaluated will not have significant direct, indirect or cumulative effects on the quality of the human environment. There are no critical differences in potential environmental effects between the alternatives.

Therefore, an EIS is not required and a FONSI has been prepared.

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Appendix A
Public and Interagency Coordination

Appendix A
IICEP Distribution List

The following agencies and individuals were contacted through IICEP distribution in the EA and/or DOPAA public comment periods. For states where review was coordinated through State NEPA Clearinghouses, individual state agencies are not listed. Because the areas being evaluated are very large, agencies at the county level are not included.

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Dear Mr. Knudsen:

The U.S. Fish and Wildlife Service (Service) has reviewed the Draft Finding of No Significant Impact (FONSI) and Draft Final Environmental Assessment (EA) dated October 2001, for Chaff and Flare deployment by the Air National Guard (ANG) in multiple Military Operations Areas (MOAs) nationwide, including five separate MOAs in Wisconsin. We offer the following comments relative to this proposed action to endangered species, National Wildlife Refuge lands, and aquatic habitats.

GENERAL COMMENTS

Overall, we believe the document presents the proposed action in an adequate fashion, with the exception of a number of areas which require further elaboration. These specific items are discussed below. Another question is whether the proposal analyzed in this EA is part of a larger proposal which will ultimately include an unknown number of other MOAs, to be collectively analyzed in several documents. The lack of a clear statement of this intent makes it difficult to put the proposed action into the proper perspective on a national scale and in terms of consistency with the National Environmental Policy Act. We suggest the need for clarification and, possibly, an additional document which adequately describes the intent of the ANG, as well as a clear description of the intended plan for conducting these analyses.

SPECIFIC COMMENTS

Alternatives
The Preferred Alternative, as presented in the document, is that of Current Operations. However, it is unclear as to whether or not chaff is currently used in Wisconsin MOAs. According to the General Accounting Office Report, *DOD Management Issues Related to Chaff*, dated September 1998, Wisconsin is not shown as a State where chaff is used. Based upon this information, it appears as though "Current Operations" are those of no chaff use in at least some of the subject MOAs. We request further clarification and coordination regarding what current operations

actually are. We would like to resolve any questions and potential issues we may have pertaining to actions included as current operations prior to preparation of the Final EA.

Environmental Consequences
The information presented within the EA makes it difficult to determine the potential impacts to Service trust resources. For example, table 4-13 presents the deposition rates for chaff and flares within each MOA, based upon the expected amount of materials used, and the total area of each of the MOAs. This apparently assumes an equal distribution of these materials throughout each MOA. While this scenario may be a reasonable assumption, no supporting information is presented to explain why this may be the case. In the FONSI, it is stated that the analysis of effects to aquatic life is ". . . based on realistic estimates of deposition rates . . ." (section 3, Environmental Effects, third paragraph). We can not find any reference within the EA to how these "realistic estimates" were made. At the least, the methods used to conduct this analysis should be described, along with a rationale for why this analysis is appropriate.

A realistic analysis also should make some general estimate for deposition rates within high use areas, such as near the Hardwood Bombing Range in Wisconsin, as well as presenting a worse-case scenario based upon the potential failure of chaff bundles and flares to deploy as intended. This worst-case scenario also should consider the fact that the pH levels encountered in central Wisconsin wetlands and water bodies tend to be low, an environmental condition which has been demonstrated to increase the toxicity of aluminum in the water column and to increase the leaching rate of magnesium, barium and chromium from flares.

This information could then be used for the types of analyses presented within tables 4-14 through 4-16, where the impacts to aquatic life from chaff and flare deployment are estimated. It would be helpful to estimate the expected likelihood or incidence of chaff bundles and flares reaching the ground without dispersing or igniting, and to also model the resulting local impacts to typical small wetlands or water bodies. This information would allow us to assess the potential impacts to aquatic habitats on the nearby Necedah National Wildlife Refuge (NWR), which is located within the Volk West MOA, just to the west of the Hardwood Bombing Range and along the major flight approach path to the range.

Federal Threatened and Endangered Species
Due to the lack of the specific information discussed above, we are unable to determine at this time whether your project is likely to adversely affect federally listed threatened or endangered species. We will evaluate your project again following the receipt of the requested information and provide a determination at that time. Any further informal or formal consultation or conference regarding impacts to Federal threatened or endangered species should be completed prior to completion of the Final EA.

Whooping crane
The Service is concerned about the potential for adverse effects from chaff and flare use to the whooping crane (*Grus americana*). Following the recommendation of the International

Whooping Crane Recovery Team, the Service recently completed a rulemaking process that designated a Nonessential Experimental Population (NEP) of this species in a large area of the Eastern United States including Wisconsin. The action was a necessary prerequisite to implementing the recommended recovery action of establishing an additional migratory population of whooping cranes in the Eastern U.S.

Reintroduction of the species into the Eastern U.S. NEP area was begun in 2001 with the release of a small group of whooping cranes which were reared at the Necedah NWR. This initial cohort of whooping crane chicks was led behind an ultralight aircraft to the selected wintering site in east-central Florida during the fall of 2001. Its was expected that the cranes would return to the Wisconsin release site of their own accord in the spring of 2002, which four of them have now done. A fifth crane has also reached Wisconsin but has not continued all the way to the release site. Releases are planned for at least 5 years, with the goal of establishing a self-sustaining population of 125 whooping cranes, consisting of a minimum of 25 breeding pairs.

One characteristic of whooping cranes noted in captive breeding flocks is the tendency of the species to pick up and ingest shiny metallic objects found laying on the ground. In the event of intact chaff bundles or flares falling to the ground in the course of training exercises, the presence of these objects may pose a risk to the health of individual cranes and, potentially, to the success of this reintroduction attempt. Therefore, an estimate of the incidence of the failure of chaff and/or flares to deploy as designed is of interest to the Service, as it would allow for the assessment of the risk to whooping cranes from objects of this type. This issue should be addressed within the EA, including an estimate of the expected probability and/or frequency that chaff bundles or flares would fail to deploy and, thus, fall to the ground intact.

As a result of the NEP designation, the Eastern U.S. NEP whooping cranes occurring on National Wildlife Refuge or National Park lands are considered of threatened status for purposes of section 7 consultation under the 1973 Endangered Species Act, as amended. Eastern U.S. NEP whooping cranes occurring on any other lands are treated as if they were proposed for listing for purposes of section 7 consultation. Accordingly, if whooping cranes from the Eastern U.S. NEP occurring on the Necedah NWR would be adversely affected by the proposed action, the Department of the Air Force should enter into formal consultation with the Service's Green Bay, Wisconsin, Ecological Services Field Office. If Eastern U.S. NEP whooping cranes would be adversely affected in areas other than on the National Wildlife Refuge, a conference, in accordance with section 7(a)(4) of the1973 Endangered Species Act, as amended, between the Department of the Air Force and the Service's Green Bay, Wisconsin, Ecological Services Field Office would be appropriate.

Other listed species within the project area
We have enclosed a list of the federally listed threatened or endangered species known to occur in the counties identified in your EA (i.e., either underlying the MOAs or adjacent counties). Following a review of the information in our files, we note that there are several inaccuracies and omissions regarding the federally listed threatened and endangered species listed as present

within your proposed project area. These discrepancies are noted below. The Final EA should be modified to reflect these changes.

On page 3-87, in the second paragraph, it is stated that the Canada lynx (*Lynx canadensis*) is listed by the State of Wisconsin as endangered. The lynx has been removed from the State's endangered species list, and is now considered a protected wild animal, with no open season. This species is also federally listed as threatened but is not known to occur in any of the counties within the identified project area.

Tables 3-63, 3-65 and 3-66 show the federally listed American burying beetle (*Nicrophorus americanus*) (listed here as the Giant Carrion Beetle) as occurring in or adjacent to these respective MOAs. This species has not been observed in Wisconsin since 1948 and is no longer considered to be extant in the State.

Table 3-63 incorrectly indicates that the American peregrine falcon (*Falco peregrinus*) is federally listed as endangered. The peregrine falcon was removed from the list of Federal threatened and endangered species on August 25, 1999. However, this species is still listed as endangered by the State of Wisconsin. The federally listed gray wolf (*Canis lupus*), Karner blue butterfly (*Lycaeides melissa samuelis*), Higgins' eye pearly mussel (*Lampsilis Higginsi*), and Kirtland's warbler (*Dendroica kirtlandii*) should be added to this table, as they occur in the counties underlying the Falls 1 and 2 MOAs.

The bald eagle (*Haliaeetus leucocephalus*), gray wolf, and Karner blue butterfly should be added, and the winged mapleleaf mussel (*Quadrula fragosa*) should be removed from table 3-64. Although historic records exist for this area, the winged mapleleaf mussel is now considered to be extant in Wisconsin only in the St. Croix River in Polk County.

The gray wolf and Karner blue butterfly should be added to table 3-65.

The bald eagle, Karner blue butterfly, and eastern prairie fringed orchid (*Platanthera leucophaea*) should be added to table 3-66.

SUMMARY COMMENTS

In summary, we believe that the ANG should clarify its future intent to analyze chaff and flare use in other MOAs in addition to that presented in this EA. This intent should be stated, either in a separate document or in the introductory portion of the subject EA. The ANG also should clarify any difference between the proposed action and actual current use of chaff and flares within the subject MOAs. In addition, the ANG should present a more detailed description of the methods used to estimate environmental impacts to aquatic resources, with a discussion of the rationale for use of these methods. Further analysis also should be presented to model a scenario where higher deposition rates may occur, as well as the consequences of worst-case scenarios. This analysis should include estimates of the expected frequency of chaff and flares

reaching the ground without deploying as designed, which could pose threats to water quality; aquatic organisms; and terrestrial animal life, especially whooping cranes. We also recommend that the section of the document which describes endangered and threatened species present in and adjacent to the subject MOAs be updated to correct the inaccuracies identified within this letter. The ANG should coordinate with the Service regarding these modifications and analyses prior to completing the Final EA so that any related issues can be resolved and the resolutions included in the Final EA.

Thank you for the opportunity to provide comments on this project. Questions pertaining to these comments and further coordination on the issues identified herein can be directed to Mr. Joel Trick of the Service's Green Bay, Wisconsin, Ecological Services Field Office. He can be reached by calling 920-465-7416.

Sincerely,

Charlie Wooley

Charles M. Wooley
Assistant Regional Director
Ecological Services

Enclosure

FEDERALLY LISTED THREATENED & ENDANGERED SPECIES KNOWN FROM SELECTED WISCONSIN COUNTIES

County	Species	Habitat
Adams	bald eagle (BE) Karner blue butterfly	Breeding & Wintering (B & W) prairie, oak savanna, and jack pine areas w/wild lupine
Clark	BE gray wolf Karner blue butterfly	B northern forested areas prairie, oak savanna, and jack pine areas w/wild lupine
Columbia	BE	W
Dodge	BE	B
Eau Claire	BE Karner blue butterfly gray wolf	B & W prairie, oak savanna, and jack pine areas w/wild lupine northern forested areas
Fond du Lac	No federally-listed species	
Green Lake	BE Karner blue butterfly	B prairie, oak savanna, and jack pine areas w/wild lupine
Jackson	BE Kirtland's warbler 1/ Karner blue butterfly gray wolf	B potential breeding in jack pine prairie, oak savanna, and jack pine areas w/wild lupine northern forested areas
Jefferson	eastern prairie fringed orchid	wet grasslands
Juneau	BE Karner blue butterfly gray wolf	B & W prairie, oak savanna, and jack pine areas w/wild lupine northern forested areas
La Crosse	BE Higgins' eye pearly mussel	B & W Mississippi River
Marathon	BE	B
Marquette	BE Karner blue butterfly	B prairie, oak savanna, and jack pine areas w/wild lupine
Monroe	northern monkshood Karner blue butterfly gray wolf	north facing slopes prairie, oak savanna, and jack pine area w/wild lupine northern forested areas
Outagamie	BE Karner blue butterfly	B & W prairie, oak savanna, and jack pine areas w/wild lupine
Portage	BE Fassett's locoweed Karner blue butterfly	B open sandy lakeshores prairie, oak savanna, and jack pine areas w/wild lupine

1/ Kirtland's warblers are not known to nest in Wisconsin. Singing males only were present in 1978, 1979, 1980, 1988, 1989, 1990, 1991, 1992, 1997, and 1998.

Shawano	BE Karner blue butterfly	B & W prairie, oak savanna, and jack pine areas w/wild lupine
Taylor	BE gray wolf	B northern forested areas
Trempealeau	BE Higgins' eye pearly mussel	W Mississippi River
Washington	No federally-listed species	
Waukesha	eastern prairie fringed orchid	wet grasslands
Waupaca	BE Karner blue butterfly	B & W prairie, oak savanna, and jack pine areas w/wild lupine
Waushara	BE Fassett's locoweed Karner blue butterfly	B open sandy lakeshores prairie, oak savanna, and jack pine areas, w/wild lupine
Winnebago	BE eastern prairie fringed orchid	B & W wet grasslands
Wood	BE Karner blue butterfly gray wolf	B prairie, oak savanna, and jack pine areas, w/wild lupine northern forested areas

Listed species
(E) = Endangered
(T) = Threatened
(B) = Breeding
(W) = Wintering

bald eagle (T)	Haliaeetus leucocephalus
Kirtland's warbler (E)	Dendroica kirtlandii
gray wolf (E)	Canis lupus
Karner blue butterfly (E)	Lycaeides melissa samuelis
Higgins' eye pearly mussel (E)	Lampsilis Higginsi
northern monkshood (T)	Aconitum noveboracense
Fassett's locoweed (T)	Oxytropis campestris var. chartacea
eastern prairie fringed orchid (T)	Platanthera leucophaea

The peregrine falcon (Falco peregrinus) was removed from the list of federal threatened and endangered species on August 25, 1999.

Joel Trick
05/02/2002 04:00 PM

To: Lyn MacLean/R3/FWS/DOI@FWS
cc:
Subject: Whooping Cranes and loose shiny objects

Lyn -

The following is in response to the question you posed to me today. Through my association with the eastern US whooping crane reintroduction project, I became aware that the potential ingestion of loose metal is a very real problem that is encountered in the captive whooping crane flock. The USGS Patuxent Wildlife Research Center is the location of the largest captive flock of whooping cranes, currently numbering more than 50 adults.

The curators there have emphasized the need for maintaining their facilities free from loose metal such as that produced during pen construction. They have gone so far as to use metal detectors to eliminate loose metal debris prior to moving cranes to the pens. When birds do ingest metal, it is sometimes necessary to operate to remove the object to save their life. No one knows why the birds tend to pick up metal this way, but it is quite different from the behavior of most other species in captivity.

I suggest that if you desire further information, you talk to Glenn Olsen at Patuxent at 301-497-5603, or alternately to George Gee at 301-497-5750.

Joel

-----Original Message-----
From: Cothern.Joe@epamail.epa.gov [mailto:Cothern.Joe@epamail.epa.gov]
Sent: Tuesday, January 29, 2002 1:27 PM
To: harry.knudsen@ang.af.mil
Cc: Duffy.Marguerite@epamail.epa.gov
Subject: EA - Deployment of chaff & flares in MOAs

Dear Mr. Knudsen,

Thank you for the opportunity to review the Environmental Assessment for Deployment of Chaff and Flares in Military Operations Areas (Phase I).

EPA Region 7 (Kansas City) offers the following:

Q: The EA is predicated upon current inventory chaff and flare units. What would be the re-opener thresholds for re-evaluating this action? (increased size of radar occlusion, flare burn duration)? Are any replacement units currently advancing through the research and development pipeline likely to trip such a threshold?

No response is requested. The questions are just supplied to assist in your decision to conclude a FONSI.

Joseph Cothern
NEPA Team Leader
Environmental Services Division
USEPA Region 7
901 N. 5th Street
Kansas City, Kansas 66101

(913) 551-7148

-----Original Message-----
From: Antosh, Cheryl C Ms ASA-I&E [mailto:Cheryl.Antosh@hqda.army.mil]
Sent: Friday, January 25, 2002 12:07 PM
To: Knudsen, HarryMrANG/CEVP
Subject: Draft Finding of No Significant Impact - Deployment of Chaff & Fl ares

Mr. Knudsen: Yesterday I received your letter to Mr. Phil Huber (Army) requesting comments on the Draft FONSI re deployment of chaff & flares. Unfortunately the post office at the Pentagon used the Brentwood facility as the main post office so your letter to us went to Ohio for irradiation & just arrived yesterday. I'm sure that we're probably very late in responding back to you but I thought I'd just let you know that we have no comments on your draft FONSI.

Cheryl Antosh
ODASA(ESOH), OASA(I&E)
110 Army Pentagon
Washington, DC 20310-0110
Room 1A909
703-692-9887
Cheryl.Antosh@hqda.army.mil

From: Knudsen, Harry [Harry.Knudsen@ang.af.mil]
Sent: December 20, 2001 8:21 AM
To: 'pconway@centurytel.net'
Cc: Farris, Ginny/WDC; Wilson, Keisha/WDC; 'brendan.smith@wicrtc.ang.af.mil'; Mitnik, Tammy; Welch, Pat - ANG/C4R; Lake, Bob - ANG/C4R; 'gunther.neumann@wicrtc.ang.af.mil'; Donovan, Tim (WI)
Subject: RE: Chaff use in Wisconsin.

Ms. Conway- Please allow me the opportunity to answer your questions on the referenced environmental assessment (EA). Let me preface this by saying the EA is based upon three relatively current (within the last five-six years) technical studies produced by the Air Force, Navy and GAO (Government Accounting Office). These reports suggest that the use of chaff does not result in significant effects on the human and natural environment. They also suggest that there may be some unique circumstance or feature in the human or natural environment that may not have been covered by the specific report, therefore, in order to be thorough to ensure all technical issues have been identified and analyzed and to have public input, the Air National Guard undertook this environmental assessment.

In the State of Wisconsin, according to Table 2-3, the anticipated number of chaff bundles that could potentially be employed is 140,341. This number assumes all aircraft will employ their total allotment of chaff every sortie or flight. Do we expect this to happen? No. We expect that somewhere between one-third and two-thirds of the chaff allocated per aircraft will be dispensed or somewhere between 45,000 and 95,000 bundles. We expect this because on each training flight it is difficult to perform all training events that would involve the deployment of chaff. It is theoretically possible, however, highly unlikely. I would like to thank you for pointing this out and we will correct the EA to reflect the above information.

The release of chaff in Wisconsin has occurred periodically over the last 40 years. In the last 10 years based upon Air Force guidance that chaff may be an environmental issue due to the relative lack of scientific data, chaff has not been used in the military operations areas (MOAs) or military training routes (MTRs). Chaff has been dropped on an infrequent basis over the actual range (Hardwood Range), however, in recent years due to changing tactics, the dropping of chaff over the range has ceased because the training value is minimal. The projected use for the year 2000 is also incorrect. This is the anticapated release for the year once the environmental assessment process has been completed and a decision reached. Again, thank you for bringing this to our attention and we will make the appropriate correction. As our contractor indicated to you, we did put out Notices of Availability for this EA and invite all comments and information. Please forward the materials we have provided you as you deem appropriate or please provide us with the names and addresses of groups that may be interested.

If you have any further questions, please contact me at your earliest convenience. Thank you.

-----Original Message-----
From: Wilson, Keisha/WDC [mailto:kwilson1@CH2M.com]
Sent: Wednesday, November 28, 2001 1:44 PM

To: Harry Knudsen (E-mail)
Cc: Farris, Ginny/WDC
Subject: RE: Chaff use in Wisconsin.

Harry,

Today I received a call from Ms. Pat Conway who is with the Coalition for Peaceful Skies in Wisconsin, and whom had already requested, and we've sent a copy of the EA to.

She has three questions...

1. In Table 2-3 in the EA the number of "projected" chaff rounds are listed. Her concern was the large numbers of chaff that was projected for the MOAs in Wisconsin, and she was wondering that if these numbers are projected, were they actually used in 2000 and if so, has a request for the approval of the use of chaff in these MOA areas been issued?

2. In the Table 2-3, under Notes: No. 4 refers to the number of chaffs- "Not currently used; number is projected" - does this mean that they have never been used?

3. If Table 2-3 refers to the projected number of chaffs to be used in 2000, she wants to know why are we seeking approval to use the chaffs in 2001?

She also asked why other environmental groups in Wisconsin have not received letters concerning the Notice of Availablity of the report. I informed her that NOA have been published in the major newspapers within the MOA areas and that hardcopies of the report has been placed in the local libraries within the MOAs.

Her email address is: pconway@centurytel.net
I've also directed her to you for any future questions she may have.

Keisha Wilson
CH2M HILL, Inc.
Herndon, Va
phone: 703-471-6405 x4127
fax: 703-471-1508
kwilson1@ch2m.com

From: Knudsen, Harry [Harry.Knudsen@ang.af.mil]
Sent: January 04, 2002 3:23 PM
To: 'patconway@centurytel.net'
Cc: Wilson, Keisha/WDC; Farris, Ginny/WDC; 'brenden.smith@wicrtc.ang.af.mil'; 'gunther.neumann@wicrtc.ang.af.mil'; Donovan, Tim (WI); Welch, Pat - ANG/C4R; Lake, Bob - ANG/C4R; Mitnik, Tammy
Subject: RE: Chaff use in Wisconsin.

Dear Pat- I hope you had a good holiday season and please feel free to contact me on any issue you feel I may be able to assist. I think that your summary is relatively accurate. Chaff has been used in the United States starting in the 1950's for sure. Military aircraft that could have dropped chaff in the state of Wisconsin have existed since that time and were based in locations where they could have flown over Wisconsin. Did these aircraft drop chaff in the state? I do not believe we have a 100% certain response but it is a very reasonable assumption to make. I say this because I know of no records to say one way or another. We are more confident in stating that once the military training airspace (MOAs and MTRs) were established, chaff was dropped over those areas until the early 1990s. Once the guidance from USAF was received, military units flying in airspace scheduled by Volk Field ceased dropping chaff with the exception of some infrequent drops over the Hardwood Range. This activity has also ceased since there was little training value that could be gained.

I have included the e-mail address for my contact at Volk Field, Major Brenden Smith and the State Public Affairs Officer, Lt Col Tim Donovon. I also included the Commander at Volk Field, Col Gunther Neumann. I believe they are the persons that can assist you. If I can be of any further service, please contact me at your earliest convenience. Thanks.

-----Original Message-----
From: Wilson, Keisha/WDC [mailto:kwilson1@CH2M.com]
Sent: Thursday, December 20, 2001 12:22 PM
To: Harry Knudsen (E-mail)
Cc: Farris, Ginny/WDC
Subject: FW: Chaff use in Wisconsin.

-----Original Message-----
From: Pat Conway [mailto:patconway@centurytel.net]
Sent: December 20, 2001 2:18 PM
To: Wilson, Keisha/WDC
Subject: Re: Chaff use in Wisconsin.

Thank you for your reply.
Just to be clear, please verify that I have summarized correctly your e-mail to me.

1. The use of chaff in Wisconsin began in the 1960's.
2. From the 1960's to 1991, chaff WAS DROPPED over MOA's and MTR's.
3. Absolutely NO CHAFF WAS DROPPED over MTR's and MOA's from 1991 to the present.
4. From 1991 to the present, Chaff was dropped over the Harwood Bombing Range, but infrequently.
5. In recent years, no chaff at all has been dropped over the Harwood Range, or anywhere in Wisconsin.

Please clarify:
In the EA on Table 2-3 it says for Wisconsin: "Not currently used." What year did chaff use begin in Wisconsin, and what year was it limited to use over the Harwood Range only and what year was it terminated from use in Wisconsin all together? Is there a contact person at the Harwood Range who can answer the many other questions I have regarding the use of Chaff in Wis?
I would greatly appreciate an e-mail address for the local PR person at the Harwood Range who can follow-up with me.
Thank you so much for taking the time to work with me on this issue. I know your days are full, and I present an extra burden on your time. I prefer to work with local ANG people when possible in order to lessen the demands on you.
Happy Holidays and best regards,
Pat Conway

> From: Wilson, Keisha/WDC <kwilson1@CH2M.com>
> To: 'patconway@centurytel.net'
> Subject: FW: Chaff use in Wisconsin.
> Date: Thursday, December 20, 2001 6:15 AM
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> From: Knudsen, Harry [mailto:Harry.Knudsen@ang.af.mil]
> Sent: December 20, 2001 8:21 AM
> To: 'pconway@centurytel.net'
> Cc: Farris, Ginny/WDC; Wilson, Keisha/WDC;
> 'brendan.smith@wicrtc.ang.af.mil'; Mitnik, Tammy; Welch, Pat - ANG/C4R;
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> referenced environmental assessment (EA). Let me preface this by saying the
> EA is based upon three relatively current (within the last five-six years)
> technical studies produced by the Air Force, Navy and GAO (Government
> Accounting Office). These reports suggest that the use of chaff does not
> result in significant effects on the human and natural environment. They
> also suggest that there may be some unique circumstance or feature in the
> human or natural environment that may not have been covered by the specific
> report, therefore, in order to be thorough to ensure all technical issues
> have been identified and analyzed and to have public input, the Air National
> Guard undertook this environmental assessment.
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> In the State of Wisconsin, according to Table 2-3, the anticipated number of
> chaff bundles that could potentially be employed is 140,341. This number
> assumes all aircraft will employ their total allotment of chaff every sortie

> or flight. Do we expect this to happen? No. We expect that somewhere
> between one-third and two-thirds of the chaff allocated per aircraft will
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> events that would involve the deployment of chaff. It is theoretically
> possible, however, highly unlikely. I would like to thank you for
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> The release of chaff in Wisconsin has occurred periodically over the last
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> years. In the last 10 years based upon Air Force guidance that chaff may
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> Notices of Availability for this EA and invite all comments and
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> Keisha Wilson
> CH2M HILL, Inc.
> Herndon, Va
> phone: 703-471-6405 x4127
> fax: 703-471-1508
> kwilson1@ch2m.com

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> the actual range (Hardwood Range), however, in recent years due to changing
> tactics, the dropping of chaff over the range has ceased because the
> training value is minimal. The projected use for the year 2000 is also
> incorrect. This is the anticapated release for the year once the
> environmental assessment process has been completed and a decision reached.
> Again, thank you for bringing this to our attention and we will make the
> appropriate correction. As our contractor indicated to you, we did put out
> Notices of Availability for this EA and invite all comments and information.
> Please forward the materials we have provided you as you deem appropriate or
> please provide us with the names and addresses of groups that may be
> interested.
>
> If you have any further questions, please contact me at your earliest
> convenience. Thank you.
>
>
>
> -----Original Message-----
> From: Wilson, Keisha/WDC [mailto:kwilson1@CH2M.com]
> Sent: Wednesday, November 28, 2001 1:44 PM

> To: Harry Knudsen (E-mail)
> Cc: Farris, Ginny/WDC
> Subject: RE: Chaff use in Wisconsin.
>
>
> Harry,
>
> Today I received a call from Ms. Pat Conway who is with the Coalition for
> Peaceful Skies in Wisconsin, and whom had already requested, and we've
sent
> a copy of the EA to.
>
> She has three questions...
>
> 1. In Table 2-3 in the EA the number of "projected" chaff rounds are
> listed. Her concern was the large numbers of chaff that was projected
for
> the MOAs in Wisconsin, and she was wondering that if these numbers are
> projected, were they actually used in 2000 and if so, has a request for
the
> approval of the use of chaff in these MOA areas been issued?
>
> 2. In the Table 2-3, under Notes: No. 4 refers to the number of chaffs-
> "Not currently used; number is projected" - does this mean that they have
> never been used?
>
> 3. If Table 2-3 refers to the projected number of chaffs to be used in
> 2000, she wants to know why are we seeking approval to use the chaffs in
> 2001?
>
> She also asked why other environmental groups in Wisconsin have not
received
> letters concerning the Notice of Availablity of the report. I informed
her
> that NOA have been published in the major newspapers within the MOA areas
> and that hardcopies of the report has been placed in the local libraries
> within the MOAs.
>
> Her email address is: pconway@centurytel.net
> I've also directed her to you for any future questions she may have.
>
>
> Keisha Wilson
> CH2M HILL, Inc.
> Herndon, Va
> phone: 703-471-6405 x4127
> fax: 703-471-1508
> kwilson1@ch2m.com

FAX TRANSMITTAL # of pages ► 9

To GINNY FALLS	From HARRY KNUDSON
Dept./Agency ORKEISHA WILSON	Phone # 301-836-8143
Fax # 703-~~796-6152~~ 471-1508	Fax #
NSN 7540-01-317-7368 5099-101	GENERAL SERVICES ADMINISTRATION

703-796-615

FAXFORM - REGION 3

U. S. FISH AND WILDLIFE SERVICE
Federal Building, 1 Federal Drive
Fort Snelling, Minnesota 55111-4056

PAGE 1 OF 9 PAGES

DATE: 5/4/02

TO: Mr. Harry A. Knudsen, Jr. FAX: 301/836-8151

FROM: Mr. Lyn MacLean (ES/HC-Project and Permit Review) PHONE: 612/713-5330
FAX: -5292

SUBJECT: FWS comments re: Draft FONSI & EA for Chaff & Flare deployment

After our phone conversation on Friday, I decided it would be better if I finalized the comment letter rather than just forward the draft comments from our Green Bay Field Office. We were able to finish it and have it signed late Friday. Today I was able to find the original T&E enclosure sheets from the field office and not have to use their faxed copy. I've also attached to this fax a copy of the Email message from Joel Trick with the contact names and phone numbers I gave to you yesterday for more information on the habit of whooping cranes ingesting metal objects.

If you have any questions concerning our comments that need immediate attention, Joel and I will both be out of the office the entire week of May 6 at a Federal Program Activities National Workshop being held in Scottsdale. We can probably be reached by leaving a message for me at the Holiday Inn - Old Town, phone 480-994-9203.

The original hard copy of our comments will be sent to you by regular mail on Monday.

I apologize for being so late in getting our comments to you,

Lyn MacLean

Form R3-195

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Bishop Henry Whipple Federal Building
1 Federal Drive
Fort Snelling, MN 55111-4056

IN REPLY REFER TO:

FWS/AES-HC

MAY 3 2002

Mr. Harry A. Knudsen, Jr.
Chief, Environmental Planning Branch
ANG/CEVP
3500 Fetchet Avenue
Andrews Air Force Base, Maryland 20762-5157

Dear Mr. Knudsen:

The U.S. Fish and Wildlife Service (Service) has reviewed the Draft Finding of No Significant Impact (FONSI) and Draft Final Environmental Assessment (EA) dated October 2001, for Chaff and Flare deployment by the Air National Guard (ANG) in multiple Military Operations Areas (MOAs) nationwide, including five separate MOAs in Wisconsin. We offer the following comments relative to this proposed action to endangered species, National Wildlife Refuge lands, and aquatic habitats.

GENERAL COMMENTS

Overall, we believe the document presents the proposed action in an adequate fashion, with the exception of a number of areas which require further elaboration. These specific items are discussed below. Another question is whether the proposal analyzed in this EA is part of a larger proposal which will ultimately include an unknown number of other MOAs, to be collectively analyzed in several documents. The lack of a clear statement of this intent makes it difficult to put the proposed action into the proper perspective on a national scale and in terms of consistency with the National Environmental Policy Act. We suggest the need for clarification and, possibly, an additional document which adequately describes the intent of the ANG, as well as a clear description of the intended plan for conducting these analyses.

SPECIFIC COMMENTS

Alternatives
The Preferred Alternative, as presented in the document, is that of Current Operations. However, it is unclear as to whether or not chaff is currently used in Wisconsin MOAs. According to the General Accounting Office Report, *DOD Management Issues Related to Chaff*, dated September 1998, Wisconsin is not shown as a State where chaff is used. Based upon this information, it appears as though "Current Operations" are those of no chaff use in at least some of the subject MOAs. We request further clarification and coordination regarding what current operations

actually are. We would like to resolve any questions and potential issues we may have pertaining to actions included as current operations prior to preparation of the Final EA.

Environmental Consequences
The information presented within the EA makes it difficult to determine the potential impacts to Service trust resources. For example, table 4-13 presents the deposition rates for chaff and flares within each MOA, based upon the expected amount of materials used, and the total area of each of the MOAs. This apparently assumes an equal distribution of these materials throughout each MOA. While this scenario may be a reasonable assumption, no supporting information is presented to explain why this may be the case. In the FONSI, it is stated that the analysis of effects to aquatic life is ". . . based on realistic estimates of deposition rates . . ." (section 3, Environmental Effects, third paragraph). We can not find any reference within the EA to how these "realistic estimates" were made. At the least, the methods used to conduct this analysis should be described, along with a rationale for why this analysis is appropriate.

A realistic analysis also should make some general estimate for deposition rates within high use areas, such as near the Hardwood Bombing Range in Wisconsin, as well as presenting a worse-case scenario based upon the potential failure of chaff bundles and flares to deploy as intended. This worst-case scenario also should consider the fact that the pH levels encountered in central Wisconsin wetlands and water bodies tend to be low, an environmental condition which has been demonstrated to increase the toxicity of aluminum in the water column and to increase the leaching rate of magnesium, barium and chromium from flares.

This information could then be used for the types of analyses presented within tables 4-14 through 4-16, where the impacts to aquatic life from chaff and flare deployment are estimated. It would be helpful to estimate the expected likelihood or incidence of chaff bundles and flares reaching the ground without dispersing or igniting, and to also model the resulting local impacts to typical small wetlands or water bodies. This information would allow us to assess the potential impacts to aquatic habitats on the nearby Necedah National Wildlife Refuge (NWR), which is located within the Volk West MOA, just to the west of the Hardwood Bombing Range and along the major flight approach path to the range.

Federal Threatened and Endangered Species
Due to the lack of the specific information discussed above, we are unable to determine at this time whether your project is likely to adversely affect federally listed threatened or endangered species. We will evaluate your project again following the receipt of the requested information and provide a determination at that time. Any further informal or formal consultation or conference regarding impacts to Federal threatened or endangered species should be completed prior to completion of the Final EA.

Whooping crane
The Service is concerned about the potential for adverse effects from chaff and flare use to the whooping crane (*Grus americana*). Following the recommendation of the International

Whooping Crane Recovery Team, the Service recently completed a rulemaking process that designated a Nonessential Experimental Population (NEP) of this species in a large area of the Eastern United States including Wisconsin. The action was a necessary prerequisite to implementing the recommended recovery action of establishing an additional migratory population of whooping cranes in the Eastern U.S.

Reintroduction of the species into the Eastern U.S. NEP area was begun in 2001 with the release of a small group of whooping cranes which were reared at the Necedah NWR. This initial cohort of whooping crane chicks was led behind an ultralight aircraft to the selected wintering site in east-central Florida during the fall of 2001. Its was expected that the cranes would return to the Wisconsin release site of their own accord in the spring of 2002, which four of them have now done. A fifth crane has also reached Wisconsin but has not continued all the way to the release site. Releases are planned for at least 5 years, with the goal of establishing a self-sustaining population of 125 whooping cranes, consisting of a minimum of 25 breeding pairs.

One characteristic of whooping cranes noted in captive breeding flocks is the tendency of the species to pick up and ingest shiny metallic objects found laying on the ground. In the event of intact chaff bundles or flares falling to the ground in the course of training exercises, the presence of these objects may pose a risk to the health of individual cranes and, potentially, to the success of this reintroduction attempt. Therefore, an estimate of the incidence of the failure of chaff and/or flares to deploy as designed is of interest to the Service, as it would allow for the assessment of the risk to whooping cranes from objects of this type. This issue should be addressed within the EA, including an estimate of the expected probability and/or frequency that chaff bundles or flares would fail to deploy and, thus, fall to the ground intact.

As a result of the NEP designation, the Eastern U.S. NEP whooping cranes occurring on National Wildlife Refuge or National Park lands are considered of threatened status for purposes of section 7 consultation under the 1973 Endangered Species Act, as amended. Eastern U.S. NEP whooping cranes occurring on any other lands are treated as if they were proposed for listing for purposes of section 7 consultation. Accordingly, if whooping cranes from the Eastern U.S. NEP occurring on the Necedah NWR would be adversely affected by the proposed action, the Department of the Air Force should enter into formal consultation with the Service's Green Bay, Wisconsin, Ecological Services Field Office. If Eastern U.S. NEP whooping cranes would be adversely affected in areas other than on the National Wildlife Refuge, a conference, in accordance with section 7(a)(4) of the1973 Endangered Species Act, as amended, between the Department of the Air Force and the Service's Green Bay, Wisconsin, Ecological Services Field Office would be appropriate.

Other listed species within the project area

We have enclosed a list of the federally listed threatened or endangered species known to occur in the counties identified in your EA (i.e., either underlying the MOAs or adjacent counties). Following a review of the information in our files, we note that there are several inaccuracies and omissions regarding the federally listed threatened and endangered species listed as present

within your proposed project area. These discrepancies are noted below. The Final EA should be modified to reflect these changes.

On page 3-87, in the second paragraph, it is stated that the Canada lynx (*Lynx canadensis*) is listed by the State of Wisconsin as endangered. The lynx has been removed from the State's endangered species list, and is now considered a protected wild animal, with no open season. This species is also federally listed as threatened but is not known to occur in any of the counties within the identified project area.

Tables 3-63, 3-65 and 3-66 show the federally listed American burying beetle (*Nicrophorus americanus*) (listed here as the Giant Carrion Beetle) as occurring in or adjacent to these respective MOAs. This species has not been observed in Wisconsin since 1948 and is no longer considered to be extant in the State.

Table 3-63 incorrectly indicates that the American peregrine falcon (*Falco peregrinus*) is federally listed as endangered. The peregrine falcon was removed from the list of Federal threatened and endangered species on August 25, 1999. However, this species is still listed as endangered by the State of Wisconsin. The federally listed gray wolf (*Canis lupus*), Karner blue butterfly (*Lycaeides melissa samuelis*), Higgins' eye pearly mussel (*Lampsilis Higginsi*), and Kirtland's warbler (*Dendroica kirtlandii*) should be added to this table, as they occur in the counties underlying the Falls 1 and 2 MOAs.

The bald eagle (*Haliaeetus leucocephalus*), gray wolf, and Karner blue butterfly should be added, and the winged mapleleaf mussel (*Quadrula fragosa*) should be removed from table 3-64. Although historic records exist for this area, the winged mapleleaf mussel is now considered to be extant in Wisconsin only in the St. Croix River in Polk County.

The gray wolf and Karner blue butterfly should be added to table 3-65.

The bald eagle, Karner blue butterfly, and eastern prairie fringed orchid (*Platanthera leucophaea*) should be added to table 3-66.

SUMMARY COMMENTS

In summary, we believe that the ANG should clarify its future intent to analyze chaff and flare use in other MOAs in addition to that presented in this EA. This intent should be stated, either in a separate document or in the introductory portion of the subject EA. The ANG also should clarify any difference between the proposed action and actual current use of chaff and flares within the subject MOAs. In addition, the ANG should present a more detailed description of the methods used to estimate environmental impacts to aquatic resources, with a discussion of the rationale for use of these methods. Further analysis also should be presented to model a scenario where higher deposition rates may occur, as well as the consequences of worst-case scenarios. This analysis should include estimates of the expected frequency of chaff and flares

reaching the ground without deploying as designed, which could pose threats to water quality; aquatic organisms; and terrestrial animal life, especially whooping cranes. We also recommend that the section of the document which describes endangered and threatened species present in and adjacent to the subject MOAs be updated to correct the inaccuracies identified within this letter. The ANG should coordinate with the Service regarding these modifications and analyses prior to completing the Final EA so that any related issues can be resolved and the resolutions included in the Final EA.

Thank you for the opportunity to provide comments on this project. Questions pertaining to these comments and further coordination on the issues identified herein can be directed to Mr. Joel Trick of the Service's Green Bay, Wisconsin, Ecological Services Field Office. He can be reached by calling 920-465-7416.

Sincerely,

Charlie Wooley

Charles M. Wooley
Assistant Regional Director
Ecological Services

Enclosure

FEDERALLY LISTED THREATENED & ENDANGERED SPECIES KNOWN FROM SELECTED WISCONSIN COUNTIES

County	Species	Habitat
Adams	bald eagle (BE) Karner blue butterfly	Breeding & Wintering (B & W) prairie, oak savanna, and jack pine areas w/wild lupine
Clark	BE gray wolf Karner blue butterfly	B northern forested areas prairie, oak savanna, and jack pine areas w/wild lupine
Columbia	BE	W
Dodge	BE	B
Eau Claire	BE Karner blue butterfly gray wolf	B & W prairie, oak savanna, and jack pine areas w/wild lupine northern forested areas
Fond du Lac	No federally-listed species	
Green Lake	BE Karner blue butterfly	B prairie, oak savanna, and jack pine areas w/wild lupine
Jackson	BE Kirtland's warbler 1/ Karner blue butterfly gray wolf	B potential breeding in jack pine prairie, oak savanna, and jack pine areas w/wild lupine northern forested areas
Jefferson	eastern prairie fringed orchid	wet grasslands
Juneau	BE Karner blue butterfly gray wolf	B & W prairie, oak savanna, and jack pine areas w/wild lupine northern forested areas
La Crosse	BE Higgins' eye pearly mussel	B & W Mississippi River
Marathon	BE	B
Marquette	BE Karner blue butterfly	B prairie, oak savanna, and jack pine areas w/wild lupine
Monroe	northern monkshood Karner blue butterfly gray wolf	north facing slopes prairie, oak savanna, and jack pine area w/wild lupine northern forested areas
Outagamie	BE Karner blue butterfly	B & W prairie, oak savanna, and jack pine areas w/wild lupine
Portage	BE Fassett's locoweed Karner blue butterfly	B open sandy lakeshores prairie, oak savanna, and jack pine areas w/wild lupine

1/ Kirtland's warblers are not known to nest in Wisconsin. Singing males only were present in 1978, 1979, 1980, 1988, 1989, 1990, 1991, 1992, 1997, and 1998.

Shawano	BE Karner blue butterfly	B & W prairie, oak savanna, and jack pine areas w/wild lupine
Taylor	BE gray wolf	B northern forested areas
Trempealeau	BE Higgins' eye pearly mussel	W Mississippi River
Washington	No federally-listed species	
Waukesha	eastern prairie fringed orchid	wet grasslands
Waupaca	BE Karner blue butterfly	B & W prairie, oak savanna, and jack pine areas w/wild lupine
Waushara	BE Fassett's locoweed Karner blue butterfly	B open sandy lakeshores prairie, oak savanna, and jack pine areas, w/wild lupine
Winnebago	BE eastern prairie fringed orchid	B & W wet grasslands
Wood	BE Karner blue butterfly gray wolf	B prairie, oak savanna, and jack pine areas, w/wild lupine northern forested areas

Listed species
(E) = Endangered
(T) = Threatened
(B) = Breeding
(W) = Wintering

bald eagle (T)	Haliaeetus leucocephalus
Kirtland's warbler (E)	Dendroica kirtlandii
gray wolf (E)	Canis lupus
Karner blue butterfly (E)	Lycaeides melissa samuelis
Higgins' eye pearly mussel (E)	Lampsilis Higginsi
northern monkshood (T)	Aconitum noveboracense
Fassett's locoweed (T)	Oxytropis campestris var. chartacea
eastern prairie fringed orchid (T)	Platanthera leucophaea

The peregrine falcon (Falco peregrinus) was removed from the list of federal threatened and endangered species on August 25, 1999.

Joel Trick
05/02/2002 04:00 PM

To: Lyn MacLean/R3/FWS/DOI@FWS
cc:
Subject: Whooping Cranes and loose shiny objects

Lyn -

The following is in response to the question you posed to me today. Through my association with the eastern US whooping crane reintroduction project, I became aware that the potential ingestion of loose metal is a very real problem that is encountered in the captive whooping crane flock. The USGS Patuxent Wildlife Research Center is the location of the largest captive flock of whooping cranes, currently numbering more than 50 adults.

The curators there have emphasized the need for maintaining their facilities free from loose metal such as that produced during pen construction. They have gone so far as to use metal detectors to eliminate loose metal debris prior to moving cranes to the pens. When birds do ingest metal, it is sometimes necessary to operate to remove the object to save their life. No one knows why the birds tend to pick up metal this way, but it is quite different from the behavior of most other species in captivity.

I suggest that if you desire further information, you talk to Glenn Olsen at Patuxent at 301-497-5603, or alternately to George Gee at 301-497-5750.

Joel

From: Knudsen, Harry [Harry.Knudsen@ang.af.mil]
Sent: May 29, 2002 3:22 PM
To: 'Mike.Mixon@faa.gov'
Cc: Farris, Ginny/WDC; Wilson, Keisha/WDC; Welch, Pat - ANG/C4R
Subject: RESPONSE TO FAA MEMORANDUM, JAN. 8, 2002

ACTION: Draft Finding of No Significant Impact for the Environmental Assessment for Deployment of Chaff and Flares in Military Operations Areas (Phase I)

Please regard this message as a response to comments, questions and issues raised in the subject Memorandum.

1. The Environmental Assessment for the Establishment of Juniper Low Military Operations Areas. Aside from this MOA, there was quite a bit of confusion over where and where not chaff and/or flares are currently being released. The Tables reflecting this information have been separated to ensure the reader can easily distinguish where and where not chaff/flares are being deployed.

2. The proposal for the Realignment of Military Operation and Warning Areas for the 173rd Fighter Wing in Oregon. See the above answer.

3. The Draft Environmental Impact Statement (DEIS) for the Proposed Training Range in Montana. The issue of chaff deployment has a little bit of history that will be included in the final EA. Basically the DoD has been deploying chaff for a large number of years, at least from the early 1950s and perhaps earlier. The USAF came forth with a letter/message in the early 1990s (I couldn't find a copy), that basically stated the USAF had reason to believe that chaff may be an environmental issue that would require some analysis. They left it up to each command on how to address the issue. The ANG decided to let units continue deploying chaff in airspace where the deployment was already occurring and in new areas, environmental documentation would be required. Shortly after this message was received by all USAF commands, ACC initiated a "Technical Study" on chaff. This effort was completed in the late 1990s along with similar studies conducted by the Navy and GAO. The general recommendation as a result of these studies was that chaff appeared to have no significant impact to the human or natural environment, however, prior to initiating chaff deployment in new areas, some form of further environmental documentation may be needed. The ANG decided to use the NEPA process not only for new areas but included some areas that deployment is already occurring to ensure no unique or special issues that were not covered in the technical documents were occurring. This process also allows full public and agency input since we do not believe we know everything regarding issues that may be connected to chaff deployment. We broke this action into two programmatic documents covering numerous areas in the United States.

Hays MOA was not included in these efforts since they are a unit that has utilized chaff deployment for a number of years, even prior to the enactment of NEPA. Their continued use of chaff would be a Categorical Exclusion from further analysis under current USAF instructions. That is not to say we will [not] include them in a future effort of this kind but we have no reason to believe their use of chaff is having any impact on the natural and human environment under Hays MOA. If, as a result of these two efforts, issues arise that are applicable to Hays MOA, we will perform appropriate environmental documentation at that time.

If there are any further questions, please contact at your earliest convenience.

Harry A. Knudsen, Jr.
Chief, Environmental Planning Branch
301-836-8143
301-836-8151 (FAX)
email: Harry.Knudsen@ang.af.mil

APPENDIX A
Table A-1
Response to Comments Received on the Phase I Draft EA for Chaff and Flares

Person Making the Comment	#	Section	Comment/Topic	Response to Comment
Pat Conway (Peaceful Skies in Wisconsin)		2.1	Clarify ongoing versus proposed use of chaff and flares in Wisconsin MOAs	Chaff is not currently used in the Wisconsin MOAs (Volk and Falls). Chaff was dropped over those areas from the time that the military training airspace (MOAs and MTRs) were established until the early 1990s. After the guidance from USAF was received, military units flying in airspace scheduled by Volk Field ceased dropping chaff with the exception of some infrequent drops over the Hardwood Range. This activity has also ceased, since there was little training value that could be gained. Text in sections 1.3.2 and 2.1, as well as Tables 1-4, 2-3 and 2-4, have been revised to clarify this point. ANG proposes to resume the previous use of chaff during (ongoing) training exercises in these MOAs.
WI DNR (Wisconsin Department of Natural Resources)	1	3.7	Wisconsin MOA description is incomplete. - Describe in more detail environmental settings in Falls 1&2, and Volk MOAs. - Mention whooping crane migratory flock in the Necedah National Wildlife Refuge	The text in section 3.7 was modified to more fully describe the environmental setting of the MOAs. A sentence was added to include Glacial Lake Wisconsin, and the description of topography was changed to flat and poorly drained. The Land Use and Visual Resources section was expanded to include more public recreation lands. The contribution that public lands provide to regional economies has been included on Page 3-107. Pattison State Park is not included in the text, as it is not located near the MOAs and is therefore inappropriate. The Karner Blue butterfly has been added to Tables 3-63 through 3-66. The Biological Resources section has been modified to include the efforts to establish a migratory flock of whooping cranes with summer nesting grounds at Necedah National Wildlife Refuge.
WI DNR	2	2.1 and 4.2	Disproportionate Amount of Chaff and Flare Use over Wisconsin MOAs. - Why there is a heavy use of chaff/flare in the Wisconsin MOAs as compared to rest of nation? - What are the safety precautions and procedures taken with chaff use.	There are three reasons for the apparently disproportionate amount of chaff and flare use over Wisconsin. First, because the MOAs listed in Table 2-2 are not all of the MOAs in the United States, the total number of aircraft sorties in Wisconsin does not represent 39% of the nationwide totals, nor do the amounts of chaff and flares used in Wisconsin represent 65% and 64%, respectively, of the nationwide totals. Second, the Wisconsin MOAs based their chaff estimates on the amount of chaff they could use, not the amount they actually use. The actual amount of chaff used is likely to be 1/3 to 2/3 of this total (e.g., 40,000 to 95,000 chaff bundles as opposed to 140,000). Third, flare deployment is biased toward weapons-release points such as Hardwood Bombing Range. Because a greater number of flares are deployed in this area, it follows that more dud flares will be deployed there, as well. Finally, dud flare density would be lower in populated areas due to the presence of a bombing range, which receives a greater proportion of flares compared to areas of even distribution. Safety measures for chaff have been added to Section 4.4.1. Suggested new tables, 4-7a and 4-9a, cannot be created because the information contained

Person Making the Comment	#	Section	Comment/Topic	Response to Comment
				within them was obtained from the Air Force and is not MOA-specific. It is based on 10 years of accident data collected Air Force-wide.
WI DNR	3	1.5	Deployment of Flares over Non-DoD Lands. - Important when considering potential safety risk and potential for biological or wildfire impacts from dud flares. - Can flares be released anywhere within the MOAs?	Incorporated to Section 4.1.3. Regulations restrict the use of flares to government-controlled land or military-owned land and the deployment altitude over non-government property to 2,000 feet above ground level. Safety measures, such as the 2,000 feet AGL minimum altitude for deployment, have been put into place to minimize the chance that public safety will be significantly affected by training exercises involving flares.
WI DNR	4	NA	Potential Risk of Flare Induced Wildfire. - Agree that risk of flare induced wildfire is low. - Pleased with past WANG cooperation with WDNR forest fire protection efforts.	No response required.
WI DNR	5	4.2	Biological Resource Impacts. - Estimated deposition rates indicate no significant impact potential, but they are not conclusive. - The risk of chaff impact could substantially vary from one MOA to another or within certain areas of a MOA, such as near the Hardwood Range in Wisconsin. Page 2-1 is confusing as to general chaff release altitude. The average release elevation should be clarified.	Extremely conservative assumptions were used to estimate deposition rates in small, isolated fresh water bodies. For example, it was assumed that all of the aluminum, magnesium and boron in the chaff and flares deployed annually enters the water column and is bioavailable (i.e., physical/chemical conditions that cause maximum bioavailability of metals). Because the Wisconsin MOAs have the (potential) maximum annual deposition rates of chaff and flares, they represent the "worst-case scenario" and were used as such in the presentation. This is why it is not necessary to develop Tables 4-14 to 4-18 for each MOA. Even in this "worst-case," modeled surface water concentrations are 1.5 percent or less of the chronic freshwater values. While chaff use is randomly distributed throughout the MOA, flare use may be more concentrated around Hardwood Bombing Range, because it is a weapons release point. However, there would need to be a 1,000-fold increase in flare use to cause surface water concentrations in this area (or any other sub-MOA area) to exceed water quality criteria, assuming metals leached from flares are bioavailable in the water column. In addition, there is a water quality monitoring program in place at Hardwood Bombing Range, and any problems suggested by data from this program would be evaluated as needed. Page 2-1 has been amended regarding chaff release altitudes. Average altitude of release is 10,000 to 25,000 AGL. Some training regimes involve lower-altitude releases, which varies between aircraft and ANG units, but the bulk of chaff is released at the average altitudes indicated. Based on the data in the NRL study, a difference of 1,000 feet in altitude results in a difference of about 2 miles of dispersal distance. Also, it should be noted that "above ground level" (AGL) does not refer to sea level as the baseline.
WI DNR	6	NA	Alternatives Analysis. - One alternative not considered is to restrict chaff/flare release in area(s) within any given MOA to minimize potential safety, biological, wildfire or other risks. - EA should identify a process allowing for identification of sensitive areas, within a safe buffer zone, to allow for	We agree that there are diverse mosaics of varying land use within each MOA. However, we also recognize that it would be extremely difficult to restrict chaff and flare use to particular portions within a MOA. Because most areas could be considered sensitive to risk in some manner, it would be difficult to establish a basis for determining where to restrict or prohibit use in particular portions of MOAs. It might not even be operationally possible. Furthermore, the buffers needed to compensate for the drift factor would be so

Person Making the Comment	#	Section	Comment/Topic	Response to Comment
			drift, where chaff/flare releases should be prohibited or restricted.	large that partitioning off the MOAs in this way would be nearly impossible.
USFWS (U.S. Fish and Wildlife Service) Region 3	1	1.3 and 2.1	The ANG should clarify its future intent to analyze chaff and flare use in other MOAs in addition to that presented in this EA. This intent should be stated, either in a separate document or in the introductory section of the EA. It is unclear as to whether or not chaff is currently used in Wisconsin… Request further clarification and coordination regarding what current operations (Preferred Alternative) actually are.	Overview of environmental documentation for chaff and flare use has been added to section 1.1. See Pat Conway comment above. Chaff use in Wisconsin is proposed to be resumed, after being discontinued in the 1990s pending environmental documentation. Training flights and use of flares in the Wisconsin MOAs are currently ongoing. Sections 1.3.2 and 2.1, and Tables 1-4, 2-3 and 2-4, have been revised to clarify this point.
USFWS Region 3	2	4.6.2	Environmental Consequences. This comment questions the distribution of chaff and flares that the model assumes. Need to explain how chaff and flares are distributed with supporting information for why this is the case. Need to describe how the realistic estimates of deposition rates were made. Methods used to conduct analysis of effects to aquatic life should be described, along with rationale for why this analysis is appropriate. Need to estimate deposition rates within high-use areas such as Hardwood Bombing Range, as well as present worst-case scenario based on potential failure of chaff and flares to deploy as intended. Should consider the fact that pH levels encountered in central Wisconsin wetlands and water bodies tend to be low. Need to estimate probability of duds reaching the ground and model local impacts to small wetlands or water bodies.	See WI DNR Comment #5 above. A more complete discussion of the distribution of chaff and flares has been included in Section 4.6.2. See WI DNR Comment #5 above. A discussion of this issue has also been included in Section 4.6.2. The consideration of pH levels in central Wisconsin wetlands and waterbodies is not necessary because the model assumes that all chaff/flare components are completely bioavailable in the water column. A discussion of this estimate has been included in Section 4.6.2.
USFWS Region 3	NA	4.6.1	Federal Threatened and Endangered Species. Whooping crane- The Service is concerned about the potential for adverse effects from chaff and flare use to the whooping crane. An estimate of the incidence of the failure of chaff and/or flares to deploy as designed is of interest to the Service, as it would allow for the assessment of the risk to whooping cranes from shiny metallic objects. This issue should be addressed within the EA, including an estimate of the expected probability and/or frequency that chaff bundles or flares would fail to deploy and, thus, fall to the ground intact.	The following discussion of the likelihood of a whooping crane coming into contact with a dud chaff bundle or flare has been included in Section 4.6.1: **Whooping Cranes** While individual chaff particles deposited in wetland or aquatic systems are unlikely to be noticed by wildlife such as waterfowl before sinking to the bottom of the water body, the shiny metallic appearance of dud chaff bundles could attract such birds, which might think the dud is a fish. Some species of waterfowl are known to be attracted to shiny metallic objects. One example is the whooping crane (*Grus americana*). The tendency of this species to pick up and ingest shiny metallic objects found laying on the ground has been noted in captive breeding flocks (Olsen and Wise, 2001). Because the whooping crane is found in an experimental population in the Necedah National Wildlife Refuge in Volk MOA, the potential presence of dud chaff bundles in whooping crane habitat is an issue that warrants additional discussion.

Person Making the Comment	#	Section	Comment/Topic	Response to Comment
				The failure rate of chaff is approximately 1.5 percent (ACC, 1997). For Volk MOA, that would translate into an average of 0.4 dud chaff bundles per square mile per year. At approximately 44,000 acres (70 square miles), the maximum anticipated exposure of the Necedah NWF Refuge to dud chaff bundles would be only 28 per year (70 x 0.4). In order for a whooping crane to come into contact with a dud bundle, two conditions would need to be met. First, the dud chaff bundle would need to fall into whooping crane habitat. Second, the dud bundle would need to be visible to the crane. If a dud bundle were to land in crane habitat with overlying water, it is likely that the force of impact would plunge an intact dud chaff bundle into the sediment and bury it. The potential for a crane to find a dud bundle is also lowered due to the fact that the area of their preferred habitat that is not covered by surface water constitutes a low percentage of the Volk MOA. Overall, the probability of a whooping crane, or other similar bird, finding and ingesting an intact dud chaff bundle is very low and most likely far below the probability of ingesting other types of existing shiny debris, such as fishing lures and various types of aluminum litter.
USFWS Region 3	NA	4.6.1	Other listed species within the project area- Remove lynx from page 3-87 Remove giant carion beetle from Tables 3-63, 3-65, and 3-66. Change the designation of the peregrine falcon in Table 3-63. Add gray wolf, Karner blue butterfly, Higgins' eye pearly mussel, and Kirtland's warbler to Table 3-63. Add bald eagle, gray wolf, and Karner blue butterfly to Table 3-64, and remove winged mapleleaf mussel. Add gray wolf and Karner blue butterfly to Table 3-65. Add bald eagle, Karner blue butterfly, and eastern prairie fringed orchid to Table 3-66.	All of these specific comments were incorporated as provided.
USFWS Region 3	NA	4.6.1	Clarification regarding Minnow MOA, located over west-central Lake Michigan	Chaff are proposed for (new/resumed) use in Minnow MOA. Minnow MOA was deleted from analysis because it is entirely over water. Minnow MOA may need to be included in future NEPA analysis before chaff use is implemented.
FAA (Federal Aviation Administration)	1	General	The Environmental Assessment for the Establishment of Juniper Low Military Operations Areas. The EA for the Establishment of the Juniper Low MOAs, dated 8/12/93 states that chaff and flares will not be utilized unless assessed in follow-on documentation. The draft FONSI for continued use indicates this activity is already taking place and that a previous analysis was conducted. Recommend the draft FONSI reflect when the Juniper Low MOA was previously assessed for chaff/flare activity.	Aside from this MOA, there was quite a bit of confusion over where and where not chaff and/or flares are currently being released. The Tables reflecting this information have been separated to ensure the reader can easily distinguish where and where not chaff/flares are being deployed. Chaff and flares are not currently used in Juniper Low MOA, only in the Juniper High MOA, which lies directly above Juniper Low at 11,000 MSL; this misstatement has been corrected.

Person Making the Comment	#	Section	Comment/Topic	Response to Comment
FAA	2	General	The proposal for the Realignment of Military Operation and Warning Areas for the 173rd Fighter Wing in Oregon. - Recommend the draft FONSI and EA reflect an accurate status of chaff/flare use consistent with past and proposed airspace actions.	See the above answer
FAA	3	General	The Draft Environmental Impact Statement (DEIS) for the Proposed Training Range in Montana, dated July 2001, indicates that the use of chaff and flares has occurred for many years in the Hays MOA. - Recommend the Hays MOA be included as an addendum to the Phase I EA.	The general recommendation as a result of (ACC, NRL) studies was that chaff appeared to have no significant impact to the human or natural environment, however, further environmental documentation may be needed for chaff deployment in new areas. The ANG decided to use the NEPA process not only for new areas but included some areas with ongoing deployment to ensure no unique or special issues that were not covered in the technical documents were occurring. We broke this action into two programmatic documents covering numerous areas in the United States. Hays MOA was not included in these efforts since they are a unit that has utilized chaff deployment for a number of years, even prior to the enactment of NEPA. Their continued use of chaff would be a Categorical Exclusion from further analysis under current USAF instructions. If, as a result of these two efforts, issues arise that are applicable to Hays MOA, we will perform appropriate environmental documentation at that time.

Appendix A
Public and Interagency Coordination

Appendix A
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The following agencies and individuals were contacted through IICEP distribution in the EA and/or DOPAA public comment periods. For states where review was coordinated through State NEPA Clearinghouses, individual state agencies are not listed. Because the areas being evaluated are very large, agencies at the county level are not included.

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P.O. Box 60036
Reno, NV 89506

Dr. Jim Mosher
Conservation Director
The Izaak Walton League of America, Inc.
707 Conservation Lane
Gaithersburg, MD 20878-2983

Ms. Maggie Coon
Director of Government and Community Relations
The Nature Conservancy
4245 Fairfax Drive
Arlington, VA 22203

Mr. John Humke
Director of Agency Relations, Western Regional Office
The Nature Conservancy
2060 Broadway, Suite 230
Boulder, CO 80302

Ms. Diane Jackson
Administrative Assistant, Ecology and Economics Research Dept.
The Wilderness Society
900 17th Street, NW
Washington, DC 20006-2596

Ms. Mona Janopaul
Conservation Counsel
Trout Unlimited
1500 Wilson Boulevard, Suite 310
Arlington, VA 22209-2404

NG

Col. David Holman
114th Fighter Wing
Air National Guard
1201 W. Algonquin Street
Sioux Falls, SD 57140-0264

Captain Travis Brown
138th Fighter Wing/EM
Air National Guard
4200 North 93rd East Avenue
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Col. David Holman
114th Fighter Wing/Public Affairs
Air National Guard
1201 W. Algonquin Street
Sioux Falls, SD 57104-0264

Major Kim Maloy
138th Fighter Wing/Public Affairs Office
Air National Guard
4200 North 93rd East Avenue
Tulsa, OK 74115-1699

Lt. Steve Warren
114th Fighter Wing/Environmental Division
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1201 W. Algonquin Street
Sioux Falls, SD 57104-0264

Mr. Mark Kickbush
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Air National Guard
3100 McKinley Avenue
Des Moines, IA 50321-2799

Lt. Col. Steven Wabrowetz
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Air National Guard
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Duluth, MN 55811-6031

Major Paul Kovach
148th Fighter Wing/Bio Environmental Office
Air National Guard
4680 Viper Street
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Major Fred Kimble
Alpena CRTC/EM
Air National Guard
5884 A Street
Alpena, MI 49707

Captain Anisa Fondren
188th Fighter Wing/Public Affairs Office
Air National Guard, 188 FW/PA
4850 Leigh Avenue
Fort Smith, AR 72903-6096

Col. Robert C. King
Iowa National Guard Public Affairs Officer
HQ Army National Guard
7700 NW Beaver Drive
Johnston, IA 50131-1902

Mr. Jeffery D. Julum
Public Affairs Officer (re: 173rd FW)
Oregon Military Department Public Affairs - AGPA
1776 Militia Way SE
P.O. Box 14350
Salem, OR 97309-5047

Major Brendan Smith
Volk Field/Public Affairs Office
Volk Field Air National Guard Base
100 Independence Drive
Camp Douglas, WI 54618-5001

-----Original Message-----
From: Antosh, Cheryl C Ms ASA-I&E [mailto:Cheryl.Antosh@hqda.army.mil]
Sent: Friday, January 25, 2002 12:07 PM
To: Knudsen, HarryMrANG/CEVP
Subject: Draft Finding of No Significant Impact - Deployment of Chaff & Fl ares

Mr. Knudsen: Yesterday I received your letter to Mr. Phil Huber (Army) requesting comments on the Draft FONSI re deployment of chaff & flares. Unfortunately the post office at the Pentagon used the Brentwood facility as the main post office so your letter to us went to Ohio for irradiation & just arrived yesterday. I'm sure that we're probably very late in responding back to you but I thought I'd just let you know that we have no comments on your draft FONSI.

Cheryl Antosh
ODASA(ESOH), OASA(I&E)
110 Army Pentagon
Washington, DC 20310-0110
Room 1A909
703-692-9887
Cheryl.Antosh@hqda.army.mil

-----Original Message-----
From: Cothern.Joe@epamail.epa.gov [mailto:Cothern.Joe@epamail.epa.gov]
Sent: Tuesday, January 29, 2002 1:27 PM
To: harry.knudsen@ang.af.mil
Cc: Duffy.Marguerite@epamail.epa.gov
Subject: EA - Deployment of chaff & flares in MOAs

Dear Mr. Knudsen,

Thank you for the opportunity to review the Environmental Assessment for Deployment of Chaff and Flares in Military Operations Areas (Phase I).

EPA Region 7 (Kansas City) offers the following:

Q: The EA is predicated upon current inventory chaff and flare units. What would be the re-opener thresholds for re-evaluating this action? (increased size of radar occlusion, flare burn duration)? Are any replacement units currently advancing through the research and development pipeline likely to trip such a threshold?

No response is requested. The questions are just supplied to assist in your decision to conclude a FONSI.

Joseph Cothern
NEPA Team Leader
Environmental Services Division
USEPA Region 7
901 N. 5th Street
Kansas City, Kansas 66101

(913) 551-7148

From: Knudsen, Harry [Harry.Knudsen@ang.af.mil]
Sent: December 20, 2001 8:21 AM
To: 'pconway@centurytel.net'
Cc: Farris, Ginny/WDC; Wilson, Keisha/WDC; 'brendan.smith@wicrtc.ang.af.mil'; Mitnik, Tammy; Welch, Pat - ANG/C4R; Lake, Bob - ANG/C4R; 'gunther.neumann@wicrtc.ang.af.mil'; Donovan, Tim (WI)
Subject: RE: Chaff use in Wisconsin.

Ms. Conway- Please allow me the opportunity to answer your questions on the referenced environmental assessment (EA). Let me preface this by saying the EA is based upon three relatively current (within the last five-six years) technical studies produced by the Air Force, Navy and GAO (Government Accounting Office). These reports suggest that the use of chaff does not result in significant effects on the human and natural environment. They also suggest that there may be some unique circumstance or feature in the human or natural environment that may not have been covered by the specific report, therefore, in order to be thorough to ensure all technical issues have been identified and analyzed and to have public input, the Air National Guard undertook this environmental assessment.

In the State of Wisconsin, according to Table 2-3, the anticipated number of chaff bundles that could potentially be employed is 140,341. This number assumes all aircraft will employ their total allotment of chaff every sortie or flight. Do we expect this to happen? No. We expect that somewhere between one-third and two-thirds of the chaff allocated per aircraft will be dispensed or somewhere between 45,000 and 95,000 bundles. We expect this because on each training flight it is difficult to perform all training events that would involve the deployment of chaff. It is theoretically possible, however, highly unlikely. I would like to thank you for pointing this out and we will correct the EA to reflect the above information.

The release of chaff in Wisconsin has occurred periodically over the last 40 years. In the last 10 years based upon Air Force guidance that chaff may be an environmental issue due to the relative lack of scientific data, chaff has not been used in the military operations areas (MOAs) or military training routes (MTRs). Chaff has been dropped on an infrequent basis over the actual range (Hardwood Range), however, in recent years due to changing tactics, the dropping of chaff over the range has ceased because the training value is minimal. The projected use for the year 2000 is also incorrect. This is the anticapated release for the year once the environmental assessment process has been completed and a decision reached. Again, thank you for bringing this to our attention and we will make the appropriate correction. As our contractor indicated to you, we did put out Notices of Availability for this EA and invite all comments and information. Please forward the materials we have provided you as you deem appropriate or please provide us with the names and addresses of groups that may be interested.

If you have any further questions, please contact me at your earliest convenience. Thank you.

-----Original Message-----
From: Wilson, Keisha/WDC [mailto:kwilson1@CH2M.com]
Sent: Wednesday, November 28, 2001 1:44 PM

To: Harry Knudsen (E-mail)
Cc: Farris, Ginny/WDC
Subject: RE: Chaff use in Wisconsin.

Harry,

Today I received a call from Ms. Pat Conway who is with the Coalition for Peaceful Skies in Wisconsin, and whom had already requested, and we've sent a copy of the EA to.

She has three questions...

1. In Table 2-3 in the EA the number of "projected" chaff rounds are listed. Her concern was the large numbers of chaff that was projected for the MOAs in Wisconsin, and she was wondering that if these numbers are projected, were they actually used in 2000 and if so, has a request for the approval of the use of chaff in these MOA areas been issued?

2. In the Table 2-3, under Notes: No. 4 refers to the number of chaffs- "Not currently used; number is projected" - does this mean that they have never been used?

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She also asked why other environmental groups in Wisconsin have not received letters concerning the Notice of Availablity of the report. I informed her that NOA have been published in the major newspapers within the MOA areas and that hardcopies of the report has been placed in the local libraries within the MOAs.

Her email address is: pconway@centurytel.net
I've also directed her to you for any future questions she may have.

Keisha Wilson
CH2M HILL, Inc.
Herndon, Va
phone: 703-471-6405 x4127
fax: 703-471-1508
kwilson1@ch2m.com

From: Knudsen, Harry [Harry.Knudsen@ang.af.mil]
Sent: January 04, 2002 3:23 PM
To: 'patconway@centurytel.net'
Cc: Wilson, Keisha/WDC; Farris, Ginny/WDC;
'brenden.smith@wicrtc.ang.af.mil'; 'gunther.neumann@wicrtc.ang.af.mil';
Donovan, Tim (WI); Welch, Pat - ANG/C4R; Lake, Bob - ANG/C4R; Mitnik,
Tammy
Subject: RE: Chaff use in Wisconsin.

Dear Pat- I hope you had a good holiday season and please feel free to contact me on any issue you feel I may be able to assist. I think that your summary is relatively accurate. Chaff has been used in the United States starting in the 1950's for sure. Military aircraft that could have dropped chaff in the state of Wisconsin have existed since that time and were based in locations where they could have flown over Wisconsin. Did these aircraft drop chaff in the state? I do not believe we have a 100% certain response but it is a very reasonable assumption to make. I say this because I know of no records to say one way or another. We are more confident in stating that once the military training airspace (MOAs and MTRs) were established, chaff was dropped over those areas until the early 1990s. Once the guidance from USAF was received, military units flying in airspace scheduled by Volk Field ceased dropping chaff with the exception of some infrequent drops over the Hardwood Range. This activity has also ceased since there was little training value that could be gained.

I have included the e-mail address for my contact at Volk Field, Major Brenden Smith and the State Public Affairs Officer, Lt Col Tim Donovon. I also included the Commander at Volk Field, Col Gunther Neumann. I believe they are the persons that can assist you. If I can be of any further service, please contact me at your earliest convenience. Thanks.

-----Original Message-----
From: Wilson, Keisha/WDC [mailto:kwilson1@CH2M.com]
Sent: Thursday, December 20, 2001 12:22 PM
To: Harry Knudsen (E-mail)
Cc: Farris, Ginny/WDC
Subject: FW: Chaff use in Wisconsin.

-----Original Message-----
From: Pat Conway [mailto:patconway@centurytel.net]
Sent: December 20, 2001 2:18 PM
To: Wilson, Keisha/WDC
Subject: Re: Chaff use in Wisconsin.

Thank you for your reply.
Just to be clear, please verify that I have summarized correctly your e-mail to me.

1. The use of chaff in Wisconsin began in the 1960's.
2. From the 1960's to 1991, chaff WAS DROPPED over MOA's and MTR's.
3. Absolutely NO CHAFF WAS DROPPED over MTR's and MOA's from 1991 to the present.
4. From 1991 to the present, Chaff was dropped over the Harwood Bombing Range, but infrequently.
5. In recent years, no chaff at all has been dropped over the Harwood Range, or anywhere in Wisconsin.

Please clarify:
In the EA on Table 2-3 it says for Wisconsin: "Not currently used." What year did chaff use begin in Wisconsin, and what year was it limited to use over the Harwood Range only and what year was it terminated from use in Wisconsin all together? Is there a contact person at the Harwood Range who can answer the many other questions I have regarding the use of Chaff in Wis?
I would greatly appreciate an e-mail address for the local PR person at the Harwood Range who can follow-up with me.
Thank you so much for taking the time to work with me on this issue. I know your days are full, and I present an extra burden on your time. I prefer to work with local ANG people when possible in order to lessen the demands on you.
Happy Holidays and best regards,
Pat Conway

> From: Wilson, Keisha/WDC <kwilson1@CH2M.com>
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> Subject: FW: Chaff use in Wisconsin.
> Date: Thursday, December 20, 2001 6:15 AM
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> From: Knudsen, Harry [mailto:Harry.Knudsen@ang.af.mil]
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> Cc: Farris, Ginny/WDC; Wilson, Keisha/WDC;
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> Cc: Farris, Ginny/WDC
> Subject: RE: Chaff use in Wisconsin.
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> Keisha Wilson
> CH2M HILL, Inc.
> Herndon, Va
> phone: 703-471-6405 x4127
> fax: 703-471-1508
> kwilson1@ch2m.com

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> phone: 703-471-6405 x4127
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FAX TRANSMITTAL # of pages ► 9

To GINNY FALLS		From HARRY KNUDSON	
Dept./Agency ORKERSHA WILSON		Phone # 301-836-8143	
Fax # 703-~~796-6152~~ 471-1508		Fax #	
NSN 7540-01-317-7368 5099-101		GENERAL SERVICES ADMINISTRATION	

703-796-615

FAXFORM - REGION 3

U. S. FISH AND WILDLIFE SERVICE
Federal Building, 1 Federal Drive
Fort Snelling, Minnesota 55111-4056

PAGE 1 OF 9 PAGES

DATE: 5/4/02

TO: Mr. Harry A. Knudsen, Jr. FAX: 301/836-8151

FROM: Mr. Lyn MacLean (ES/HC-Project and Permit Review) PHONE: 612/713-5330
FAX: -5292

SUBJECT: FWS comments re: Draft FONSI & EA for Chaff & Flare deployment

After our phone conversation on Friday, I decided it would be better if I finalized the comment letter rather than just forward the draft comments from our Green Bay Field Office. We were able to finish it and have it signed late Friday. Today I was able to find the original T&E enclosure sheets from the field office and not have to use their faxed copy. I've also attached to this fax a copy of the Email message from Joel Trick with the contact names and phone numbers I gave to you yesterday for more information on the habit of whooping cranes ingesting metal objects.

If you have any questions concerning our comments that need immediate attention, Joel and I will both be out of the office the entire week of May 6 at a Federal Program Activities National Workshop being held in Scottsdale. We can probably be reached by leaving a message for me at the Holiday Inn - Old Town, phone 480-994-9203.

The original hard copy of our comments will be sent to you by regular mail on Monday.

I apologize for being so late in getting our comments to you,

Lyn MacLean

Form R3-195

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Bishop Henry Whipple Federal Building
1 Federal Drive
Fort Snelling, MN 55111-4056

IN REPLY REFER TO:

FWS/AES-HC

MAY 3 2002

Mr. Harry A. Knudsen, Jr.
Chief, Environmental Planning Branch
ANG/CEVP
3500 Fetchet Avenue
Andrews Air Force Base, Maryland 20762-5157

Dear Mr. Knudsen:

The U.S. Fish and Wildlife Service (Service) has reviewed the Draft Finding of No Significant Impact (FONSI) and Draft Final Environmental Assessment (EA) dated October 2001, for Chaff and Flare deployment by the Air National Guard (ANG) in multiple Military Operations Areas (MOAs) nationwide, including five separate MOAs in Wisconsin. We offer the following comments relative to this proposed action to endangered species, National Wildlife Refuge lands, and aquatic habitats.

GENERAL COMMENTS

Overall, we believe the document presents the proposed action in an adequate fashion, with the exception of a number of areas which require further elaboration. These specific items are discussed below. Another question is whether the proposal analyzed in this EA is part of a larger proposal which will ultimately include an unknown number of other MOAs, to be collectively analyzed in several documents. The lack of a clear statement of this intent makes it difficult to put the proposed action into the proper perspective on a national scale and in terms of consistency with the National Environmental Policy Act. We suggest the need for clarification and, possibly, an additional document which adequately describes the intent of the ANG, as well as a clear description of the intended plan for conducting these analyses.

SPECIFIC COMMENTS

Alternatives
The Preferred Alternative, as presented in the document, is that of Current Operations. However, it is unclear as to whether or not chaff is currently used in Wisconsin MOAs. According to the General Accounting Office Report, *DOD Management Issues Related to Chaff*, dated September 1998, Wisconsin is not shown as a State where chaff is used. Based upon this information, it appears as though "Current Operations" are those of no chaff use in at least some of the subject MOAs. We request further clarification and coordination regarding what current operations

actually are. We would like to resolve any questions and potential issues we may have pertaining to actions included as current operations prior to preparation of the Final EA.

Environmental Consequences
The information presented within the EA makes it difficult to determine the potential impacts to Service trust resources. For example, table 4-13 presents the deposition rates for chaff and flares within each MOA, based upon the expected amount of materials used, and the total area of each of the MOAs. This apparently assumes an equal distribution of these materials throughout each MOA. While this scenario may be a reasonable assumption, no supporting information is presented to explain why this may be the case. In the FONSI, it is stated that the analysis of effects to aquatic life is ". . . based on realistic estimates of deposition rates . . ." (section 3, Environmental Effects, third paragraph). We can not find any reference within the EA to how these "realistic estimates" were made. At the least, the methods used to conduct this analysis should be described, along with a rationale for why this analysis is appropriate.

A realistic analysis also should make some general estimate for deposition rates within high use areas, such as near the Hardwood Bombing Range in Wisconsin, as well as presenting a worse-case scenario based upon the potential failure of chaff bundles and flares to deploy as intended. This worst-case scenario also should consider the fact that the pH levels encountered in central Wisconsin wetlands and water bodies tend to be low, an environmental condition which has been demonstrated to increase the toxicity of aluminum in the water column and to increase the leaching rate of magnesium, barium and chromium from flares.

This information could then be used for the types of analyses presented within tables 4-14 through 4-16, where the impacts to aquatic life from chaff and flare deployment are estimated. It would be helpful to estimate the expected likelihood or incidence of chaff bundles and flares reaching the ground without dispersing or igniting, and to also model the resulting local impacts to typical small wetlands or water bodies. This information would allow us to assess the potential impacts to aquatic habitats on the nearby Necedah National Wildlife Refuge (NWR), which is located within the Volk West MOA, just to the west of the Hardwood Bombing Range and along the major flight approach path to the range.

Federal Threatened and Endangered Species
Due to the lack of the specific information discussed above, we are unable to determine at this time whether your project is likely to adversely affect federally listed threatened or endangered species. We will evaluate your project again following the receipt of the requested information and provide a determination at that time. Any further informal or formal consultation or conference regarding impacts to Federal threatened or endangered species should be completed prior to completion of the Final EA.

Whooping crane
The Service is concerned about the potential for adverse effects from chaff and flare use to the whooping crane (*Grus americana*). Following the recommendation of the International

Whooping Crane Recovery Team, the Service recently completed a rulemaking process that designated a Nonessential Experimental Population (NEP) of this species in a large area of the Eastern United States including Wisconsin. The action was a necessary prerequisite to implementing the recommended recovery action of establishing an additional migratory population of whooping cranes in the Eastern U.S.

Reintroduction of the species into the Eastern U.S. NEP area was begun in 2001 with the release of a small group of whooping cranes which were reared at the Necedah NWR. This initial cohort of whooping crane chicks was led behind an ultralight aircraft to the selected wintering site in east-central Florida during the fall of 2001. Its was expected that the cranes would return to the Wisconsin release site of their own accord in the spring of 2002, which four of them have now done. A fifth crane has also reached Wisconsin but has not continued all the way to the release site. Releases are planned for at least 5 years, with the goal of establishing a self-sustaining population of 125 whooping cranes, consisting of a minimum of 25 breeding pairs.

One characteristic of whooping cranes noted in captive breeding flocks is the tendency of the species to pick up and ingest shiny metallic objects found laying on the ground. In the event of intact chaff bundles or flares falling to the ground in the course of training exercises, the presence of these objects may pose a risk to the health of individual cranes and, potentially, to the success of this reintroduction attempt. Therefore, an estimate of the incidence of the failure of chaff and/or flares to deploy as designed is of interest to the Service, as it would allow for the assessment of the risk to whooping cranes from objects of this type. This issue should be addressed within the EA, including an estimate of the expected probability and/or frequency that chaff bundles or flares would fail to deploy and, thus, fall to the ground intact.

As a result of the NEP designation, the Eastern U.S. NEP whooping cranes occurring on National Wildlife Refuge or National Park lands are considered of threatened status for purposes of section 7 consultation under the 1973 Endangered Species Act, as amended. Eastern U.S. NEP whooping cranes occurring on any other lands are treated as if they were proposed for listing for purposes of section 7 consultation. Accordingly, if whooping cranes from the Eastern U.S. NEP occurring on the Necedah NWR would be adversely affected by the proposed action, the Department of the Air Force should enter into formal consultation with the Service's Green Bay, Wisconsin, Ecological Services Field Office. If Eastern U.S. NEP whooping cranes would be adversely affected in areas other than on the National Wildlife Refuge, a conference, in accordance with section 7(a)(4) of the1973 Endangered Species Act, as amended, between the Department of the Air Force and the Service's Green Bay, Wisconsin, Ecological Services Field Office would be appropriate.

Other listed species within the project area

We have enclosed a list of the federally listed threatened or endangered species known to occur in the counties identified in your EA (i.e., either underlying the MOAs or adjacent counties). Following a review of the information in our files, we note that there are several inaccuracies and omissions regarding the federally listed threatened and endangered species listed as present

within your proposed project area. These discrepancies are noted below. The Final EA should be modified to reflect these changes.

On page 3-87, in the second paragraph, it is stated that the Canada lynx (*Lynx canadensis*) is listed by the State of Wisconsin as endangered. The lynx has been removed from the State's endangered species list, and is now considered a protected wild animal, with no open season. This species is also federally listed as threatened but is not known to occur in any of the counties within the identified project area.

Tables 3-63, 3-65 and 3-66 show the federally listed American burying beetle (*Nicrophorus americanus*) (listed here as the Giant Carrion Beetle) as occurring in or adjacent to these respective MOAs. This species has not been observed in Wisconsin since 1948 and is no longer considered to be extant in the State.

Table 3-63 incorrectly indicates that the American peregrine falcon (*Falco peregrinus*) is federally listed as endangered. The peregrine falcon was removed from the list of Federal threatened and endangered species on August 25, 1999. However, this species is still listed as endangered by the State of Wisconsin. The federally listed gray wolf (*Canis lupus*), Karner blue butterfly (*Lycaeides melissa samuelis*), Higgins' eye pearly mussel (*Lampsilis Higginsi*), and Kirtland's warbler (*Dendroica kirtlandii*) should be added to this table, as they occur in the counties underlying the Falls 1 and 2 MOAs.

The bald eagle (*Haliaeetus leucocephalus*), gray wolf, and Karner blue butterfly should be added, and the winged mapleleaf mussel (*Quadrula fragosa*) should be removed from table 3-64. Although historic records exist for this area, the winged mapleleaf mussel is now considered to be extant in Wisconsin only in the St. Croix River in Polk County.

The gray wolf and Karner blue butterfly should be added to table 3-65.

The bald eagle, Karner blue butterfly, and eastern prairie fringed orchid (*Platanthera leucophaea*) should be added to table 3-66.

SUMMARY COMMENTS

In summary, we believe that the ANG should clarify its future intent to analyze chaff and flare use in other MOAs in addition to that presented in this EA. This intent should be stated, either in a separate document or in the introductory portion of the subject EA. The ANG also should clarify any difference between the proposed action and actual current use of chaff and flares within the subject MOAs. In addition, the ANG should present a more detailed description of the methods used to estimate environmental impacts to aquatic resources, with a discussion of the rationale for use of these methods. Further analysis also should be presented to model a scenario where higher deposition rates may occur, as well as the consequences of worst-case scenarios. This analysis should include estimates of the expected frequency of chaff and flares

reaching the ground without deploying as designed, which could pose threats to water quality; aquatic organisms; and terrestrial animal life, especially whooping cranes. We also recommend that the section of the document which describes endangered and threatened species present in and adjacent to the subject MOAs be updated to correct the inaccuracies identified within this letter. The ANG should coordinate with the Service regarding these modifications and analyses prior to completing the Final EA so that any related issues can be resolved and the resolutions included in the Final EA.

Thank you for the opportunity to provide comments on this project. Questions pertaining to these comments and further coordination on the issues identified herein can be directed to Mr. Joel Trick of the Service's Green Bay, Wisconsin, Ecological Services Field Office. He can be reached by calling 920-465-7416.

Sincerely,

Charlie Wooley

Charles M. Wooley
Assistant Regional Director
Ecological Services

Enclosure

FEDERALLY LISTED THREATENED & ENDANGERED SPECIES KNOWN FROM SELECTED WISCONSIN COUNTIES

County	Species	Habitat
Adams	bald eagle (BE) Karner blue butterfly	Breeding & Wintering (B & W) prairie, oak savanna, and jack pine areas w/wild lupine
Clark	BE gray wolf Karner blue butterfly	B northern forested areas prairie, oak savanna, and jack pine areas w/wild lupine
Columbia	BE	W
Dodge	BE	B
Eau Claire	BE Karner blue butterfly gray wolf	B & W prairie, oak savanna, and jack pine areas w/wild lupine northern forested areas
Fond du Lac	No federally-listed species	
Green Lake	BE Karner blue butterfly	B prairie, oak savanna, and jack pine areas w/wild lupine
Jackson	BE Kirtland's warbler 1/ Karner blue butterfly gray wolf	B potential breeding in jack pine prairie, oak savanna, and jack pine areas w/wild lupine northern forested areas
Jefferson	eastern prairie fringed orchid	wet grasslands
Juneau	BE Karner blue butterfly gray wolf	B & W prairie, oak savanna, and jack pine areas w/wild lupine northern forested areas
La Crosse	BE Higgins' eye pearly mussel	B & W Mississippi River
Marathon	BE	B
Marquette	BE Karner blue butterfly	B prairie, oak savanna, and jack pine areas w/wild lupine
Monroe	northern monkshood Karner blue butterfly gray wolf	north facing slopes prairie, oak savanna, and jack pine area w/wild lupine northern forested areas
Outagamie	BE Karner blue butterfly	B & W prairie, oak savanna, and jack pine areas w/wild lupine
Portage	BE Fassett's locoweed Karner blue butterfly	B open sandy lakeshores prairie, oak savanna, and jack pine areas w/wild lupine

1/ Kirtland's warblers are not known to nest in Wisconsin. Singing males only were present in 1978, 1979, 1980, 1988, 1989, 1990, 1991, 1992, 1997, and 1998.

Shawano	BE Karner blue butterfly	B & W prairie, oak savanna, and jack pine areas w/wild lupine
Taylor	BE gray wolf	B northern forested areas
Trempealeau	BE Higgins' eye pearly mussel	W Mississippi River
Washington	No federally-listed species	
Waukesha	eastern prairie fringed orchid	wet grasslands
Waupaca	BE Karner blue butterfly	B & W prairie, oak savanna, and jack pine areas w/wild lupine
Waushara	BE Fassett's locoweed Karner blue butterfly	B open sandy lakeshores prairie, oak savanna, and jack pine areas, w/wild lupine
Winnebago	BE eastern prairie fringed orchid	B & W wet grasslands
Wood	BE Karner blue butterfly gray wolf	B prairie, oak savanna, and jack pine areas, w/wild lupine northern forested areas

Listed species
(E) = Endangered
(T) = Threatened
(B) = Breeding
(W) = Wintering

bald eagle (T)	Haliaeetus leucocephalus
Kirtland's warbler (E)	Dendroica kirtlandii
gray wolf (E)	Canis lupus
Karner blue butterfly (E)	Lycaeides melissa samuelis
Higgins' eye pearly mussel (E)	Lampsilis Higginsi
northern monkshood (T)	Aconitum noveboracense
Fassett's locoweed (T)	Oxytropis campestris var. chartacea
eastern prairie fringed orchid (T)	Platanthera leucophaea

The peregrine falcon (Falco peregrinus) was removed from the list of federal threatened and endangered species on August 25, 1999.

Joel Trick

05/02/2002 04:00 PM

To: Lyn MacLean/R3/FWS/DOI@FWS
cc:
Subject: Whooping Cranes and loose shiny objects

Lyn -

The following is in response to the question you posed to me today. Through my association with the eastern US whooping crane reintroduction project, I became aware that the potential ingestion of loose metal is a very real problem that is encountered in the captive whooping crane flock. The USGS Patuxent Wildlife Research Center is the location of the largest captive flock of whooping cranes, currently numbering more than 50 adults.

The curators there have emphasized the need for maintaining their facilities free from loose metal such as that produced during pen construction. They have gone so far as to use metal detectors to eliminate loose metal debris prior to moving cranes to the pens. When birds do ingest metal, it is sometimes necessary to operate to remove the object to save their life. No one knows why the birds tend to pick up metal this way, but it is quite different from the behavior of most other species in captivity.

I suggest that if you desire further information, you talk to Glenn Olsen at Patuxent at 301-497-5603, or alternately to George Gee at 301-497-5750.

Joel

From: Knudsen, Harry [Harry.Knudsen@ang.af.mil]
Sent: May 29, 2002 3:22 PM
To: 'Mike.Mixon@faa.gov'
Cc: Farris, Ginny/WDC; Wilson, Keisha/WDC; Welch, Pat - ANG/C4R
Subject: RESPONSE TO FAA MEMORANDUM, JAN. 8, 2002

ACTION: Draft Finding of No Significant Impact for the Environmental Assessment for Deployment of Chaff and Flares in Military Operations Areas (Phase I)

Please regard this message as a response to comments, questions and issues raised in the subject Memorandum.

1. The Environmental Assessment for the Establishment of Juniper Low Military Operations Areas. Aside from this MOA, there was quite a bit of confusion over where and where not chaff and/or flares are currently being released. The Tables reflecting this information have been separated to ensure the reader can easily distinguish where and where not chaff/flares are being deployed.

2. The proposal for the Realignment of Military Operation and Warning Areas for the 173rd Fighter Wing in Oregon. See the above answer.

3. The Draft Environmental Impact Statement (DEIS) for the Proposed Training Range in Montana. The issue of chaff deployment has a little bit of history that will be included in the final EA. Basically the DoD has been deploying chaff for a large number of years, at least from the early 1950s and perhaps earlier. The USAF came forth with a letter/message in the early 1990s (I couldn't find a copy), that basically stated the USAF had reason to believe that chaff may be an environmental issue that would require some analysis. They left it up to each command on how to address the issue. The ANG decided to let units continue deploying chaff in airspace where the deployment was already occurring and in new areas, environmental documentation would be required. Shortly after this message was received by all USAF commands, ACC initiated a "Technical Study" on chaff. This effort was completed in the late 1990s along with similar studies conducted by the Navy and GAO. The general recommendation as a result of these studies was that chaff appeared to have no significant impact to the human or natural environment, however, prior to initiating chaff deployment in new areas, some form of further environmental documentation may be needed. The ANG decided to use the NEPA process not only for new areas but included some areas that deployment is already occurring to ensure no unique or special issues that were not covered in the technical documents were occurring. This process also allows full public and agency input since we do not believe we know everything regarding issues that may be connected to chaff deployment. We broke this action into two programmatic documents covering numerous areas in the United States.

Hays MOA was not included in these efforts since they are a unit that has utilized chaff deployment for a number of years, even prior to the enactment of NEPA. Their continued use of chaff would be a Categorical Exclusion from further analysis under current USAF instructions. That is not to say we will [not] include them in a future effort of this kind but we have no reason to believe their use of chaff is having any impact on the natural and human environment under Hays MOA. If, as a result of these two efforts, issues arise that are applicable to Hays MOA, we will perform appropriate environmental documentation at that time.

If there are any further questions, please contact at your earliest convenience.

Harry A. Knudsen, Jr.
Chief, Environmental Planning Branch
301-836-8143
301-836-8151 (FAX)
email: Harry.Knudsen@ang.af.mil

1854 Authority
Bois Forte
Grand Portage

Airpark Square
4428 Haines Road
Duluth, MN 55811-1524
218/722-8907
Fax No. 218/722-7003

November 6, 2001

HARRY KNUDSEN, JR
CHIEF ENVIRONMENTAL PLANNING BRANCH
ANG/CEVP
3500 FLETCHET AVENUE
ANDREWS AFB, MD 20762-5157

Re: Draft FONSI for ANG chaff/flare operations

Dear Mr. Knudsen,

Thank you for the opportunity to comment on the Air National Guard operations. The 1854 Authority is an inter-tribal natural resource agency charged with protecting the off-reservation rights of the Bois Forte and Grand Portage bands of Lake Superior Chippewa to hunt, fish, and gather within the 1854 Treaty Area. These lands were ceded to the US Government under the Treaty of 1854.

At this time we have no concerns with the findings of the Environmental Assessment for Deployment of Chaff and Flares in Military Operations Areas from October 2001. The proposed action, Alternative 1 – Current Operations is acceptable.

Again, thank you for the opportunity to comment. Please keep us on the mailing list for future comment on other proposed actions.

Sincerely,

Andrew J. Edwards
Biological Services Director

Cc: File

Facsimile Transmittal

Bureau of Indian Affairs
Great Plains Regional Office
115 4TH Avenue SE
Aberdeen, South Dakota 57401
Phone: (605) 226-7621 Fax: (605) 226-7358

December 19, 2001

To: Harry Knudsen, Jr., Chief, Environmental Planning

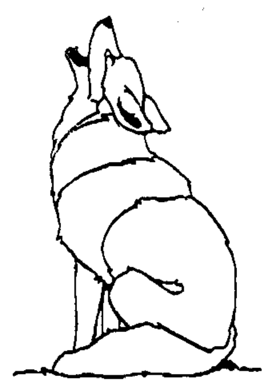
From: Diane Mann-Klager, Regional Wildlife Biologist

Comments:

We have reviewed you Draft Finding of No Significant Impact, which is based on the analyses found in the Environmental Assessment for Deployment of Chaff and Flares in Military Operations Areas (phase I), dated October 2001. We have no comments.

Thank you,

Diane Mann-Klager



NOT LIKELY TO ADVERSELY AFFECT FINDING
The described action is not likely to adversely affect federally-listed or proposed species or their habitats.
Date 4/09/02
Consultation # 2-14-02-I-0151
Approved by [signature]
U.S. FISH and WILDLIFE SERVICE, TULSA, OK

ANG/CEVP
3500 Fetchet Avenue
Andrews AFB MD 20762-5157

Mr. Ken Frazier
Tulsa OK Ecological Services Field Office
US Fish and Wildlife Service Region 2
222 South Houston, Suite A
Tulsa, OK 74127-8909

Dear Mr. Frazier,

The National Guard Bureau (NGB) invites your comments on the enclosed Draft Finding of No Significant Impact (FONSI), which is based on the analyses found in the *Environmental Assessment for Deployment of Chaff and Flares in Military Operations Areas (Phase I)*, dated October 2001.

If you would like a copy of the EA for review, please contact me and specify your preference for either a hardcopy or an electronic copy on CD-ROM.

In accordance with the National Environmental Policy Act (NEPA) and its implementing regulations, the NGB has prepared the EA to identify and evaluate potential environmental and socioeconomic effects and any mitigation measures relevant to the ongoing use of self-protection chaff and flares during training flight operations, in existing Military Operations Areas (MOAs) that are managed by Air National Guard (ANG) units throughout the U.S.

Copies of the Draft FONSI have been sent to the individuals and organizations listed in the enclosed Interagency and Intergovernmental Coordination for Environmental Planning (IICEP) Distribution List. If there are additional agencies that you feel should review and comment, please provide them with a copy of this letter and Draft FONSI (or notify me and I will do so).

A public Notice of Availability will be published in major newspapers serving the communities near the MOAs that are evaluated in the EA and copies of the EA will be available for public inspection in the public libraries on the enclosed list.

Please forward your written comments to: Mr. Harry Knudsen, Jr., Chief, Environmental Planning Branch, ANG/CEVP, 3500 Fetchet Avenue, Andrews AFB, MD 20762-5157; or by fax to (301) 836-8151; or by email to harry.knudsen@ang.af.mil.

Comments should be provided no later than 60 days from your receipt of this letter. Thank you for your assistance in this matter.

HARRY A. KNUDSEN, Jr.
Chief, Environmental Planning Branch
Environmental Division

Encl. Draft Finding of No Significant Impact
IICEP Distribution List
List of Libraries

FAXFORM - REGION 3

U. S. FISH AND WILDLIFE SERVICE
Federal Building, 1 Federal Drive
Fort Snelling, Minnesota 55111-4056

PAGE 1 OF 12 PAGES

DATE: 1/8/02

TO: Mr. Harry A. Knudsen, Jr. FAX: 301/836-8151

FROM: Mr. Lyn MacLean (ES/HC-Project and Permit Review) PHONE: 612/713-5330
FAX: -5292

SUBJECT: DOD Chaff-Use Policy referenced in the FWS letter of December 26, 2001

Per our phone conversation earlier today, I checked for the source of the reference to the DOD chaff-use policy mentioned in the FWS letter. It came from the article in Navy Medicine (see attached copy). The policy is discussed on the bottom of page 3 and top of page 4. If you are successful in getting a copy of referenced source (section 3212.02 of the CJCS Manual), I would appreciate your sending me a copy.

Also of interest in the article is the second paragraph under "Health Effects on Livestock & Wildlife" on page 7, which mentions that surveys as part of one study (USAF 1997) found clumps of undeployed chaff in an MOA. Unfortunately, the type of chaff that might have been utilized is not mentioned.

Lyn MacLean

Form R3-195

Human and Environmental Health Issues Related to Use of Radio Frequency Chaff

LT Darryl P. Arfsten, Ph.D., MSC, USNR
Research Biochemist
Naval Health Research Center Detachment (Toxicology)
2612 Fifth St, Bldg 433, Area B
Wright-Patterson Air Force Base, OH 45433

LT Cody L. Wilson, Ph.D., MSC, USNR
U.S. Navy CBRNE Training Program
U.S. Army Center for Health Promotion & Preventive Medicine
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and

Barry J. Spargo, Ph.D.
Head, Environmental Quality Sciences, Code 6115
Naval Research Laboratory
4555 Overlook Ave, S.W.
Washington DC 20375

*-Disclaimer: The opinions and assertions contained herein are strictly those of the authors, and are not to be construed as official or reflecting the views of the Navy Department or the military at large.

Correspondence should be directed to:

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Navy Medicine, Volume 92, No. 5 (September-October 2001):12-16

Radiofrequency (RF) chaff is an electronic countermeasure designed to reflect radar waves and obscure planes, ships, and other assets from radar tracking sources. Chaff consists of aluminum-coated glass fibers (also referred to as dipoles) ranging in lengths from 0.8 to 0.75 cm. Chaff is released or dispensed from military vehicles in cartridges or projectiles that contain millions of dipoles. When deployed, a diffuse cloud of dipoles is formed that is undetectable to the human eye. Chaff is a very light material that can remain suspended in air anywhere from 10 minutes to 10 hours and can travel considerable distances from its release point, depending on prevailing atmospheric conditions (USAF 2001). Training for military personnel, particularly aircraft pilots, in the use of chaff is necessary to deploy this electronic countermeasure effectively. As with most acquired skills, the deployment of chaff must be maintained by practicing in-flight release during training. It is estimated that the U.S. Armed Forces dispense about 500 tons of chaff per year (USAF 2001), with most chaff being released during training exercises within the continental United States.

Concerns have been raised since the early 1950s by both the public and government officials on the potential impacts of chaff on the environment. In response to these concerns, the Department of Defense (DOD) has sponsored or conducted research to address issues related to the use of chaff by the military including: (a) questions on its persistence and fate in the environment, (b) the effects of chaff on human, livestock, and wildlife health, and (c) the impact of chaff release on natural and cultural resources (GAO 1998, Hullar et al. 1999, USAF 1997, Cataldo et al. 1992, National Guard Bureau 1990, USAF 1978, Systems Consultants 1977). In this review, we address the historical and current use of chaff, the importance of its use in training and the effects of chaff on humans and the environment.

History and Use of Chaff

RF chaff was first used as a radar countermeasure in December 1943 by U.S. bombers flying over Bremen, Germany. At this time, chaff consisted of solid aluminum pieces of non-specific sizes that were tossed from cockpit windows or dropped from trap doors on the underside of bomber aircraft. Tactics of the time were to generate huge chaff plumes to provide slow-moving bombers with some protection against ground-based anti-aircraft fire.

Chaff technology has evolved considerably since World War II. Modern chaff is composed of glass fibers coated with a 3 μm-thick layer of high purity (99%) aluminum, which gives chaff its radar-reflective properties (Figure 1). Chaff fibers are approximately 60% glass and 40% aluminum by weight. Lead was used as a weighting material in early versions, but this metal is no longer incorporated into chaff (GAO 1998, USAF 1997). Chaff fibers are also coated with a lipid to prevent clumping. Modern chaff is cut to specific lengths that correspond to one-half the wavelength of specified radar bands. Along with chaff, "chaff debris" is also dispensed during the release of chaff. Typical chaff debris includes paper, cardboard, styrene plastic caps, pistons, and miscellaneous plastic parts.

Chaff is typically deployed in cartridges or projectiles, but can also be dumped or tossed from military vehicles. Chaff cartridges typically contain up to 100 million chaff fibers or dipoles (GAO 1998, USAF 1997). Training cartridges used by U.S. Navy aircraft contain about 5 million dipoles per cartridge (Hullar et al. 1999). Zuni rockets, used by the Navy to screen surface vessels from radar, contain about 8.5 pounds of chaff. Mortars are also used to launch chaff from ships and these projectiles contain up to 24 pounds of chaff. The Army will be capable in the near future of deploying over 300 pounds of chaff within 10 minutes to hide ground units from radar detection.

Current DOD Chaff Use Policy and Initiatives

Currently, DOD severely restricts the use of chaff in training in order to reduce pollution of the environment and to protect civilian airspace. At the height of the Cold War, training with RF chaff was permissible at all military training ranges and MOAs within the United States. Since 1990, the DOD has attempted to balance the chaff training needs of the Armed Services with concerns of the public and government for the possible negative impacts of chaff use on the environment. In 1998, the Joint Chiefs of Staff issued a directive incorporating chaff use policies of each of the Armed Forces and placed significant restrictions on the use of chaff for training in the United States (CJCSM, 1998). As a result, the number of training sites where chaff training is permitted has been reduced to approximately 50 selected ranges and MOAs in and around the US (see Fig. 2). Additionally, flight rules were changed and now stipulate that chaff should not be released below certain altitudes during training to ensure chaff plumes are widely dispersed and dipole ground level concentrations are very low. Likewise, DOD policy for chaff operations requires that every effort be made to conduct chaff drops away from major air routes and air route hubs and to avoid frequent dispersal over the same ground points. DOD policy also specifies that all planned chaff releases and training flight plans be reported to the Federal Aviation Administration and local environmental agencies.

In addition to making extensive policy changes in chaff use, DOD has initiated several cooperative relationships with Department of Interior (DOI) agencies aimed at minimizing the impact of chaff on public lands. Among these efforts is a committee formed between the DOD and the Bureau of Land Management to periodically evaluate the chaff deployment policies of each of the Armed Services for training conducted over public lands (GAO 1998).

Environmental Fate and Impact

Intact chaff fibers do not pose an inhalation risk to humans; however, degradation of the fiber might result in reduction to a size amenable to respiration and this is discussed further below. As such, degradation of chaff fibers under various environmental and mechanical conditions has also been of interest. The abrading of chaff dipoles to respirable diameters during pyrotechnic discharge or by weathering has been an issue of concern expressed by various parties (Hullar et al. 1999). The USAF found no evidence that chaff dipoles are abraded to respirable particulate during pyrotechnic discharge under controlled conditions (USAF 1997). Further studies are needed to definitively determine whether respirable chaff dipoles are released or formed in the process of dispersal.

Because of its large diameter relative to other particulate contaminants, chaff does not add to particulate matter (i.e., PM_{10} or $PM_{2.5}$) emissions as defined by the EPA. To understand what affect chaff may have on human health, Hullar et al. (1999) assumed that chaff degraded into PM_{10} and $PM_{2.5}$ and estimated the contribution of chaff to the respirable fractions. In their estimates, chaff would account for less than 0.25% of the particulate emission measurements for Churchill County, NV (Fallon Naval Air Station). Similar predictions were made for St. Mary's County, MD, (Patuxent NAS), where chaff releases contribute no more than 0.008% of the total particulate matter emissions. Currently, the US Navy is sponsoring studies to determine chaff air concentrations at ground level of training ranges and housing areas located at Fallon NAS. Preliminary results indicate that chaff plumes comprise less than 0.5% of the particulate matter present at these sampling areas.

Several investigations have demonstrated that Al-coated dipoles are resistant to weathering and breakdown under desert conditions. A 1977 US Navy-sponsored a study found no evidence to indicate that chaff degrades significantly or quickly in water from the Chesapeake Bay nor did this material leach significant amounts of aluminum into the Bay. A recent study by our group found no evidence that 25 years of chaff operations at the Naval Research Laboratory detachment at Chesapeake Beach, MD resulted in a significant increase in sediment or soil aluminum concentrations (Wilson et al 2000). However, additional studies are needed to determine the half-life of chaff dipoles in various soils and environmental conditions and whether dipoles breakdown to respirable particles. A current study at the University of Nevada, Desert Research Institute is examining the propensity of chaff dipoles to be reduced to respirable sizes by wind-driven sand abrasion.

Human Health Effects

It has been suggested that chaff poses an inhalation hazard and may induce diseases of the respiratory tract. This idea has been addressed in detail by several groups (Hullar et al. 1999, Carpenter et al. 2000). Chaff dipoles are manufactured at diameters that are too large (~40 μM) to be inhaled into the lung. If inhaled, dipoles are predicted to deposit in the nose, mouth, or trachea and are either swallowed or expelled. Although there is no definitive evidence from the epidemiological literature that chaff exposure is not harmful, there is epidemiological information available on workers involved in the glass fiber manufacturing industry. Data from these studies suggests that exposure to fibrous glass is not associated with increased risk of death from respiratory disease.

There are reports that occupational exposure to aluminum may increase the risk of asthma (Sordrager et al. 2001, Vandenplas et al. 1998) and pulmonary fibrosis (Chip et al. 1998, Nemery 1998). We are not aware of any cases of occupationally induced asthma or pulmonary fibrosis among workers involved in the manufacture or handling of RF chaff. Intact chaff dipoles are not expected to penetrate the lungs and therefore, would not be expected to increase the risk of either asthma or pulmonary fibrosis among exposed persons. Dermal contact with RF chaff is a possible exposure scenario for sailors and ground troops during training exercises or combat. A review of historical medical records of military personnel at potential risk will be conducted in the near future. However, to date there is no data on the ability of chaff to cause dermal or ocular irritation in humans or animals. Occupational exposure to fibrous glass has been linked to eye and skin irritation and irritation of the nasal and oral mucous membranes (NIOSH 1977).

Ingestion of chaff dipoles could occur through drinking unfiltered water drawn from a source containing chaff or by swallowing fibers that become trapped in the mouth and upper airway following inhalation of chaff. Children that consume large amounts of soil (i.e., geophagcous) are potentially at risk of ingesting chaff if this material is present in the soil. There are no reports of children or adults that have developed adverse health effects after ingestion of chaff. However, studies in which laboratory animals were dosed with chaff at varying doses revealed no gross or histological signs of toxicity or mechanical injury upon postmortem examination (Wilson et al. 1999)

It has been speculated for some time that Al may be associated with several neurodegenerative diseases (ATSDR 1992) and chaff dipoles are a potential source of aluminum in cases of accidental ingestion. However, the link between dietary Al ingestion and development of neurodegenerative diseases remains tenuous. Absorption of Al by the human gastrointestinal tract is minimal (<1%), with most ingested Al being passed out of the body in the feces (Jouhanneau et al. 1997). It has been shown that the bioavailability of Al from ingested chaff in both *in vitro* and *in vivo* models is considerably less than that of $Al(OH)_3$, which is a source of Al in common Al-based antacids (Wilson et al. 1999).

Health Effects on Livestock & Wildlife

The potential negative impact of chaff on wildlife and livestock health has been a major issue for the DOD since the 1950's. A number of legal claims have been filed against the USAF alleging that livestock had died from ingesting chaff while grazing (USAF 1979). Studies conducted in cattle and goats at the University of Wisconsin and found no evidence that chaff ingestion posed a significant health hazard for farm animals (USAF 1979). In similar studies, the Canadian Department of Agriculture found no evidence of toxicity in calves fed RF chaff (CDA 1972).

At least one study (USAF 1997) describes several ground surveys of two chaff use MOAs and reports that chaff debris, including plastic end caps, foil, and paper wrappers, was visible on the training ranges. Clumps of chaff from cartridges that did not deploy correctly were also observed. However, animal abundance and nesting activities of rodents or birds were considered normal. It was concluded from the results of this study that chaff interference with wildlife activities is negligible.

Chaff has also been deployed over estuarine environments, several federal agencies have commissioned studies of the effects of chaff on these ecosystems. Multiple marine organisms, including benthic polychaetes, American oyster, blue mussel, Blue crab, filter-feeding menhaden, and killifish, were utilized in studies investigating the impact of chaff on organisms in the Chesapeake Bay and found no evidence that RF chaff was acutely toxic to any of the species tested. Concentrations of chaff used in these studies were described 10 to 100 times the exposure level expected to be found in the Chesapeake Bay.

Degradable Chaff

Recently, the U.S. Navy considered developing chaff that could be quickly degraded (GAO 1998). One candidate under consideration for use as training chaff consisted of Al-coated degradable glass fibers. Contact with water results in degradation of the fiber. However, problems with incomplete degradation and lack of evidence that chaff is harmful to the environment resulted in suspension of further development of a degradable chaff in 1999.

Discarded styrene dispenser pistons and endcaps are visible to the human eye and account for about 95% of the total mass of product released to the environment during chaff deployment. As such, the Navy is considering the use of chaff dispenser pistons and endcaps constructed with biodegradable polymers. This program is in its preliminary stages and studies are now on-going at the Naval Research Laboratory and Naval Health Research Center Toxicology Detachment to identify biodegradable materials with little potential for ecotoxicity. The Navy plans to field biodegradable chaff dispensers and endcaps by FY 2003.

The Future of Chaff

Any military pilot will tell you the importance of chaff. This material, usually dispersed a couple handfuls at a time during an ever shrinking window of time often no greater than seconds, means the difference between the loss of life and destruction of a multi-million dollar aircraft in air-to-air combat and survival. Split second timing while executing a number of operations at Mach speed can only be acquired by training. Chaff, its composition and its use in training, has changed dramatically over the past few decades. The changes have resulted from research advances and an appreciation for potential environmental impacts of military activities. While dramatic advances in chaff are not anticipated, it use in training and combat will continue for the foreseeable future.

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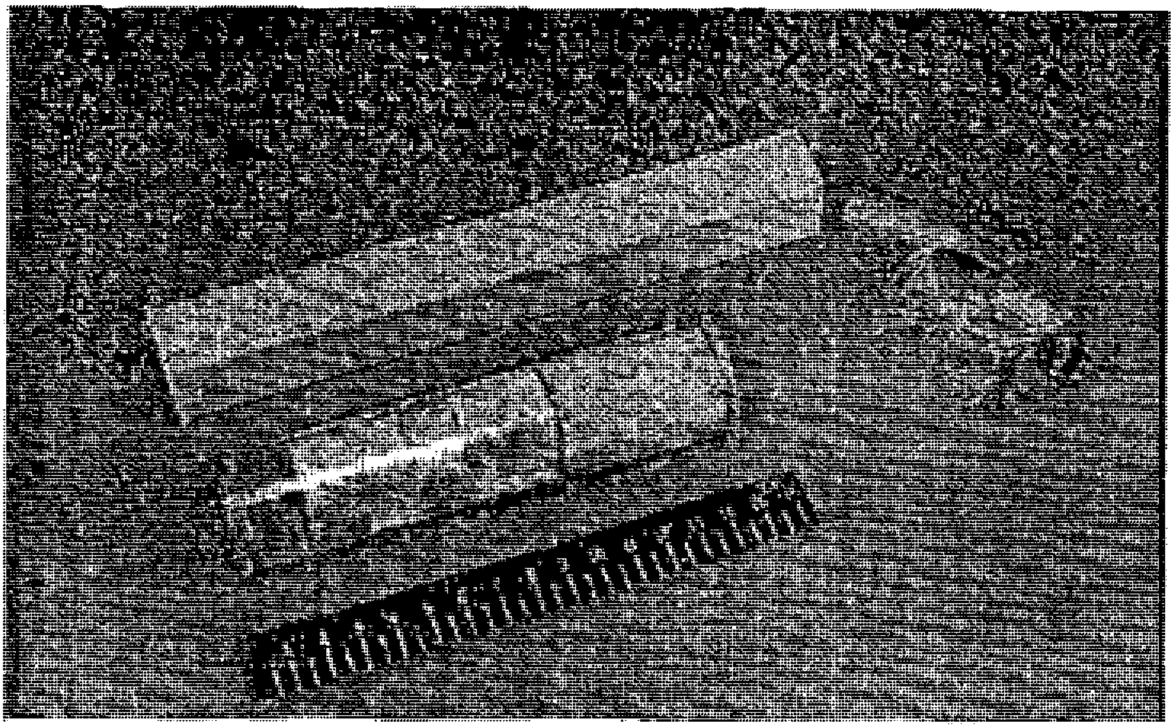

Figure 1. Radio frequency chaff cartridges (Air Force version RR-188/AL, top; Navy version RR-144/AL, bottom) and chaff fibers (right). Fibers of different lengths can be seen in the Navy operational version (clear cylinder). These lengths correspond to the frequency modes of the radar spectrum. In training, however, cartridges containing only 1.8 cm fibers are used (not shown).

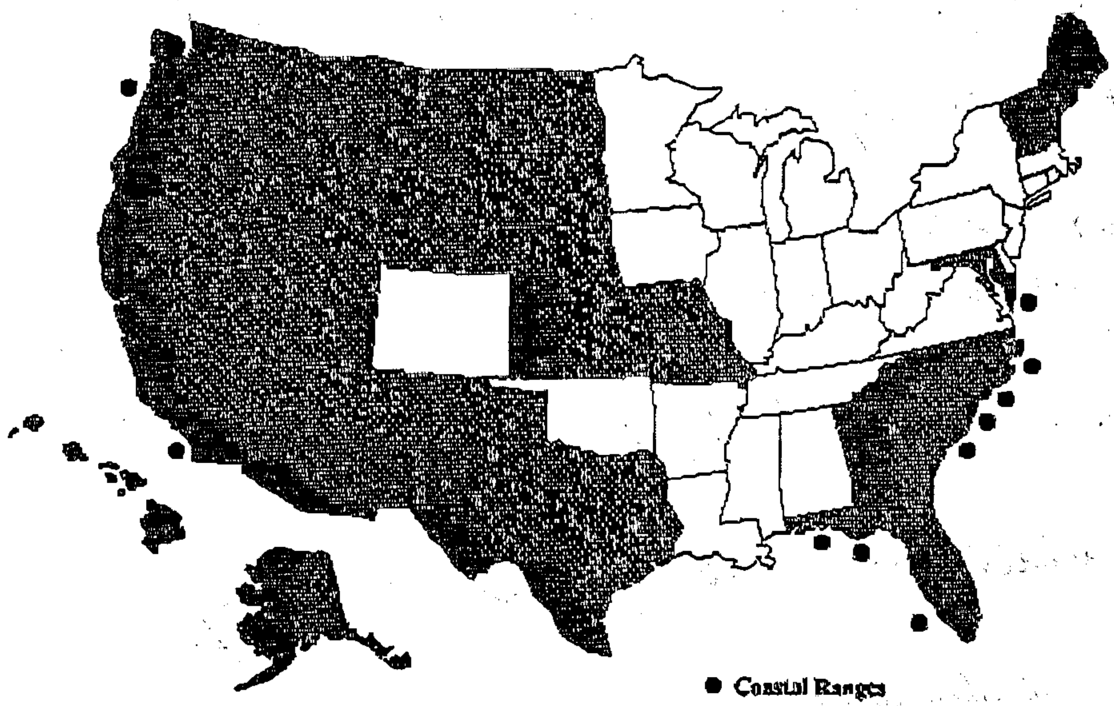

Figure 2. Chaff is used in training over ranges in 26 states, 1 territory, and 10 off-shore areas encompassing approximately 2.7 million square miles (dark shaded states). Coastal ranges estimated at 400 mi^2 each. Figure is adapted from the GAO report (1998).

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Bishop Henry Whipple Federal Building
1 Federal Drive
Fort Snelling, MN 55111-4056

IN REPLY REFER TO:

FWS/AES-HC

December 26, 2001

Mr. Harry A. Knudsen, Jr.
Chief, Environmental Planning Branch
Air National Guard Environmental Division
ANG/CEVP
3500 Fetchet Avenue
Andrews AFB, Maryland 20762-5157

Subject: Request for Extension of Review Period for Environmental Assessment for Deployment of Chaff and Flares in Military Operations Areas (Phase I), dated October 2001

Dear Mr. Knudsen:

The U.S. Fish and Wildlife Service (FWS) respectfully requests an extension of time to allow for additional review related to the Environmental Assessment (EA) for Deployment of Chaff and Flares in Military Operations Areas (Phase I). Your letter transmitting the Draft Finding of No Significant Impact (FONSI), which we received on November 6, 2001, indicates that comments should be provided no later than 60 days from receipt of the letter. We hope to have comments to you no later than February 15, 2002.

The transmittal letter and Draft FONSI describe the action as "ongoing use" of chaff and flares. The Draft FONSI goes on to indicate that the Air National Guard (ANG) proposes to "continue using" chaff and flares during training operations in 15 MOAs, which are listed in Item 1 and shown on Figure 1-1. The Draft FONSI also describes Alternative 1, the Proposed Action, as "Current Operations." Based on the above description , we were not overly concerned with the proposal and did not immediately request copies of the EA. However, in a search on the internet for related materials, we came across a report in *Navy Medicine* on "Human and Environmental Health Issues Related to Use of Radio Frequency Chaff." A section of that report dealing with the current Department of Defense (DOD) chaff-use policy indicates that, as a result of a 1998 directive from the Joint Chiefs of Staff, the number of training sites where chaff training is permitted has been reduced to approximately 50 selected ranges and MOAs in the U.S. A related figure in the report (adapted from a 1998 GAO report) shows that chaff training is used in only 26 states. Of the states within our region of the FWS, current training with chaff use is shown only for Missouri. No chaff use is shown for Iowa, Minnesota, Wisconsin, or Michigan.

As there appeared to be a substantial discrepancy between the description in the 1998 GAO report of current training use of chaff and the description of the ANG's proposed action as "ongoing use," we requested a number of copies of the Draft EA for distribution to potentially affected refuges and field offices. Our initial review of Table 2-3 in the Draft EA confirms that more than 70 percent of the chaff rounds proposed to be used are newly proposed use and not "continuing use." The table indicates that chaff is not currently used in MOAs in Wisconsin or Michigan. Of particular concern is that much of the newly proposed use in Wisconsin is in MOAs over or in close proximity to the FWS's Necedah National Wildlife Refuge. Table 2-3 does indicate current chaff use in Iowa and Minnesota, contradicting the 1998 GAO report. We would appreciate receiving clarification on whether there is, in fact, current use of chaff in MOAs in Iowa and/or Minnesota. Clarification would also be appreciated concerning current and/or proposed use of chaff and/or flares in the Minnow MOA, located over west-central Lake Michigan. That MOA is shown on Figure 1-1 in the Draft FONSI and Figure 2-3 in the Draft EA. However, no description of the MOA is provided in Section 3 of the Draft EA, and no mention is made of the Minnow MOA in Section 2.1. Clarification concerning the minimum altitude at which chaff would be released would also be appreciated. We understand that DOD policy stipulates that chaff should not be released below certain altitudes during training to ensure that chaff plumes are widely dispersed and dipole ground concentrations are very low.

Table 2-4 of the Draft EA indicates that the use of flares in the MOAs in Michigan is also newly proposed use and not "continuing use." In light of the fact that much of the proposed use of chaff and some of the proposed use of flares is newly proposed use and not a continuation of current use, the ANG might want to consider circulating an amended Draft FONSI and amended pages for the Draft EA to revise the description of the proposed action (preferred alternative).

Due to the fact that FWS staff in potentially affected refuges and field offices received copies of the Draft EA only shortly before the start of the holidays, we will require additional time to review the document and other related materials concerning potential environmental effects associated with the use of chaff and flares. Therefore, we are requesting an extension of the review and comment period until February 15, 2002.

Sincerely,

Lynn M. Lewis

Acting Assistant Regional Director,
Ecological Services

Fields of Opportunities

STATE OF IOWA

THOMAS J. VILSACK, GOVERNOR
SALLY J. PEDERSON, LT. GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
JEFFREY R. VONK, DIRECTOR

November 16, 2001

Mr. Harry A. Knudsen
Department of the Air Force
Air National Guard
ANG/CEVP
3500 Fetchet Avenue
Andrews AFB, MD 20762-5157

RE: FONSI status for the Environmental Assessment for Deployment of Chaff and Flares in Military Operations Areas (Phase I), dated October, 2001

Dear Mr. Knudsen:

Thank you for inviting our comments on the impact of the above referenced project on protected species and rare natural communities. We have no comments to provide at this time, but when an actual event is to occur, please contact us for comments and environmental review before that occurrence.

If you have any questions about this letter or if you require further information, please contact Keith Dohrmann at (515) 281-8967.

Sincerely,

ALLEN L. FARRIS
IOWA DEPARTMENT OF NATURAL RESOURCES

AF:kd

01-666L.doc

WALLACE STATE OFFICE BUILDING / DES MOINES, IOWA 50319
515-281-5918 TDD 515-242-5967 FAX 515-281-6794 WWW.STATE.IA.US/DNR

STATE OF NEBRASKA

DEPARTMENT OF ENVIRONMENTAL QUALITY
Michael J. Linder
Director
Suite 400, The Atrium
1200 'N' Street
P.O. Box 98922
Lincoln, Nebraska 68509-8922
Phone (402) 471-2186
FAX (402) 471-2909

Mike Johanns
Governor

December 7, 2001

Harry A. Knudsen, Jr.
Chief, ANG/CEVP
Environmental Division
Department of the Air Force
3500 Fetchet Avenue
Andrews AFB MD 20762-5157

RE: Assessment for Deployment of
Chaff & Flares in Military Operations Areas

Dear Mr. Knudsen:

Our agency has been asked to review the above referenced project. We have no comments regarding any impact within our programs or jurisdiction.

Should you have any questions, feel free to contact me at 402/471-2186.

Sincerely,

Jay D. Ringenberg
Deputy Director, Programs

JDR:hs

WISCONSIN DEPT. OF NATURAL RESOURCES

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Scott McCallum, Governor
Darrell Bazzell, Secretary
Scott A. Humrickhouse, Regional Director

West Central Region Headquarters
1300 W. Clairemont Avenue
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Telephone 715-839-3700
FAX 715-839-6076
TTY 715-839-2786

January 2, 2001

Harry A Knudsen, Jr.
Department of the Air Force-Air National Guard
ANG/CEVP
3500 Fetchet Avenue
Andrews AFB MD 20762-5157

Dear Mr. Knudsen:

The Wisconsin Department of Natural Resources (WDNR) has reviewed the Air National Guard's (ANG) October, 2001 draft Finding of No Significant Impact (FONSI) and draft Environmental Assessment (EA) for (continued) Deployment of Chaff and Flares in Military Operations Areas (Phase 1) across the United States. This project is of interest to us in that Falls 1 and 2 and Volk East, West and South military operations areas (MOA's) airspace overlies parts or all of 17 central Wisconsin counties.

WDNR is not aware of any human or biological health impacts or significant wildfires that have occurred as a result of historic ANG use of chaff and flares in Wisconsin. WDNR has general authority to assure that National Ambient Air Quality Standards (NAAQS) are met. And while we would generally agree with EA findings that potential for adverse environmental effects is low, we also recognize that information is limited such that a complete scientific understanding of environmental risk is unavailable. Accordingly, we support a cautious approach with respect to any activity that may pose risk to the Wisconsin's air, land and water resources. Comments that follow are provided in effort to minimize such risk.

1. Wisconsin MOA description is incomplete.

   In order to properly evaluate chaff and flare deployment risk in Wisconsin (Falls 1 and 2, and Volk West, South and East MOA's) the environmental setting needs to be accurately described. There are two notable omissions in Section 3.7.

   First, military airspace overlies historic Glacial Lake Wisconsin, a roughly 1800 square mile area centered near Necedah, which is also near WANG's Hardwood Bombing Range and near the center of Wisconsin MOA's. Whereas the topography is described on page 3-85 to be hilly, much of the area is flat, poorly drained and extensive wetland communities are present.

   The second area feature understated is the substantial amount of public land that underlies Wisconsin MOA's. Discussion on page 3-97 should be expanded to more accurately depict the large amount of public recreation land (including Necedah National Wildlife Refuge, state natural areas, state and county forests, state and county/local parks, etc.). Doing so would help better denote the substantial amount of public use that occurs on lands underlying Wisconsin MOA's. Enclosed are two brochures (State Park System and Public Wildlife Recreation Land) that may help doing so for this EA and possible future ANG projects in Wisconsin.

A few other comments on the description:

-Biological Resources, page 3-87, should mention ongoing efforts to establish a second migratory flock of federally endangered whooping cranes, with summer nesting grounds to be located at Necedah National Wildlife Refuge (for more info see *www.operationmigration.org/*).

-Pattison State Park is located in NW Wisconsin, not south of Falls MOA (page 3-97).

-Tables 3-63 through 3-66 each should list the federally endangered Karner blue butterfly (see attachment 3, a map of Karner blue butterfly high potential range in Wisconsin).

-Page 3-104 should note the considerable contribution that public lands and recreation use provide to regional economies.

2. Disproportionate Amount of Chaff and Flare Use over Wisconsin MOA's

We note from tables 2-2, 2-3 and 2-4 that the total number of aircraft sorties in Wisconsin MOA's is 39% of the nationwide totals, but that 65% of all chaff and 64% of all flares are deployed in Wisconsin MOA's. Why the heavy use in Wisconsin compared to the rest of the nation? Table 4-11 shows the estimated number of dud flares in Wisconsin is much greater than any other ANG MOA's nationwide. As such, the EA should clearly point out that the potential for problems associated with chaff and/or flare use is substantially higher in Wisconsin than anywhere else in the nation. Page 4-17, section 4.4.2 notes that "Procedures have been put into place to minimize the chance that public safety will be significantly effected by training exercises involving chaff." What are these procedures? Two new tables should be added (Tables 4-7*a* and 4-9*a)* that estimate chaff and flare hazard rating per each MOA. This may show, given the large volume of chaff/flare use and comparative small size of Wisconsin vs. other nation-wide MOA's (not to mention Wisconsin MOA's have the two highest population densities), an unacceptable safety risk of chaff and/or flare use in Wisconsin.

3. Deployment of Flares over Non-DoD Lands

Page 1-7, section 1.5.3 indicates, per AFI 13-212, "...flares may be dropped only if specifically authorized for use on the range and when ground impact will occur on (presume federal?) government controlled land." The remainder of the EA (see table 4-11) indicates that flares can be released anywhere within the MOA's. Which is the case? This is important when considering potential safety risk and potential for biological or wildfire impacts from dud flares.

4. Potential Risk of Flare Induced Wildfire

As stated earlier, we are not aware of past major wildfire incidents due to flare use. There have routinely been fires at Hardwood Bombing Range, though we are not involved in suppression and do not know if they were caused by flare or air-to-ground or other weapons use. We agree that risk of flare induced wildfires is low. Further, we are generally pleased with past WANG cooperation with WDNR forest fire protection efforts. We encourage continued cooperative efforts in the future, particularly during high and extreme fire conditions.

5. Biological Resource Impacts

Evaluation of potential biological impacts, section 4.6, focuses on review of (limited) available relevant literature and projected debris deposition rates using models, with emphasis on toxicity risk in terrestrial and aquatic habitats. We would agree that studies referenced generally indicate no significant impact potential, but we do not think they are conclusive. There are a number of variables noted in the text that could influence impact potential, notably actual (vs. calculated) deposition rate of chaff/flare components and salinity and pH of receiving water/soil. Thus, risk of impact could substantially vary from one MOA to the next. Also, it is reasonable to assume that deployment of chaff and flares, and associated deposition rates, may be measurably higher within certain areas rather than uniformly dispersed throughout each entire MOA area. For instance, would more frequent use of chaff and flares occur in Wisconsin MOA's near Hardwood Bombing Range (page 2-1 suggests a general chaff deployment near weapon release points, page 2-3 seems to imply a similar pattern for flares).

Also, page 2-1 is confusing as to general chaff release altitude. The average altitude for release is described to be from 10,000 to 25,000 feet MSL. Yet the previous sentence indicates chaff is generally released, for fighter-type aircraft (by far the most commonly used according to table 2-2), below 4500 feet AGL. The approximate mean ground level of Wisconsin is 1050 above sea level. The average release elevation should be clarified, as it could have a dramatic effect on debris dispersion rates and deposition patterns (i.e. assuming other factors are equal, the lower the release point the less dispersal).

Given the much higher level of flare/chaff use in Wisconsin as compared to other MOA's, it would seem reasonable to assume that the greatest risk of impact would occur here. Tables 4-14 through 4-18 should be developed for each MOA. Areas within each MOA where flare/chaff deployment is highest, such as near bombing ranges, should be identified and deposition rates adjusted to estimate a worst-case condition. In addition, sensitivity of resources in and surrounding ranges should be considered, such as those noted in comment #1. If projected deposition estimates for any MOA-specific analysis indicates an undesirable or unacceptable risk to certain areas within that MOA, or level of risk is inconclusive and highly sensitive resources are present, mitigation measures should be proposed (possibly by the appropriate local ANG unit) to prevent impacts <u>before</u> they occur. Or, rather than relying solely on assumptions and models, a monitoring program could be used to actually measure fallout volume and components in expected high deposition areas. Areas around Hardwood Range would seem to be ideal locations for such "worst-case" monitoring. Based either on the projected or measured deposition rates, the need for mitigation could be determined. Mitigation could include impact avoidance such as by establishing chaff or flare deployment restrictions/prohibitions when one or more threshold deposition rate(s) are reached. *

As noted in the Select Panel Report on Environmental Effects of RF chaff appended to the EA, WDNR supports the recommendation for DOD sponsored research on use of degradable chaff in hopes of further reducing risk of potential negative environmental effects.

6. Alternatives Analysis

Coinciding with comment #5, one alternative not considered, but which should have been, is to restrict chaff/flare release in area(s) within any given MOA to minimize potential safety, biological, wildfire or other risks. Given their typically large size, there must be diverse mosaics of varying land uses within portions of each MOA within the U.S. As is the case underlying Wisconsin MOA's, some lands are more sensitive or have greater risk of adverse impact from chaff or flare use than others- population centers or high public use areas, sensitive biological communities, fire-prone forest lands or cover types, etc. Similar to the concept of seasonal use limits (alternative 4), the EA should at least identify a process allowing for identification of sensitive areas, with a safe buffer zone to allow for drift, where chaff/flare releases should be prohibited or restricted.

The Department appreciates the opportunity for review and your consideration of the above comments. Please provide a copy of the final EA when it becomes available. If you have questions please contact me at (715) 839-3747.

Sincerely,

Tom Lovejoy
Environmental Impact Coordinator

cc:
Dan Gonnering- WANG, Volk Field
Joel Trick- FWS, Green Bay Field Office
Dave Siebert- SS/7
WCR routing

Texas Review and Comment System
Review Notification

Applicant/Origination Agency: Department of the Air Force - Air National Guard
Contact Name: Mr. Harry Knudsen
Contact Phone:
Email:

Project Name: FONSI on EA for deployment of Chaff & Flares in MOA (Phase I)

Funding Agency:
SAI/EIS#: TX-I-20011119-0001-50
Date Received: 11/19/2001
Date Comments Due BPO: 12/19/2001

Review Participants

Agencies	Cogs
	Nortex Regional Planning Commission Mr. Dennis Wilde Executive Director P.O. Box 5144 Wichita Falls, TX 76307-5144

Special Notes/Comments:

Summary of application provided by SPOC. Reviewers should contact applicant directly to receive a full copy for review.

☒ **No Comment**

Review Agency **Signature**

Return Comments to: Denise S. Francis /gc

Denise S. Francis, State Single Point of Contact
Governor's Office of Budget & Planning
P.O. Box 12428
Austin, TX 78711
(512) 305-9415

January 25, 2002

Harry A. Knudsen, Jr.
Chief, Environmental Planning Branch, ANG/CEVP
3500 Fetchet Avenue
Andrews AFB, MD 20762-5157

RE: Proposed Deployment of Chaff and Flares in Military Operation Areas, Lamar, Red River, and Bowie Counties

Mr. Knudsen:

Thank you for coordinating with this agency in your planning activities regarding the proposed deployment of chaff and flares in Military Operations Areas (MOAs) throughout the United States. Texas Parks and Wildlife Department (TPWD) staff has reviewed the Draft Final Environmental Assessment (DFEA) and offer the following comments regarding the proposed activities.

Drifting chaff and/or flares from the Rivers MOA in southwestern Oklahoma could potentially reach Lamar, Red River, and Bowie Counties in Texas. However, no adverse impacts to fish and wildlife resources in Texas are anticipated from the use of chaff and flares on Rivers MOA.

Thank you for the opportunity to review and comment on this project.

Sincerely,

Danny Allen
Wildlife Habitat Assessment Program
Wildlife Division

DLA:pmo.8954

4200 SMITH SCHOOL ROAD
AUSTIN, TEXAS 78744-3291
512-389-4800
www.tpwd.state.tx.us

U.S. Department of Transportation
Federal Aviation Administration

Memorandum

Subject: **ACTION**: Draft Finding of No Significant Impact for the Environmental Assessment for Deployment of Chaff and Flares in Military Operations Areas (Phase I)

Date: JAN 8 2002

From: Manager, Airspace Branch, ANM-520

Reply to Attn. of:

To: Air Force Regional Representative, ANM-900

We have conducted a review of the Draft Finding of No Significant Impact (FONSI) for the Environmental Assessment (EA) for Deployment of Chaff and Flares in Military Operations Areas (MOA's). The Proposed Action in the FONSI and EA is for the continued use of chaff and flares for training flight operations in 15 MOA's that are managed by 8 Air National Guard units.

The **Environmental Assessment for the Establishment of the Juniper Low Military Operations Areas**, dated August 12, 1993, states that chaff and flares will not be utilized unless assessed in follow-on documentation. The draft FONSI is for the continued use of chaff and flares in the Juniper MOA's, which indicates this activity is already taking place and that a previous analysis was conducted. Recommendation: The draft FONSI reflect when the Juniper Low MOA was previously assessed for chaff and flare activity.

The proposal for the **Realignment of Military Operation and Warning Areas for the 173rd Fighter Wing in Oregon**, dated March 21, 2001, is for the modification of Juniper, Hart, and Goose MOA's and establishment of the Dolphin MOA. The Categorical Exclusion for this proposal says chaff and flare use is currently being addressed in all ANG airspace and the use of chaff or flares in the proposed airspace will be determined by the outcome of that process. The draft FONSI and Environmental Assessment for the Deployment of Chaff and Flares in Military Operations Areas, dated October 2001, is for the continued use of this activity is in the Juniper, Hart, and Goose MOA's. Recommendation: The draft FONSI and accompanying EA reflect an accurate status of the chaff and flare use consistent with past and proposed airspace actions.

The **Draft Environmental Impact Statement (DEIS) for the Proposed Training Range in Montana**, dated July 2001, indicates that the use of chaff and flares has occurred for many years in the confines of the Hays MOA. The draft FONSI does not include the Hays MOA for the continued use of chaff and flares. Recommendation: The Hays MOA be included as an addendum to the Deployment of Chaff and Flares in Military Operations Areas (Phase I) study.

The draft FONSI is inconsistent and does not accurately reflect the existing and proposed chaff and flare activity for the MOA's utilized by the ANG in the Northwest Mountain Region. The ANG units need to be surveyed and the National Guard Bureau provided an up-dated status of chaff and flare use for the Phase I study and existing airspace proposals.

If you have any questions or need further information please contact Jim Lambert, ANM-520.3, at (425) 227-2538.

Carla J. Mawhorter

Carla J. Mawhorter

cc:
ATA-300

Telefax Coversheet

Date: 10 Jan 2002
To: ANG/CEVP (Mr Harry Knudsen, Jr.)
Telephone: 301-836-8143/DSN278-8143/telefax 301-836-8139/email: harry.knudsen@ang.af.mil

Message: Harry. Attached is a 2-page memo from Carla Mawhorter [Manager, Airspace Branch, ANM-520]. She and her branch environmental expert [Jim Lambert] have identified several inconsistencies between the FONSI and what appears to be actually occurring in several ANG units. Please call me so we can discuss these issues. The big question is: How can the ANG resolve these issues? ANM-520 will be looking for a formal response from your office.
If I'm not here when you call, Lt Col Sam Shrimpton should be available to take your call.

Regards, Mike
Page 1 of 3

FROM:
Michael J. Mixon
Lt Col, US Air Force
Senior Air Force Representative (AFREP)
FAA Northwest Mountain Region
ANM-900/910
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APPENDIX A
Table A-1
Response to Comments Received on the Phase I Draft EA for Chaff and Flares

Person Making the Comment	#	Section	Comment/Topic	Response to Comment
Pat Conway (Peaceful Skies in Wisconsin)		2.1	Clarify ongoing versus proposed use of chaff and flares in Wisconsin MOAs	Chaff is not currently used in the Wisconsin MOAs (Volk and Falls). Chaff was dropped over those areas from the time that the military training airspace (MOAs and MTRs) were established until the early 1990s. After the guidance from USAF was received, military units flying in airspace scheduled by Volk Field ceased dropping chaff with the exception of some infrequent drops over the Hardwood Range. This activity has also ceased, since there was little training value that could be gained. Text in sections 1.3.2 and 2.1, as well as Tables 1-4, 2-3 and 2-4, have been revised to clarify this point. ANG proposes to resume the previous use of chaff during (ongoing) training exercises in these MOAs.
WI DNR (Wisconsin Department of Natural Resources)	1	3.7	Wisconsin MOA description is incomplete. - Describe in more detail environmental settings in Falls 1&2, and Volk MOAs. - Mention whooping crane migratory flock in the Necedah National Wildlife Refuge	The text in section 3.7 was modified to more fully describe the environmental setting of the MOAs. A sentence was added to include Glacial Lake Wisconsin, and the description of topography was changed to flat and poorly drained. The Land Use and Visual Resources section was expanded to include more public recreation lands. The contribution that public lands provide to regional economies has been included on Page 3-107. Pattison State Park is not included in the text, as it is not located near the MOAs and is therefore inappropriate. The Karner Blue butterfly has been added to Tables 3-63 through 3-66. The Biological Resources section has been modified to include the efforts to establish a migratory flock of whooping cranes with summer nesting grounds at Necedah National Wildlife Refuge.
WI DNR	2	2.1 and 4.2	Disproportionate Amount of Chaff and Flare Use over Wisconsin MOAs. - Why there is a heavy use of chaff/flare in the Wisconsin MOAs as compared to rest of nation? - What are the safety precautions and procedures taken with chaff use.	There are three reasons for the apparently disproportionate amount of chaff and flare use over Wisconsin. First, because the MOAs listed in Table 2-2 are not all of the MOAs in the United States, the total number of aircraft sorties in Wisconsin does not represent 39% of the nationwide totals, nor do the amounts of chaff and flares used in Wisconsin represent 65% and 64%, respectively, of the nationwide totals. Second, the Wisconsin MOAs based their chaff estimates on the amount of chaff they could use, not the amount they actually use. The actual amount of chaff used is likely to be 1/3 to 2/3 of this total (e.g., 40,000 to 95,000 chaff bundles as opposed to 140,000). Third, flare deployment is biased toward weapons-release points such as Hardwood Bombing Range. Because a greater number of flares are deployed in this area, it follows that more dud flares will be deployed there, as well. Finally, dud flare density would be lower in populated areas due to the presence of a bombing range, which receives a greater proportion of flares compared to areas of even distribution. Safety measures for chaff have been added to Section 4.4.1. Suggested new tables, 4-7a and 4-9a, cannot be created because the information contained

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				within them was obtained from the Air Force and is not MOA-specific. It is based on 10 years of accident data collected Air Force-wide.
WI DNR	3	1.5	Deployment of Flares over Non-DoD Lands. - Important when considering potential safety risk and potential for biological or wildfire impacts from dud flares. - Can flares be released anywhere within the MOAs?	Incorporated to Section 4.1.3. Regulations restrict the use of flares to government-controlled land or military-owned land and the deployment altitude over non-government property to 2,000 feet above ground level. Safety measures, such as the 2,000 feet AGL minimum altitude for deployment, have been put into place to minimize the chance that public safety will be significantly affected by training exercises involving flares.
WI DNR	4	NA	Potential Risk of Flare Induced Wildfire. - Agree that risk of flare induced wildfire is low. - Pleased with past WANG cooperation with WDNR forest fire protection efforts.	No response required.
WI DNR	5	4.2	Biological Resource Impacts. - Estimated deposition rates indicate no significant impact potential, but they are not conclusive. - The risk of chaff impact could substantially vary from one MOA to another or within certain areas of a MOA, such as near the Hardwood Range in Wisconsin. Page 2-1 is confusing as to general chaff release altitude. The average release elevation should be clarified.	Extremely conservative assumptions were used to estimate deposition rates in small, isolated fresh water bodies. For example, it was assumed that all of the aluminum, magnesium and boron in the chaff and flares deployed annually enters the water column and is bioavailable (i.e., physical/chemical conditions that cause maximum bioavailability of metals). Because the Wisconsin MOAs have the (potential) maximum annual deposition rates of chaff and flares, they represent the "worst-case scenario" and were used as such in the presentation. This is why it is not necessary to develop Tables 4-14 to 4-18 for each MOA. Even in this "worst-case," modeled surface water concentrations are 1.5 percent or less of the chronic freshwater values. While chaff use is randomly distributed throughout the MOA, flare use may be more concentrated around Hardwood Bombing Range, because it is a weapons release point. However, there would need to be a 1,000-fold increase in flare use to cause surface water concentrations in this area (or any other sub-MOA area) to exceed water quality criteria, assuming metals leached from flares are bioavailable in the water column. In addition, there is a water quality monitoring program in place at Hardwood Bombing Range, and any problems suggested by data from this program would be evaluated as needed. Page 2-1 has been amended regarding chaff release altitudes. Average altitude of release is 10,000 to 25,000 AGL. Some training regimes involve lower-altitude releases, which varies between aircraft and ANG units, but the bulk of chaff is released at the average altitudes indicated. Based on the data in the NRL study, a difference of 1,000 feet in altitude results in a difference of about 2 miles of dispersal distance. Also, it should be noted that "above ground level" (AGL) does not refer to sea level as the baseline.
WI DNR	6	NA	Alternatives Analysis. - One alternative not considered is to restrict chaff/flare release in area(s) within any given MOA to minimize potential safety, biological, wildfire or other risks. - EA should identify a process allowing for identification of sensitive areas, within a safe buffer zone, to allow for	We agree that there are diverse mosaics of varying land use within each MOA. However, we also recognize that it would be extremely difficult to restrict chaff and flare use to particular portions within a MOA. Because most areas could be considered sensitive to risk in some manner, it would be difficult to establish a basis for determining where to restrict or prohibit use in particular portions of MOAs. It might not even be operationally possible. Furthermore, the buffers needed to compensate for the drift factor would be so

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			drift, where chaff/flare releases should be prohibited or restricted.	large that partitioning off the MOAs in this way would be nearly impossible.
USFWS (U.S. Fish and Wildlife Service) Region 3	1	1.3 and 2.1	The ANG should clarify its future intent to analyze chaff and flare use in other MOAs in addition to that presented in this EA. This intent should be stated, either in a separate document or in the introductory section of the EA. It is unclear as to whether or not chaff is currently used in Wisconsin... Request further clarification and coordination regarding what current operations (Preferred Alternative) actually are.	Overview of environmental documentation for chaff and flare use has been added to section 1.1. See Pat Conway comment above. Chaff use in Wisconsin is proposed to be resumed, after being discontinued in the 1990s pending environmental documentation. Training flights and use of flares in the Wisconsin MOAs are currently ongoing. Sections 1.3.2 and 2.1, and Tables 1-4, 2-3 and 2-4, have been revised to clarify this point.
USFWS Region 3	2	4.6.2	Environmental Consequences. This comment questions the distribution of chaff and flares that the model assumes. Need to explain how chaff and flares are distributed with supporting information for why this is the case. Need to describe how the realistic estimates of deposition rates were made. Methods used to conduct analysis of effects to aquatic life should be described, along with rationale for why this analysis is appropriate. Need to estimate deposition rates within high-use areas such as Hardwood Bombing Range, as well as present worst-case scenario based on potential failure of chaff and flares to deploy as intended. Should consider the fact that pH levels encountered in central Wisconsin wetlands and water bodies tend to be low. Need to estimate probability of duds reaching the ground and model local impacts to small wetlands or water bodies.	See WI DNR Comment #5 above. A more complete discussion of the distribution of chaff and flares has been included in Section 4.6.2. See WI DNR Comment #5 above. A discussion of this issue has also been included in Section 4.6.2. The consideration of pH levels in central Wisconsin wetlands and waterbodies is not necessary because the model assumes that all chaff/flare components are completely bioavailable in the water column. A discussion of this estimate has been included in Section 4.6.2.
USFWS Region 3	NA	4.6.1	Federal Threatened and Endangered Species. Whooping crane- The Service is concerned about the potential for adverse effects from chaff and flare use to the whooping crane. An estimate of the incidence of the failure of chaff and/or flares to deploy as designed is of interest to the Service, as it would allow for the assessment of the risk to whooping cranes from shiny metallic objects. This issue should be addressed within the EA, including an estimate of the expected probability and/or frequency that chaff bundles or flares would fail to deploy and, thus, fall to the ground intact.	The following discussion of the likelihood of a whooping crane coming into contact with a dud chaff bundle or flare has been included in Section 4.6.1: **Whooping Cranes** While individual chaff particles deposited in wetland or aquatic systems are unlikely to be noticed by wildlife such as waterfowl before sinking to the bottom of the water body, the shiny metallic appearance of dud chaff bundles could attract such birds, which might think the dud is a fish. Some species of waterfowl are known to be attracted to shiny metallic objects. One example is the whooping crane (*Grus americana*). The tendency of this species to pick up and ingest shiny metallic objects found laying on the ground has been noted in captive breeding flocks (Olsen and Wise, 2001). Because the whooping crane is found in an experimental population in the Necedah National Wildlife Refuge in Volk MOA, the potential presence of dud chaff bundles in whooping crane habitat is an issue that warrants additional discussion.

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				The failure rate of chaff is approximately 1.5 percent (ACC, 1997). For Volk MOA, that would translate into an average of 0.4 dud chaff bundles per square mile per year. At approximately 44,000 acres (70 square miles), the maximum anticipated exposure of the Necedah NWF Refuge to dud chaff bundles would be only 28 per year (70 x 0.4). In order for a whooping crane to come into contact with a dud bundle, two conditions would need to be met. First, the dud chaff bundle would need to fall into whooping crane habitat. Second, the dud bundle would need to be visible to the crane. If a dud bundle were to land in crane habitat with overlying water, it is likely that the force of impact would plunge an intact dud chaff bundle into the sediment and bury it. The potential for a crane to find a dud bundle is also lowered due to the fact that the area of their preferred habitat that is not covered by surface water constitutes a low percentage of the Volk MOA. Overall, the probability of a whooping crane, or other similar bird, finding and ingesting an intact dud chaff bundle is very low and most likely far below the probability of ingesting other types of existing shiny debris, such as fishing lures and various types of aluminum litter.
USFWS Region 3	NA	4.6.1	Other listed species within the project area- Remove lynx from page 3-87 Remove giant carion beetle from Tables 3-63, 3-65, and 3-66. Change the designation of the peregrine falcon in Table 3-63. Add gray wolf, Karner blue butterfly, Higgins' eye pearly mussel, and Kirtland's warbler to Table 3-63. Add bald eagle, gray wolf, and Karner blue butterfly to Table 3-64, and remove winged mapleleaf mussel. Add gray wolf and Karner blue butterfly to Table 3-65. Add bald eagle, Karner blue butterfly, and eastern prairie fringed orchid to Table 3-66.	All of these specific comments were incorporated as provided.
USFWS Region 3	NA	4.6.1	Clarification regarding Minnow MOA, located over west-central Lake Michigan	Chaff are proposed for (new/resumed) use in Minnow MOA. Minnow MOA was deleted from analysis because it is entirely over water. Minnow MOA may need to be included in future NEPA analysis before chaff use is implemented.
FAA (Federal Aviation Administration)	1	General	The Environmental Assessment for the Establishment of Juniper Low Military Operations Areas. The EA for the Establishment of the Juniper Low MOAs, dated 8/12/93 states that chaff and flares will not be utilized unless assessed in follow-on documentation. The draft FONSI for continued use indicates this activity is already taking place and that a previous analysis was conducted. Recommend the draft FONSI reflect when the Juniper Low MOA was previously assessed for chaff/flare activity.	Aside from this MOA, there was quite a bit of confusion over where and where not chaff and/or flares are currently being released. The Tables reflecting this information have been separated to ensure the reader can easily distinguish where and where not chaff/flares are being deployed. Chaff and flares are not currently used in Juniper Low MOA, only in the Juniper High MOA, which lies directly above Juniper Low at 11,000 MSL; this misstatement has been corrected.

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FAA	2	General	The proposal for the Realignment of Military Operation and Warning Areas for the 173rd Fighter Wing in Oregon. - Recommend the draft FONSI and EA reflect an accurate status of chaff/flare use consistent with past and proposed airspace actions.	See the above answer
FAA	3	General	The Draft Environmental Impact Statement (DEIS) for the Proposed Training Range in Montana, dated July 2001, indicates that the use of chaff and flares has occurred for many years in the Hays MOA. - Recommend the Hays MOA be included as an addendum to the Phase I EA.	The general recommendation as a result of (ACC, NRL) studies was that chaff appeared to have no significant impact to the human or natural environment, however, further environmental documentation may be needed for chaff deployment in new areas. The ANG decided to use the NEPA process not only for new areas but included some areas with ongoing deployment to ensure no unique or special issues that were not covered in the technical documents were occurring. We broke this action into two programmatic documents covering numerous areas in the United States. Hays MOA was not included in these efforts since they are a unit that has utilized chaff deployment for a number of years, even prior to the enactment of NEPA. Their continued use of chaff would be a Categorical Exclusion from further analysis under current USAF instructions. If, as a result of these two efforts, issues arise that are applicable to Hays MOA, we will perform appropriate environmental documentation at that time.

Appendix B
Aircraft and Training Missions

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Aircraft Characteristics

Because of its central location and diverse capabilities, many different types of aircraft use the MOAs and their associated airspace. U.S. Air Force (USAF) aircraft such as the A-10, B-1, B-2, B-52, C-26, C-130, F-15, F-16, F-111, F-117, and the LR-36; and U.S. Navy aircraft such as the A-6 and F-18 are representative of the types of aircraft flying in the MOAs and within the associated airspace.

The A-10 aircraft was designed for two primary purposes: provide close air support for friendly forces and immobilize enemy armor with its 30 millimeter (mm) gattling gun. The aircraft can carry laser guided and conventional air-to-surface ordnance in addition to its armor piercing gattling gun.

The B-1 aircraft is a strategic bomber designed for deep penetration into enemy territory. The B-1 has a low-altitude "dash" capability to evade enemy threats at high speed. The aircraft is capable of carrying nuclear and conventional air-to-surface ordnance.

The B-2 aircraft is a stealth technology bomber. Distinctive in its flying wing configuration, the aircraft is capable of flying at high or low altitudes with a low probability of being detected by conventional radars. The aircraft carries an internal load of conventional air-to-surface ordnance.

The B-52 aircraft is the oldest operational bomber in the USAF fleet with over 30 years of operational service. The aircraft can carry internally and externally a wide range of conventional air-to-surface ordnance while operating at very high or very low altitudes.

The C-26 twin turboprop aircraft is used as a mission support aircraft, carrying 12 to 15 passengers and/or cargo.

The C-130 turboprop aircraft is the USAF's workhorse for inter- and intra-theater airlift. This versatile aircraft is designed to airdrop cargo and/or troops to forward operating locations in all weather conditions.

The F-15 aircraft is designed to achieve and maintain air superiority using an advanced radar system capable of detecting adversarial aircraft at approximately 100 or more miles away, air-to-air armament, and superior maneuvering capability. The F-15 is capable of flying as low as 100 feet AGL and as high as 60,000 feet MSL in performing its air superiority mission.

The F-15E aircraft, a derivative of the F-15C/D, is designed for air-to-surface ordnance delivery and defense suppression. Designed with enhanced radar, the aircraft is capable of navigating at low altitude at night and in all weather conditions to strike targets deep into enemy territory. The aircraft carries a wide range of conventional and laser guided air-to-surface ordnance.

The F-16 aircraft is equipped with a computerized weapons delivery system. It also has a self-defense and offensive air-to-air combat capability against both fighter and bomber aircraft. It is equipped with long-range air-to-air radar capable of acquiring enemy aircraft at distances of up to 80 NM; missiles can be launched at ranges of 20 NM or more. The F-16 is capable of flying at altitudes as low as 100 feet AGL to evade enemy radar and weapons system detection while en route to and from target areas, and up to FL 500 in order to intercept high-altitude enemy aircraft and to avoid low-altitude threats.

The F-117 aircraft is a stealth technology fighter. The aircraft is designed to fly high or low altitude with internally carried air-to-surface ordnance while having a low probability of being detected by radar.

The LR-36 is a twin turbofan aircraft used for mission support taskings, carrying passengers and/or cargo, and for electronic countermeasures training for fighter aircrews.

The Tornado is a multi-role supersonic combat aircraft. Its capabilities and missions include low-altitude, all-weather close air support, and battlefield interdiction, as well as air defense, air superiority, and reconnaissance.

The Navy's A-6 aircraft is a multi-purpose aircraft designed for suppression of enemy defenses through electronic counter measures and interdiction with conventional ordnance. The aircraft's bulbous nose and a curved refueling probe just forward of the cockpit are unique design features of this aircraft.

The F-18 aircraft has a computerized weapons delivery system and an advanced radar system that gives the aircraft an air-to-air and air-to-surface weapons delivery capability. It is equipped with a long range air-to-air radar capable of acquiring enemy aircraft at distances of up to 80 NM; missiles can be launched at ranges of 20 NM or more. Its mission and capabilities are similar to the F-16. The F-18 is capable of flying at altitudes as low as 100 feet AGL to evade enemy radar and weapons system detection while en route to and from target areas, and up to 50,000 feet MSL to intercept high-altitude enemy aircraft and to avoid low-altitude threats.

Several types of rotary wing aircraft (i.e., helicopters such as the AH-1 and UH-1) could also operate on ANG or USAF ranges. These aircrafts fly administrative support missions (e.g., explosive ordnance disposal) in addition to providing airborne support for simulated ground forces.

Training Activities Associated with the Proposed Action

The following subsections describe the various types of training required of military aircrews that would typically occur in MOAs.

Low-Altitude Surface Attack Tactics

Scenario 1 – Simulated Weapons Delivery

This scenario consists of two or more attack aircraft performing low-altitude navigation on an MTR leading into a MOA or restricted area. The aircraft simulate a variety of weapons deliveries against a target. Targets are stationary, strategic objects, including bridges and railroad yards. An attack includes passes by each aircraft within the flight, time sequenced over the target to provide safe separation during a simulated weapon delivery. If the surface attack tactics are practiced within a weapons delivery range, practice munitions can be expended and delivery accuracy analyzed.

Precise timing during the ingress to the target is practiced, as is target acquisition from a level approach between 500 feet AGL and 1,000 feet AGL. Aircraft flying at this altitude are simulating a high-threat situation. At a preplanned point, the aircraft begins a rapid climb to 3,000 to 5,000 feet AGL, and occasionally up to 12,000 feet AGL, to visually acquire the target. From the maximum altitude, a simulated low-angle weapons delivery between 10 to 20 degrees, or a high-angle delivery between 30 to 45 degrees of dive angle, is made.

Egress tactics from the target area are also practiced. Aircrews practice returning to low altitude as quickly and safely as possible while regaining their desired low-altitude tactical formation. Surface attack tactics can be enhanced by the addition of a threat aircraft attempting to disrupt or negate an attack.

Scenario 2 – Close Air Support

This scenario normally consists of two aircraft performing low-altitude navigation on an MTR leading into a MOA or restricted area. This mission is flown to support ground-based U.S. Army or Marine forces in close proximity to enemy forces. Approaching the MOA or restricted area, the aircraft establish radio contact with a Forward Air Controller (FAC) who gives the flight a situation briefing. The situation briefing includes the location of friendly and enemy troops, the ground commander's objectives, and the location of any known surface-to-air threats. The FAC will also restrict the flight's operations, as necessary, to ensure the safety of friendly troops. The close-air support aircraft simulate carrying ordnance appropriate for supporting the ground commander's objectives.

The close-air support aircraft enter the simulated target area in one of two ways. One way is a high-altitude entry from approximately 5,000 feet AGL to orient themselves based on the FAC's situation briefing. After establishing the exact location of friendly troops, the close-air support flight will simulate delivering ordnance as the FAC directs. The FAC, who is in constant radio contact with the ground commander, will designate the impact point for each ordnance delivery based on the effectiveness of each weapons delivery. After expending the simulated ordnance, the flight departs the target area at medium or high altitude.

A second entry is from a pop-up maneuver, simulating a high-ground threat situation. This type entry begins with the aircraft at low altitude (approximately 500 feet AGL) to avoid detection by enemy radar and visual acquisition. At a preplanned point, the aircraft begins a rapid climb to 3,000 to 5,000 feet AGL, and occasionally up to 12,000 feet AGL, to visually acquire the target. From the maximum or apex altitude, a simulated low-angle weapons delivery between 10 to 20 degrees is made. After expending the simulated ordnance, the flight departs the target area at low, medium, or high altitude.

Air Combat Training

Air combat training involves at least two and usually four aircraft practicing the maneuvers and fundamentals of offensive and defensive aerial attack. Pilots learn the capabilities of threat aircraft and weapons systems while employing tactics to exploit an adversary's weaknesses. Two or more aircraft may operate as a team to enhance detection of adversary aircraft, defeat attacks, and maneuver as a mutually supportive element to negate and destroy the adversary forces. Aircraft simulate air-to-air ordnance launches during such training.

Airspace used for air combat training must be large enough to permit realistic offensive and defensive tactics. If the area is too small, pilots can be distracted by the need to constantly monitor their proximity to airspace boundaries. Additionally, aircrews need to exercise the onboard radar to its maximum extent for realistic training. The *USAF Airspace Master Plan* suggests the area should be 60 NM wide and 70 NM long, extending vertically to FL 500.

Air combat training is flown above 5,000 feet AGL throughout the altitude structure available in the training airspace. A typical scenario involves opposing forces, with one group defending an area while the other group attempts to pass through the defended area or engage the defensive group. The goal of air combat training is to refine pilot skills in radar and visual lookout as well as offensive and defensive employment of tactics and weapons. Basic fighter maneuvers, air combat maneuvering, and air combat tactics training also refine air-to-air skills of military pilots.

Basic fighter maneuvering is the fundamental training of all air-to-air flight maneuvering. This training is normally conducted with two similar aircraft to practice individual offensive and defensive maneuvering against a single adversary. Offensive and defensive aircraft maneuvering and weapons employment are emphasized on these missions. Most engagements rely on visually identifying an adversary as opposed to radar detection.

Air combat maneuvering training usually involves three similar aircraft. This training emphasizes intra-flight coordination, survival tactics, and two-ship maneuvering against a single adversary. The training scenarios vary by having the adversary either within visual range or beyond visual range dependent on the specific training objectives. The use of on-board radar is emphasized.

Air combat tactics training requires three or four aircraft. This scenario involves designating friendly and enemy forces, which separate as far possible in the maneuvering airspace to begin tactics training. The training begins with opposing forces coming toward each other within specified altitude bands to ensure safe separation. The purpose of this training is teamwork, targeting and sorting by radar, and intercept tactics to enhance survival. If two different type aircraft train together, the training is called dissimilar air combat tactics. Maximum use of on-board detection systems are utilized, such as radar and threat warning receivers.

Air Combat Maneuvering Instrumentation Training

The Air Combat Maneuvering Instrumentation (ACMI) system is the most powerful, state-of-the-art training aid for combat aircrews. The ACMI provides enhanced safety for aircrews training in aerial combat, air-to-ground weapons delivery, surface-to-air defenses, and electronic warfare. The ACMI also provides real-time monitoring and recording of aircrew training activities. The system has a no-drop weapons scoring capability for fighter aircraft and can emit a mobile electronic threat signal against all aircraft. The ACMI system is composed of four major components:

- The Airborne Instrumentation System (AIS)
- The Tracking Instrumentation System (TIS)
- The Control and Computation System (CCS)
- The Display and Debriefing System (DDS)

The AIS is an airborne externally or internally mounted pod. The AIS transmits essential aircraft data, such as altitude, airspeed, velocity, gravitational forces, and weapons information to the TIS throughout an entire mission. The TIS is a network of antennas that communicate data to and from each aircraft. The TIS is the data link between the AIS and the CCS. The CCS is the central control and computation system for the ACMI. The CCS calculates aircraft position and weapons simulations and relays the data to the DDS. The DDS provides aircrews the means for real-time control and debriefing, using three-dimensional graphics and mission data. The ACMI's sophisticated instrumentation, strict training rules and safety regulations, combine to make this training the safest available.

Low-Altitude Air-to-Air Training

Low-altitude air-to-air training normally involves two to four aircraft practicing the maneuvers and fundamentals of offensive and defensive aerial attack. This mission is usually flown in conjunction with other training missions such as surface attack tactics or low-altitude intercepts.

Low-altitude air-to-air training is conducted below 5,000 feet AGL. A typical scenario involves designating one or more aircraft as interceptor, tasked to locate and intercept a low-altitude flight of aircraft en route to a target. Participants are at minimum altitude for very short periods of time. The ingressing aircraft must detect and react appropriately to negate the interceptor's attack and proceed to the target area. Maneuvering is restricted because of the aircraft's proximity to the ground. Training is optimized when the interceptors are dissimilar (different type) aircraft to differentiate friend/foe roles. The goal of low-altitude air-to-air training is to refine pilot skills in radar and visual lookout and maneuvering required at low altitude to negate an attack. Low-altitude air-to-air training also provides valuable training for the interceptor in low-altitude intercept tactics and techniques. Low-altitude air-to-air training is most realistic when conducted over land because pilots are required to be constantly aware of changing terrain elevation and obstacles. This training also increases a pilot's depth perception acuity.

Airspace used for low-altitude air-to-air training must be large enough to permit realistic offensive and defensive tactics. If the area is too small, pilots can be distracted by the need to constantly monitor their proximity to airspace boundaries. In addition, smaller airspace concentrates noise over any one location. For low-altitude air-to-air training, a MOA for orbiting defensive aircraft combined with one or more MTRs for the ingressing/egressing aircraft provides the most realistic training opportunity. The *USAF Airspace Master Plan* suggests the optimum airspace for this type training would be 70 NM long and 60 NM wide below 5,000 feet AGL.

Low-Altitude Step-Down Training

Fighter aircrews must train to fly at very low altitude to allow for safe, survivable, and effective tactical navigation and weapons delivery. Step-Down Training is used to practice aircraft maneuvers at an altitude at which a pilot is comfortable, and gradually develop proficiency skills at low altitudes. Pilots use terrain features to avoid detection by airborne and land-based radar systems. They must learn to navigate at low altitude while maintaining tactical formation to provide maximum self-defense capability. Hard turns, along with climbs and dives, need to be practiced frequently to maintain low-altitude maneuvering proficiency.

Intercept Training

Radar-equipped fighter aircraft can train at altitudes as low as 100 feet AGL and up to 50,000 feet MSL to detect, intercept, identify, and if necessary, destroy hostile aircraft. In a typical training scenario, the interceptor(s) and target(s) are positioned beyond the expected detection capability of the interceptor's on-board radar. The target aircraft attempts to penetrate the area protected by the interceptor. The interceptor, in many cases with the aid of ground-based or airborne radars, attempts to detect the target, maneuver to identify the aircraft, and reach a position from which armament could be successfully employed. Airspace for intercept training should have at least one dimension large enough to position interceptor and target beyond the radar detection range of each aircraft. During low-altitude intercept training, participants operate at minimum altitude for very short periods of time. The *USAF Airspace Master Plan* suggests the optimum airspace for this type training would be 70 NM long and 60 NM wide, extending vertically up to FL 500.

[Source: National Guard Bureau, Draft Environmental Impact Statement Addressing the Hardwood Range Expansion and Associated Airspace Actions, 1997]

Appendix C
Chaff and Flare Type Descriptions

Table C-1
Types of Chaff

Attribute	Chaff Types							
	RR-112A/AL	**RR-112/AL**	**RR-149A/AL**	**RR-149/AL**	**RR-170A/AL**	**RR-180/AL**	**RR-188**	**RR-185/AL RR-ZZZ**
Aircraft	B-52	B-52	B-52	B-52, C-130	A-10, B-1, C-5, C-17, C-130, C-141, F-15, F-16	A-10, C-130, F-15, F-16	A-10, F-15, F-16	B-52
Composition	Aluminum coated glass	Foil	Aluminum coated glass	Foil	Aluminum coated glass	Aluminum coated glass	Aluminum coated glass	Aluminum coated glass
Mode	Mechanical	Mechanical	Mechanical	Mechanical	Pyrotechnic	Pyrotechnic	Pyrotechnic	Mechanical
Configuration	Rectangular aluminum foil laminated Kraft paper box with 2 polystyrene supports	Rectangular aluminum foil laminated Kraft paper box with 2 polystyrene supports	Rectangular aluminum foil laminated Kraft paper box with 2 polystyrene supports	Rectangular aluminum foil laminated Kraft paper box with 2 polystyrene supports	Rectangular tube cartridge	Rectangular tube cartridge with dual longitudinal compartments	Rectangular tube cartridge	Rectangular plastic box held together with metal clips
Size	2.8 × 4.8 × 0.8 inches (10.75 cubic inches)	2.8 × 4.8 × 0.8 inches (10.75 cubic inches)	2.8 × 4.8 × 0.8 inches (10.75 cubic inches)	2.8 × 4.8 × 0.8 inches (10.75 cubic inches)	8 x 1 x 1 inches (8 cubic inches)	8 x 1 x 1 inches (8 cubic inches)	8 x 1 x 1 inches (8 cubic inches)	2.8 x 4.8 x 0.8 inches (10.75 cubic inches)
No. of Dipoles	11 million	0.55 million or 1.1 million	Unknown	1.78 million	3.12 million	2.72 million	5.46 million	Classified
Dipole size (x-section)	1 mil (diameter)	0.45 × 8 mils	1 mil (diameter)	0.45 × 6 mils	1 mil (diameter)	0.7 mil (diameter)	1 mil (diameter)	1 mil (diameter)
Impulse Cartridge	None	None	None	None	BBU-35/B	BBU-48/B	BBU-35/B	None
Other Comments	Box ejected	Older type; box ejected	Box ejected	Older type; box ejected	Cartridge stays in aircraft	"Superfine" type; not yet in inventory	Less interference with FAA radar (no D and E bands); will replace RR-170 for training	Special order for Desert Storm

Source: Specifications and Technical Orders for Chaff, Air Logistics Center, Warner Robins AFB; Specifications for Chaff, Aeronautical Systems Division, Wright Patterson AFB and Tracor, Inc.

SOURCE: *Environmental Effects of Self-Protection Chaff and Flares* (ACC, 1997)

Table C-2
Components of Chaff: Glass Fibers and Aluminum Coating

Element	**Chemical Symbol**	**Percent (by weight)**
Glass Fiber		
Silicon dioxide	SiO_2	52-56
Alumina	Al_2O_3	12-16
Calcium Oxide and Magnesium Oxide	CaO & MgO	16-25
Boron Oxide	B_2O_3	8-13
Sodium and Potassium Oxide	Na_2O & K_2O	1-4
Iron Oxide	Fe_2O_3	1 or less
Aluminum Coating*		
Aluminum	Al	99.45 min
Silicon + Iron	Si+Fe	0.55 max
Copper	Cu	0.05 max
Manganese	Mn	0.05 max
Magnesium	Mg	0.05 max
Zinc	Zn	0.05 max
Vanadium	V	0.05 max
Titanium	Ti	0.03 max
Others		0.03 max

* Aluminum is typically Alloy 1145
Sources: Military Specification R-6034b; Aluminum Association, Inc.

Table C-3
Impulse Cartridges Used for Chaff

Component	**BBU-35/B**	**BBU-48/B**
Overall Size Overall Volume Total Explosive Volume	0.625 inches ′ 0.530 inches 0.163 inches^3 0.034 inches^3	0.975 inches ′ 0.60 inches 0.448 inches^3 0.0031 inches^3
Bridgewire	Tophet A 0.0025 inches ′ 0.15 inches	
Initiation Charge	0.008 inches^3 130 mg 7650 psi boron 20.0% potassium perchlorate 80%**	0.0013 inches^3 50 mg titanium 30% potassium perchlorate 44% boron nitride 25%
Booster Charge	0.008 inches^3 105 mg 7030 psi boron 18.0% potassium nitrate 82.0%	
Main Charge	0.017 inches^3 250 mg loose fill RDX* pellets 38.2% potassium perchlorate 30.5% boron 3.8% potassium nitrate 15.3% super floss 4.6% viton A 7.6%	0.0018 inches^3 50 mg nitrocellulose 88.7% dinitrotoluene 9.5% diphenylamine 0.9% potassium sulphate 0.9% graphite 0.2%

* RDX is cyclotrimethylenetrinitramine (1, 3, 5-trinitro-hexa-hydro-s-triazine)
** Previous manufactures of BBU-35/B contained 15% potassium perchlorate and 64% calcium chromate
mg = milligram
psi = pounds per square inch
Note: some values do not add up to 100% due to rounding
Source: Air Logistics Center, Hill AFB, UT and IMR Powder Company, Plattsburgh, NY

Table C-4
Self-Protection Flares

Attribute	ALA-17	MJU-7/B MBT Lot	MJU-7/B	MJU-7A/B	M-206	MJU-10/B	MJU-23/B
Aircraft	B-52	F-4, F-16, C-130	F-4, F-16, C-130	F-4, F-15, F-16, C-130	A-10, AC-130, C-17, F-16	F-15	B-1
Mode	Parasitic	Parasitic	Non-parasitic	Semi-parasitic	Parasitic	Semi-parasitic	Non-parasitic
Configuration	2 cylindrical cartridges in series	Rectangular	Rectangular	Rectangular	Rectangular	Rectangular	Cylindrical
Size	Each cylinder 4.75 x 2.25 in (diameter)	1 x 2 x 8 in (16 cubic inches)	1 x 2 x 8 in (16 cubic inches)	1 x 2 x 8 in (16 cubic inches)	1 x 1 x 8 in (8 cubic inches)	2.66 x 2 x 8 in; (42.6 cubic inches)	10.5 x 2.75 in (diameter); (19.8 cubic inches)
Impulse cartridge	None; electrically activated M-2 squib	BBU-36/B	BBU-36/B	BBU-36/B; MJU-7(T-1)/B simulator uses M-796	M-796	BBU-36/B; MJU-10(T-1)/B simulator uses M-796	BBU-46/B
Safety and Initiation Device	None	None	Mechanical mechanism with ignition charge	Slider assembly	None	Slider assembly	Mechanical mechanism with ignition charge
Weight (nominal)	Pellet: 18 oz Canister: 10 oz	13 oz	13 oz	13 oz (T-1 type: 4.8 oz)	6.9 oz	40 oz (T-1 type: 7.2 oz)	43 oz
Other Comments	Canister ejected with first unit	No longer being produced	No longer being produced	Simulator version (T-1) uses potassium chlorate, powdered sugar, and yellow dye smoke charge	Simulator version (T-1) uses potassium chlorate, powdered sugar, and yellow dye smoke charge	Simulator version (T-1) uses potassium chlorate, powdered sugar, and yellow dye smoke charge	

in = inch oz = ounce
Source: USAF Technical Orders 11A16-40-7, 11A16-41-7, 11A16-46-7

Table C-5
Typical Composition and Debris of Self-Protection Flares

Part	Components
Combustible	
Flare Pellet	Polytetrafluoroethylene (Teflon) ($-[C_2F_4]_n-$ n=20,000 units) Magnesium (Mg) Fluoroelastomer (Viton, Fluorel, Hytemp)
First Fire Mixture[1]	Boron (B) Magnesium (Mg) Potassium perchlorate ($KClO_4$) Barium chromate ($BaCrO_4$) Fluoroelastomer
Immediate Fire/Dip Coat	Polytetrafluoroethylene (Teflon) ($-[C_2F_4]_n-$ n=20,000 units) Magnesium (Mg) Fluoroelastomer
Primer Assembly (in Safety and Initiation Device)[2]	Initiation Charge (15 mg) Lead styphnate Lead azide (N_6Pb) Barium nitrate (N_2O_6Ba) Antimony trisulfide (Sb_2S_3) Tetracene ($C_{18}H_{12}$) Output Charge (40 mg) Zirconium (Zr) Molybdenum trioxide (MoO_3) Potassium perchlorate ($KClO_4$)
Assemblage (Debris)	
Aluminum Wrap	Mylar or filament tape bonded to aluminum tape
End Cap	Plastic (nylon) or aluminum[3]
Felt Spacers	Felt pads (0.25 inches by cross section of flare)
Piston	Plastic (nylon, tefzel, zytel) or aluminum[6]
Slider Assembly[4]	2 plastic pieces, 0.5 ′ 0.825 ′ 2 inches, (delrin) 2 springs, 0.625 ′ 0.125 inches, (steel) 1 roll pin (steel)
Safety and Initiation Device[5]	G-weight (steel) Locking bar and fork (steel) Push button and spring (steel) Firing pin (steel) Primer assembly

Generally applies to M-206, MJU-7/B, MJU-7A/B, and MJU-10/B flares, except as noted below.

Notes:

1) MJU-10/B does not have first fire mix; all other types do.
2) Within safety and initiation device used by MJU-7/B (non parasitic) and MJU-23/B only.
3) Aluminum used in MJU-10 and MJU-23/B only. MJU-23/B end cap has 0.5 inches of black rubber potting compound for shock absorption.
4) MJU-7/B and MJU-10/B only.
5) Used in non-parasitic MJU-7/B and MJU-23/B only.
6) Aluminum used in MJU-23/B only.

Source: Ogden Air Logistics Center, Hill AFB, Utah

Table C-6
Impulse Cartridges Used with Flare Units

Component	BBU-36/B	BBU-46/B	M-796
Overall Size Overall Volume Total Explosive Volume	0.740 in x 0.550 in 0.236 cubic inches 0.081 cubic inches	1.224 in x 0.520 in 0.612 cubic inches 0.294 cubic inches	0.449 in x 0.530 in 0.104 cubic inches 0.033 cubic inches
Bridgewire	Tophet A	Tophet A	Tophet A 0.0025 in (diameter)
Closure Disk	scribed disc, washer	polyester film disc and plain discs for main charge and initiator	scribed disc, washer
Initiation Charge Volume Weight Compaction Composition	 0.01 cubic inches 100 mg 6200 psi 42.5% boron 52.5% potassium perchlorate 5.0% Viton A	 0.017 cubic inches to fill cavity 5100 psi 49.5% potassium perchlorate 49.5% titanium with potassium dichromate 1.0% Viton A or Fluorel	 0.011 cubic inches 100 mg 5500 psi 20.0% boron 80.0% calcium chromate
Booster Charge Volume Weight Compaction Composition	 0.01 cubic inches 150 mg 5100 psi 20% boron 80% potassium nitrate	 0.138 cubic inches 290 mg loose fill 23.7% boron 70.3% potassium nitrate 6% laminac binder	 0.011 cubic inches 70 mg 5500 psi 18% boron 82% potassium nitrate
Main Charge Volume Weight Compaction Composition	 0.061 cubic inches 655 mg loose fill Hercules #2400 smokeless powder *	 0.138 cubic inches 490 mg loose fill Hercules green dot powder	 0.011 cubic inches 185 mg loose fill Hercules HPC-1 (~40% nitrocellulose)

* Hercules #2400 smokeless powder contains nitrocellulose (50-77%), nitroglycerine (15-43%), and trace quantities of other materials.
in = inch
psi = pounds per square inch
Source: Air Logistics Center, Hill AFB, UT

Appendix D
Wind Rose Diagrams

Appendix D
Wind Rose Diagrams

To support the environmental evaluation of releasing chaff in DOD training flights, an evaluation of winds at each of the targeted MOA's has been completed. A total of 14 MOA's were targeted for evaluation. For each MOA, the nearest station with available meteorological data was determined. A total of six meteorological stations were identified as representative of the 15 locations. Table 1 summarizes the meteorological stations evaluated, the MOA for which each of the stations is representative, the period of data summarized, and the altitudes evaluated. Each altitude was selected based on operations to be expected at one of the MOA's for which that station is considered to be representative.

For each of the meteorological stations, wind rose diagrams were prepared. One wind rose was generated for each level of operational interest, and one wind rose for each surface station. The wind roses at different altitudes were generated from National Weather Service stations with twice daily radiosonde balloon soundings. The surface wind roses were done using hourly surface station readings at the corresponding stations. The surface data and radiosonde data were obtained from the National Climatic Data Center.

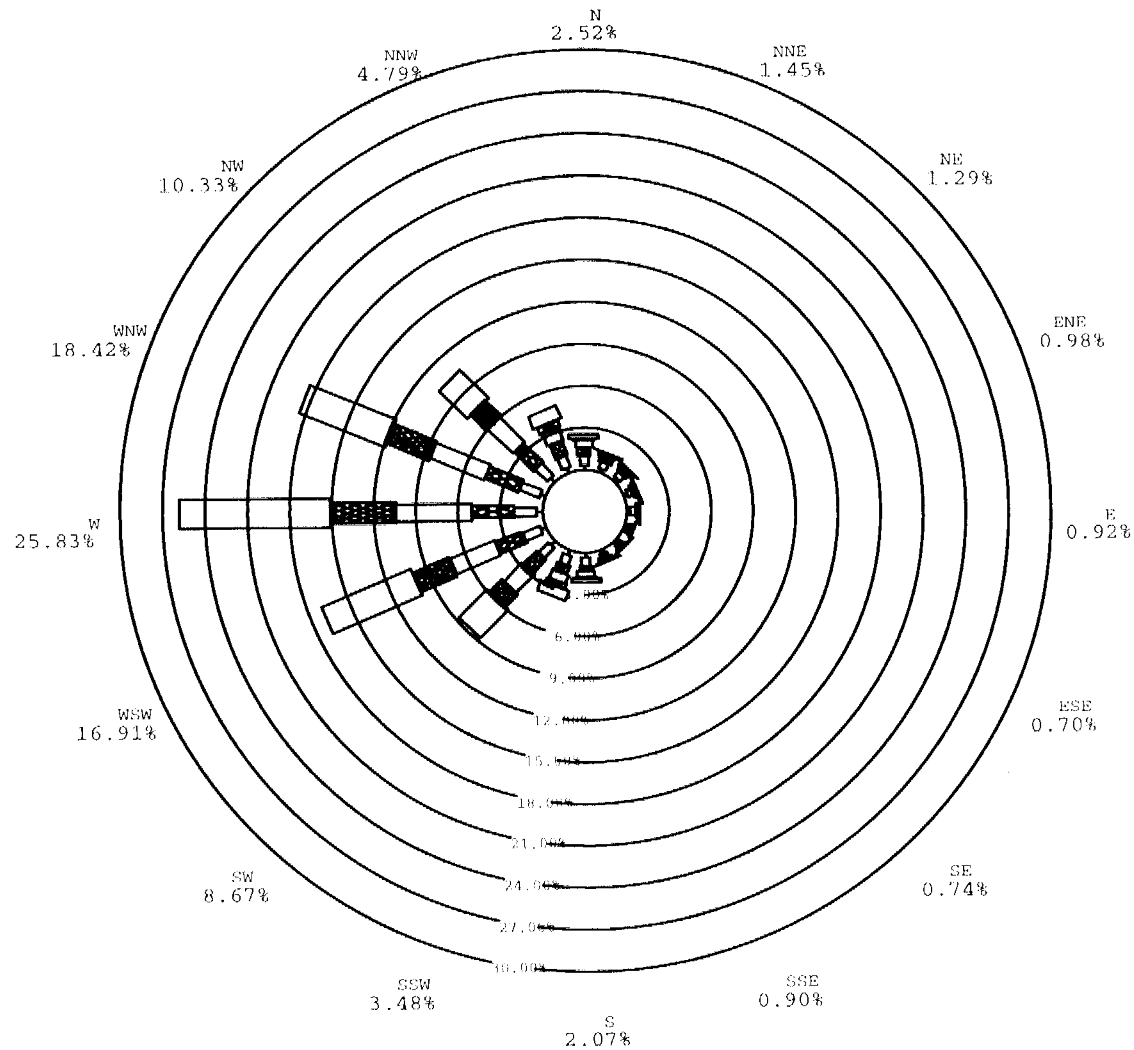
Wind roses are graphical representations of the percent of frequency of occurrence of winds by direction. Wind roses are interpreted as the direction the wind is blowing from. Tables containing the data also are available.

The analysis was performed by first identifying the surface locations for MOAs. Both a surface station and upper-air (radiosonde) station were selected to be associated with a MOA. The surface data and radiosonde data were then collected and processed. For surface locations, input files were created from the surface data. For the upper-air data, a program was created that selected radiosonde data from the specified altitude boundaries to create input files for those altitudes. Once all the various input files for both surface data and radiosonde data were assembled they were run in the wind rose program to obtain the figures attached.

The wind roses at elevations should be used to determine likely transport of materials in the air from elevated releases. The surface wind roses should be used to determine the patterns of dispersion near the ground either from an elevated release that falls to the ground, or from ground-level releases.

Table 1
Summary Table of Data used for WINDROSE

Station Name (lat. & long)	Station Number	MOA included	Meteorology Data Used	Altitudes (feet)
Flint Bishop, MI (both) (42-58.0 N, 83-45.0 W)	14826	Steelhead, Pike E/W	1990-1994	surface 300 - 50,000 6,000 - 50,000
Green Bay, WI (both) (44-29.0 N, 88-08.0 W)	14898	Volks E/W/S, Falls 1 and 2	1991-1995	surface 100 - 18,000 500 - 18,000 8,000 - 18,000
International Falls, MN (both) (48-34.0 N, 93-23.0 W)	14918	Beaver, Snoopy	1991-1995	surface 300 - 18,000 6,000 - 31,000
North Platte, NE (both) (41-08.0 N, 100-41.0 W)	24023	Crypt N/Cen/S, Lake Andes	1991-1995	surface 6,000 - 18,000 7,000 - 27,000 7,000 - 44,000
Medford, OR (both) (42-23.0 N, 122-52.8 W)	24225	Goose, Hart, Juniper Low N/S	1991-1995	surface 500 - 11,000, 3000 - 18,000 11,000 - 18,000 18,000 - 28,000 18,000 - 50,000
Monett, MO (radiosonde) (36.883 N, 93.900 W) Little Rock, AR (surface) (34-44.0 N, 92-14.0 W)	03946 13963	Rivers, Hog Low/High N/S, Shirley	1990-1994	surface 100 - 6,000 6,000 - 18,000 6,000 - 22,000 10,000 - 29,000



HOURLY AVERAGE SURFACE WINDS

PERCENTAGE FREQUENCY OF OCCURRENCE

STABILITY CLASS ALL

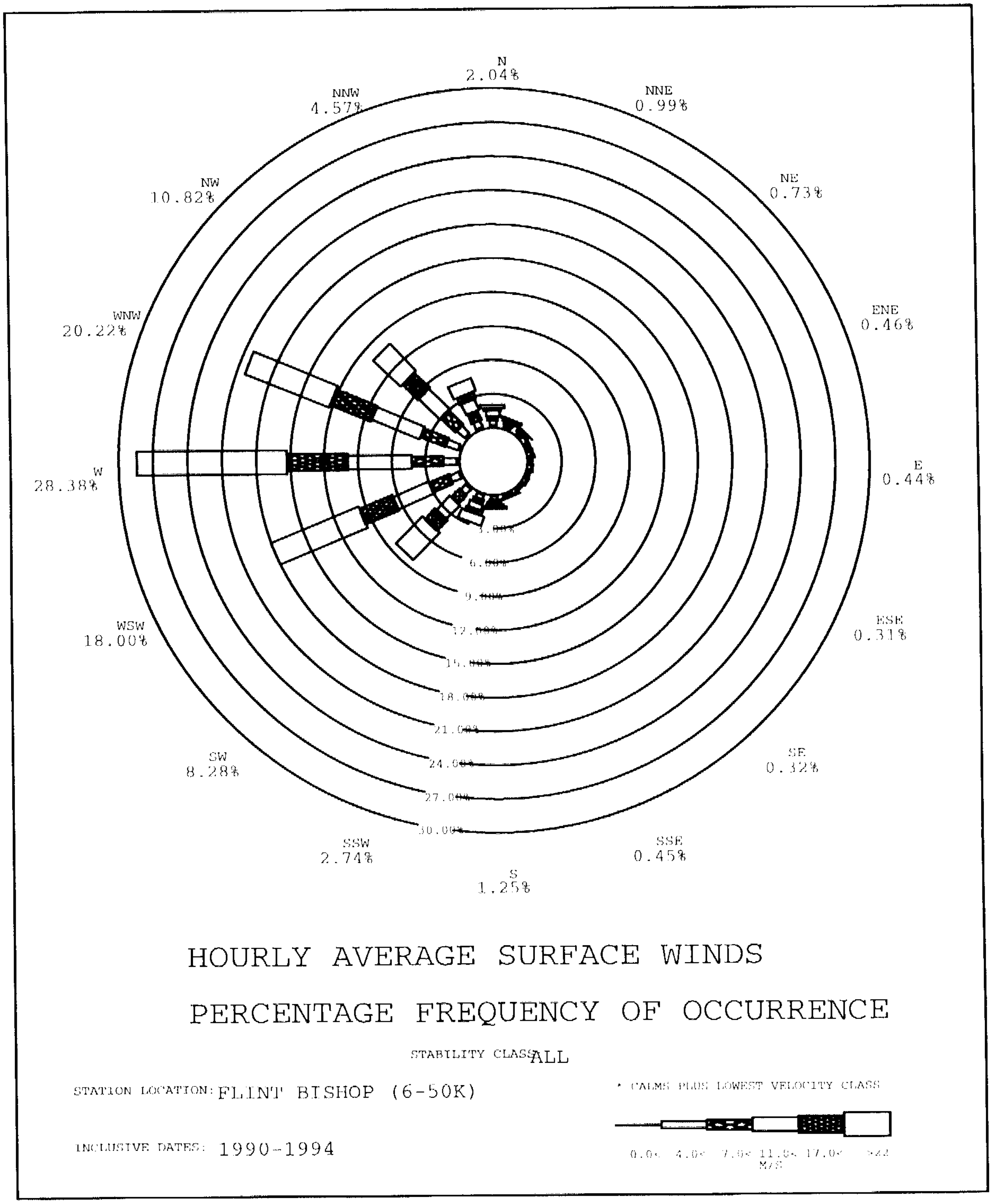
STATION LOCATION: FLINT BISHOP 300-50,000

INCLUSIVE DATES: 1990-1994

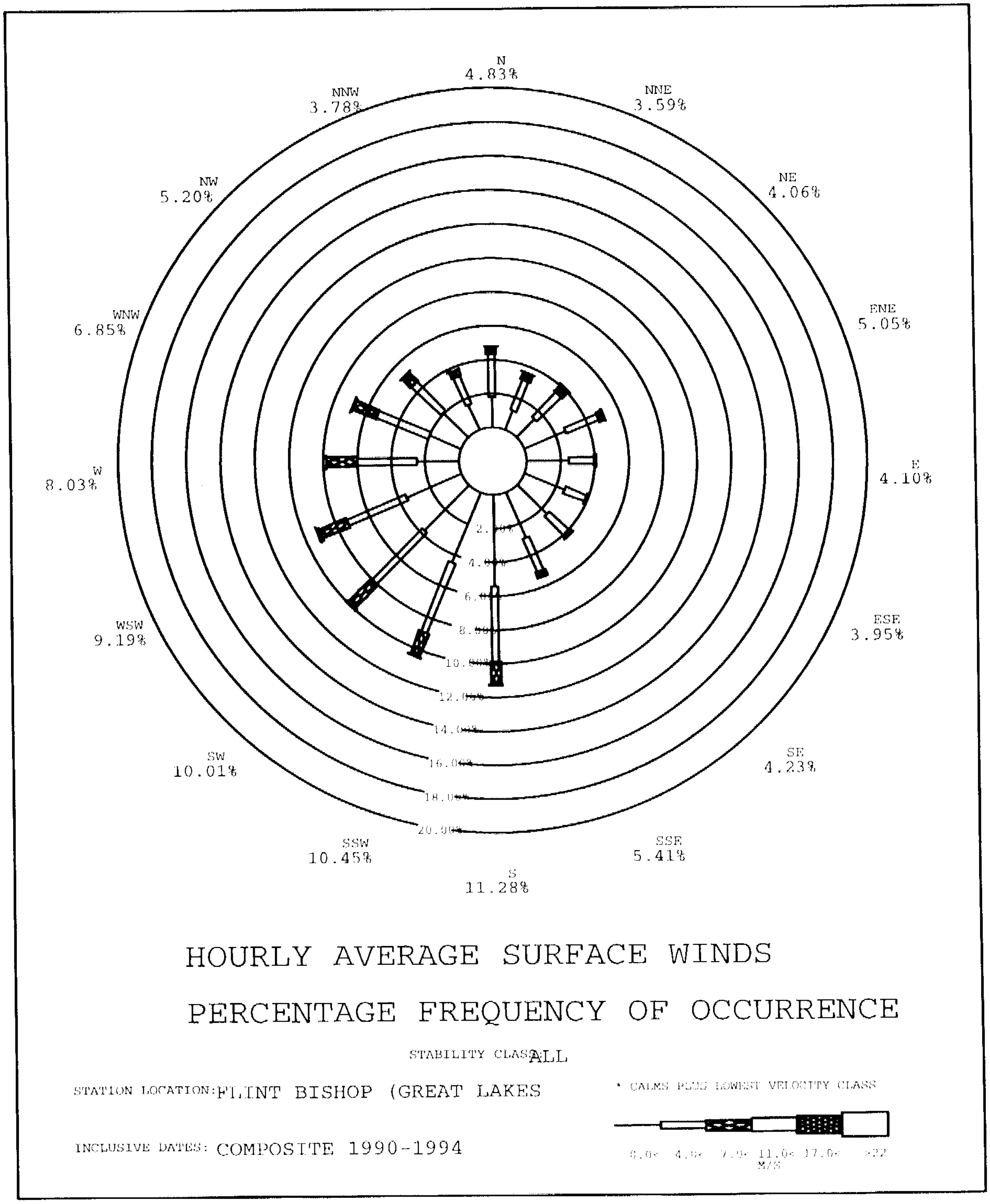
* CALMS PLUS LOWEST VELOCITY CLASS

0.0< 4.0< 7.0< 11.0< 17.0< >22
M/S

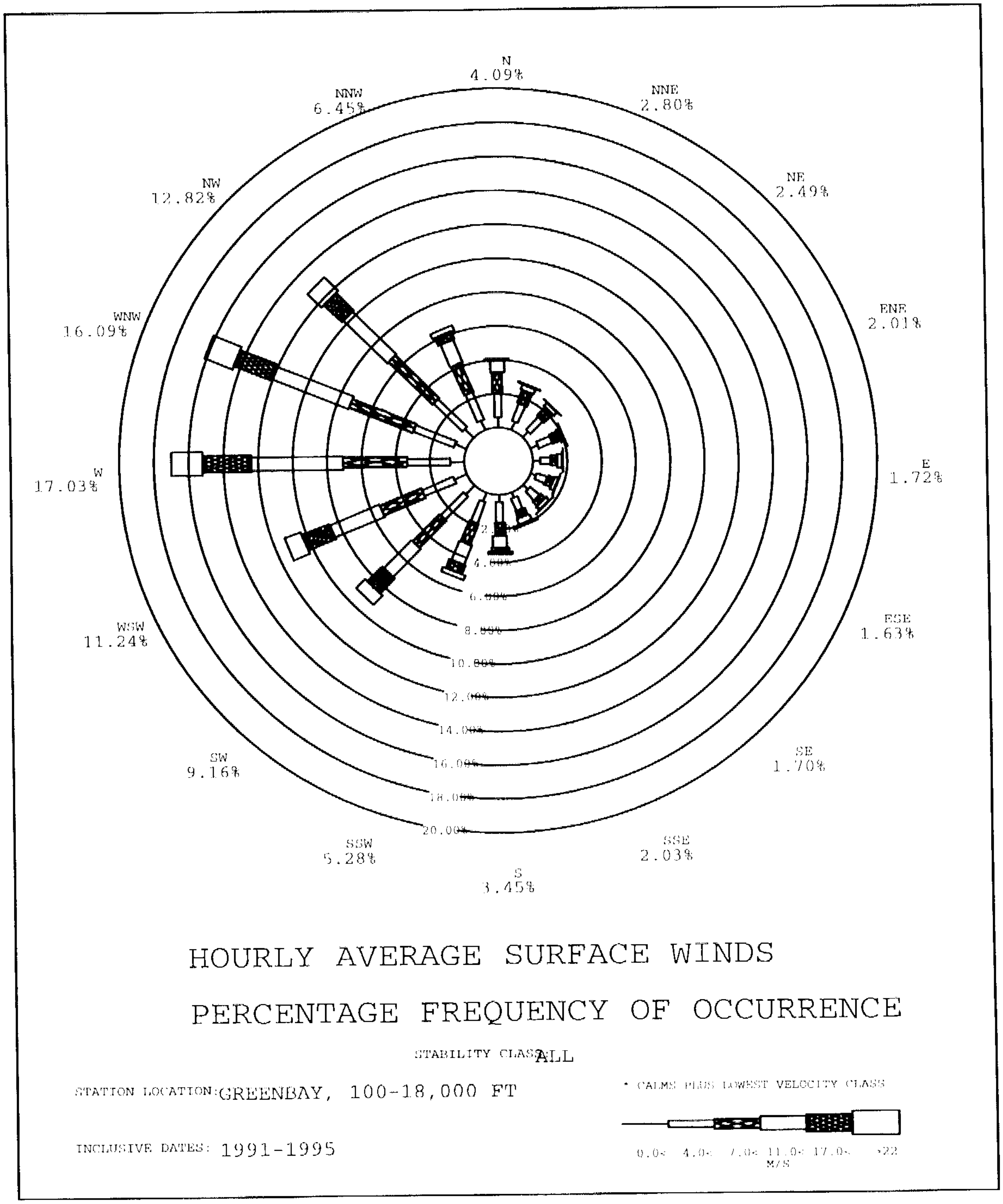
Station: Flint Bishop, MI for 300- 50,000 FEET



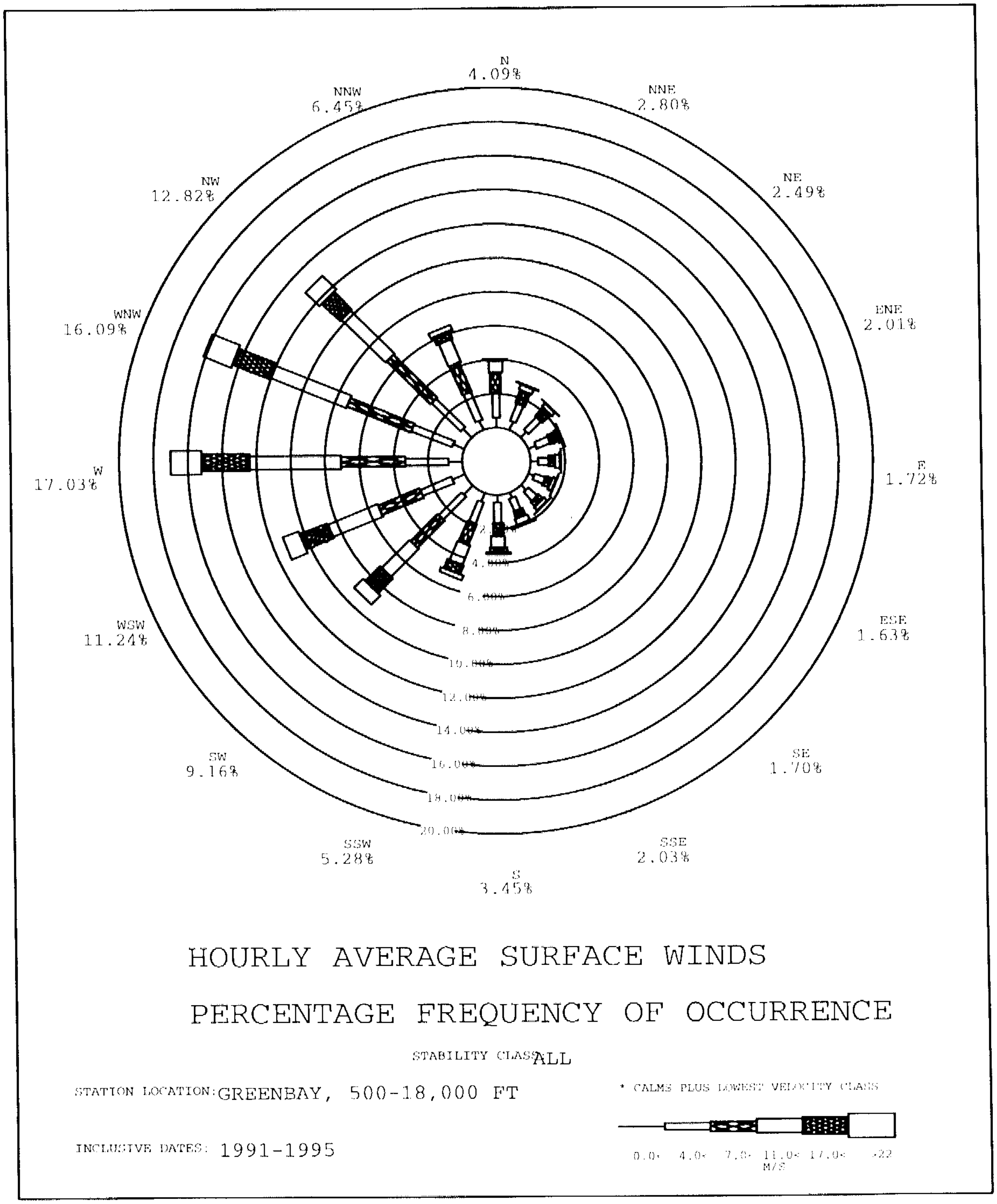
Station: Flint Bishop, MI for 6,000- 50,000 FEET



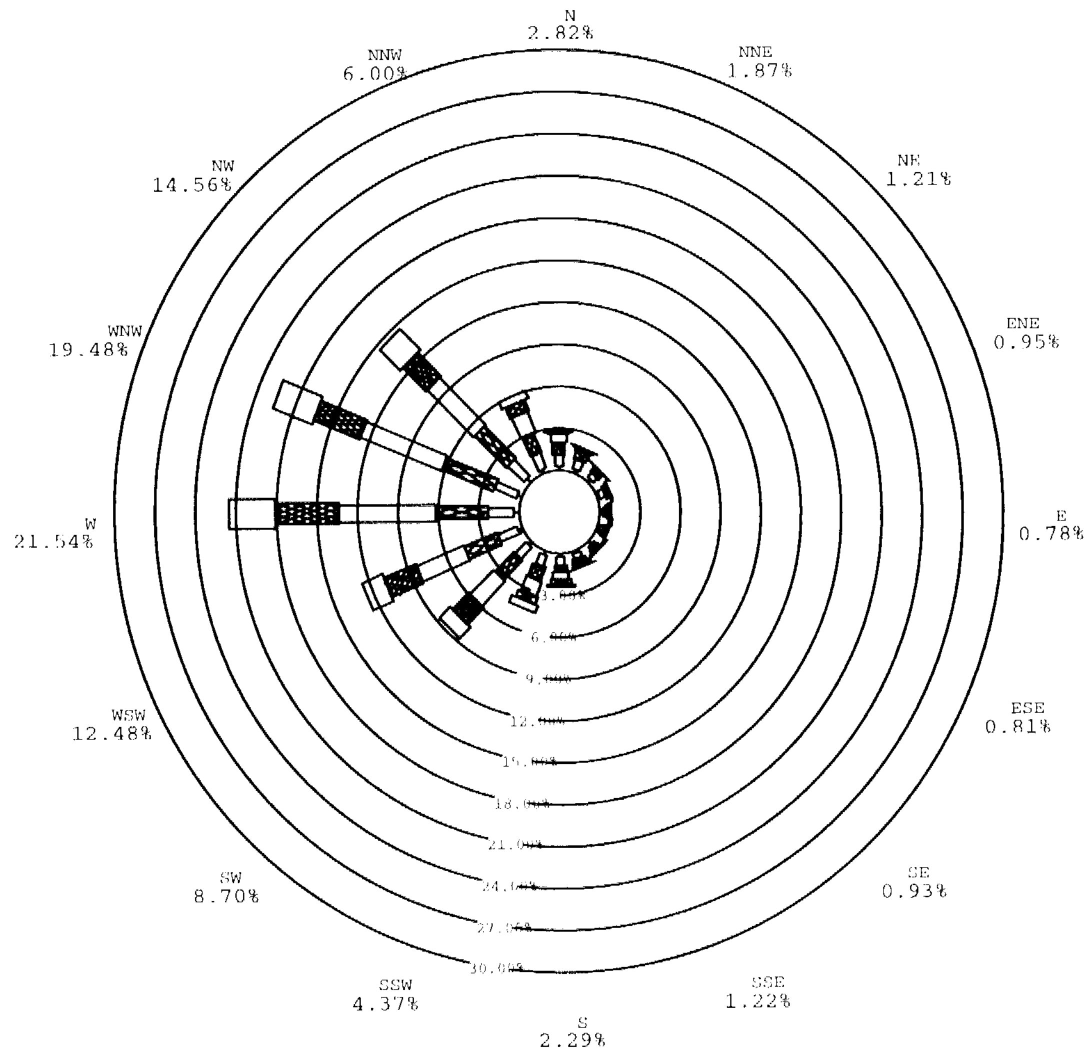
Station: Flint Bishop, MI, Surface Data



Station: Green Bay, WI for 100-18,000 FEET



Station: Green Bay, WI for 500-18,000 FEET



HOURLY AVERAGE SURFACE WINDS

PERCENTAGE FREQUENCY OF OCCURRENCE

STABILITY CLASS ALL

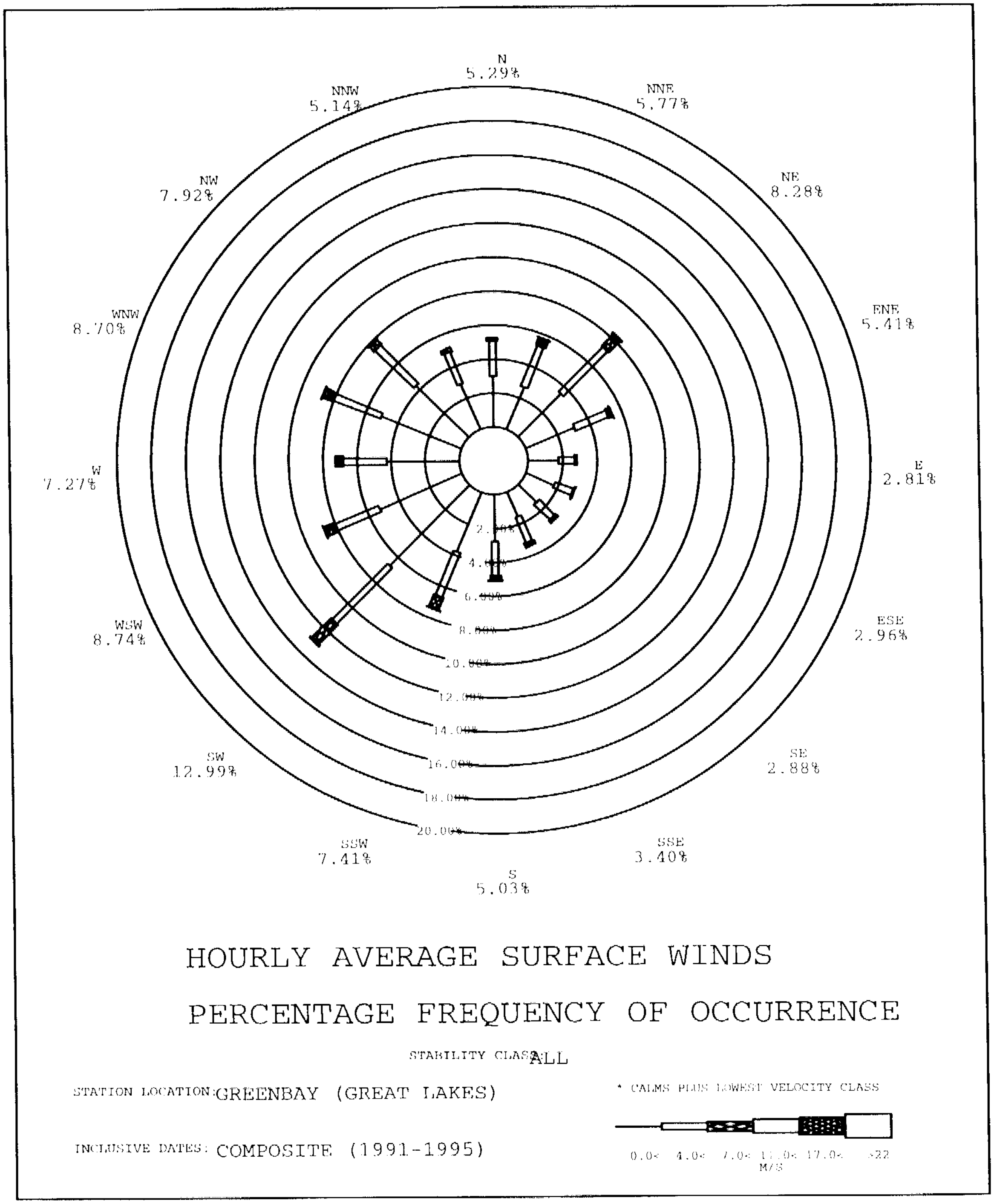
STATION LOCATION GREENBAY 8,000-18,000 FT

* CALMS PLUS LOWEST VELOCITY CLASS

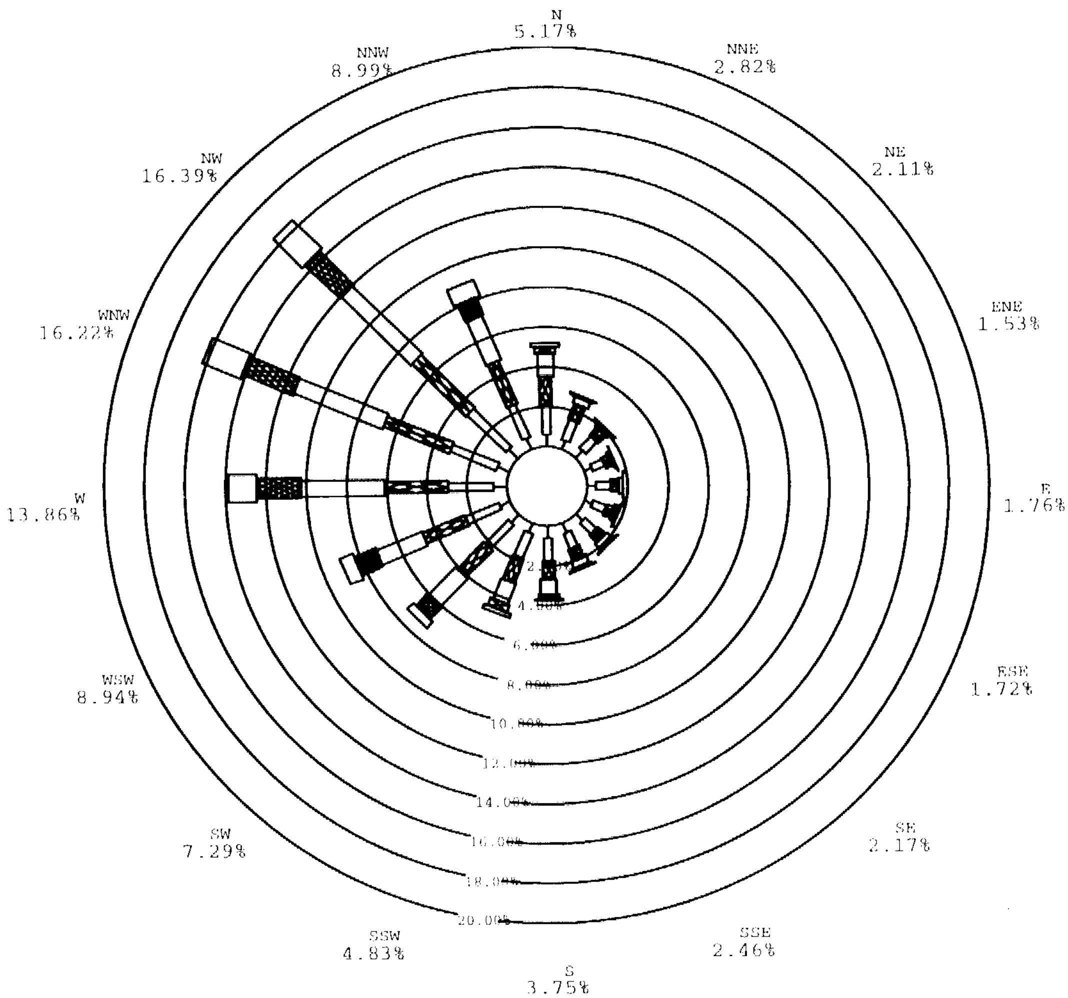
0.0- 4.0- 7.0- 11.0- 17.0- >22
M/S

INCLUSIVE DATES: 1991-1995

Station: Green Bay, WI for 8,000-18,000 FEET



Station: Green Bay, WI -Surface Data



HOURLY AVERAGE SURFACE WINDS

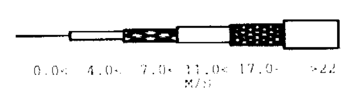
PERCENTAGE FREQUENCY OF OCCURRENCE

STABILITY CLASS ALL

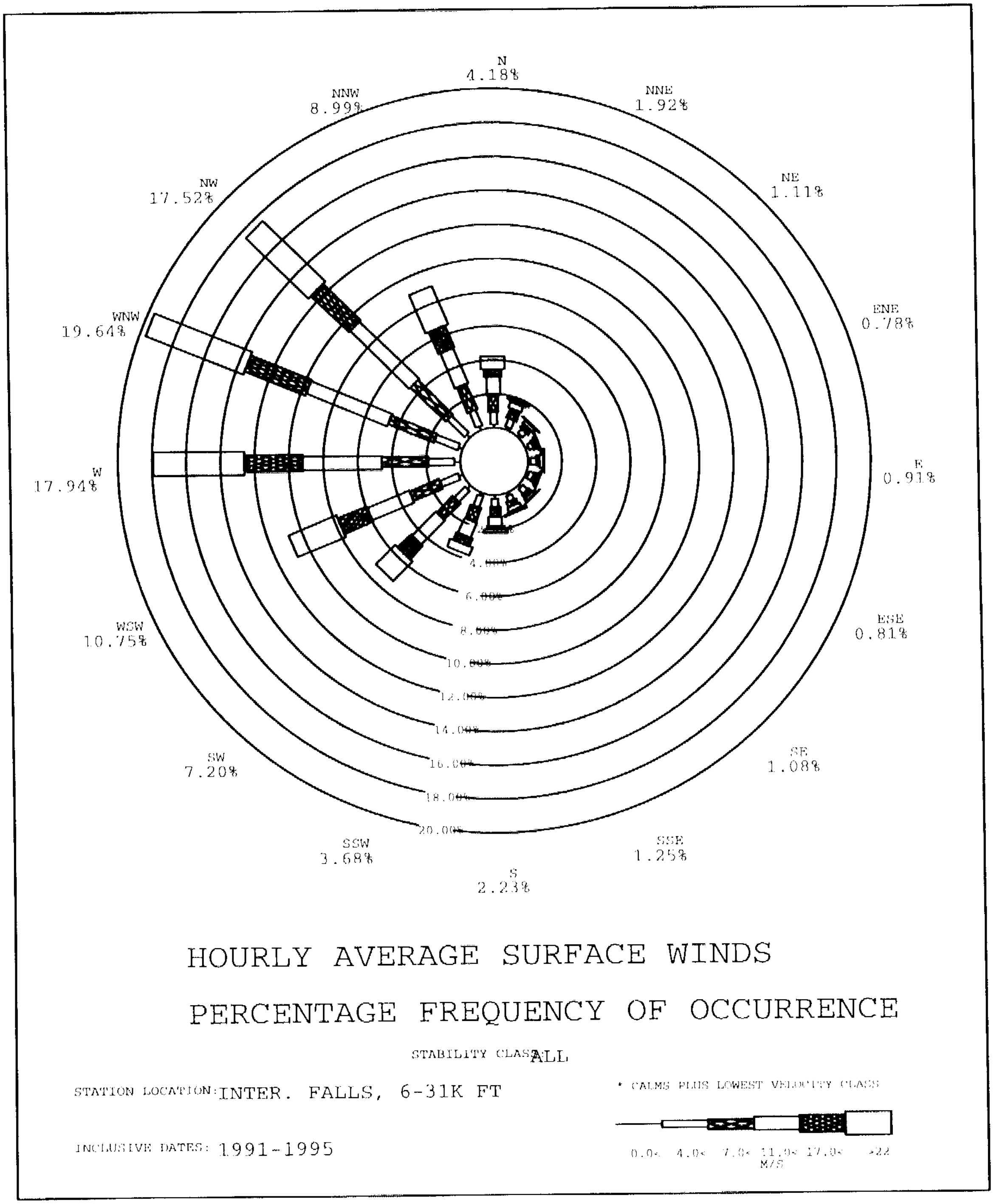
STATION LOCATION: INTER. FALLS (0.3-18K)

INCLUSIVE DATES: 1991 1995

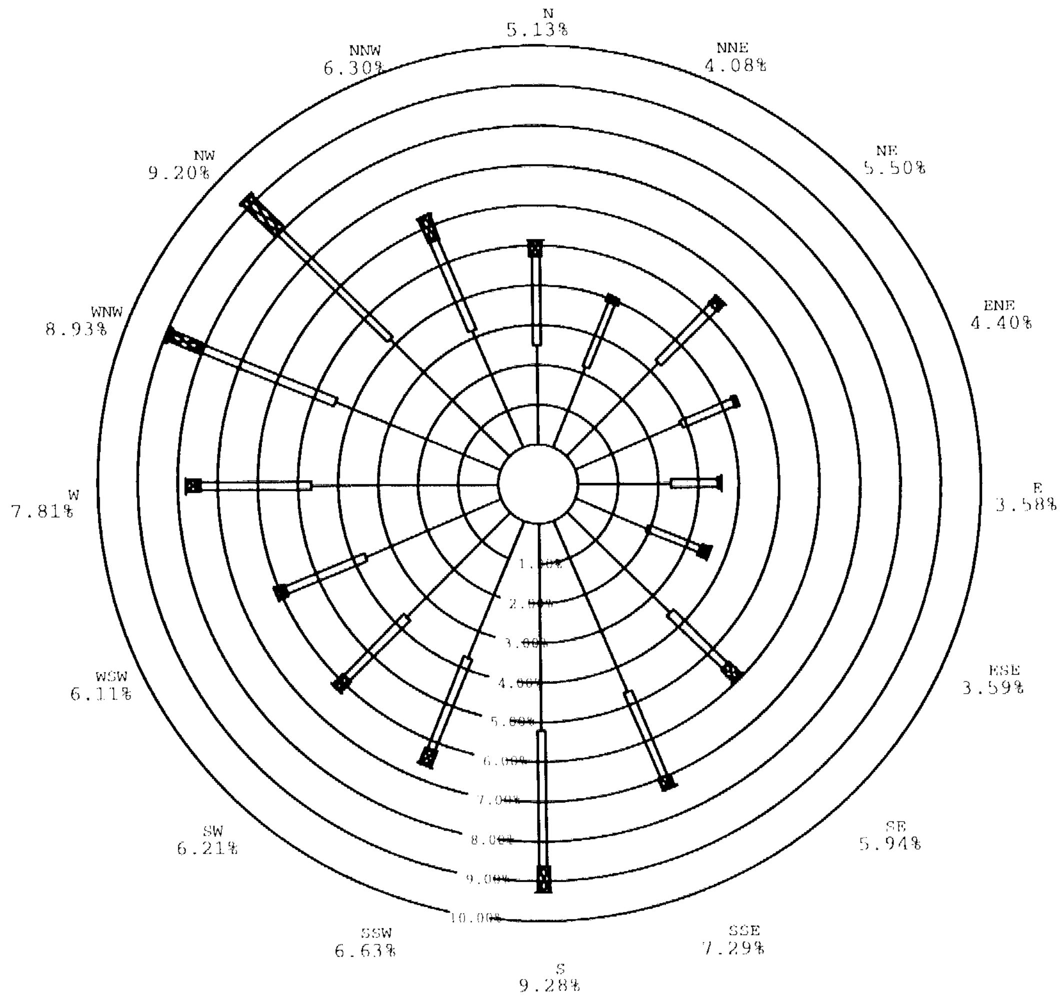
* CALMS PLUS LOWEST VELOCITY CLASS



Station: International Falls, MN for 300-18,000 FEET



Station: International Falls, MN for 6,000-31,000 FEET



HOURLY AVERAGE SURFACE WINDS

PERCENTAGE FREQUENCY OF OCCURRENCE

STABILITY CLASS: ALL

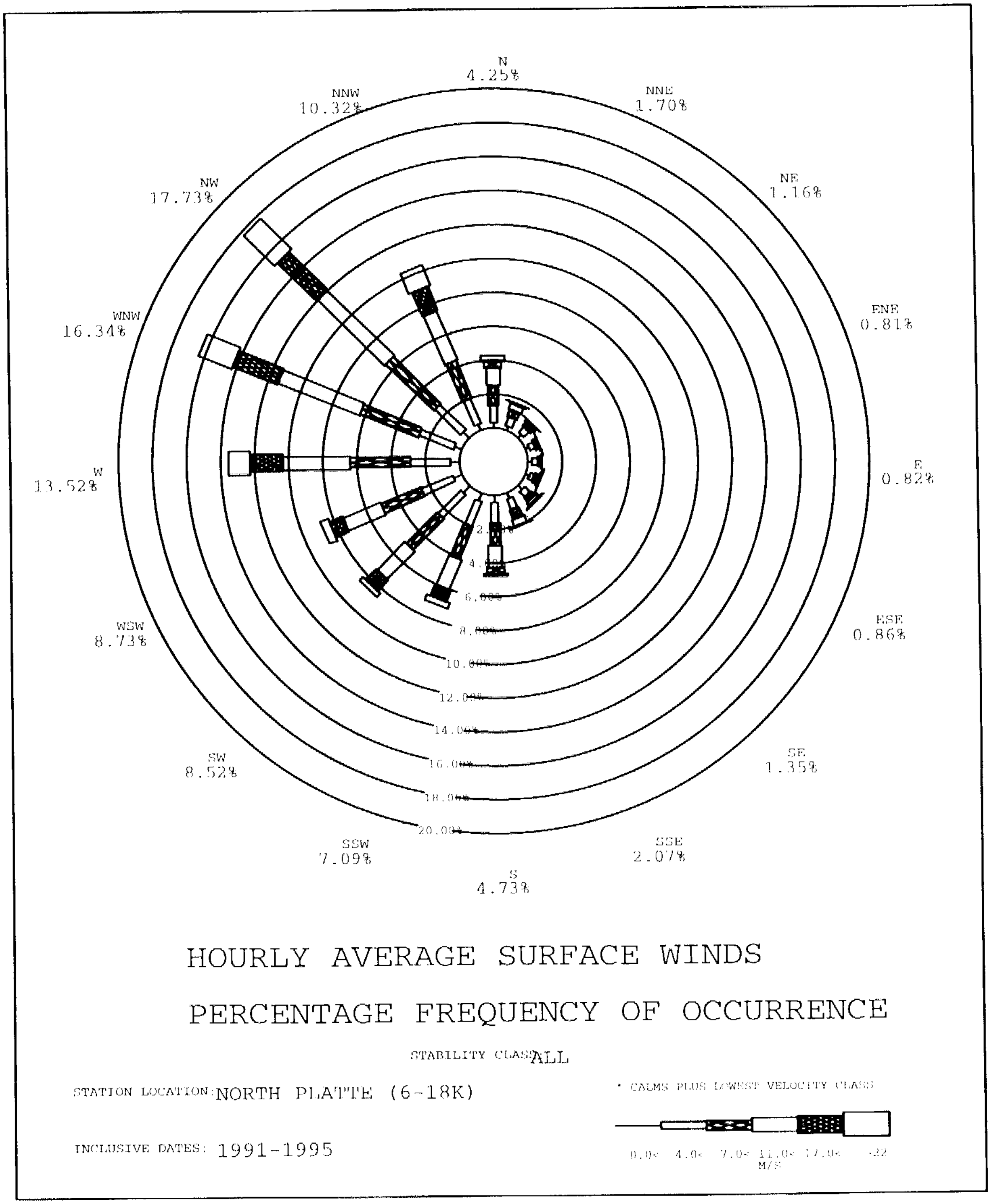
STATION LOCATION: INTERNATIONAL FALLS

INCLUSIVE DATES: COMPOSITE (1991-1995)

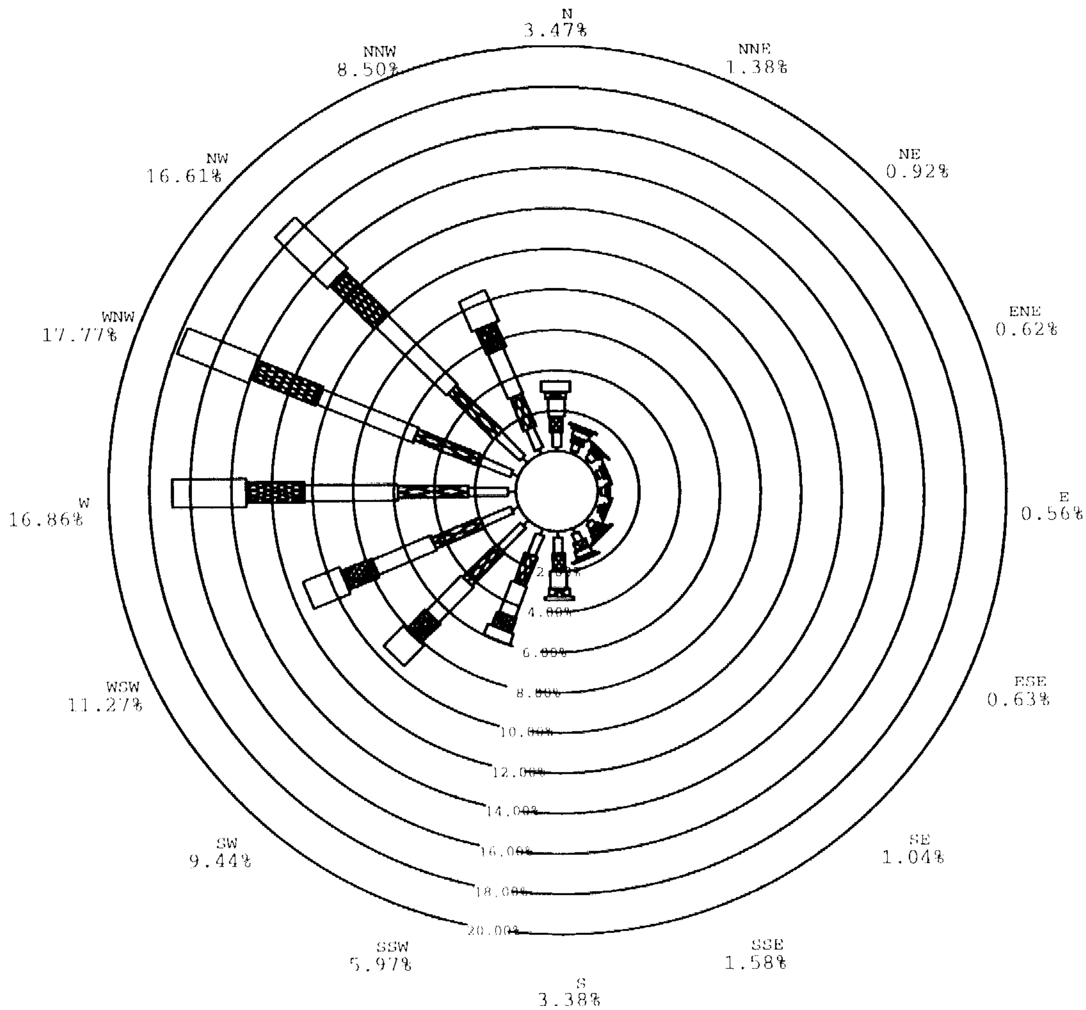
* CALMS PLUS LOWEST VELOCITY CLASS

0.0- 4.0- 7.0- 11.0- 17.0- >22
M/S

Station: International Falls, MN- Surface Data



Station: North Platte, NE for 6,000- 18,000 FEET



HOURLY AVERAGE SURFACE WINDS

PERCENTAGE FREQUENCY OF OCCURRENCE

STABILITY CLASS ALL

STATION LOCATION: NORTH PLATTE (7-27K)

INCLUSIVE DATES: 1991-1995

* CALMS PLUS LOWEST VELOCITY CLASS

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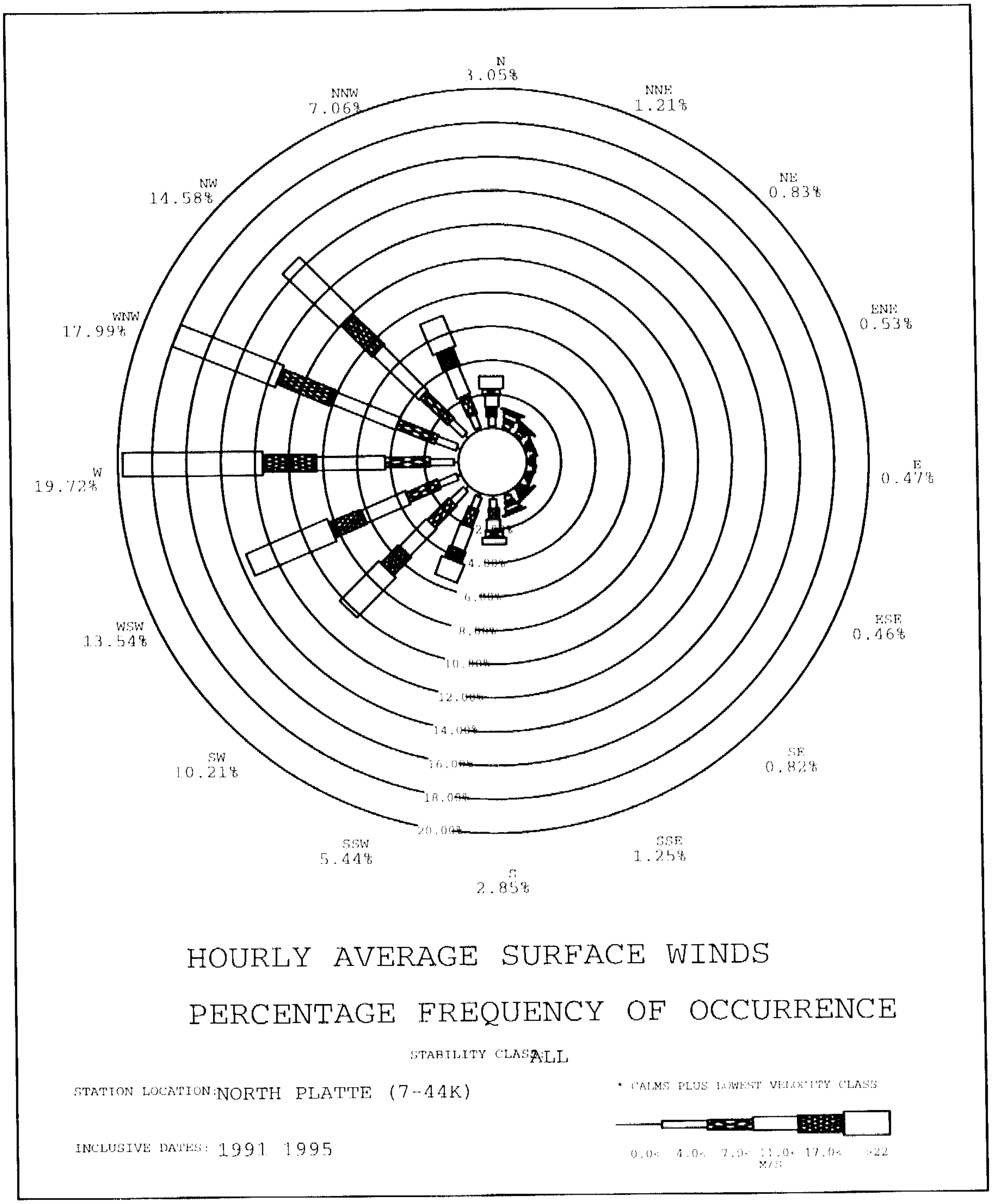
M/S

Station: North Platte, NE for 7,000- 27,000 FEET



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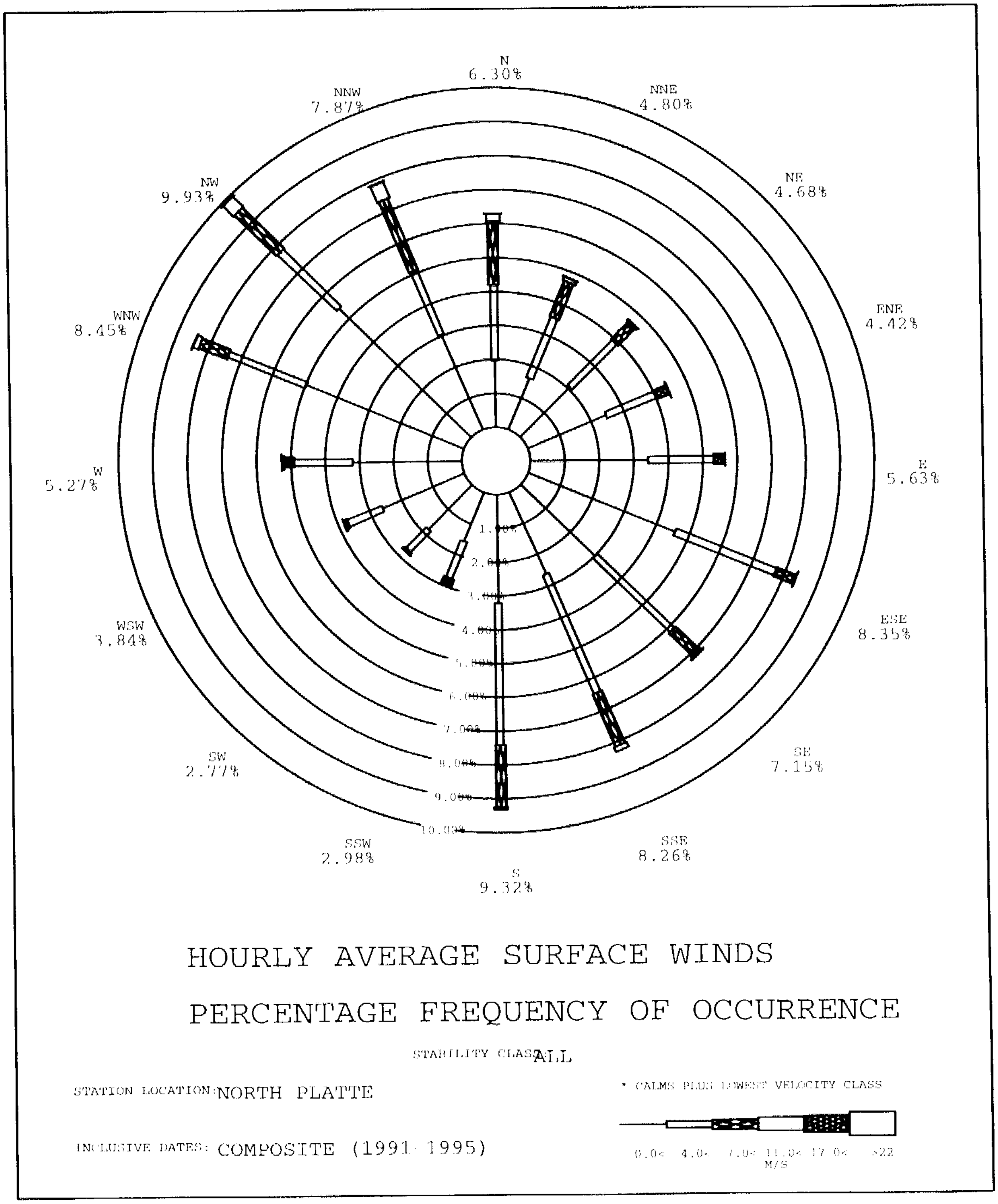

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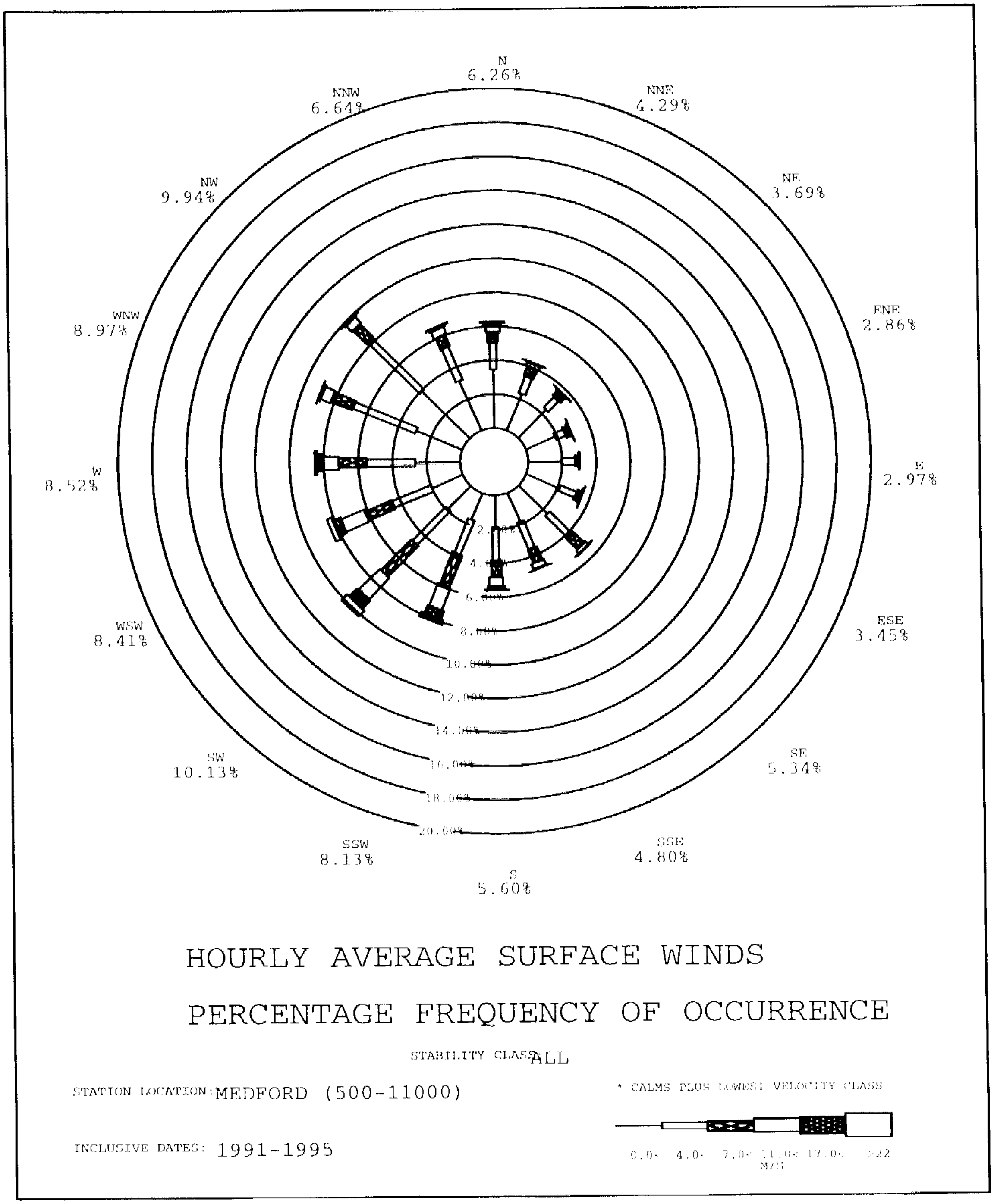
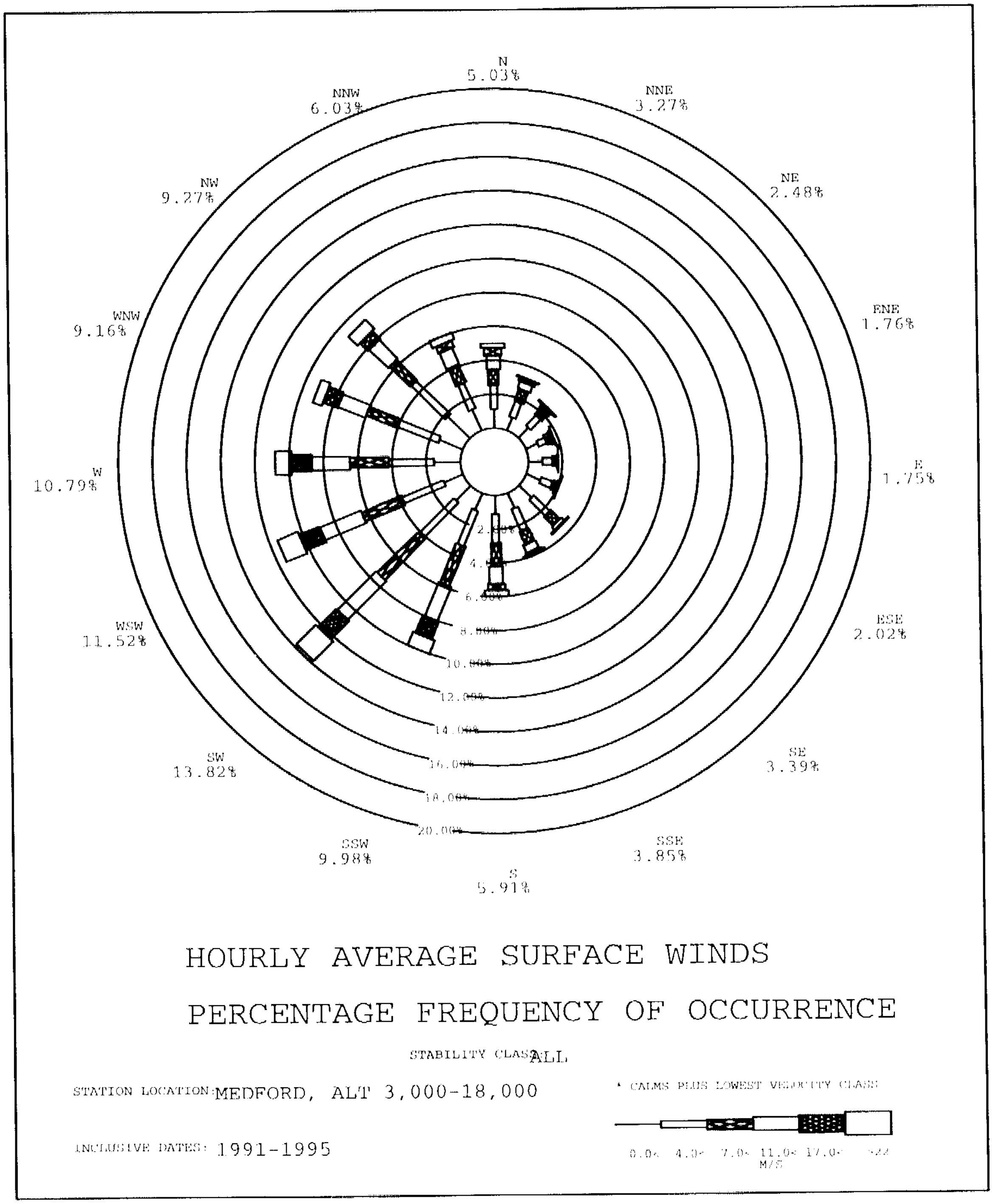


Station: Medford, OR for 500- 11,000 FEET



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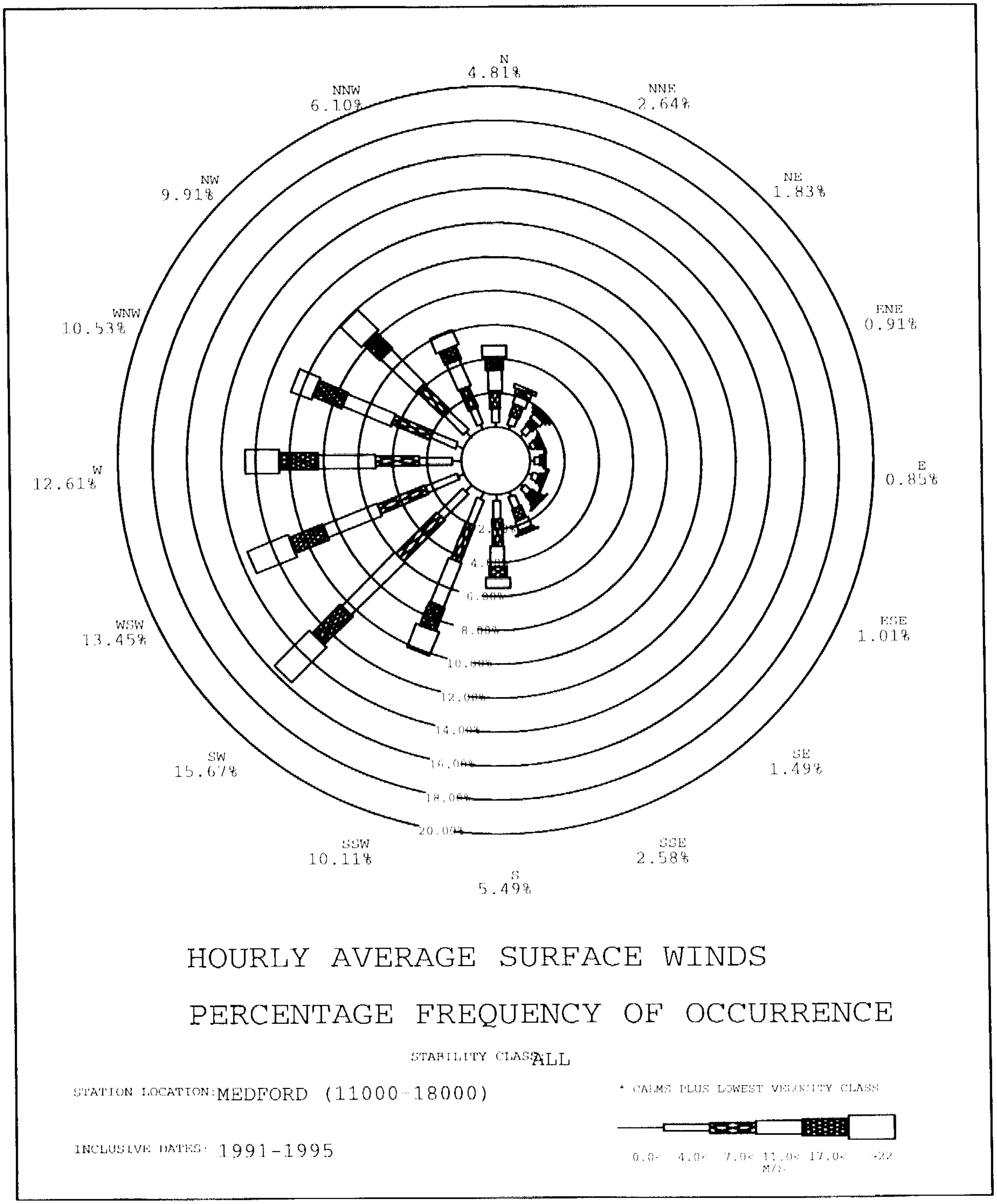

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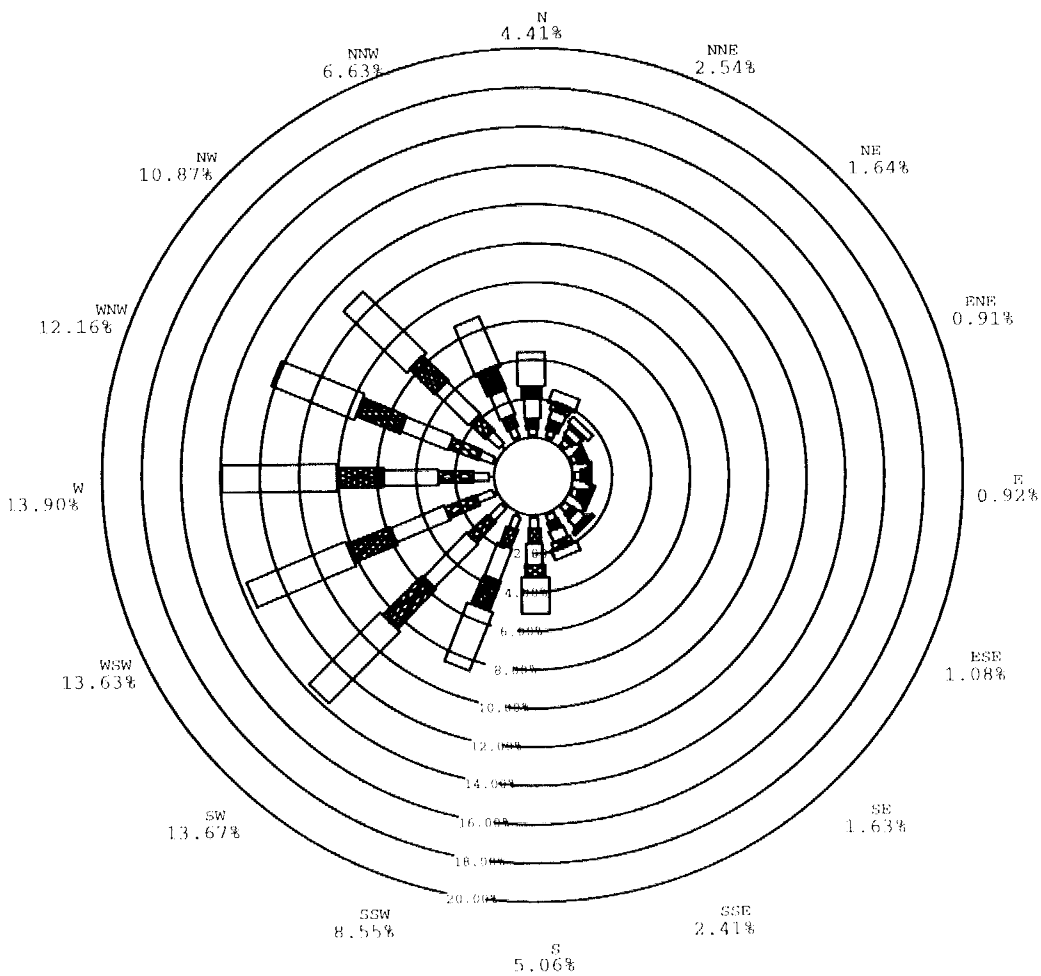


HOURLY AVERAGE SURFACE WINDS

PERCENTAGE FREQUENCY OF OCCURRENCE

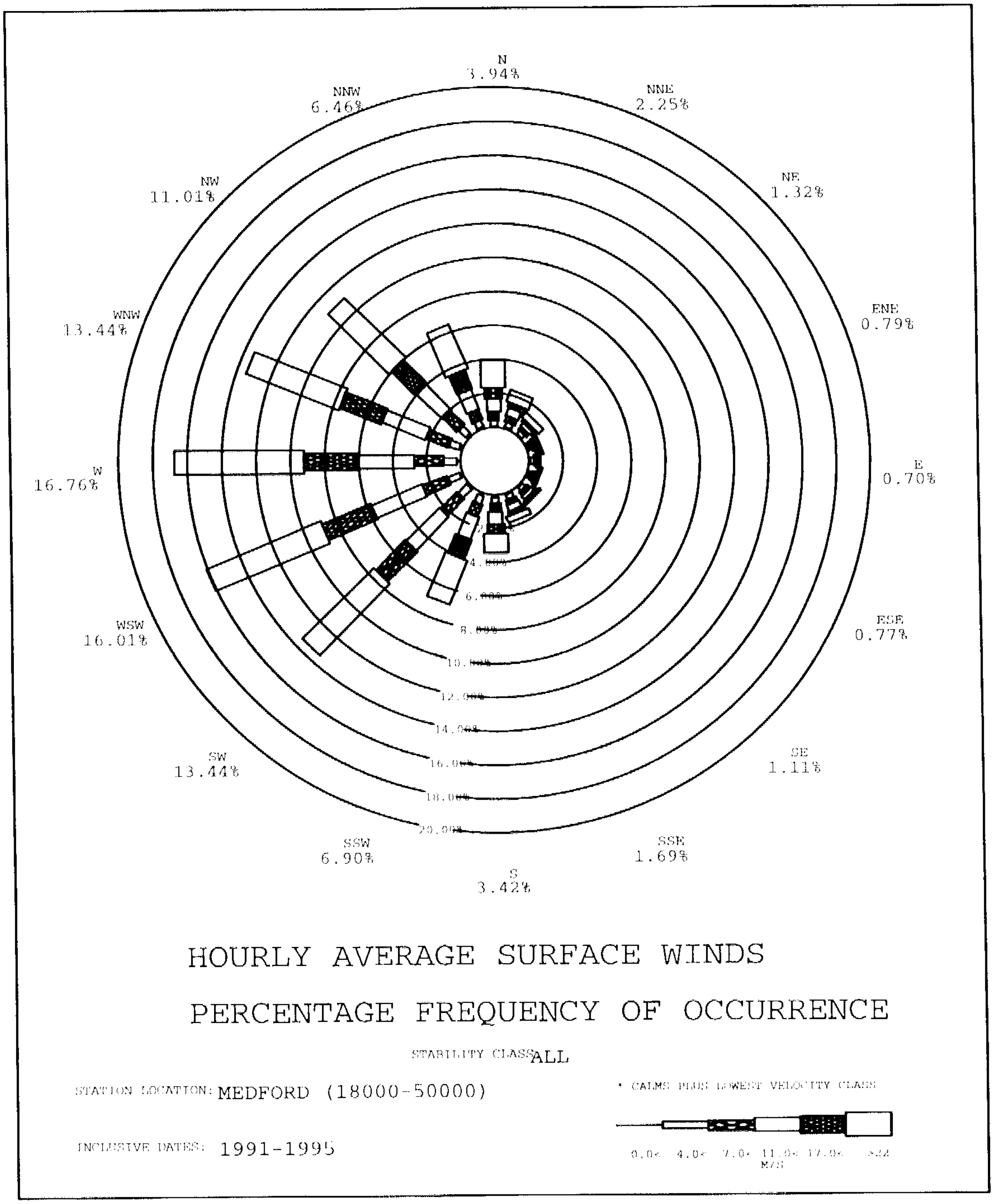
STABILITY CLASS ALL

STATION LOCATION: MEDFORD (18000-28000)

INCLUSIVE DATES: 1991-1995

* CALMS PLUS LOWEST VELOCITY CLASS

Station: Medford, OR for 18,000- 28,000 FEET



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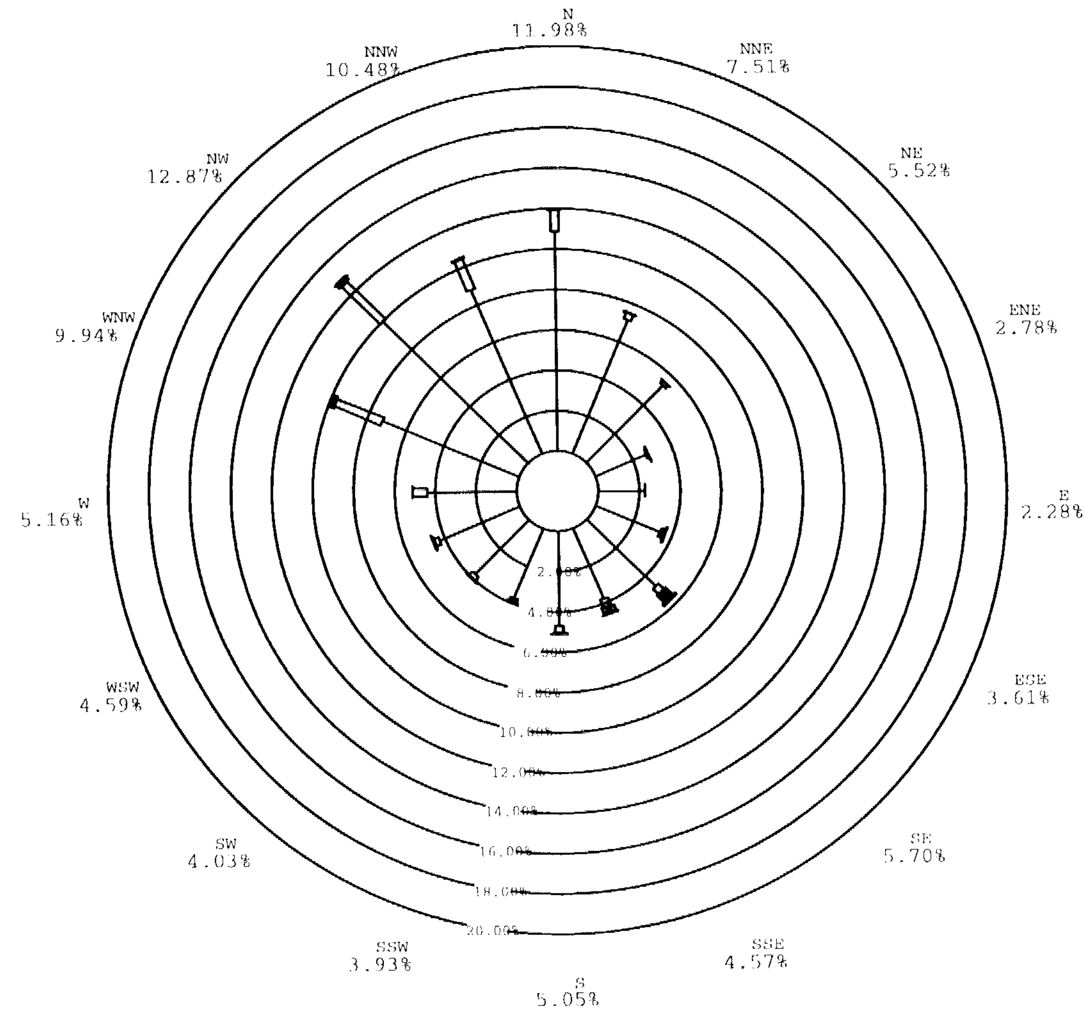


HOURLY AVERAGE SURFACE WINDS

PERCENTAGE FREQUENCY OF OCCURRENCE

STABILITY CLASS ALL

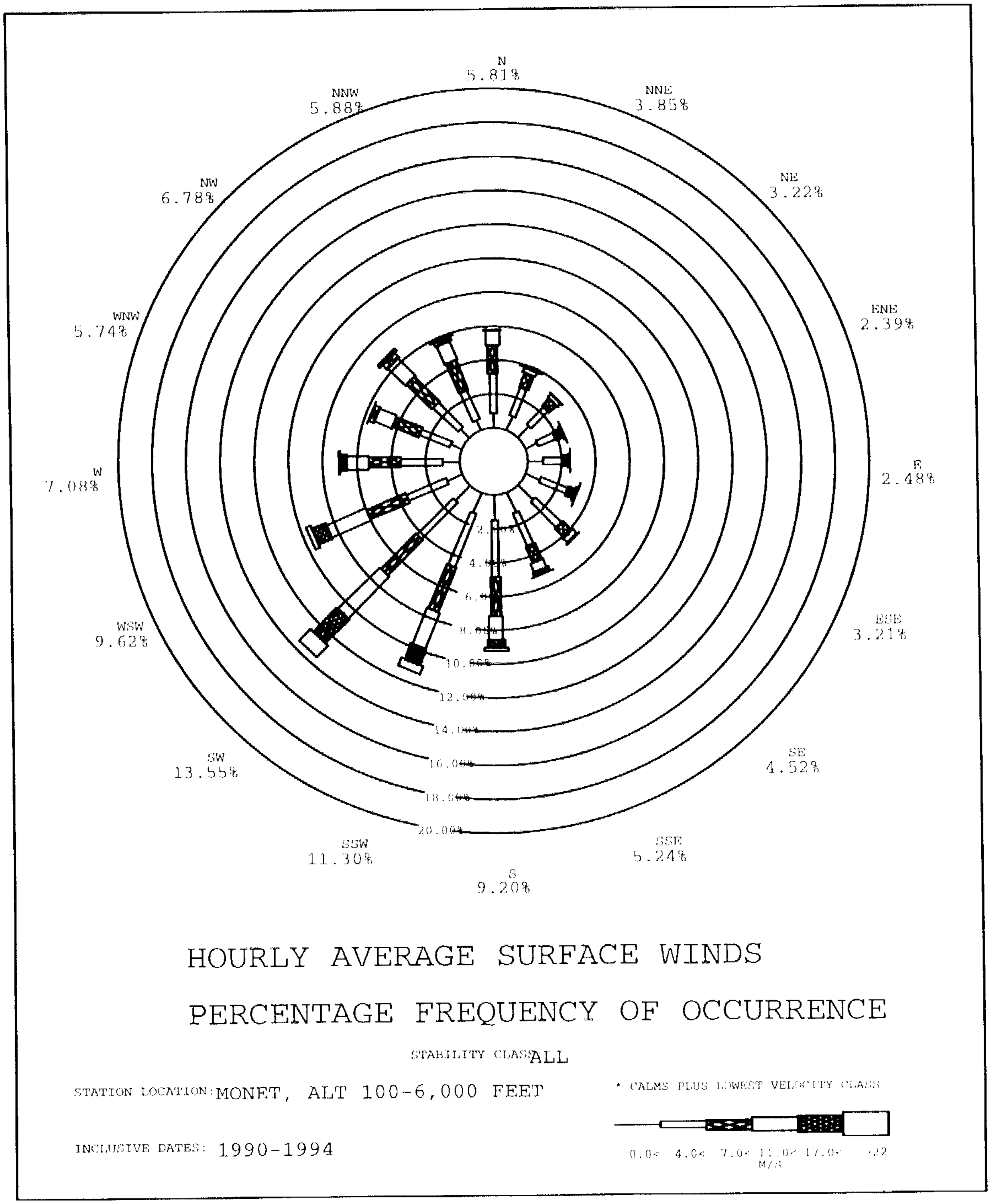
STATION LOCATION: MEDFORD (NORTHWEST)

INCLUSIVE DATES: COMPOSITE 1991-1995

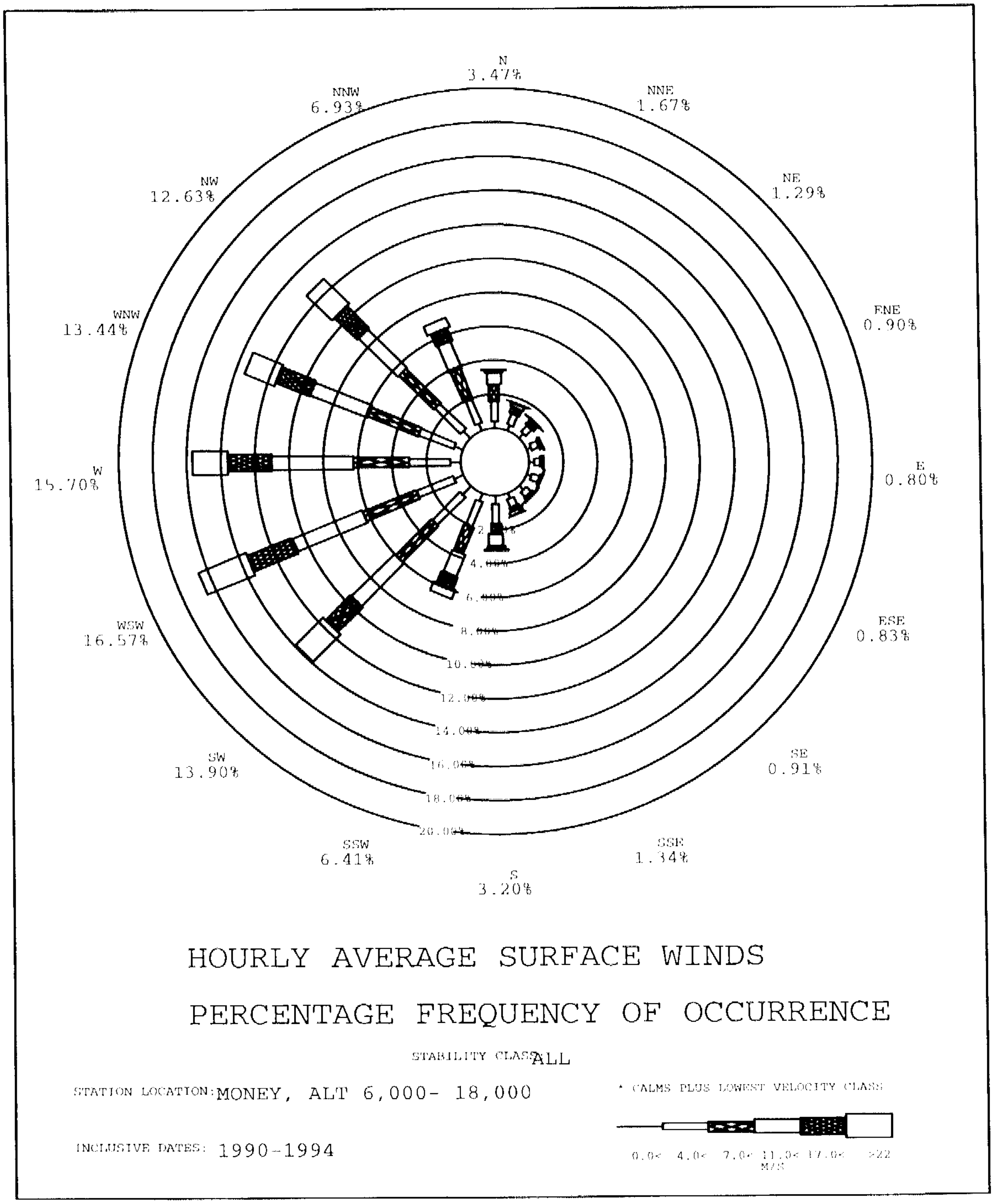
* CALMS PLUS LOWEST VELOCITY CLASS

0.0- 4.0- 7.0- 11.0- 17.0- >22
M/S

Station: Medford, OR- Surface Data



Station: Monett, MO for 100-6,000 FEET



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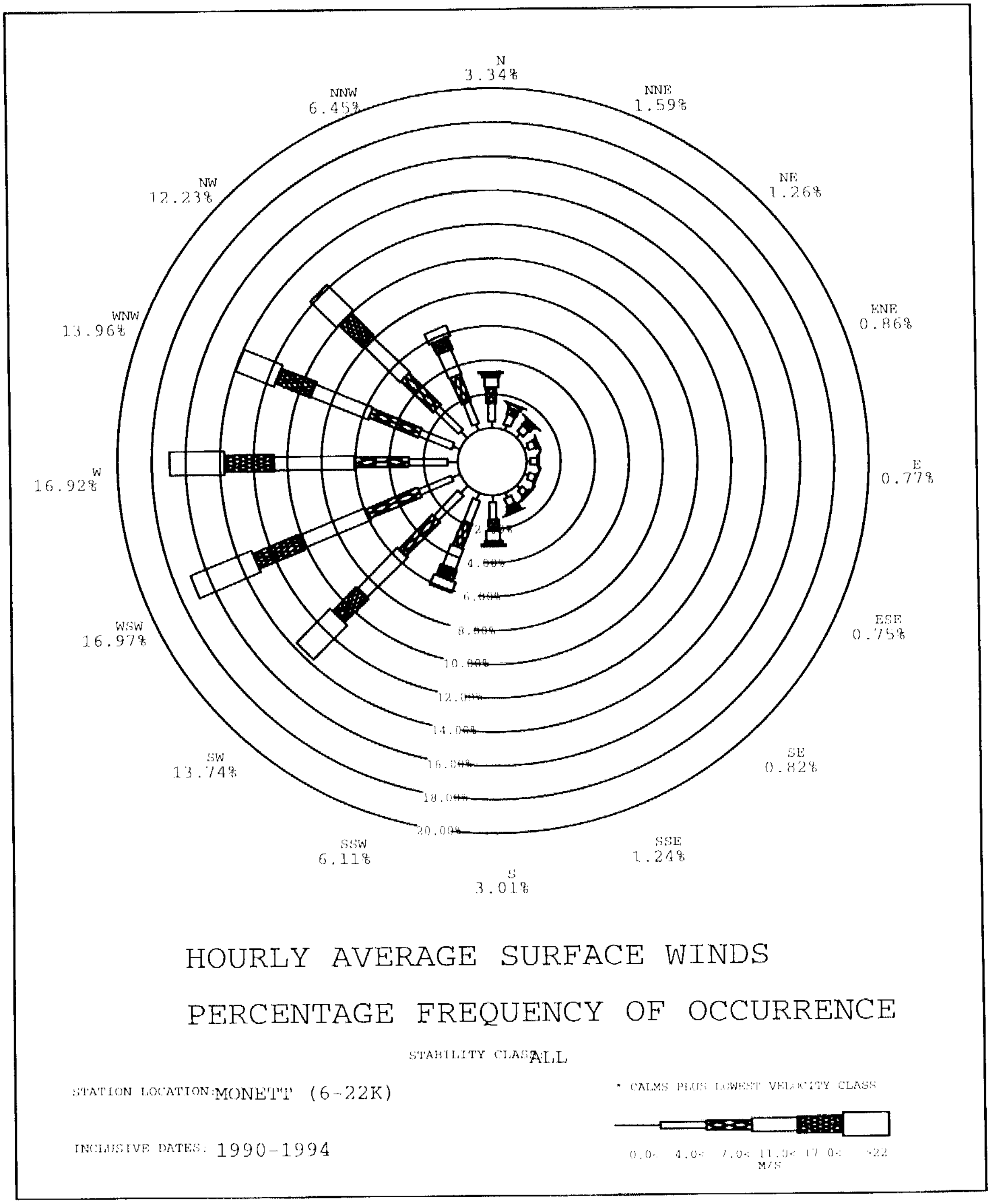

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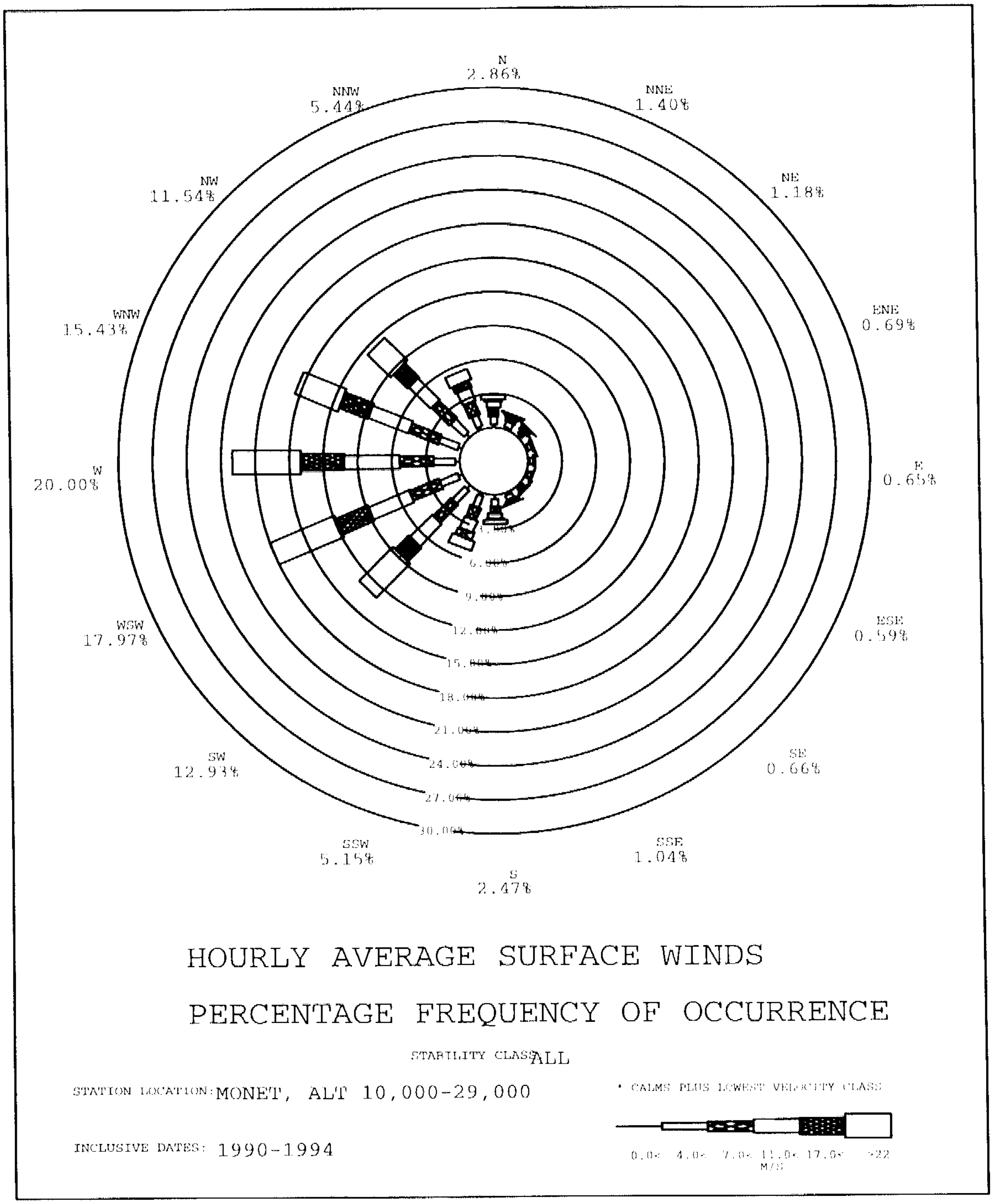

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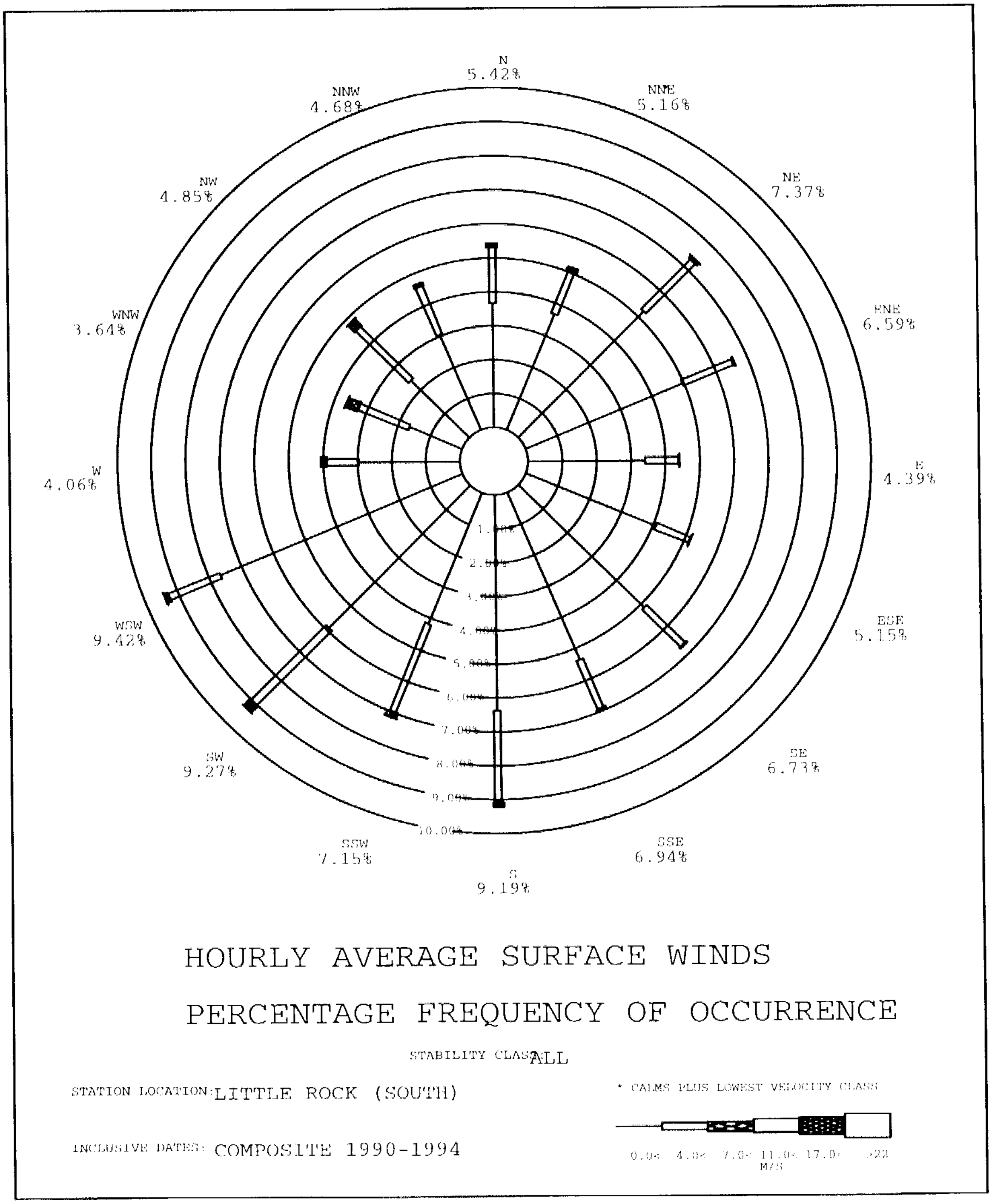

Station: Little Rock, AR- Surface Data

Appendix E
Select Panel Report

Naval Research Laboratory

Washington, DC 20375-5320

NRL/PU/6110- -99-389

Select Panel

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John G. Watson, Ph.D.
Desert Research Institute

ENVIRONMENTAL EFFECTS OF RF CHAFF

A Select Panel Report to the Undersecretary of Defense for Environmental Security

Transmitted via:

Barry J. Spargo, Ph.D.
Chemistry Division

and the

Assistant Secretary of the Air Force
Assistant Secretary of the Army
Assistant Secretary of the Navy

AUGUST 31, 1999

Table of Contents

List of Figures

Select Panel

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A biographical sketch of each panel member can be found in Appendix A.

Disclosures

The opinions and assertions contained herein are those of the Select Panel on the Environmental Effects of RF Chaff and are not to be construed as official or reflecting the views of the Departments of Defense or other agencies of the U.S. government. The use of trademark or brand names is incidental and not intended to endorse their use or exclusion.

Acknowledgements

The panel would like to thank the following individuals for their time and expertise in informing and educating the panel members on the military's research and development and use of RF chaff in training and operational settings.

J. Kevin Roll, Lt Col, USAF
Air Combat Command, Langley AFB

Mr. William R. Rock
PMA272J3

Cody L.Wilson, LT, USNR
Naval Medical Research Laboratory

Mr. Victor L. Kutsch
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Ms. Rebecca VanHooser
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Dr. Jo Ann Ratto
U.S. Army Soldier Systems Command

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Brad Goetsch, CAPT, USN
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In addition, the panel would like to thank the following commands and government agencies for hosting site visits, responding to requests for information and providing documents.

National Security and International Affairs Division
General Accounting Office

Naval Research Laboratory

Naval Strike and Warfare Center
Naval Air Station Fallon

Picatinny Army Arsenal

National Oceanographic and Atmospheric
Administration, National Weather Service

Air Combat Command
Langley Air Force Base

U.S. Department of Agriculture

International Affairs Division
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The Honorable Robert L. Pirie Jr.
Assistant Secretary of the Navy for Installations and Environment
1000 Navy Pentagon
Washington, DC

Subj: Environmental Effects of RF Chaff: A Select Panel Report to the Undersecretary of Defense for Environmental Security

Dear Mr. Pirie:

We are pleased to submit to you our Select Panel Report on "Environmental Effects of RF Chaff." It has been a privilege to serve on this panel and prepare this report.

We find that current use of RF chaff for training purposes provides no negative environmental effects that can be identified or postulated. We come to this conclusion using "upper bounds" (or worst-case) estimates based on the amounts and areas of chaff use, analysis of known literature data related to the effects of RF chaff, and reasonable, prudent extrapolations and derivations from these data.

In our work, we have operated wholly independent from the military services in terms of analysis of data and reaching our conclusions. At the same time, we are grateful for the support, information, and courtesies provided to us from each of the services and their staff. We particularly acknowledge the very professional, continuous, and helpful support provided us by Barry J. Spargo, Ph.D., Naval Research Laboratory, Washington, D.C.

We will be pleased to discuss the report with you and your colleagues in the Department of Defense. Thank you for the opportunity to serve in this way and we trust the report will be useful.

Respectfully,

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Executive Summary

This report presents the assessment of the environmental effects of radio-frequency (RF) chaff as determined by a select panel of university-based research scientists, each with published expertise in a relevant field of study. The analytical approach was to use paradigms from environmental toxicology and related disciplines, "upper bounds" (or worst-case) estimates based on the amounts and areas of chaff use, analysis of known literature data related to the effects of RF chaff, and reasonable, prudent extrapolations and derivations from these data.

The Panel concludes that widespread environmental, human, and agricultural impacts of RF chaff as currently used in training are negligible, and far less than those from other man-made emissions, based on available data, analyses, estimations, and related information. Empirical information is lacking concerning the extent to which chaff abrades and is resuspended to the atmosphere and actual exposure in populated areas near release. However, upper limit calculations suggest that those impacts are also negligible.

Prior studies and the analysis provided here do not warrant modification of current DOD RF chaff training practices based on environmental concerns. However, significant increases in RF chaff use in training beyond its use in the recent past or the use of degradable chaff as a replacement would require further consideration of environmental impact.

Up to 2.3 million bundles of RF chaff are released annually by the military services worldwide for operational and training purposes. This is about 500 tons per year (tpy), approximately the same as emissions from a single coal-powered generating station. Of this amount 5 tpy and 0.12 tpy were released respectively at NAS Fallon and Patuxent River NAS, the two case-study sites.

Virtually all RF chaff is 10-100 times larger than PM_{10} and $PM_{2.5}$, the air particulates of concern for public health. If, however, all RF chaff were of those sizes, it would only be 0.006-0.0016% of those particulates emitted annually in the U.S. Based on the MOA (military operating area) for use of RF chaff, and using accepted air transport models and conservative estimates for settling and areal distribution, average rates of deposition were estimated to be 8.7 and 12 g ha^{-1} yr^{-1}; a direct weight estimate was 2.8 g ha^{-1} yr^{-1}. Therefore, RF chaff (which is comprised of 40% aluminum and 60% silicon, the two most common elements in the Earth's crust) introduces only 1/50,000 and 1/5,000 the amounts of silicon dioxide and aluminum oxide in the top 2 cm of soil in the areas where it is deposited. Based on available data and analysis, the environmental fate of released chaff is likely to be deposition of whole fibers directly on the soil surface. It is possible fibers could be broken or abraded; even so, most of the fragments would be too large to be respired into the lungs.

Respirable particles are those which lodge in the lungs and, if toxic or hazardous, cause lung damage. Ambient air concentrations of RF chaff are calculated as 0.036 and 0.0061 $\mu g\ m^{-3}$ for NAS Fallon and Patuxent River NAS, respectively. For example, if chaff were actually PM_{10} or $PM_{2.5}$, it would contribute 0.5% and 1.2% of the PM_{10} and $PM_{2.5}$ background concentrations of 7 and 3 $\mu g\ m^{-3}$ for Nevada. Epidemiological studies of workers in glass fiber production show no evidence of glass fibers of the size and type used for RF chaff causing lung damage. Aluminum toxicity is possible, but epidemiological studies among workers are equivocal.

The maximum amount of aluminum ingested by cows from chaff would be only 1/100,000 of the maximum tolerable level of soluble Al in the diet (based on the areal depositions above). No toxic effects were found in feeding massive doses of chaff to calves. Toxic effects are unlikely through the rumen due to pH effects. Negative pulmonary effects are unlikely for the same reasons as they are unlikely in humans.

Deleterious effects on marine and freshwater organisms are unlikely because siliceous spicules (similar to chaff particles) are already part of marine and freshwater sponges that are natural parts of those ecosystems. Furthermore, toxicity tests using marine organisms show no deleterious effects at appropriate exposure levels.

Of the several open questions noted in the 1998 GAO report on RF chaff, only the extent of break-up and abrasion of chaff, and the resulting shapes and resuspension chaff particles, are considered significant. It is recommended that these studies be done. Because degradable chaff is being developed for environmental and operation reasons, it is recommended that its environmental effects be evaluated in a systematic, integrated research program conducted consistent with approaches in this report and through the leadership of a qualified scientific program manager.

Summary Findings and Recommendations

- Chaff particle concentrations in air are 1/100th of allowable limits set by EPA and less that 1/10th of the natural background concentration for suspended soil particles.
- Deposition of chaff, even under areas of intensive use, is hundreds of times less than the annual deposition of dust in the southwestern U.S. The chemical composition of chaff is very similar to the chemical composition of desert dust.
- Estimated U.S. chaff emissions are several orders of magnitude less than the U.S. mass emissions estimated by the U.S. EPA for dust, vehicle exhaust, power generation and industrial emitters.
- Deposition of chaff does not result in the accumulation of toxic or otherwise undesirable substances in soils.
- The risk of exposure for humans through inhalation or ingestion is considered negligible because chaff fibers are too large pass through the nose or mouth or do not exceed known toxic thresholds.
- Inhalation and ingestion exposure to domestic livestock and non-domestic grazers is considered minimal to nil. Nutritional values of chaff are low and comparable in composition to soil.

- Marine and freshwater organisms exposed to relevant levels of chaff are unlikely to exhibit effects in their growth or development.

- Previous studies on the environmental effects of chaff failed to consider realistic chaff exposure levels. Extremely high, non-relevant exposures were used to predict an effect.

- Of the open questions identified by the GAO, only resuspension, abrasion and local exposure of chaff were identified as requiring additional research efforts by the DOD

- The panel recommends that the DOD address the following questions related to the resuspension and fate of chaff:

    1. What fraction of emitted chaff breaks up in atmospheric turbulence into respirable particles?
    2. How much chaff is abraded and resuspended after it is deposited on a surface?
    3. What are the shapes of chaff particles after abrasion?
    4. What is the empirical terminal deposition velocity of chaff?
    5. What is the spatial distribution of chaff under different release and meteorological conditions?
    6. How do chaff emissions and expected concentrations compare to emissions and concentrations from other particle emitters over the time and areas where chaff is released?
    7. What quantities of inhalable chaff are found in communities near training facilities where chaff is released?

- Degradable chaff is under development. However, the environmental effects of this material are unknown, and current DOD efforts fall short of demonstrating degradability, ultimate fate, and environmental effects.

- Further, the panel recommends an organized program addressing the environmental effects of degradable chaff.

Introduction

In 1998, the U.S. General Accounting Office (GAO), the investigative arm of the U.S. Congress, prepared a report for the Honorable Harry S. Reid, Senator, Nevada on the environmental effects of chaff. The GAO report entitled, "Environmental Protection: DOD Management Issues Related to Chaff (GAO Report, GAO/NSAID-98-219, September 1998)" is incorporated in full in this report (Appendix B). In that report the GAO concluded, "[the] DOD and the services have developed ongoing initiatives to address certain concerns raised by the military's use of chaff. These initiatives include plans for increased liaison with agencies such as [Bureau of Land Management] BLM, [Fish and Wildlife Service] FWS, and [National Weather Service] NWS. Nevertheless, the public, DOD studies, and other federal agencies continue to raise questions about the potential adverse effects of chaff. DOD has not systematically followed up to determine whether these questions merit further action. Further, the Navy has initiated a degradable chaff research and development program but has not yet completely analyzed the operational and environmental benefits it expects to achieve."

Furthermore, the GAO recommended that the Secretary of Defense direct "the Secretaries of the Army, the Navy, and the Air Force to determine the merits of open questions made in previous chaff reports and whether additional actions are needed to address them..."

The Assistant Secretary of the Navy for Installations and Environment (ASN I&E), in consultation with his counterparts in the Air Force and Army, recommended that a Blue Ribbon Panel of non-government scientists be established. The Panel was asked to review the environmental effects of radio frequency (RF) chaff used by the U.S. military in training exercises in and around the continental United States (CONUS) and to make recommendations to decrease scientific uncertainty where significant environmental effects of RF chaff are possible. And to address, where appropriate, open questions raised by the GAO report as follows:

- long-term and chronic exposure to inhaled chaff fibers;
- resuspension rates of coated and uncoated chaff fibers;
- weathering rates and chemical fate of metal coatings in soil, fresh and marine waters;
- review of threshold metal toxicity values in humans, animals, and fresh and marine organisms;
- evaluation of potential impacts of fibers;
- respirability of fibrous particles in avian species;
- aquatic and marine studies to establish the impact of fibers;
- pathology of inhaled fibers;
- chaff accumulation on water bodies and its affect on animals;
- bioassay tests to assess toxicity of chaff to aquatic organisms, and;
- the potential for impacts on highly sensitive aquatic habitats.

Panel Charge. The panel was charged with the following:

- Review available reports on the environmental effects of RF chaff released during military training.
- Assess chaff reports using the following criteria:
  - appropriateness of the scientific questions being asked;
  - soundness of methodology and approach;
  - completeness of the study and;
  - consistency of results with comparable studies.
- Identify information shortfalls preventing adequate assessment of significant chaff impact in an environmental context.
- Prepare a report that assesses the present scientific certainty and uncertainty of the environmental effects of RF chaff and recommend additional actions to decrease scientific uncertainty where significant environmental effects of RF chaff are possible. Specifically, "determine the merits of open questions made in previous chaff reports and whether additional actions are needed to address them.[1]"

Panel Composition. The panel members were selected from a pool of candidates with expertise in areas that could address the open questions identified by the GAO report. The panel was composed of academicians with expertise in of disciplines, which include: environmental engineering, soil biogeochemistry, toxicology, medical pathology, agronomy, public health, air quality management and marine biology. Specifically, each panel member was selected because the research they conducted had direct bearing on or applicability to the questions raised by the GAO.

Panel Review Process. The GAO report was a primary reference document and provided the panel context. The panel also reviewed numerous available studies conducted related to the use and environmental effects of chaff (see Appendix C). Briefings on the current research and development efforts being conducted by the DOD and private sector as well as site visits provided the panel with additional information.

The panel used a two-phased approach to complete the charge. The first phase was a review of the studies to date, focussing on the soundness of the study, and data gaps. The second phase of the review was to assess the potential environmental impact of RF chaff based on its use in training in specified regions of the U.S., which included a visit to one of the major training sites, Fallon NAS, NV. Finally, in light of phase two results, the panel assessed whether reanalysis of existing studies or additional studies should be conducted.

[1] Environmental Protection: DOD Management Issues Related to Chaff, GAO Report, GAO/NSAID-98-219, September 1998

Analysis

To address the issues cited in the GAO report and make conclusions regarding the potential effects of RF chaff on plants, animals and humans, an understanding of the amount or mass of RF chaff released, deposited, or remaining in the atmosphere in a given area are required. These quantitative parameters cannot be precisely estimated or measured. A number of unknown factors determine the deposition of chaff and its distribution in air and on the Earth's surface (e.g. soil, sediment, and water). These factors include, but are not limited to: the altitude and location, prevailing winds, and meteorological conditions where chaff is released.

Owing to the inability to obtain detailed information on these factors, upper bounds are estimated for the extent to which released chaff might contribute to adverse air quality, dry land deposition and aquatic deposition. These estimates are made for the entire U.S. and for two case study areas where chaff is released, the Fallon Naval Air Station (NAS) in Churchill County, Nevada and the Patuxent River NAS in St. Mary's County, Maryland near the Chesapeake Bay. These upper limits are compared to contributions from similar emitters with allowable levels defined by environmental standards, and with current knowledge of effects of chaff and chaff-like materials on human, animal and aquatic life.

Chaff Emissions

A typical bundle of training chaff contains ~5 million fibers, each of 1-mil (25 μm) diameter and typically 1 to 2 cm length and composed of glass silicate with an aluminum coating (trace elements include B, Ca, Mg, Na, Ti, Fe, and F). Each bundle contains ~150 g of chaff. U.S GAO (1998) estimates that ~2.3 million of these bundles are released annually by all services in operational and training settings worldwide.

Approximately 30,000 bundles of RR-144 (Navy training round) chaff are released per year at the NAS Fallon. Most of the chaff is released at 15,000 to 20,000 ft. above ground level (agl) over an area of ~10,000 mi^2. Less than 5 % is released below 5,000 ft agl, and less than 1% is released below 1,000 ft agl (Goetsch, 1999). Low-level tactics are no longer favored as a rule, due to increased threats, such as shoulder-launched missiles at low altitudes. Actual usage was 38,000 bundles in FY 1997[2], and 21,000 bundles in FY 1998 (Goetsch, 1999). At the Patuxent River NAS, 683 bundles were released during 1998 over an area of 2400 mi^2 (Rock, 1999).

The amount of chaff released worldwide by all services is approximately 500 tons per year (tpy); the amount released at Fallon NAS is equivalent to ~5 tpy, and the amount released at Patuxent River NAS is ~0.12 tpy. The 500 tpy release is comparable to primary particle emissions from some individual U.S. point sources, such as a coal-fired power station.

On a national basis, the total chaff emissions constitute an extremely small fraction of directly-emitted particle emission. The significance of chaff release in the atmosphere over the U.S. is provided by comparison to total particle emissions of PM_{10} and $PM_{2.5}$, which are estimated by the U.S. EPA. PM_{10} and $PM_{2.5}$ emissions are estimated and their concentrations are monitored

[2] The GAO report (p24) states 13,212 bundles used at NAS Fallon in 1997.

because they are inhalable[3] and thus have a potential negative human health effect. Particles in the PM_{10} and $PM_{2.5}$ ranges are 10 to 100 X smaller than chaff. Going further, *if* all chaff released nationwide were PM_{10} it would constitute 0.0016% of the national releases. If it were all in$PM_{2.5}$ this fraction would rise to 0.006%. These levels are much lower than releases from any other category.

To provide a perspective on the amount of chaff released into the atmosphere over the U.S., Figures 1 and 2 summarize U.S. particle emissions from different source categories estimated by the U.S. Environmental Protection Agency (U.S. EPA, 1998) for 1997. Particle emissions are estimated for PM_{10} and $PM_{2.5}$ (particles with aerodynamic diameters less than 10 μm and 2.5 μm, respectively) because these are regulated by National Ambient Air Quality Standards (NAAQS; U.S. EPA, 1997) to protect public health. Of these particle emissions, fugitive dust from paved and unpaved roads, construction, agriculture, and wind erosion make up the majority of the inventory and have compositions most similar to chaff.

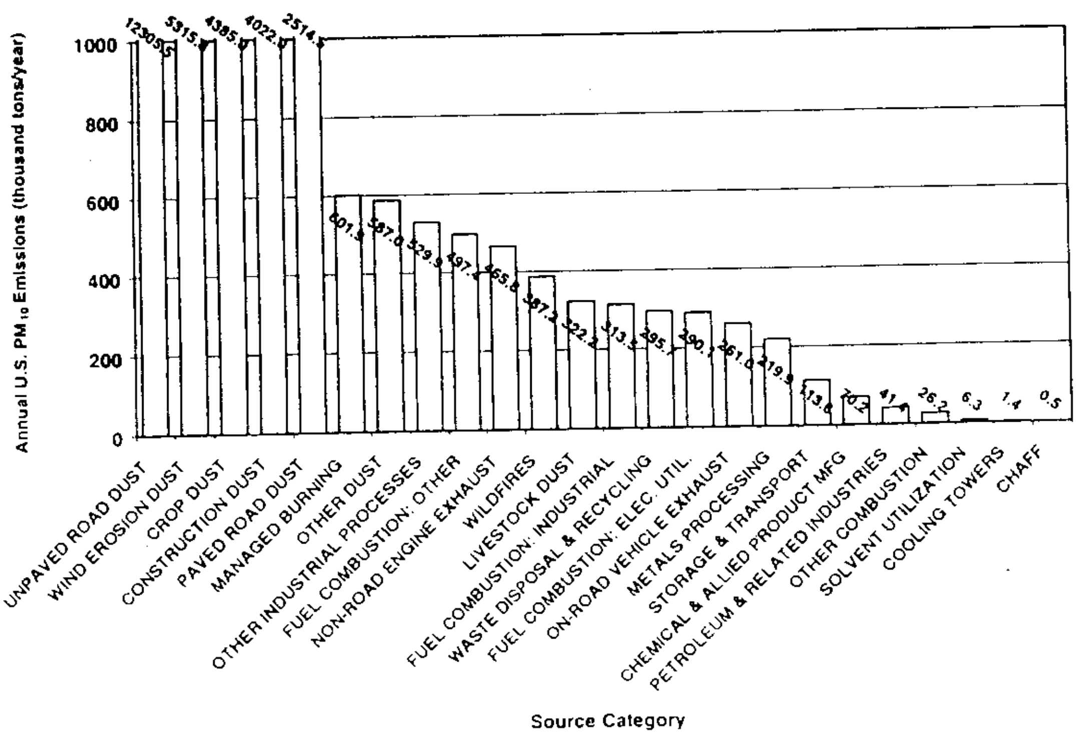

Figure 1. U.S. National Emission in 1997 for PM_{10}. Source: U.S. EPA, 1998. The chaff category is included as an upper limit assuming all chaff abrades to the PM_{10} size fraction.

[3] In this context an inhalable particle is of dimensions capable of being transported through the upper respiratory tract into the alveolar tissues of the lung.

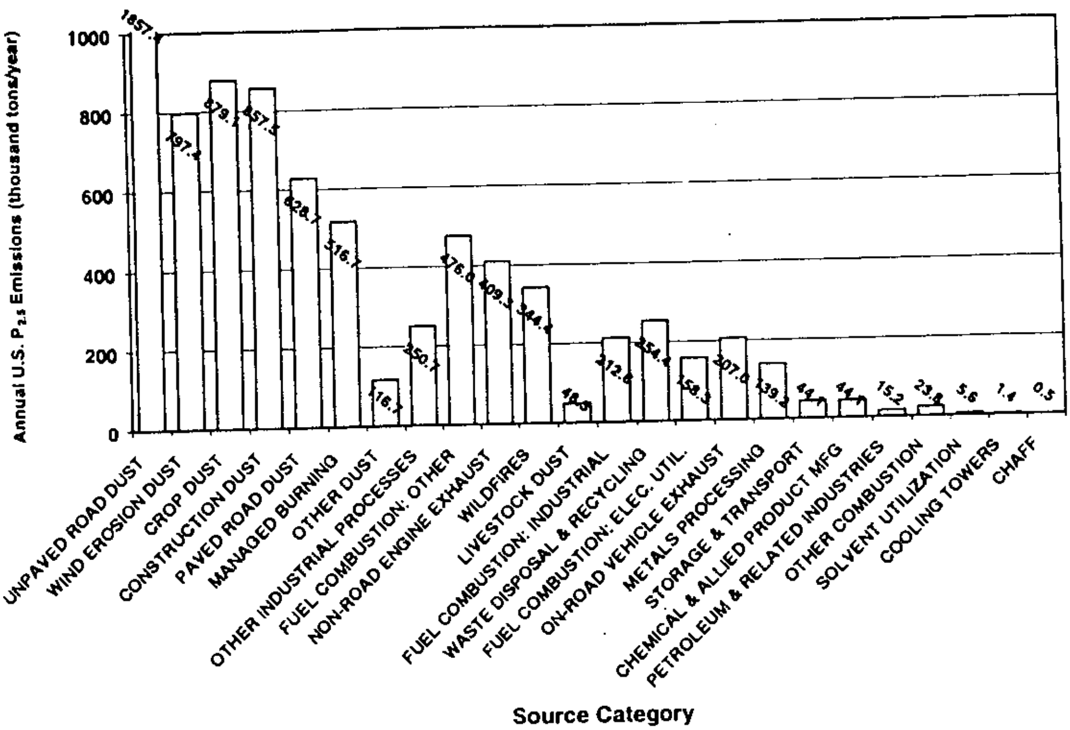

Figure 2. U.S. National Emission in 1997 for $PM_{2.5}$. Source: U.S. EPA, 1998. The chaff category is included as an upper limit assuming all chaff abrades to the $PM_{2.5}$ size fraction.

The values reflected in Figures 1 and 2 are upper limits for chaff emission calculated as PM_{10} and $PM_{2.5}$. A U.S. Air Force study[4] found that chaff particles entering a PM_{10} sampler retained their original dimensions. Their analysis of soil samples in chaff release areas also found that most dipoles detected in soil retained their original dimensions (no quantitative data available). Actual equivalent emissions in the PM_{10} or $PM_{2.5}$ size ranges would be much smaller than these estimates because it appears that only a small fraction of dipoles will degrade into particles sizes less than 2.5 or 10 μm.

Further reduction in particle size may occur after deposition, however, when deposited dipoles are abraded by soils and possibly resuspended. There is insufficient information about the extent to which chaff particles are broken up by abrasion. The amounts and times of resuspension from surfaces depends on wind speeds over the surfaces of test ranges, but the total amount cannot exceed the 500 tpy total if all deposited chaff were reduced to smaller particles.

For Fallon and Patuxent River Naval Air Stations, comparable PM_{10} and $PM_{2.5}$ emissions for Churchill County, NV and St. Mary's County, MD, where these stations are located are given in Figures 3 through 6.

[4] Environmental Effects of Self-Protection Chaff and Flares, August 1997, USAF, Air Combat Command

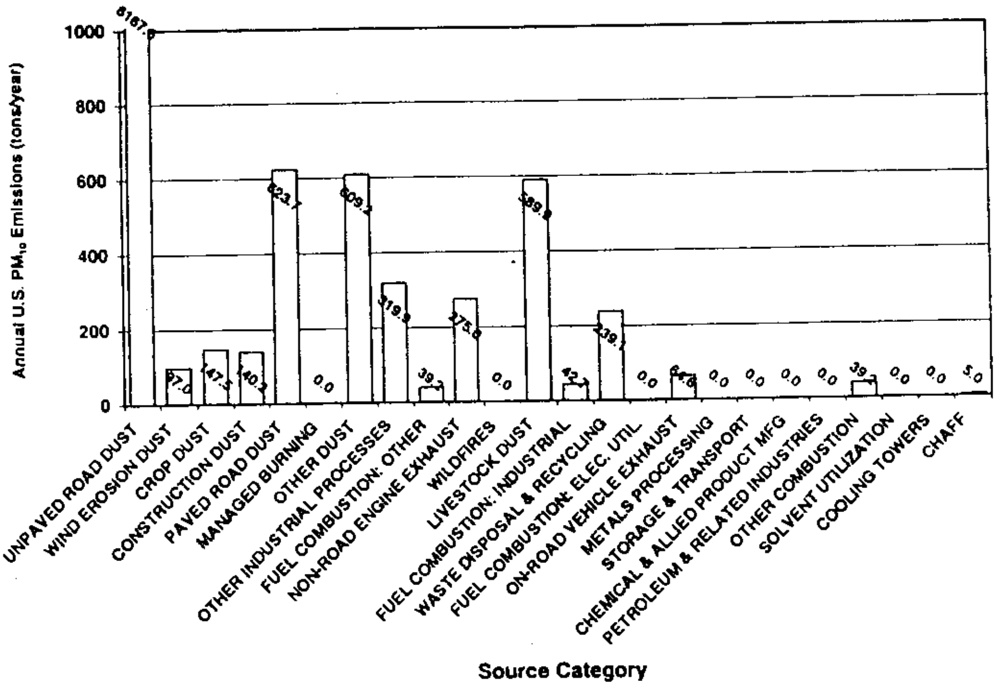

Figure 3. Churchill County, NV, PM_{10} Emissions estimates for 1997. Source: U.S. EPA, 1998.

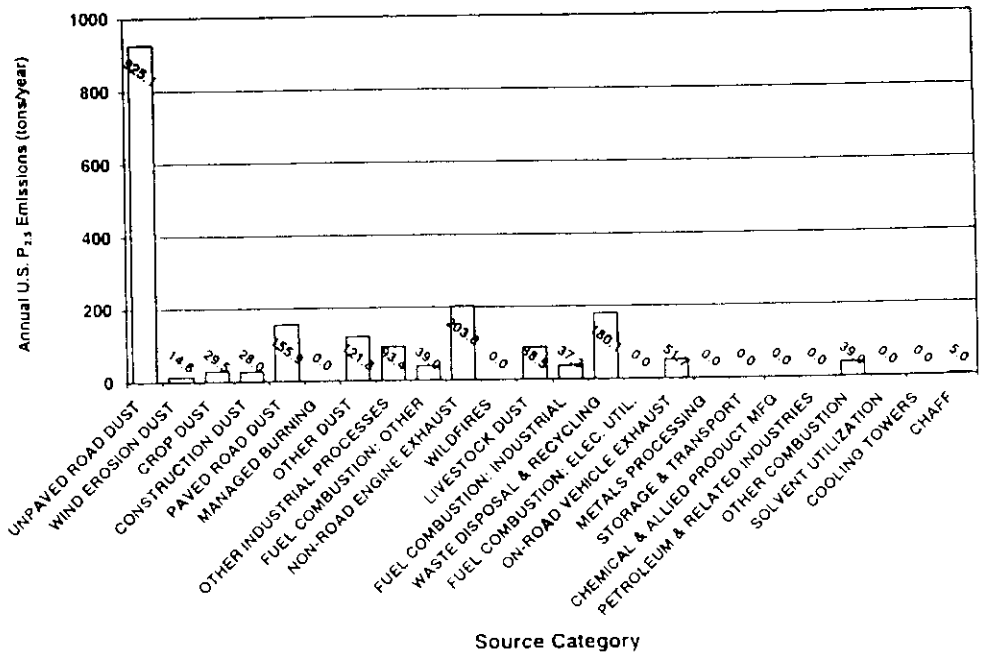

Figure 4. Churchill County, NV, $PM_{2.5}$ Emissions estimates for 1997. Source: U.S. EPA, 1998.

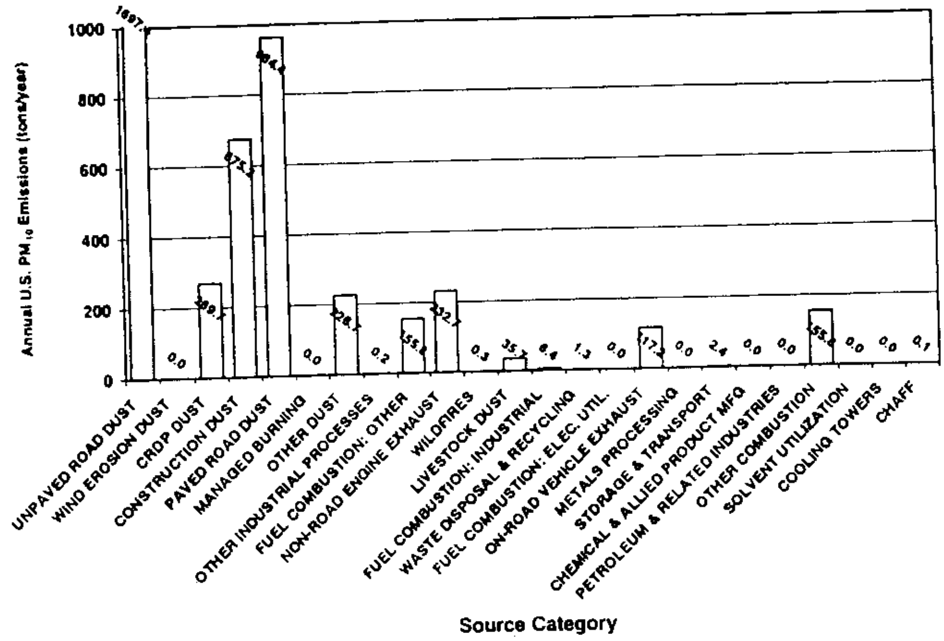

Figure 5. St. Mary's County, MD, PM_{10} Emissions estimates for 1997. Source: U.S. EPA, 1998.

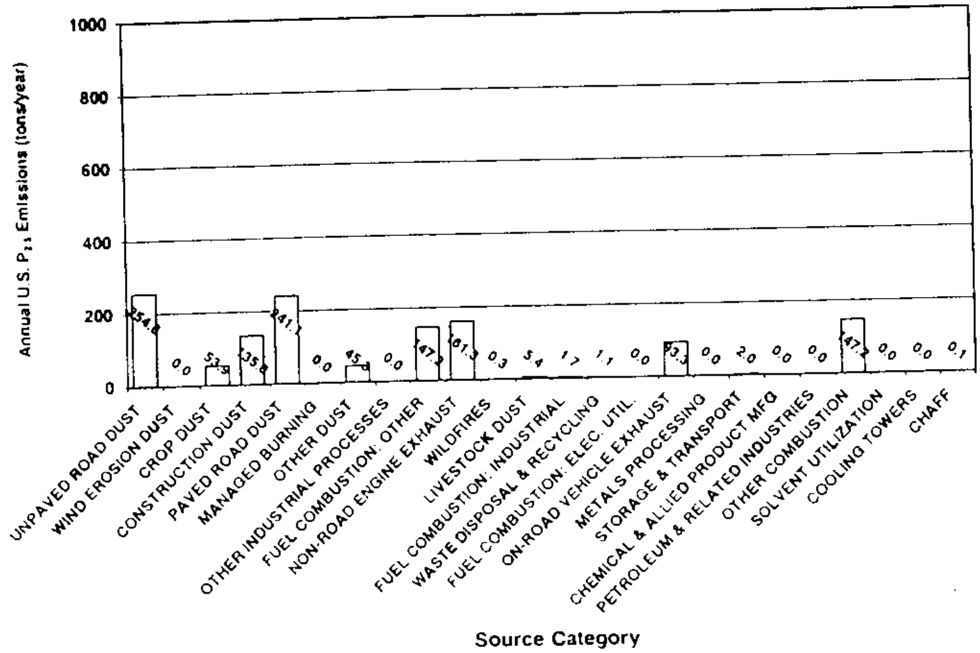

Figure 6. St. Mary's County, MD, $PM_{2.5}$ Emissions estimates for 1997. Source: U.S. EPA, 1998.

These figures show that if chaff released in these counties was completely abraded to the PM_{10} or $PM_{2.5}$ size fraction, its emissions would still be very small compared to other emissions within the county. At most, chaff would constitute 0.05% of PM_{10} and 0.25% of $PM_{2.5}$ emissions in Churchill County and 0.003% of PM_{10} and 0.009% of $PM_{2.5}$ emissions in St. Mary's County.

Chaff Deposition and Environmental Fate

Figure 7 shows the extent to which chaff is removed from the atmosphere assuming gravitational settling velocities[5] of 30 cm s^{-1}, a lower estimate for chaff deposition rates (Cataido et al., 1992). Estimates are made for release heights of 100 m, 500 m, 1000 m, 5000 m and 10,000 m agl. Two models are used to estimate residence time (Hinds, 1982): 1) a "stilled chamber" model, in which particles fall in the absence of atmospheric mixing; and 2) a "stirred chamber" model in which particles are instantaneously mixed uniformly throughout the depth between release height and ground level. These extreme models bound the actual atmospheric situation in which a fraction of particles falls directly to the surface and another fraction is mixed aloft by atmospheric turbulence. These extreme estimates show atmospheric residence times ranging from ~10 min for the majority of chaff dipoles released at 100 m to ~10 hr for most of the dipoles released at 10,000 m. Observations indicate that chaff dipoles that retain their original sizes do not stay suspended for long periods. These calculated residence times are longer than those observed on radar traces of chaff releases.

Deposition in desert ecosystems of the southwestern U.S. The panel was provided with estimates of chaff deposition in the vicinity of NAS Fallon—for instance, an estimate of 0.04 ounces per acre per year, equivalent to 2.8 g ha^{-1} yr^{-1}, was cited (Goetsch, 1999).

For comparison, the panel made two additional, independent estimates, each using a different approach. Approach 1: it was assumed that 30,000 bundles yr^{-1}, each with a mass of 150 g, are dispersed over the area of operations (MOA), which comprises 6.4 million acres at NAS Fallon. NAS Fallon personnel indicated that the chaff is released over approximately 20 % of the MOA, so it is assumed in this approach that the chaff falls only on this area of intensive use—518,000 ha. The average rate of deposition would then be 8.7 g ha^{-1} yr^{-1}, or (0.00087 g m^{-2} yr^{-1}). Note that this calculation provides an upper-bound on the rate of chaff deposition at NAS Fallon; the actual deposition rate will probably be much less because chaff is likely to be dispersed over a much larger area as a result of prevailing winds and atmospheric turbulence. Similar calculations for Nellis AFB indicate deposition ranging from 9 to 30 g ha^{-1} yr^{-1}.

Approach 2: this approach was based on estimated atmospheric dispersion rates and chaff settling rates to calculate an order-of-magnitude rate of chaff deposition on the ground. It was assumed that 1-mil glass fiber chaff is employed, with a settling velocity[6] of 30 cm s^{-1}. A typical

[5] Jiusto, JE and WJ Eadie. 1963 Terminal fall velocity of radar chaff. Journal of Geophysical Research 68:2858-2861. Provides theoretical estimates and empirical measurements of the fall velocity at altitudes ranging from 0 to 20 km. Values range from 62 cm s^{-1} to 139 cm s^{-1}. Faster velocities at higher altitudes is associated with lower air viscosity.

[6] Environmental Effects of Self-Protection Chaff and Flares, August 1997, USAF, Air Combat Command

scenario is based on wind speeds[7] of 30 ft s^{-1} at 10,000 ft agl, 15 ft s^{-1} at 5000 ft agl, so the mean horizontal travel is 250,000 ft for chaff released at 10,000 ft agl. The reasonableness of this number can be confirmed by multiplying an average wind speed of 15 ft s^{-1} (neglecting the shape of the wind velocity profile) by calculated chaff fall time.

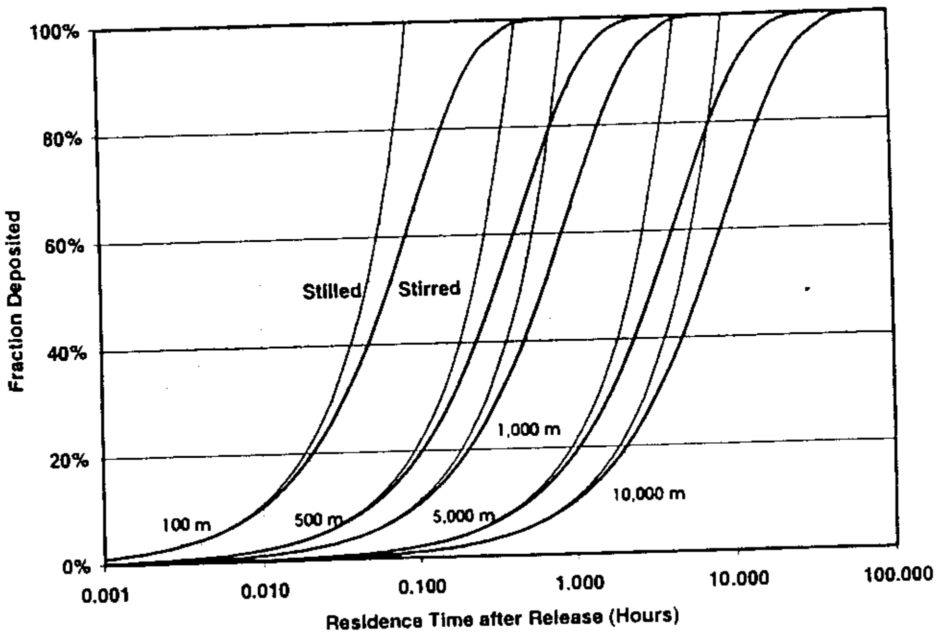

Figure 7. Fractions of chaff particles deposited after different release times and elevations above ground level. Mixed and stirred chamber models (Hinds, 1982) are used to bound atmospheric mixing conditions assuming a deposition velocity of 30 cm s^{-1}.

Dispersion of chaff was estimated using the Pasquill-Gifford model (e.g., Seinfeld, 1986) with a neutral stability category (a conservative approach, because most chaff is released during the day). The expected patch of chaff on the ground resulting from the release of one round is an area 8,000 m wide by 12,000 m long (1 std dev.). Release of 30,000 bundles of chaff per year in a pattern that would distribute such chaff patches along two sides of the roughly square MOA would result in deposition of ca. 40 fibers m^{-2} yr^{-1} on the ground. In actuality, the variability in release point and atmospheric transport are likely to result in more dispersion. Under certain meteorological conditions, large fibers or particles can be transported over surprisingly long (hundreds of miles) distances. For example, particles from the Sahara desert can be transported across the Atlantic Ocean and deposited in the southeastern region of the U.S. (Prospero, 1999). Similarly, media reports indicate that chaff released during the Kosovo air campaigns has been transported over several hundred miles to areas in the Southeastern Balkans.

[7] *ibid.*

The estimate resulting from Approach 2 corresponds to a positively biased chaff deposition of approximately 12 g ha^{-1} yr^{-1}, within range of the value estimated in Approach 1. Both estimates are close to the value of 0.04 oz $acre^{-1}$ yr^{-1} (= 2.8 g ha^{-1} yr^{-1}) cited for NAS Fallon (Goetsch, 1999). The similarity of the three estimates is probably coincidental, given the many approximations and assumptions that were necessary; however, it builds confidence that the correct general magnitudes are known.

These estimates of chaff deposition are consistent with reports of the identification of chaff in soil samples gathered at Nellis AFB[8]. Soil samples were 10 x 10 cm in area and 2 cm in depth. Concentrations of chaff ranged between 0.02 and 251 mg kg^{-1} of soil, with most samples having < 0.5 mg kg^{-1}. Assuming 1.4 g cm^{-3} soil density, the maximum amount of chaff that was observed in any soil was about 7 g m^{-2}, with most samples having < 0.014 g m^{-2}. It would take about 9.3 yr to accumulate > 0.014 g m^{-2}, if chaff is deposited at the rate of 15 g ha^{-1} yr^{-1}, a middle value among the rates calculated for Nellis AFB. Assuming little fiber degradation in soils, this calculation suggests that the amount of chaff that has accumulated on the ground is consistent with deposition rates that are less than 15 g ha^{-1} yr^{-1}, during the past 50 years of chaff usage at Nellis AFB.

The calculation of Approach 2 implies an atmospheric concentration of one fiber per 10,000 m^3 of air for release of one bundle of chaff at 10,000 ft agl. This is equivalent to an airborne concentration of 0.003 μg m^{-3}.

Deposition of chaff at Patuxent River NAS. Using Approach 1, the maximum rate of deposition of chaff at Patuxent River NAS was 0.16 g ha^{-1} yr^{-1}. As of the writing of this report, chaff usage over Patuxent River NAS was 919 bundles in 1999, resulting in the deposition of 0.20 g ha^{-1} yr^{-1}. These estimates are more than 10X lower than the deposition calculated at NAS Fallon.

For chaff dispersed by mortar rounds from naval vessels[9], the estimated deposition is 53 dipoles ft^{-2} for the area of deposition under a single round that disperses chaff at a height of 300 ft. This deposition corresponds to 170 g chaff ha^{-1}. This estimate is much higher than deposition calculated for the southwestern U.S., where the altitude of chaff release is much higher and the calculations are long-term averages for the entire MOA, rather than for the area directly beneath a single release. The estimate of 170 g ha^{-1} yr^{-1} represents an upper-limit of chaff deposition to be expected from normal operations over land and at sea and is a rare event.

Environmental fate of chaff in air, soils, and aquatic systems. The environmental fate of chaff includes alterations that may occur between its release and its deposition on the ground, and the long-term degradation and burial processes that it experiences after hitting the ground.

Chaff fibers experience little breakup before reaching the ground and is based on the fact that breakup of fibers would degrade the effectiveness of chaff. Chaff ejection systems result in minimal breakup. Because ejection of chaff appears to subject the fibers to much larger forces

[8] *ibid.*, p.3-39

[9] Rapid Bloom Offboard Chaff System Evaluation and Naval Air Systems Command Multi-Frequency Chaff Evaluation.

than would atmospheric turbulence, it is unlikely that fibers that survive ejection intact subsequently break up during their fall to earth.

Although breakup of fibers during ejection is probably not a significant process, this can be confirmed from radar cross-section data. Because breakup of fibers will significantly affect the radar cross section of the chaff cloud, radar echoes should be examined for both loss of reflectivity (relative to modeled data or control studies) at the frequencies for which the chaff is designed and for appearance of larger-than-predicted reflectance at higher frequencies, due to the presence of short fragments. It is possible that such a study could be conducted at minimal cost using existing data. The panel recommends that this be considered by those having the appropriate radar expertise as well as access to classified radar cross section data.

Geochemical significance of chaff deposition. Chaff is approximately 60% glass fibers and 40% aluminum by weight (Rock, 1999). To put this in a geochemical perspective, the deposition of chaff can be compared with airborne dusts found in the high desert environment. The comparison to desert dust is relevant because the composition of dust is dominated by silicon dioxide (SiO_2) and aluminum oxide (Al_2O_3), which are the most common minerals in the Earth's crust (Pye, 1987).

Reheis and Kihl (1995) measured the mean total deposition of silt and clay ranges from 4.3 to 15.7 g m^{-2} yr^{-1} in the Mojave Desert of California and southern Nevada. From 1984-1989 these values are 10,000X higher than the rate of chaff deposition in this region. However, much of the dust that is deposited in arid lands may be derived from local sources. Chadwick et al. (1995) estimate that the *net* input of silt + clay to soils in northern Nevada ranges from 0.2 to 0.4 g m^{-2} yr^{-1}, which is 375X higher than the annual deposition of chaff that was calculated for NAS Fallon.

Windblown dusts typically contain between 50 and 60% SiO_2 (Pye, 1987), which is similar to the content of Si in the glass fibers of chaff. Using the reported chemical composition of each fraction[10], then each gram of chaff deposited at NAS Fallon carries 0.32 g of SiO_2 (or 0.15 g of elemental Si) to the soil surface. The glass fibers in chaff contain a small amount of Al, but the coating on chaff is nearly pure aluminum. Each gram of chaff deposited adds about 0.44 g of Al to the soil surface. Compared to these inputs, the average soil contains >50,000X more Si and 5000X more Al in the upper 2 cm. The remaining constituents in chaff, dominated by Ca, Mg, and B, are also common in airborne dusts. The deposition of Ca in chaff is about 5600X lower than the background rate Ca deposition from the atmosphere in the southwestern U.S., where the atmospheric deposition of Ca leads to the formation massive deposits of caliche in desert soils (Schlesinger, 1985).

Ambient Concentrations

Particle size and mass concentration have both been determined to affect the public health significance of airborne particles (U.S. EPA, 1996, Vedal, 1997). Small particles also have lower deposition velocities and can remain suspended for much longer time periods than those

[10] Environmental Effects of Self-protection Chaff and Flares, August 1997, USAF, Air Combat Command , Table 3.2-1, see Appendix C

indicated by Figure 7. National Ambient Air Quality Standards (NAAQS) for particulate matter (PM; U.S. Environmental Protection Agency, 1997) specify:

1. Twenty-four hour average $PM_{2.5}$ not to exceed 65 μg m^{-3} for a three-year average of annual 98th percentile at any population-oriented monitoring site in a Metropolitan Planning Area (MPA).
2. Three-year annual average $PM_{2.5}$ not to exceed 15 μg m^{-3} concentrations from a single community-oriented monitoring site or the spatial average of eligible community exposure sites in a MPA.
3. Twenty-four hour average PM_{10} not to exceed 150 μg m^{-3} for a three-year average of annual 99th percentiles at any monitoring site in a monitoring area.
4. Three-year average PM_{10} not to exceed 50 μg m^{-3} for three annual average concentrations at any monitoring site in a monitoring area.

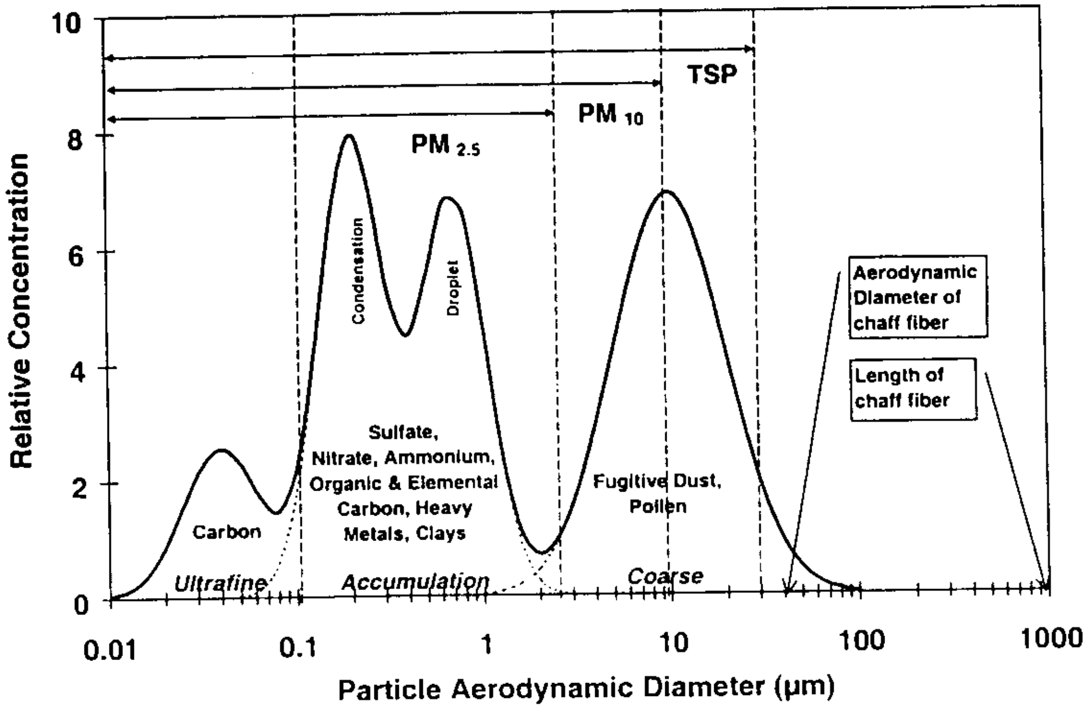

Figure 8. Typical distribution of particle sizes in the atmosphere. Concentrations at larger particle sizes are limited by gravitational settling.

How particles of different sizes are typically distributed in the atmosphere, the size fractions occupied by $PM_{2.5}$, PM_{10}, and a prior NAAQS for Total Suspended Particulate (TSP) is shown in Figure 8.

Particles larger than 30 μm deposit to the surface within less than an hour after suspension unless they are injected to or released from high altitudes. This deposition effectively limits atmospheric concentrations for very large particles. Without substantial decomposition, chaff particles deposit rapidly to surfaces, as shown in Figure 7.

The "ultrafine particles" (Oberdörster et al., 1995; Fitzgerald et al., 1997; Kotzick et al., 1997) in Figure 8 have diameters less than ~0.08 µm that are emitted directly from combustion sources or that condense from cooled gases soon after emission. Ultrafine particle lifetimes are usually less than one hour because they rapidly coagulate with larger particles or serve as nuclei for cloud or fog droplets. The nucleation range is detected only when fresn emissions are close to a measurement site or when new particles have been recently formed in the atmosphere (Lundgren and Burton, 1995).

The "accumulation" range consists of particles with diameters between 0.08 and ~2 µm. These particles result from the coagulation of smaller particles emitted from combustion sources, from gas-to-particle conversion, from condensation of volatile species, and from finely ground dust particles. Chemical-specific size distributions show that these sub-modes exist in several different environments (Hering and Friedlander, 1982; Hoppel et al., 1990; Sloane et al., 1991). John et al. (1990) interpreted the peak centered at ~0.2 µm as a "condensation" mode containing gas-phase reaction products, and the ~0.7 µm peak as a "droplet" mode resulting from growth by nucleation of particles in the smaller size ranges and by reactions that take place in water droplets. The liquid water content of ammonium nitrate, ammonium sulfate, sodium chloride, and other soluble species increases with relative humidity, and this is especially important when relative humidity exceeds 70% (Tang, 1976). When these modes contain soluble particles, their peaks shift toward larger diameters as humidity increases (Tang, 1976, 1980, 1993; Tang et al., 1977; McMurry et al., 1987; Zhang, 1989). The ultrafine and accumulation ranges constitute the "fine" particle size fraction, and the majority of sulfuric acid, ammonium bisulfate, ammonium sulfate, ammonium nitrate, organic carbon, and elemental carbon is found in this size range.

The $PM_{2.5}$, PM_{10}, and TSP size fractions commonly measured by air quality monitors are identified in Figure 8 by the portion of the size spectrum that they occupy. The mass collected is proportional to the area under the distribution within each size range. The TSP size fraction ranges from 0 to ~30 µm, the PM_{10} fraction ranges from 0 to 10 µm, and the $PM_{2.5}$ size fraction ranges from 0 to 2.5 µm in aerodynamic diameter. No sampling device operates as a step function, passing 100% of all particles below a certain size and excluding 100% of the particles larger than that size. When sampled, each of these size ranges contains a certain abundance of particles above the upper size designation of each range (Watson et al., 1983; Wedding and Carney, 1983). As a result, it is possible for a small fraction of chaff particles to pass through the size-selective inlets that are used to separate PM_{10} from other particle sizes.

The following are reasonable to worst case assumptions to estimate the largest increments in ambient PM_{10} and $PM_{2.5}$ concentrations that might be contributed by chaff emissions:

1. All released chaff abrades to sizes less than 2.5 or 10 µm. As noted above, it is probable that only a small fraction of released chaff achieves sizes <10 µm and that an even smaller fraction (<<1%) achieves sizes <2.5 µm.
2. All chaff released during a year remains suspended within the borders of the continental United States or of a specific air station practice range. As shown in Figure 7, it is probable that most of the dipoles settle to the surface within less than a day after release; remaining chaff would be transported beyond U.S. borders within a few weeks.

3. Chaff is released at 5,000 m above ground level and mixes evenly throughout that altitude. Higher concentrations at lower altitudes imply deposition to the surface that would quickly reduce ambient concentrations. This is within the range of altitudes estimated for most naval chaff releases and an elevation at which particles can remain aloft long enough to be transported long distances from the release point. Non-depositing chaff particles released at lower altitudes would eventually be mixed within the troposphere over a yearlong period, as evidenced by the penetration of long-lived halocarbons to the stratosphere.

With these assumptions, a 500 tpy chaff release would result in an annual average concentration of PM_{10} or $PM_{2.5}$ over the continental United States (area 3,539,341 mi^2) of .01 $\mu g\ m^{-3}$. If one-tenth of these emissions were dispersed over the state of Nevada (area 109,895 mi^2), the annual average concentration would be 0.032 $\mu g\ m^{-3}$. For NAS Fallon, a 5 tpy release over 10,000 mi^2 would result in an annual average concentration of 0.036 $\mu g\ m^{-3}$. For Patuxent River NAS, a 0.12 tpy release over 2400 mi^2 would yield an annual average concentration of 0.0061 $\mu g\ m^{-3}$.

The same upper limit concentration estimates would apply if all chaff were released and mixed through the specified volume in a day or even within an hour, since no deposition losses are assumed. In reality there are higher concentrations just after release before the chaff plume disperses in the atmosphere. If operations are confined to the designated test areas, however, off-site concentrations should not exceed these upper limits. These are far below the annual average NAAQS of 50 $\mu g\ m^{-3}$ for PM_{10} and 15 $\mu g\ m^{-3}$ for $PM_{2.5}$ that have been set to protect public health.

These levels are compared with spatial distributions of background PM_{10} and $PM_{2.5}$ concentrations in Figures 9 and 10 (courtesy J. Sisler, National Parks Service, Ft. Collins, CO). These isopleths include data from monitors in populated areas at Lake Tahoe, CA and Washington, D.C. that do not represent background levels, but most of the monitors are distant from nearby emitters.

Within the continental United States, annual average background PM_{10} concentrations range from a minimum of 6.4 $\mu g\ m^{-3}$ in northern California and western Nevada to 20 $\mu g\ m^{-3}$ along the eastern seaboard. For $PM_{2.5}$, concentrations are lowest at 2.9 to 3.3 $\mu g\ m^{-3}$, in the inland west, including Nevada, Utah, Wyoming, northern Arizona, and western Colorado.

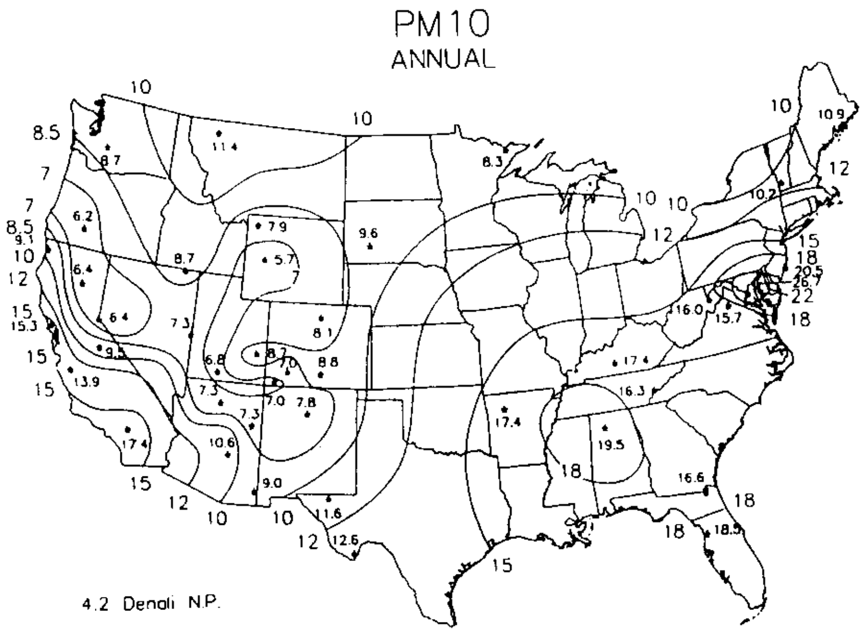

Figure 9. Annual average PM_{10} concentrations ($\mu g\ m^{-3}$) from 1988-95 at IMPROVE regional background sites in the continental United States (James Sisler, National Parks Service).

The $PM_{2.5}$ fraction is chemically characterized in the IMPROVE network and soil-related elements are used to estimate the geological contribution to $PM_{2.5}$. Chaff would be perceived by this network as part of this fraction. Figure 11 shows that these soil levels range from 0.2 $\mu g\ m^{-3}$ near the west coast to 1.0 $\mu g\ m^{-3}$ near the east coast. Soil concentrations in the inland western states are ~0.5 $\mu g\ m^{-3}$. These background levels are more than ten times the highest levels that chaff might contribute with extremely conservative assumptions about particle size and deposition rates.

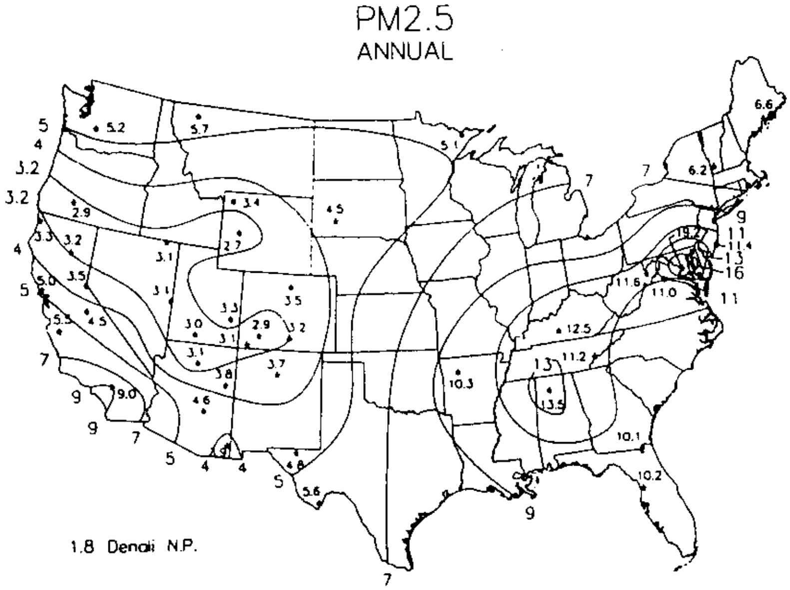

Figure 10. Annual average $PM_{2.5}$ concentrations ($\mu g\ m^{-3}$) from 1988-95 at IMPROVE regional background sites in the continental United States (James Sisler, National Parks Service).

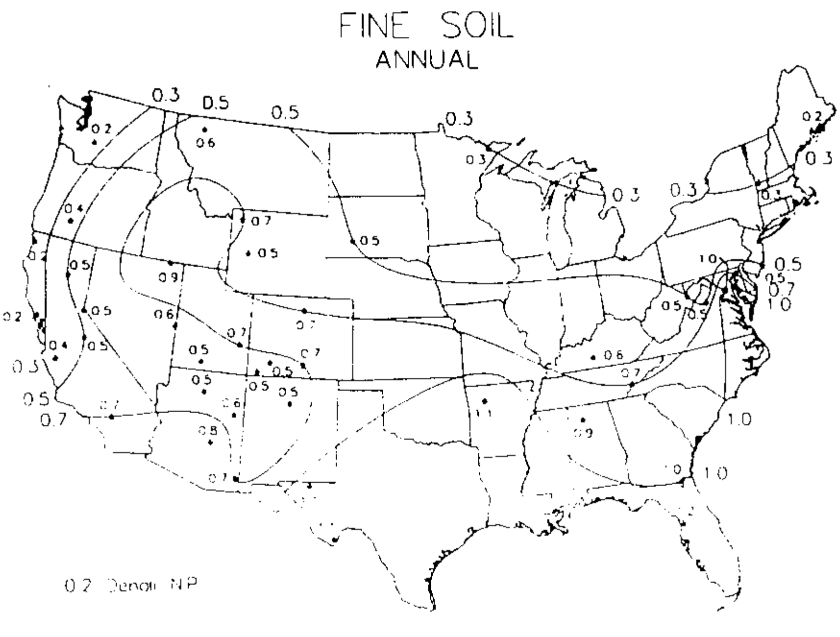

Figure 11. Annual average geological contributions ($\mu g\ m^{-3}$) to $PM_{2.5}$ from 1988-95 at IMPROVE regional background sites in the continental United States (James Sisler, National Parks Service).

Effects of Chaff on Humans

The size of chaff dipoles is too large to be easily inhaled by humans. Figure 12 (Phalen et al., 1991; ACGIH, 1993; Heyder et al., 1986; Swift and Proctor, 1982) shows the fraction of particles with different sizes that deposit in different parts of the human body when particle-laden air is breathed. The aerodynamic diameter of a chaff dipole cross section (~40 µm) is also shown. Most particles larger than 10 µm are removed in the mouth or nose prior to entering the body. Ten to 60% of the particles passing the trachea with aerodynamic diameters less than 10 µm may deposit in the lung where they might cause harm. The lung deposition curve is bimodal, peaking at 20% for ~3 µm particles and at 60% for ~0.03 µm particles. These curves show that the amount of particles larger than 2 or 3 µm transmitted through mouth-breathing is significantly larger than the amount transmitted when breathing takes place through the nose.

Extreme abrasion would be needed to reduce chaff to these size ranges. The most probable breakup of a dipole would be perpendicular to its length, with remaining particles having a diameter similar to the dipole radius, with an aerodynamic diameter of ~40 µm. Figure 12 shows that only a very small number of these particles pass through the upper respiratory system into the lung.

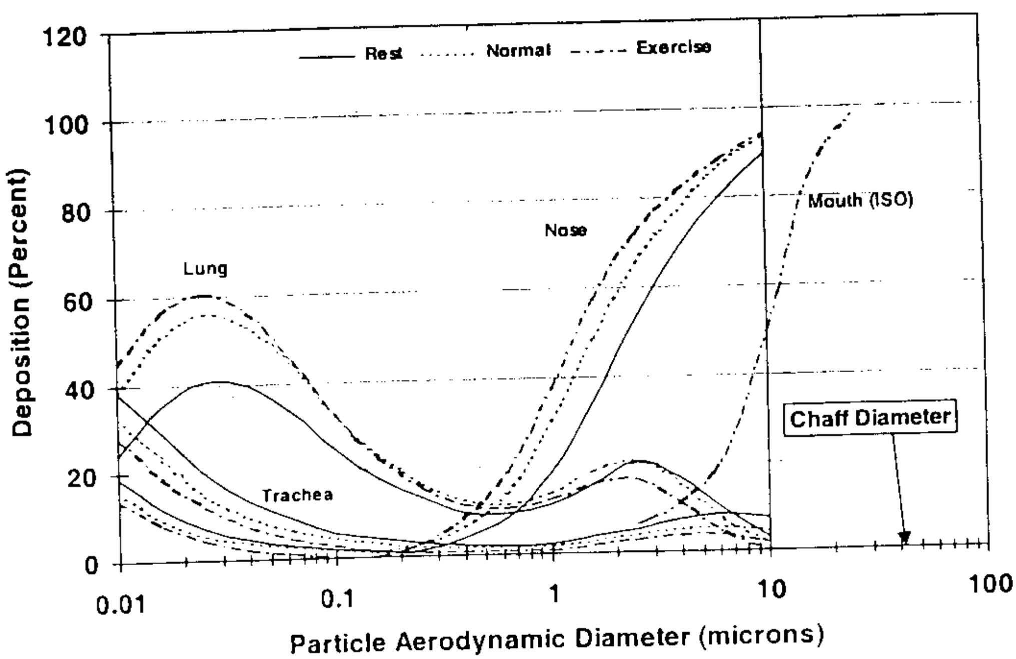

Figure 12. Human deposition of particles in the mouth, nose, trachea. Deposition varies with breathing rate, as indicated by curves measured at rest, normal, and exercise breathing rates.

A relevant analogy is that of the Bedouins of the Sahara desert, who live in a sea of sand, which is composed of silica (silicon dioxide). Silica is a common, well-known cause of nodular fibrosis of the lungs. However, the Bedouins do not get silicosis (nodular fibrosis of the lungs due to silica) because the sand particles are not of a respirable size. They are too large to inhale into the alveolated portion of the lungs and produce disease.

Human lungs at autopsy contain a mixture of respired dusts, some of which are capable of producing disease. These include carbon (anthracotic pigment), silica, silicates, iron, and asbestos. In most cases however, no disease attributable to these dusts is seen, because their concentrations are too low. Even if abraded chaff particles reached the depths of the human lung, the fraction would be small compared to inhaled dust from other sources any disease would not likely result. Since fibrous glass and aluminum oxide in chaff are relatively nontoxic, disease would be unlikely. A much more toxic substance such as asbestos can produce serious lung disease, but even asbestos has a threshold level, below which no disease is produced.

Airborne chaff fibers have not been epidemiologically associated with human disease. Nonetheless, concern for possible ill effects on humans has been voiced by the public and echoed in newspapers (Mullen, 1998; Ropp, 1999) from areas near chaff dispersal.
Though no human data on chaff toxicity exist, its possible toxicity can be assessed with studies on fibrous glass and aluminum. The National Institute for Occupational Safety and Health (NIOSH) published a recommended standard for occupational exposure to fibrous glass, including a review of previous studies on fibrous glass and health risks (US Department of Health, Education and Welfare, 1977). These studies investigated the health of those primarily involved in the manufacture of fibrous glass products. Effects on skin and mucous membranes and respiratory effects were reviewed, including epidemiological studies. Smaller lengths of glass fibers were irritating to the skin, but sensitization, an immune response, did not occur. Similar mechanical irritation could also occur with exposure to the eye or nasal or oral mucous membranes. These problems were self-limited and avoidable.

A few individuals had lung disease due to aspiration of plugs or masses of glass fibers, but in several case series, no chronic disease was detected. Most studies are epidemiological, and often the degree to which the subjects being studied smoked was not investigated. Two diseases would be primarily in such studies: fibrosis (scarring) of the lungs, an irreversible disabling chronic disease, and primary cancer of the lung proper (carcinoma) or the pleura (malignant mesothelioma). The majority of these studies showed no significant differences between glass workers and non-exposed controls, and no difference between mildly and severely exposed glass workers.

In one study, an excess of cases of glass workers dying of "nonmalignant respiratory disease" was noted (Bayliss et al., 1976). The precise nature of the diseases was not stated, and exposure to other dusts in other occupations was not excluded, nor was the role of cigarette use. A more recent publication states that fibrous glass is not associated with an excess of death from nonmalignant lung disease (Ameille et al., 1998). The workers in the above study (Bayliss et al., 1976) were exposed to 80,000 glass fibers m^{-3} of air; fibers had a median diameter of 1.8 µm and length of 28 µm. Thus, these fibers are much smaller than chaff and were more likely to have been inhaled. The atmospheric concentration of the fibers also was very much higher than any concentration, which could be achieved in open air.

Enterline et al. (1983) and McDonald et al. (1990) studied workers in 17 plants that had produced most of the fibrous glass and mineral wool from 1940-1952. The authors concluded that: "Respiratory cancer deaths were not excessive for the fibrous glass workers..." and "This study provided no consistent evidence of a respiratory disease hazard related to exposure to man-made fibers among the workers who produce these fibers." There was again an excess of nonmalignant respiratory disease deaths, but the increase was not related to amount of exposure to glass.

Weill et al. (1983) studied workers in seven plants that produced man-made vitreous fibers (MMVF), which includes fibrous glass. No abnormalities in lung function were found in the workers, and chest film showed only very mild abnormalities in a minority. The authors concluded: "In general, however, the minimal evidence of respiratory effects detected in this investigation, which cannot, at present, be considered clinically significant, is encouraging concerning the question of potential health effects of exposure to MMVF." A review of MMVF in 1998 came to a similar conclusion: "At the present time there is no evidence of a pneumoconiosis risk in workers exposed in either glass, rock or slag wool production plants. This is probably due to the low respirability and low persistence of these fibers when compared to asbestos"(Ameille, 1998). No increased risk for cancer was found as well.

A study of autopsy lung tissue from 112 workers employed in plants where MMVF's, including fibrous glass, were manufactured was carried out to search for the burden of these fibers (Weill, 1983). Nearly three-fourths of the lung samples contained no MMVF's. The remaining 26% contained MMVF's in very low levels. The fibers appeared to be partially degraded. Fiber concentrations did not correlate with years of occupational exposure. Thus, glass fibers do not appear to accumulate in the lungs of those most heavily exposed to such fibers.

The above studies were in humans exposed to glass fibers of respirable size over long periods of time at concentrations far exceeding those possible in the open air. Still, the effects of this intense exposure were trivial; in most comparisons of glass workers with non-exposed controls, there were no significant differences. No excess cases of cancer or lung fibrosis were detected (Gibbs, 1998). A Committee on Environmental Health of the American Collage of Chest Physicians put it this way: "Fiberglass inhalation seems to produce a minimal tissue response in the lungs...There is no evidence to indicate that inhaling fiber glass is associated with either permanent respiratory impairment or carcinogenesis...."(Gross, 1976).

Aluminum is a very common metal in the earth's crust and thus is a part of the natural soil layer. This light, durable metal has many uses and manufacturing involving aluminum is widespread. It is estimated that nearly two million people in the United States are exposed to aluminum as part of their occupation (Nemery, 1998). However, lung disease due to aluminum is a controversial topic. Some say aluminum does not cause any lung disease (fibrosis), while others claim to have seen rare examples of lung disease due to aluminum. All agree that "parenchymal lung disease...appears to be very uncommon." (Nemery, 1998). The few cases reported appear to have been heavy exposures to respirable-sized particles during manufacturing, an exposure that should not have occurred. Other cases of disease may involve exposure to silica as well, as well as other chemical bound to the aluminum. Thus the aluminum itself may not be at fault.

Various authors conclude that aluminum exposure is not associated with an increased risk of cancer. Rarely, it may cause pulmonary fibrosis if large numbers of respirable particles are inhaled (Nemery, 1998; Chip et al., 1998). Considering the large number of workers exposed to aluminum, the likelihood of harmful exposure appears extremely small. Exposure in the open air, as from chaff, would not result in disease because the concentration of aluminum/glass particles is so low and the particles are too large to be respirable.

As discussed in other sections, nearly all chaff fibers are too large a size to be respirable. The tiny number of fibers that could be inhaled because they are of respirable size or have degraded to such a size are insufficient to produce disease. Persons occupationally, that is, heavily exposed to the components of chaff fibers are at no increased risk for lung fibrosis or cancer. The components of chaff, that is, glass and aluminum, do not have any proven fibrogenic or carcinogenic potential. This is very different from certain types of asbestos fibers, which are both fibrogenic and carcinogenic. In summary, available human data on chaff and its components fail to show an increased incidence of lung disease.

Effect of Chaff on Domestic Livestock

Nutritional effects due to chaff ingestion. Given the chemical composition of chaff and the limited potential for exposure of grazing animals to chaff fibers, it is highly unlikely that any harmful effects are to be expected due to chaff ingestion by livestock. Chemically, chaff fibers are very similar in composition to predominant minerals in the earth's crust, Al_2O_3 and SiO_2.

Although the aluminum in chaff exists as relatively inert metallic aluminum coated on the glass fibers, it could be postulated that after ingestion some of the aluminum could be leached during passage through the gut. While there is no information in the literature to document toxic effects due to metallic aluminum ingestion (Sorenson et al., 1974), conditions do exist in the gut that (theoretically at least) could give rise to some aluminum solublization. Salts of aluminum can interfere with animal nutrition. As Al^{+3}, aluminum can interfere with phosphorus absorption and cause secondary phosphorus deficiency in both ruminants and non-ruminants (NRC, 1980). The primary factors that affect the severity of aluminum toxicity are the amount of aluminum, the solubility of the aluminum, and the level of phosphorus in the diet. Bailey (1977) and Valdivia et al. (1978) found no adverse effects of feeding soluble salts of aluminum to calves at rates of up to 1200 mg kg^{-1} aluminum in the diet. Similar investigations with sheep showed no adverse effects up to 1215 mg kg^{-1} aluminum. Based on these studies, the National Research Council (NRC) recommends that the maximum tolerable level of soluble aluminum (Al^{+3}) for cattle and sheep is approximately 1000 mg kg^{-1} in the diet. Research on the effects of aluminum on non-ruminant animals has been confined mainly to turkeys and chicks (Cakir et al. 1978; Storer and Nelson, 1968). The NRC recommendation is that dietary aluminum from soluble salts for non-ruminants should be limited to approximately 200 mg kg^{-1}. It also should be noted, however, that although the NRC recommendations limit Al ingestion at the high end, there is some evidence that feeding limited amounts of Al salts can actually improve animal performance (Dishington, 1975; McManus and Bigham, 1978).

The degree to which any given amount of aluminum metal leaches from chaff in the gut will be determined by two factors: the ambient pH, and the residence time of the chaff particle. In general, conversion of aluminum metal to Al^{+3} requires a pH of 5.0 or lower. Rumen pH rarely drops below 5.4 and is normally closer to 6.0, depending on the nature of the diet. Again, depending on diet, the mean residence time for a particle in the rumen is about 24 hours. The pH of the abomasum drops to 4.5 and the remainder of the hindgut is somewhat lower. Rate of passage at this stage is variable but usually rapid, ranging from several minutes to several hours (G. Varga, personal communication). Because of the fine fibrous nature of chaff, it is possible that some of the material could collect over time and form "hairballs" in the rumen that could remain for a considerable period of time. Indeed, actual hairballs have been found in cows during post-mortem examination of rumen contents. It is also possible that chaff fibers could collect in the villi of the omasum, which is a filtering organ between the rumen and abomasum. Like the rumen, however, the omasum is usually well-buffered and non-acidic. It is also relatively dry. Thus it is unlikely that any significant amount of aluminum in ingested chaff would be exposed to internal conditions long enough to render it toxic to the animal.

Nevertheless, a "worst possible case" can be calculated, based on estimated daily dry matter intake and potential for chaff ingestion by cows in the NAS Fallon area. Beef cattle consume somewhere around 2% of their body weight daily as plant dry matter. For a typical 550 kg beef cow, the daily feed intake would be approximately 11 kg dry matter. If all the aluminum in ingested chaff were became the soluble (Al^{+3}) form, 11 g of Al^{+3} (11,000 mg Al^{+3} per 11 kg feed) would need to be nutritionally available daily to reach the 1000 mg kg^{-1} dietary threshold for toxicity determined by the NRC. This is highly unlikely given that the conversion of Al to Al^{+3} is very slow in the dry, non-oxidizing environment in Nevada and the annual loading rate for chaff (at least for NAS Fallon). Mass balance calculations (See "Chaff Distribution", above) showed that ≤ 20 g ha^{-1} are deposited per year over the test site. The highest expected stocking density for livestock on good rangeland is one animal unit (cow or cow-calf pair) per 2 ha. Thus, one animal unit would have access to 40 g chaff annually, of which only 16 g (40%) would be aluminum metal.

Finally, when all of this information is put in proper perspective, it is clear how minuscule a threat chaff presents to livestock, at least nutritionally. Coming back to the soil, aluminum in soil can range from 4 to 30% of the dry matter (Allen, 1984), and is present in various forms, including silicate clays, hydrated oxides, phosphates, and in ionic form. Grazing animals are known to consume considerable amounts of soil, with soil intakes inversely related to the amount of available plant material. Soil intakes as high as 400 g day^{-1} have been observed for grazing ewes (Healy, 1967), and 1.3 kg day^{-1} for cattle (Mayland et al., 1973) with no negative effects. Clearly, the contribution of chaff aluminum to the large mass of native aluminum potentially ingested is very small indeed and poses no conceivable threat to livestock.

Physical effects due to chaff ingestion. Because of its fibrous glass composition, chaff does have the potential to cause physical harm to gut mucosa if ingested. Unfortunately very little research has examined this potential. One unpublished study, a report to the Director of

Canadian Electronic Warfare[11] fed aluminum coated fiberglass chaff to beef calves (approximately 180 kg live weight) at up to 7 g day^{-1}. It is instructive that a preliminary investigation found that the animals rejected the chaff outright, and that the material had to be evenly scattered over the grain ration and thoroughly mixed with molasses before the calves would eat it. The feeding treatments were applied for up to 39 consecutive days, during which time no differences were shown between chaff-fed and control animals in terms of weight gain or blood chemistry. Post-mortem examination, including a detailed histological examination of sections of the entire gut showed no lesions. Small chaff fragments found trapped in between the villi of the reticulum did not appear to have provoked any cellular reaction. Based on these results, MacKay[12] concluded that long-term tests for chronic toxicity were unwarranted. In another unpublished study at the Pennsylvania State University (R. Adams, personal communication), 1.8 kg of chaff was fed daily to dairy calves. "No adverse effects were found in the several animals receiving such over an appreciable period of feeding." Both of these sources of information indicate that ingested chaff poses no threat to animal health.

Inhalation hazards to livestock. Most of the research addressing inhalation hazards of glass fibers has been conducted either on humans or laboratory animals (CDC, 1977; Lee et al. 1979). Results of this work (reported in a section above entitled, "Chaff and Other Atmospheric Particulates") should apply to domestic livestock as well. Suffice it to say that because of their size (15-25 μm diameter) the primary fibers are not considered to be capable of being inhaled. After they deposit on the ground, however, they can be fragmented to smaller sizes through abrasion and erosion. The degree to which this occurs is unknown, and warrants an experimental approach as suggested in the section below entitled, "Remaining Questions and Experimental Approaches."

Chaff and Its Effects on Marine and Freshwater Ecosystems.

There are three possible ways chaff could affect aquatic systems: 1) by the addition of aluminum and glass to these systems, and/or; 2) by the particles themselves on the ecology of aquatic organisms, and/or; 3) by transmission through the food chain, such as to ducks that feed on aquatic organisms.

As has been pointed out in previous sections, Al_2O_3 and SiO_2 are the most common minerals in the earth's crust. Since ocean waters are in constant exposure to crustal materials, there is little reason to believe that the addition of small amounts of chaff will have any effect on either water or sediment composition.

We can consider estimates of amounts of glass and aluminum added to the ocean by human activities in forms other than chaff. As an example, Clean Ocean Action gives data for beverage cans and glass bottles picked up on New Jersey beaches in 1994. About 5 kg km^{-1} of bottles and 450 g km^{-1} of beverage cans (assumed to be aluminum) were collected. The total beach shore of New Jersey is about 200 km in the counties that participated in the cleanup. If we assume the debris came from the shore to 1 km offshore we would have about 0.45 g ha^{-1} yr^{-1} of aluminum

[11] The Ingestion of Fiberglass Chaff by Cattle, Canada Department of Agriculture for the Director of Electronic Warfare, Canadian Forces Headquarters, 1972.

[12] *ibid.*

from beverage cans. This is of the same order of magnitude as the estimated chaff deposition over the Chesapeake Bay. Of course, there are other sources of aluminum metal in both fresh and ocean waters.

Studies of the effects of water exposed to 1000 mg L^{-1} chaff on freshwater water fleas (*Daphnia magna*) showed no effect, although the animals were not exposed directly to the fibers[13]. In another series of tests, Chesapeake Bay animals were exposed directly to the chaff fibers. Blue crabs, menhaden and killifish were force fed whole and broken fibers for several weeks at concentrations up to 1000 times that to which they would be exposed in the Bay. No effects were observed. There was no significant effect at 10 times the environmental exposure (the most concentrated level used) in one-day-old oyster larvae. Nor were there significant effects at 100 times the environmental exposure in 10-day-old oyster larvae; at 1000 times the environmental exposure, there was a small effect on larval size. Polychaetes were tested at 10 times the environmental exposure with no effect, although some of the worms used the chaff in their burrows. In summary, these experiments indicate that aquatic organisms exposed to chaff levels that occur in Chesapeake Bay do not show any effects from the chaff[14].

When considering the possible effects of chaff particles themselves on aquatic systems, we can ask whether or not there are natural particles of a similar nature to which these systems and their inhabitants are already adapted. The siliceous spicules of some sponges are similar to chaff.

The most abundant shallow water sponges in the oceans are in the subclass *Monaxonida* of the *Demospongiae* (Hyman, 1940). All of these sponges have siliceous spicules, composed of opal glass. All freshwater sponges also contain siliceous spicules. Freshwater sponges are common in clean ponds, lakes, streams, and rivers. They occur throughout North America. Barton and Addis (1997) described them in six drainage basins in western Montana. Sponge spicules come in different shapes but many are simple, straight, needle-like objects, made of SiO_2, often with sharp pointed ends. Some representative spicule sizes from the marine sponges of British Columbia are from 1-30 μm in diameter and from 40-8500 μm long (Smecher, 1999). Chaff fibers are about 25 μm in diameter up to centimeters long. Sponge spicules are therefore about the same diameter as chaff whether it be whole or split longitudinally (if that happens). Unbroken chaff fibers are much longer than spicules, but it is highly likely that interactions between chaff and animals will occur with fibers that have been broken and therefore more like spicules.

Sponge spicules are present in sediments from both geological and recent times in freshwater and marine sediments (Cohen and Davies 1989, Harrison et al., 1979). Freshwater sponges are abundant in Okefenokee Swamp in southern Georgia, a wilderness area over which chaff is dispersed during air training. Some samples of peat from Okefenokee swamp contain up to 3% siliceous spicules from freshwater sponges (Cohen 1973). In Florida lake sediments, sponge silica averaged 31.5 mg g^{-1} (Conley and Schelske, 1993). To put this in context, 30 mg g^{-1} would be about 6 mg g^{-1} of wet sediment assuming 80% water content. The chaff deposition at

[13] Aquatic Toxicity and Fate of Iron and Aluminum Coated Glass Fibers, Haley, M.V. and Kurnas, C.W., US Army Chemical Research, Development, and Engineering Center, ERDEC-TR-422, 1992.
[14] Effects of Aluminized Fiberglass on Representative Chesapeake Bay Marine Organisms, Systems Consultants, Inc under contract to the US Naval Research Laboratory, 1977.

Patuxent River NAS was a little over 0.2 g ha^{-1} yr^{-1}. If we assume sediment deposition on the average keeps up with sea level rise of about 2 mm yr^{-1} and sediment density is about 1, the chaff concentration at Patuxent River NAS over the long term would be 10 ug g^{-1}, over three order of magnitude lower than the sponge silica in Florida lake sediments.

Aquatic animals contact spicules in the ordinary course of their lives. There is also evidence that animals that feed on sponges ingest the spicules without damage. Freshwater sponges are the most important invertebrate food for juvenile ring-neck ducks (Mcauley and Longcore 1988). Crayfish feed on them (Williamson 1979) and a Brazilian fish eats them so regularly that it is used as a collecting mechanism by sponge experts (Volkmer-Ribeiro and Grosser, 1981). In the sea, sponges are eaten and their spicules found in sea urchins (Birenheide et al., 1992), euphausid shrimp (Ritz et al. 1990), clams (Osorio et al., 1987), larval king crabs (Feder at al., 1980), and hawksbill turtles (Ernst et al., 1994). It is clear from these examples that aquatic organisms get along with sponge spicules. They do not eat sponges to get the spicules, but they ingest the spicules in the course of eating the sponges. They handle the spicules without harm. Since chaff fibers are of similar composition and size once the aluminum chips off and the fibers break up, aquatic organisms should have no difficulty dealing with those they may encounter.

While sponge spicules provide a reasonable analog to the RF chaff, they are extremely rare compared to diatoms, the frustrules (cell covers) of which are composed of silica. Diatoms are an important component of both marine and freshwater food webs and are routinely ingested by many types of zooplankton and fish larvae. The bulk of the silica passes through the digestive system and is packaged into fecal pellets. Silicoflagellates and radiolaria are other groups of aquatic organisms that incorporate silica into their structures. It should also be noted that silicon dioxide is soluble in water, the actual solubility is dependent on the specific form.

Open Questions and Degradable Chaff

Open Questions. A number of open questions were identified in the GAO report with respect to the environmental effects of RF chaff. Those questions were:

- long-term and chronic exposure to inhaled chaff fibers;
- resuspension rates of coated and uncoated chaff fibers;
- weathering rates and chemical fate of metal coatings in soil, fresh and marine waters;
- review of threshold metal toxicity values in humans, animals, and fresh and marine organisms;
- evaluation of potential impacts of fibers;
- respirability of fibrous particles in avian species;
- aquatic and marine studies to establish the impact of fibers;
- pathology of inhaled fibers;
- chaff accumulation on water bodies and its affect on animals;
- bioassay tests to assess toxicity of chaff to aquatic organisms, and;
- the potential for impacts on highly sensitive aquatic habitats.

In light of the analysis described in the body of this report and the scientific studies to date, the panel concludes that only two significant questions remain regarding the environmental effects of the current RF chaff used in training and should be considered for further study. Specifically, the resuspension rates of chaff fibers and their physical fate (considered above as weathering rates) should be addressed. Guidance as to the scientific questions that should be asked in such studies and suggested experimental approaches are provided in the Panel Recommendations section below.

The current data and "upper bounds" estimates significantly reduce the uncertainty of environmental effect to the remaining open questions identified by the GAO. While some of those questions may be important in scientific pursuit, there is just not enough evidence to suggest, given the current use of chaff, that these questions will yield significant results or further our understanding of environmental effects in general.

Degradable Chaff. The DOD is currently developing degradable chaff, which is driven by both environmental and operational needs. There is not a strong sense by the panel that a well - planned programmatic approach to addressing non-engineering issues has been developed. Two studies are known that address ecotoxicity of degradable chaff. But a cohesive program to address environmental concerns, such as those that resulted in a request for a GAO investigation of standard chaff (RF chaff used to date), has not been identified. This leads the panel to conclude that as degradable chaff moves from the R&D stages to use in training that the research addressing environmental issues will be spotty and result only in response to pressure placed on the DOD. The panel recommends that a small to modest program with a scientific program manger be established. The program manager, in consultation with a scientific advisory group, should develop a cohesive realistic set of projects to address real environmental issues that will result with the use of degradable chaff.

Panel Findings

- *Chaff emissions.* Although chaff particles are much larger than the PM_{10} and $PM_{2.5}$ particle emissions estimated by EPA, total U.S. emissions are orders of magnitude less than those from suspended dust, vehicle exhaust, power generation, and industrial processes. This is true for the United States as a whole and for counties surrounding test areas where chaff is released.

- *Chaff concentrations.* Under worst case conditions that assume no deposition and complete breakup to respirable PM_{10} and $PM_{2.5}$, chaff releases will not provide more than a 0.05 $\mu g\ m^{-3}$ over current ambient concentrations. This is less than one-hundredth of the particle levels set by U.S. EPA to protect public health. It is less than one-tenth of the $PM_{2.5}$ geological concentrations found at U.S. background monitoring sites.

- *Possible nutritional effects due to chaff ingestion*: Risk is minimal to nil for both humans and livestock, considering the chemical composition of chaff (essentially identical to soil) and low chaff loading to the environment.

- *Possible physical effects due to chaff ingestion:* Ingestion of glass fibers conceivably could induce lesions and other harmful responses in either humans or livestock. The limited studies conducted on ruminants, however, have shown no harmful effects in feeding trials lasting several weeks. A definitive answer to the question of long-term exposure would require further research.

- *Possible inhalation hazards to livestock:* Primary chaff fibers are too large to be inhaled by livestock. Secondary fibers, resulting from the break-up in the environment to smaller fibers, possibly could be small enough to be inhaled. To be a significant inhalation hazard these secondary fibers must be resuspended in the air and transported in sufficient quantities to a location where they can be inhaled. As above, a definitive answer will require further research.

- Aquatic animals are exposed to siliceous sponge spicules at sizes similar to chaff often at much higher concentrations than chaff and have been through geological time without damage.

Panel Recommendations

- The panel recommends that the DOD address the following questions related to the resuspension and fate of chaff (guidance is provided in the following section):

    1. What fraction of emitted chaff breaks up in atmospheric turbulence into inhalable particles?
    2. How much chaff is abraded and resuspended after it is deposited on a surface?
    3. What are the shapes of chaff particles after abrasion?
    4. What is the empirical terminal deposition velocity of chaff?
    5. What is the spatial distribution of chaff clouds under different release and meteorological conditions?
    6. How do chaff emissions and expected concentrations compare to emissions and concentrations from other particle emitters over the time periods and areas where chaff is released?
    7. What quantities of inhalable chaff are found in communities near training facilities where chaff is released?

- Further, the panel recommends an organized program addressing the environmental effects of degradable chaff

Remaining Questions and Experimental Approaches

After examining the available information, the following questions remain to be answered by experiment. The experiments described can be conducted for the different types of chaff used in the U.S. using existing expertise and facilities.

What fraction of emitted chaff breaks up in atmospheric turbulence into inhalable particles?
Simulate worst-case chaff breakup in the laboratory by placing a known quantity of chaff into a fluidized bed and agitating it for 24-hours (or longer) while sampling the atmosphere above the bed through PM_{10} and $PM_{2.5}$ inlets onto filters. The fluidized bed agitation and the accompanying abrasion of adjacent fibers should exceed expected turbulent movements found in the atmosphere. Weigh the filters to estimate the quantities of PM_{10} and $PM_{2.5}$ produced per unit weight of chaff. Weight the chaff before and after agitation to determine the total amount lost to the atmosphere. Sieve the chaff before and after agitation to determine changes in large particle size distribution (presumably none of the long fibers will penetrate the >100 mesh sieves, but broken up portions of fibers will penetrate).

How much chaff is abraded and resuspended after it is deposited on a surface?
Simulate chaff suspension in a laboratory wind tunnel by depositing a thin layer on soil surfaces similar to those over which chaff is released. Worst-case abrasion could be simulated by using a loose surface with maximum abrasion potential. Chaff would be evenly mixed within this reservoir to maximize abrasion by the loose soil particles. Sample onto Nucleopore filters that can be examined microscopically to determine the quantity of chaff in different size ranges.

What are the shapes of chaff particles after abrasion?
Obtain samples on Nucleopore filters and examine them under an electron microscope. Determine the fraction of abraded particles that are amorphous and those that form respirable fibers. Apply x-ray analysis to individual particles to determine the extent to which the aluminum coating separates from the glass fibers.

What is the empirical terminal deposition velocity of chaff?
Release a known quantity of chaff from atop a fall tower onto a continuously recording microbalance. Determine the equivalent velocity for 10%, 50%, and 90% of the falling fibers to reach the surface. Infer the orientation of chaff falling in still air from this distribution. Cataido et al. (1992) used the theoretical approach of Liu et al. (1993) to determine an equivalent Stokes diameter that is the basis for estimating terminal velocities. This theory is based on the prolate spheroid model of Fuchs (1964). While Liu et al. (1993) experimentally showed that this aerodynamic diameter could be used to estimate PM_{10} inlet properties, they did not address gravitational deposition of large chaff particles. The degree to which the oblate spheroid model represents actual deposition of these dipoles is unknown.

What is the spatial distribution of chaff clouds under different release and meteorological conditions?
Record NEXRAD images of chaff releases in areas where test ranges are in the proximity of sensors. Analyze these images for duration and intensity of chaff distributions after release. Map zones of influence and superimpose these on population density and land use maps.

Determine the extent to which flight operations can be coordinated with meteorological conditions to minimize the impact of chaff deposition on sensitive areas.

How do chaff emissions and expected concentrations compare to emissions and concentrations from other particle emitters over the time periods and areas where chaff is released?
Repeat emissions comparisons and worst-case concentration calculations for specific counties over which chaff is expected to have an influence. Use more specific information about quantities released at different altitudes within and around county boundaries, fractions abraded to PM_{10} or $PM_{2.5}$, size and spatial extent of the chaff cloud, and other emissions within affected counties.

What quantities of inhalable chaff are found in communities near training facilities where chaff is released?
Acquire samples of particles on filter media over long time periods and examine them chemically and microscopically for the quantity of intact and abraded chaff. Daily and weekly average samples are taken throughout an entire year in representative communities. Radar and wind measurements are examined to determine when nearby communities are most likely receive chaff particles. These samples are submitted to appropriate analyses to determine the relative contributions from chaff and other PM_{10} and $PM_{2.5}$ sources. Properties to be sought are determined from the same analysis applied to chaff that has been subjected to abrasion.

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Abbreviations

AFB, Air Force Base

ASN (I&E), Assistant Secretary of the Navy for Installations and Environment

BLM, Bureau of Land Management

CONUS, Continental United States

DOD, Department of Defense

FWS, Fish and Wildlife Service

GAO, General Accounting Office

MMVF, man-made vitreous fibers

MOA, Military Operating Area

MPA, Metropolitan Planning Area

NAAQS, National Ambient Air Quality Standards

NAS, Naval Air Station

NEXRAD, Next Generation Weather Radar

NRC, National Research Council

NWS, National Weather Service

$PM_{2.5}$, Particulate Matter less than 2.5 microns

PM_{10}, Particulate Matter less than 10 microns

R&D, Research and Development

RF, Radio Frequency

TSP, Total Suspended Particles

USAF, United States Air Force

US EPA, Environmental Protection Agency

Units of Measure

cm, centimeter

ft. agl, feet above ground level

ft, feet

g, gram

ha, hectare

hr, hour

kg, kilogram

m, meter

mg, milligram

mi, mile

min, minute

s, second

std dev, standard deviation

tpy, tons per year

um, micrometer

ug, microgram

yr, year

Appendices

A. Panel Member Profiles

B. Environmental Protection: DOD Management Issues Related to Chaff, GAO Report, GAO/NSAID-98-219, September 1998

C. Bibliography. Chaff Environmental R&D

Appendix A

Biographical Sketch: Panel Members

Steven L. Fales
Professor of Agronomy
Pennsylvania State University

Dr. Steven Fales is a Professor and Department Head of Agronomy in the College of Agricultural Sciences, Penn State University. Dr Fales is also the Director of the Grazing Research and Education Center, which focuses on environmental sustainability and profitability of animal agriculture through better use of grassland resources. Dr. Fales' research focuses on crop management, forage crop quality, physiology, and utilization; plant-plant and plant-animal interactions in pastoral environments; pasture management; ecology of intensive grazing systems. He is a member or officer of a number of research councils. Dr Fales is the author or co-author of over 30 refereed journal articles, several book chapters, and numerous bulletins and other publications.

Harold F. Hemond
Professor, Civil and Environmental Engineering
Massachusetts Institute of Technology

Dr. Harold Hemond is William E. Leonhard Professor of Civil and Environmental Engineering and Director of the R.M. Parsons Laboratory at the Massachusetts Institute of Technology. Dr Hemond's research focuses on biogeochemistry, groundwater quality; and environmental instrumentation. Currently, he and his colleagues are studying major reservoirs and human exposure pathways of chemical contamination on the Aberjona Watershed. They have developed techniques for in-situ measurement of the disappearance rates of environmental contaminants in streams, and have characterized specific microorganisms within a microbial community involved in biodegradation in order to determine the predominant organisms either directly involved or indirectly involved in degrading toluene, a model environmental contaminant. Much ongoing work focuses on the transport of arsenic in the waters of the Aberjona, sediment processes that govern mobility of arsenic, and plant uptake processes of this toxic metal. Prof. Hemond is an author of *Chemical Fate and Transport in the Environment*, a widely used university textbook.

Theodore L. Hullar
Director, Cornell Center for the Environment
Cornell University

Dr. Ted Hullar is the Director of Cornell's Center for the Environment at Cornell University. Dr. Hullar is the former Chancellor of the University of California at Riverside and at Davis and is a Professor Emeritus in the Environmental Toxicology Department at UC Davis. As Director of the Center for the Environment, he is responsible for establishing major grants, one or more new undergraduate environmental degrees at Cornell, and new program initiatives such as for watersheds, environmental informatics, and integrated natural and social science programs. Other objectives include assisting and providing leadership for development of a new public policy and public affairs program, multi-college programs for environment, and new forms of state- and federal-Cornell relationships.

Petros Koutrakis
Professor, Environmental Sciences
Harvard University

Dr. Petros Koutarkis is a professor in the Environmental Sciences Department, School of Public Health, Harvard University. Dr. Koutrakis' research activities focus on the development of human exposure measurement techniques and the investigation of sources, transport, and the fate of air pollutants. In collaboration with his colleagues in the Environmental Chemistry Laboratory, he has developed an ambient particle concentrator that can be used to conduct human and animal inhalation studies. He has also developed a personal ozone monitor, a continuous fine particle measurement technique and several other sampling methods for a variety of gaseous and particulate air pollutants. These novel techniques have been used extensively by air pollution scientists and human exposure assessors in United States and worldwide. Dr. Koutrakis has conducted a number of comprehensive air pollution studies in the United States, Canada, Spain, Chile, and Greece that investigate the extent of human exposures to acid and oxidant air pollutants that may effect respiratory health. Recent research interests include the development and evaluation of new technologies that can be used to characterize human exposure to and health effects of air pollutants such as particle filters and diffusion denuders. Dr. Koutrakis is Technical Editor-in-Chief for the Journal of the Air & Waste Management Association.

William H. Schlesinger
Professor of Botany and Geology
Duke University

Dr. William H. Schlesinger is James B. Duke Professor in the Department of Botany at Duke University, where he holds a joint appointment in the Division of Earth and Ocean Sciences of the Nicholas School of the Environment. Completing his A.B. at Dartmouth (1972), and Ph.D. at Cornell (1976), he joined the faculty at Duke in 1980. He is the author or coauthor of over 125 scientific papers and the widely-adopted textbook Biogeochemistry: An analysis of global change (Academic Press, 2nd ed. 1997). He was elected a member of the American Academy of Arts and Sciences in 1995.

Currently, Dr. Schlesinger focuses his research on the role of soils in the global carbon cycle. He has worked extensively in desert ecosystems and their response to global change-often leading to the degradation of soils and regional desertification. Currently, he serves as Principal Investigator for the NSF-sponsored program of Long Term Ecological Research (LTER) at the Jornada Basin in southern New Mexico, where he examines changes in soil chemistry and soil erosion that accompany the desertification of semiarid grasslands. Past work includes studies of the formation of caliche in soils of the Mojave desert of California, the contribution of wind erosion to the chemistry of rainfall in the southwestern U.S., and studies that link the distribution of overland flow to the distribution and abundance of desert shrubs.

Richard E. Sobonya
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University of Arizona

Dr. Richard Sobonya is the Director of the Residency Program and the Division Chief of Anatomic Pathology at the University of Arizona College of Medicine. Following a fellowship in pulmonary pathology, Dr. Sobonya spent two years at the Armed Forces Institute of Pathology in the Pulmonary-Mediastinal Branch. He then joined the faculty at Kansas University Medical Center. He became a faculty member at the University of Arizona College of Medicine in 1977, and was a participating investigator in a multidisciplinary NIH grant on the epidemiology of obstructive lung diseases for 15 years. His special interests, besides lung pathology, include directing the Autopsy Service and participating in electron microscopy, muscle pathology, and cardiac pathology. Publications include over 80 original articles and chapters in several texts on pulmonary pathology. He is a Fellow of the American College of Chest Physicians and the College of American Pathologists.

John M. Teal
Professor Emeritus
Woods Hole Oceanographic Institution

Dr. John Teal is a Professor Emeritus at the Woods Hole Oceanographic Institute and Director of Teal, Ltd. Environmental Consultants. His research over the years has focused in the following areas: wetland and coastal ecology, especially salt and brackish marsh ecosystem structure and function; fish nursery value, nutrient cycling, hydrology, productivity, eutrophication, marsh restoration, pollution effects and environmental risk; groundwater influences on water bodies, groundwater contamination with nutrients; wastewater treatment by natural and artificial wetlands; petroleum pollution and hydrocarbon biogeochemistry; coastal marine ecology including dune and beach ecology; and aquaculture and fisheries. Dr. Teal is the author of more than 140 peer-reviewed scientific papers, ten articles in popular publications, four encyclopedia articles, six children's articles on oceanography, and four trade books. Dr Teal is a member of several editorial boards, scientific panels, and scientific advisory boards.

John G. Watson
Research Professor
Desert Research Institute

Dr. Watson is a Research Professor at the Desert Research Institute of the University and Community College System of Nevada. His research includes the development and evaluation of measurement processes, receptor models, and the effects of measurement uncertainty on model results. Major projects that Dr. Watson has participated in include the development of receptor modeling and data analysis software and its integration with source and receptor databases. Dr. Watson is principal investigator for the California Regional $PM_{10}/PM_{2.5}$ Air Quality Study, the Mexico City Particulate Study, the Southern Nevada Air Quality Study, and the Fresno $PM_{2.5}$ Supersite. Dr. Watson was previously principal investigator, or a major participant in the Project MOHAVE study of regional contribution to haze in the Grand Canyon, the Mt. Zirkel Visibility Study to determine haze contributions in the Mt. Zirkel Wilderness in northern Colorado, and the Northern Front Range Air Quality Study to determine contributions to $PM_{2.5}$ near Denver, CO. Dr. Watson has more than twenty years of experience in the study of suspended particles and is the author or co-author of more than 100 peer-reviewed publications and more than 150 technical reports.

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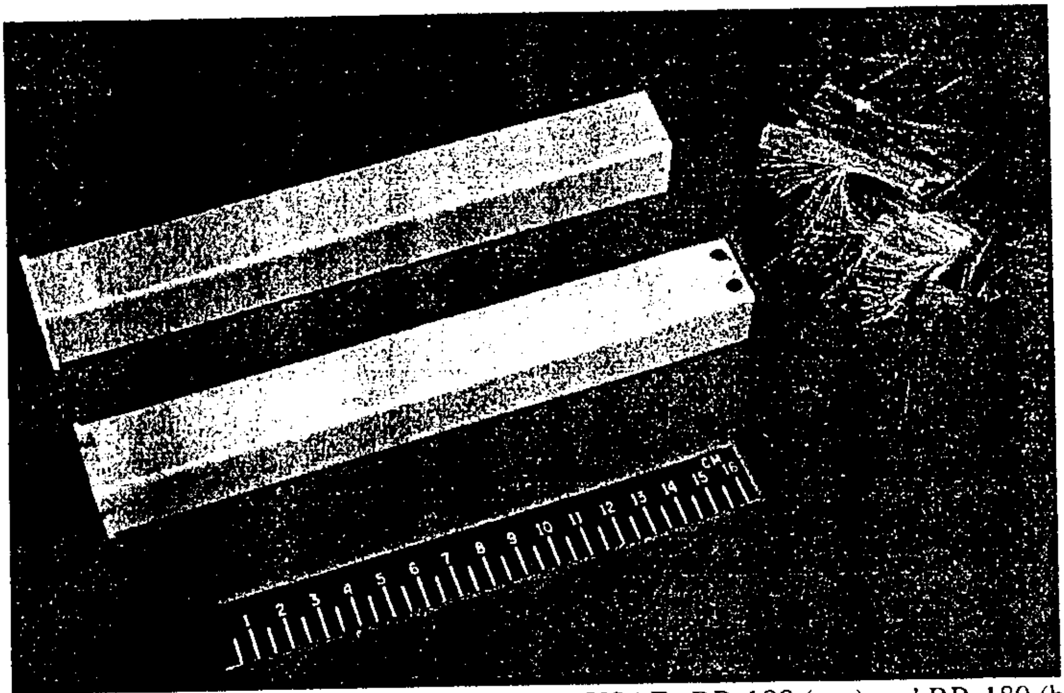
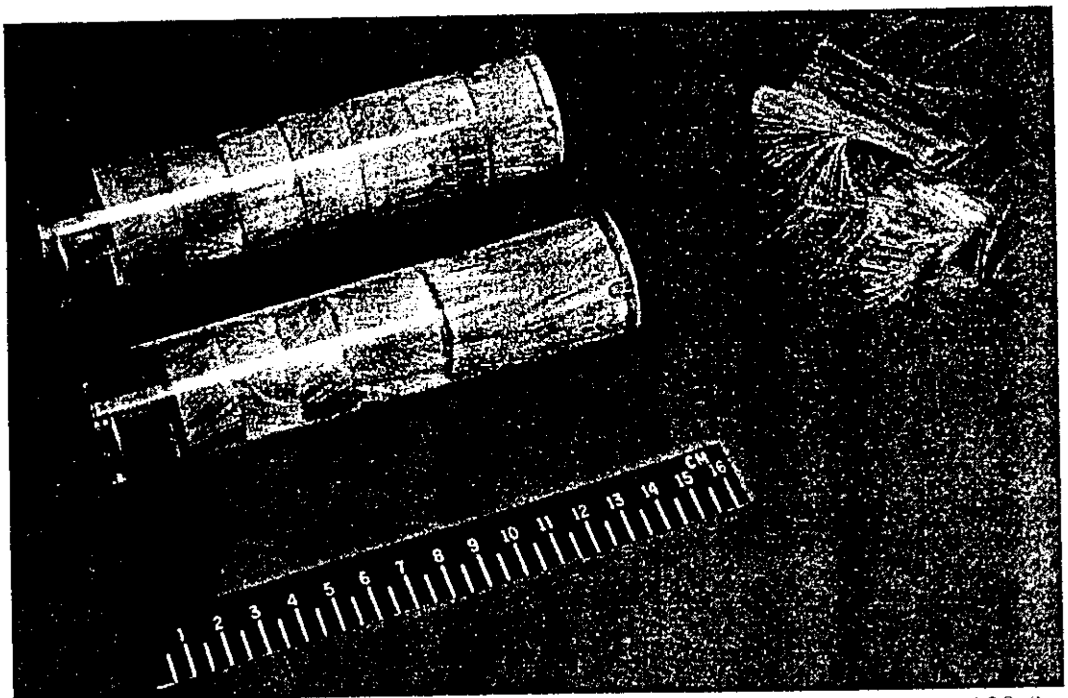
Appendix D

Examples of RF Chaff Bundles



.ining and operation RF chaff rounds used by the USAF. RR-188 (top) and RR-180 (bottom).



ıining and operation RF chaff rounds used by the USN. RR-144 (top) and RR-129 (bottom).

Appendix F
Wildland Fire Ignition Potential Study

Draft Report

Wildland Fire Ignition Potential Assessment for Phase I National Guard Military Operations Areas in the United States

Prepared for

CH2M HILL

June 2000

AIR SCIENCES INC.
Portland, Oregon

Contents

Contents

Tables

Figures

Executive Summary

A study was conducted to quantitatively assess the ignition potential associated with the airborne releases of self-protection flares over 14 National Guard Military Operations Areas (MOAs) in the United States. To assess the ignition potential in these areas, current fuels information and up to 20 years of historical fire weather data were collected and analyzed. The weather and fuels data were modeled with the fire danger rating calculations in the FireFamily+ model to reveal the expected probability of fire ignition resulting from the use of military flares within each MOA. These results are summarized in this report.

The ignition potential in MOAs was assessed using elements of the National Fire Danger Rating System (NFDRS), which is currently used to assess wildland fire danger by most state and federal agencies. Two NFDRS indices were used to assess the ignition potential in the MOAs. They are: Probability of Ignition (P(I)) and Ignition Component (IC). P(I) is the probability that a firebrand will start a fire (reportable or not) after landing on receptive fuels. This differs from the IC, which incorporates burning conditions and the spread rate of a fire to estimate the probability (actually, an index value) of a firebrand becoming a reportable fire (nominally, ¼ acre or larger).

The 50th, 93rd, and 100th percentile P(I) and IC values were computed for each month of the year for each MOA. A subjective rating of each area's ignition potential was then assigned based on the 50th percentile IC values. The subjective rating was based on the State of Minnesota Department of Environmental Quality (DEQ)'s fire danger rating system (http://www.ra.dnr.state.mn.us/fire/maps/fbi_q.html). The Minnesota DEQ recognizes five fire danger rating classes based on IC. They are:

- Low: $0 \leq IC < 10$
- Moderate: $11 \leq IC < 20$
- High: $21 \leq IC < 30$
- Very high: $31 \leq IC < 40$
- Extreme: $41+ \leq IC$

Using this system of classification, the ignition potential of the 14 Phase I MOAs were characterized as follows:

- Low: Steelhead MOA
- Moderate: Beaver, Snoopy, Rivers, Hog, Lake Andes, Falls, Volk, Shirley, and Crypt MOAs
- Very high: Dolphin, Juniper, and Goose MOAs
- Extreme: Hart MOA

The study also documents the expected P(I) and IC values for each month of the year based on current fuels information and historical weather conditions. This information

is needed to prescribe mitigation measures, which are designed to minimize the risk of wildland fire within the MOAs.

SECTION 1

Introduction

This technical report summarizes an investigation designed to quantitatively assess the ignition potential associated with the airborne releases of self-protection flares over National Guard Military Operations Areas (MOAs) in the United States. A total of 25 National Guard MOAs will eventually be studied. Fourteen of these MOAs are included in Phase I, which is the subject of this technical report. The remaining 11 MOAs will be evaluated later in Phase II. The names and locations of the Phase I MOAs are listed in Table 1-1 below.

To assess the ignition potential in these areas, data on fire history, historical weather observations, and fire fuels were collected and analyzed. The weather and fuels data were then modeled using fire danger rating prediction methods to reveal the expected probability of fire ignition resulting from the use of military flares within each MOA. These results are summarized in this report. Because the historical occurrence of fire in an area is just one possible outcome of events in an MOA , the fire history data are of limited value in assessing ignition potential. A more robust evaluation technique is needed to assess the ignition potential as a function of fuel and fire weather data and independent of historical occurrence.

The ignition potential was assessed using key components of the National Fire Danger Rating System (NFDRS; Bradshaw et al., 1984), which is currently used to assess wildland fire danger by most state and federal agencies. Two NFDRS indices were used to assess the ignition potential in the MOAs. They are: Probability of Ignition (P(I)) and Ignition Component (IC). P(I) is the probability that a firebrand will start a fire (reportable or not) after landing on receptive fuels. This differs from the IC, which incorporates burning conditions and the spread rate of a fire to estimate the probability (actually, an index value) of a firebrand becoming a reportable fire (nominally, ¼ acre or larger).

This report does not evaluate the probability that a self-protection flare will still be burning when it reaches the ground. The ultimate assessment of ignition potential should involve the product of the probability that a release of self-protection flares from aircraft would reach the ground (in turn, a function of the type of flare, the meteorological conditions, and the altitude of the release) and the spread component (SC).

TABLE 1-1
Location Summary of MOAs for Phase I Investigation

Region	MOA Name	Area (sq. mi.)	States	Counties
Northwest	Goose	1,520	OR, CA	Modoc, CA; Klamath, Lake, OR
	Hart	3,291	OR, CA, NV	Lake, Harney, OR; Modoc, CA; Washoe, NV
	Juniper Low N/S	8,488	OR	Lake, Harney, Crook, Deschutes, OR
	Dolphin	Unknown	OR	Coos, Curry, Josephine, OR
Midwest	Crypt N/Cen/S	6,067	IA	Buena Vista, Calhoun, Cherokee, Humboldt, Ida, Plymouth, Pocahontas, Sac, Webster, Woodbury, Carroll, Crawford, Greene, Monona, Clay, Dickinson, Kossuth, O'Brien, Osceola, Palo Alto, Sioux, IA
	Lake Andes	4,637	SD, NE	Aurora, Bon Homme, Brule, Charles Mix, Davison, Douglas, Gregory, Hutchinson, Lyman, Tripp, SD; Boyd, Holt, Keya Paha NE
Great Lakes	Beaver	3,305	MN	Beltrami, Lake of the Woods, Itasca, Koochiching, MN
	Steelhead	2,930	MI	Arenac, Huron, Iosco, Sanilac, Tuscola, MI
	Snoopy E/W	5,094	MN	Snoopy East: Cook, Lake, St. Louis MN Snoopy West: none
	Pike E/W	4,771	MI	Alpena, Presque Isle, MI
	Volk E/W/S	3,829	WI	Juneau, Wood, Adams, Columbia, Dodge, Green Lake, Marquette, Portage, Waupaca, Waushara, Jackson, Monroe, Clark, WI
	Falls 1 and 2	1,798	WI	Clark, Eau Claire, Jackson, La Crosse, Monroe, Trempealeau, Wood, WI
South	Rivers	2,560	OK	Atoka, Bryan, Choctaw, Latimer, Le Flore, McCurtain, Pittsburg, Pushmataha, OK
	Hog Low/High N/S	2,623	AR, OK	Franklin, Logan, Scott, Sebastian, Yell, Montgomery, Polk, AR; Le Flore, OK
	Shirley	4,067	AR	Baxter, Cleburne, Conway, Faulkner, Independence, Izard, Jackson, Newton, Pope, Searcy, Sharp, Stone, Van Buren, White, AR

SECTION 2

Methods of Analysis

The methodology used to assess the ignition potential in the Phase I MOAs includes the following tasks:

- Task 1—Map the vegetation conditions and fire weather stations located in and around each MOA.
- Task 2—Characterize the fuel models found within each MOA.
- Task 3—Characterize the fire weather conditions within each MOA using up to 20 years of historical data for representative stations.
- Task 4—Compute fire danger rating parameters that are used to assess ignition potential—including the Ignition Component (IC) and the Spread Component (SC)—for each day and year of historical weather data. Calculate the Probability of Ignition [P(I)] using the predicted daily IC and SC values.
- Task 5—Aggregate the data by month of year and compute the 50^{th}, 93^{rd}, and 100^{th}-percentile values for the IC and P(I) for each month of the year.

This section describes in more detail the data sources and assumptions that went into each of these tasks.

2.1 Mapping of Vegetation Conditions and Weather Stations

The mapping of vegetation conditions and weather stations within and around each MOA was performed using an ArcView® application developed by Air Sciences. The ArcView® application used data from three sources:

- MOA boundary coverage
- Vegetation grid coverage
- Weather station location coverage

This GIS application will be used later to identify the proportion of the total area in each MOA occupied by different vegetation types (later, mapped into individual NFDRS fuel models). It was also used to identify the weather stations that are found within and near each MOA. Each of these data sources is described below.

A set of composite GIS maps showing the MOA boundaries, vegetation cover types, and fire weather stations for each of the 14 Phase I MOAs is provided in Appendix A.

2.1.1 MOA BoundaryCoverage

The MOA boundaries were mapped using ArcView® *shapefiles* provided by the National Guard. These shapefiles contained one or more polygons representing each MOA area.

2.1.2 Vegetation Grid Coverage

The vegetation cover within each MOA was mapped using a coarse-scale (one-kilometer grid cell resolution) vegetation grid layer for the conterminous United States provided by the USDA Forest Service's Missoula Fire Sciences Laboratory in Missoula, Montana. The data layer contains 26 major vegetation types found in the United States and three non-vegetation types—water, barren, and urban land (Table 2-1). This layer, together with the MOA boundary coverage, was used in ArcView® by Air Sciences to estimate the percentage of each vegetation type within each MOA. Later in the analysis, the vegetation cover types will be mapped into individual NFDRS fuel models for purposes of characterizing the ignition potential for each month of the year within each MOA.

2.1.3 WIMS Weather Station Coverage

The locations of weather stations in and around each MOA were mapped using data from the U.S. Department of Agriculture's Weather Information Management System (WIMS). WIMS weather stations are fire weather stations maintained by federal and state land management agencies and are designed to record once-daily observations of fire-weather-related meteorological variables for purposes of tracking the fire danger rating. The locations of the WIMS weather stations were retrieved from the National Fire Management Integrated Database (NFMID), which is accessible via the National Fire and Aviation Management Web Applications homepage at http://famweb.usda.gov/.

2.2 Assignment of NFDRS Fuel Models

To assess the ignition potential within each MOA, one or more NFDRS fuel models must be assigned to represent the predominant vegetation cover types found there. The National Fire Danger Rating System contains a list of 20 fuel models (or profiles) designed to provide a coarse representation of the range of fuel types found within the United States. Each representative fuel bed (called a "fuel model") is characterized in terms of numerous variables that influence fire behavior, including: fuel loading by fuel size class, heat content and surface area to volume ratio by size class, the wind speed reduction factor, whether the fuel bed is shaded or unshaded, and more. These fuel models are used extensively for fire prediction and influence the calculation of the IC greatly. Note that the probability of ignition, P(I), is influenced only by weather regime and is therefore independent of the fuel model chosen.

ArcView® was used to determine the approximate percentage of each MOA occupied by the vegetation cover types shown in Table 2-1. These percentages were summarized in a table, and a representative NFDRS fuel model was assigned to each cover type (Table 2-2). Note that the NFDRS fuel model is the second letter from the left in the column labeled "Corresponding Fuel Model." From one to four fuel models were required to characterize each MOA.

TABLE 2-1
Vegetation Classifications Used in Grid Dataset from the Missoula Fire Sciences Laboratory

Cover Type ID	Vegetation Classification
1	Agriculture
2	Grassland
3	Wetlands
4	Desert Shrub
5	Other Shrub
6	Oak and Pine
7	Oak and Hickory
8	Oak, Gum, and Cypress
9	Elm, Ash, and Cottonwood
10	Maple, Beech, and Birch
11	Aspen and Birch
12	Western Hardwoods
13	White, Red, and Jack Pine
14	Spruce and Fir (East)
15	Longleaf and Slash Pine
16	Loblolly and Shortleaf Pine
17	Ponderosa Pine
18	Douglas -fir
19	Larch
20	Western White Pine
21	Lodgepole Pine
22	Hemlock and Sitka Spruce
23	Fir and Spruce
24	Redwood
25	Pinyon Pine and Juniper
26	Alpine Tundra
27	Barren
28	Water
30	Urban/Development/Agriculture

TABLE 2-2

NFDRS Fuel Model Assignments for Phase I MOAs

MOA	Vegetation Cover Type	Percent Coverage	Corresponding Fuel Model
Beaver	11: Aspen-Birch	70%	7R1PE3
	13: White-Red-Jack Pine	20%	7C1PE3
	10: Maple-Beech-Birch	10%	7R1PE3
Crypt	1: Agriculture	95%	7L1PE3
	7: Oak–Hickory	5%	7R1PE3
Dolphin	18: Douglas-fir	80%	7G3PE3
	22: Hemlock-Sitka Spruce	20%	7G3PE3
Falls 1&2	1: Agriculture	60%	7L1PE3
	11: Aspen-Birch	10%	7R1PE3
	7: Oak-Hickory	10%	7R1PE3
	10: Maple-Beech-Birch	10%	7R1PE3
	13: White-Red-Jack Pine	10%	7C1PE3
Goose	17: Ponderosa Pine	60%	7C2PE1
	25: Pinyon Pine-Juniper	20%	7T2PE1
	5: Other Shrub	20%	7F2PE1
Hart	5: Other Shrub	70%	7F1PE2
	4: Desert Shrub	20%	7T1PE2
	25: Pinyon Pine-Juniper	5%	7T1PE2
	17: Ponderosa Pine	5%	7C1PE2
Hog	16: Loblolly-Shortleaf Pine	60%	7C2PE3
	6: Oak–Pine	20%	7R2PE3
	30: Urban/Develop/Agr.	20%	7H2PE3
Juniper	5: Other Shrub	60%	7F2PE1
	4: Desert Shrub	40%	7T2PE1
Lake Andes	2: Grassland	60%	7L1PE2
	1: Agriculture	40%	7L1PE2
Pike	18: Water	100%	---
Rivers	16: Loblolly-Shortleaf Pine	50%	7C2PE2
	6: Oak-Pine	30%	7R2PE2
	1: Agriculture	10%	7L2PE2
	30: Urban/Develop/Agr.	10%	7H2PE2
Shirley	7: Oak–Hickory	70%	7R2PE3
	30: Urban/Develop/Agr.	20%	7H2PE3
	6: Oak-Pine	10%	7R2PE3
Snoopy	11: Aspen-Birch	80%	7R1PE3
	13: White-Red-Jack Pine	15%	7C1PE3
	10: Maple-Beech-Birch	5%	7R1PE3

TABLE 2-2 (continued)
NFDRS Fuel Model Assignments for Phase I MOAs

MOA	Vegetation Cover Type	Percent Coverage	Corresponding Fuel Model
Steelhead	1: Agriculture	90%	7L1PE3
	10: Maple-Beech-Birch	5%	7R1PE3
	11: Aspen-Birch	5%	7R1PE3
Volk	1: Agriculture	80%	7L1PE3
	13: White-Red-Jack Pine	10%	7C1PE3
	11: Aspen-Birch	10%	7R1PE3

2.3 Characterization of Historical Weather Conditions

The historical weather conditions within each MOA were characterized using data obtained for a set of representative WIMS weather stations selected for each MOA. These data are needed to model the expected fire behavior for each MOA and for each month of the year.

Characterizing the historical weather conditions within each MOA was a two-step process. First, up to five WIMS weather stations were selected to represent the meteorological conditions within the MOA, and the data for each *representative* station was obtained. Second, the data for the representative stations were combined to form a single, composite weather set for each MOA. The composite weather set is needed later in the computation of ignition potential for each MOA. Data from multiple stations were sought in order to maximize the number of daily observations used in the modeling analysis of ignition potential.

2.3.1 Weather Station Selection

WIMS weather stations were chosen to be representative of each MOA on the basis of three criteria:

- Proximity to MOA—Preference was given to the WIMS weather stations located within—or closest to, if none were found to be within—the MOA boundaries.
- Representative vegetation—Preference was given to WIMS weather stations that were characterized by the same vegetation cover type as the predominant vegetation type within each MOA.
- Data completeness—Preference was given to the WIMS weather stations that had the least amount of missing data (daily observations) over the 20-year period from 1980 through 1999.

Each representative station was also subjectively ranked according to these criteria, ranging from 1 (highest rank) to 5 (lowest rank). The importance of the rank will be seen later in the development of the composite data set. In that process, the observations for a specific date are taken first from the highest rank. If data are not available for a particular date from the station with the highest rank, then the second, third, and even fourth rank stations are queried until the data for that date are found.

Table 2-3 presents a summary of the WIMS weather stations that were selected for each MOA. This table shows the name of the MOA, the WIMS weather stations that were selected, how well the weather station matches the selection criteria, and the weather station rank.

A plethora of WIMS weather stations was available to choose from for each Western MOA. However, in the Midwestern States there were relatively few WIMS weather stations to select from. This is because the fire hazard is much less in the Midwest than in the West, and so fewer stations have been installed there. For Crypt (Iowa) and Lake Andes (South Dakota), it was necessary to use data from WIMS weather stations located nearly 150 miles from the MOA boundary.

Following the selection of the representative stations, the historical weather data for each station were downloaded from the NFMID database (accessible via the National Fire and Aviation Management Web Applications homepage at http://famweb.usda.gov/). The data were downloaded in 1972 Remote Access Weather Station (RAWS) file format, a format required by the FireFamily+ suite of models.

2.3.2 Composite Weather Set Development

Following this step, the daily weather observations for each MOA were combined into a single composite weather set. This was necessary to fill any data voids and to obtain as closely as possible a 20-year record of data for each MOA

A Microsoft Excel macro application was developed by Air Sciences to prepare the composite data set for each MOA. The macro was designed to perform the following operations:

1. Upload the data for each representative WIMS weather station into an Excel spreadsheet. Each daily observation occupies a separate row in the spreadsheet.
2. Column-sort the daily observations by station number, according to station rank (see Table 2-3).
3. Perform various quality control checks to screen out any missing or anomalous records. For example, records with wind speeds greater than 75 miles per hour (close to weak tornado wind speeds) are marked and excluded from the composite dataset. Similarly, any records with blank values for relative humidity are excluded from the composite dataset.
4. Export a composite weather data set (in 1972 RAWS format) containing the highest ranked observation for each day queried from the WIMS weather stations.

Following the initial screening, this composite weather set was run through FireFamily+. This model is described in the next section.

TABLE 2-3

Summary of Representative WIMS Weather Stations for Each Phase I MOA

MOA	WIMS Station Number	Selection Criteria: Proximity to MOA (Distance)	Selection Criteria: Representative Vegetation?	Selection Criteria: Data Completeness (Years Missing)	Rank (Order of Use)
Beaver	210902	Inside	Yes	6	2
	211004	Inside	Yes	<1	1
Crypt	216801	Outside (150 mi.)	Yes	9	2
	216901	Outside (150 mi.)	Yes	>10	3
	217801	Outside (150 mi.)	Yes	2	1
Dolphin	352917	Inside	Yes	5	1
	353044	Inside	Yes	9	2
	352816	Inside	Yes	11	3
	352542	Inside	Yes	16	4
Falls	473901	Inside	Yes	<1	1
Goose	40302	Outside	Yes	>10	4
	353328	Inside	Yes	<1	1
	353403	Inside	Yes	3	2
	353423	Inside	No	3	3
Hart	260109	Inside	Yes	10	1
	260111	Inside	Yes	12	3
	353421	Inside	No	2	4
	353424	Inside	Yes	10	2
	353516	Outside	Yes	7	5
Hog	33001	Outside	Yes	19	2
	34702	Inside	Yes	<1	1
Juniper	353406	Outside	Yes	<1	3
	353426	Inside	Yes	9	2
	353505	Outside	Yes	16	6
	353512	Inside	Yes	4	1
	353517	Outside	Yes	8	4
	353525	Outside	Yes	14	5
Lake Andes	252402	Outside (~100 mi.)	Yes	7	2
	394184	Outside (~100 mi.)	Yes	6	1
Rivers	346303	Inside	Yes	2	1
Shirley	31201	Inside	Yes	5	2
	32001	Outside (<10 mi.)	Yes	<1	1
Snoopy West	210502	Inside	Yes	4	2
	210601	Inside	Yes	6	3
	210602	Inside	Yes	7	1
Steelhead	203802	Outside (~100 mi.)	Yes	<1	1
Volk	473501	Inside	Yes	17	2
	474101	Inside	Yes	3	1
	474191	Inside	Yes	18	3

2.4 Assessing Ignition Potential Within MOAs

2.4.1 Ignition Potential Measures

The risk of fire resulting from the use of self-protection flares was assessed using two (related) measures of ignition potential that are part of the NFDRS—the probability of ignition (P(I)), and the ignition component (IC). The probability of ignition, defined as the probability that a firebrand will ignite the finest fuels in the fuel bed, is weather-dependent but not fuel model-dependent. The ignition component, defined as the probability that a fire will start and spread to a reportable size (nominally, ¼ acre or larger), is both fuel model- and fire weather-dependent.

In most models that compute the NFDRS parameters, the probability of ignition is considered an intermediate value used in the calculation of the IC and for that reason almost never reported by itself. Therefore, for our purposes it was necessary to back-calculate the P(I) using computed values of the IC and another NFDRS parameter, the Spread Component (SC). The SC is a measure of the forward rate of spread of a fire burning within a fuel model under a given set of topographic and meteorological conditions (units of feet per minute). As is true of the IC the SC is both fuel model- and fire weather-dependent.

If the IC and SC are known, the P(I) values may be computed using the equation:

$$P(I) = IC \cdot \left(\frac{SC}{SC_{max}} \right)^{-0.5} \qquad (1)$$

where SC_{max} is the published theoretical maximum fire rate of spread for each NFDRS fuel model (a constant).

2.4.2 The FireFamily+ Program

For this investigation, the daily IC and SC were computed for each of the assigned fuel models (discussed in Section 2.2) and each day of composite weather data (discussed in Section 2.3) using the FireFamily+ program. Firefamily+ is a Windows 95/98/NT program that summarizes fire climatology and fire occurrence for one or more weather stations stored in the National Integrated Fire Management Interagency Database (NIFMID). It incorporates the functionality of several fire behavior prediction models—including pcFIRDAT, pcSEASON, FIRES, and CLIMATOLOGY—into an integrated Windows program that operates on a database structure.

The Fire & Aviation Management branch of the USDA Forest Service developed FireFamily+. The software and users guide is available for download at the following website: http://www.fs.fed.us/fire/planning/nist/distribu.htm.

2.4.3 Interpretation of Ignition Potential by MOA

To interpret the ignition potential in each MOA, the 50th (median), 93rd, and 100th (maximum) percentile P(I) and IC values for each NFDRS fuel model was reported for each month of the year. The 50th percentile is the median value and is representative of conditions on a "typical" or "average" day within the MOA. The 93rd percentile is the midpoint of the High NFDRS weather class and is considered a "reasonable worst-case" estimate. The 93rd percentile value means that 93 percent of the time (or roughly 28 days per month), the value is less than the 93rd percentile value, and 7 percent of the time (two days per month) it is greater than the 93rd percentile value. The higher the 50th and 93rd percentile IC and P(I) values, the higher the ignition potential.

As a measure of average expected risk, the 50th percentile IC value will be reported for each month of the year. Later, we will discuss the overall ignition potential by fuel type, month, and MOA, as well as review possible mitigation measures.

2.4.4 Excel Spreadsheet Application

To assist in performing these calculations, Air Sciences developed a second Microsoft Excel application. This macro is designed to perform the following functions:

1. Extract the daily values of SC and IC from the FireFamily+ export files for each assigned fuel model.
2. Sort the daily observations by month; and within each month, sort again in ascending order from lowest value to highest value.
3. Calculate the daily P(I) using Equation (1) above.
4. Compute the cumulative frequency for IC and P(I) (separately) for each month of the year (by MOA).
5. Compute the area-weighted average IC and P(I) using the percent coverage of fuel models shown in Table 2-2.
6. Perform a search for the 50th, 93th, and 100th percentile IC and P(I) values for each month of the year (by MOA). These percentile levels represent the "typical" condition, a "reasonable worst-case" condition, and the "worst-case" condition, respectively, within each MOA.
7. Produce a graph of the 50th percentile IC by month of year for each MOA (see Section 3).

SECTION 3

Results

The results of the ignition potential assessment for the 14 Phase I National Guard MOAs are presented in Figures 3-1 through 3-14, with tabular data presented in Tables 3-1 through 3-14.

In each of the figures, a subjective rating of the ignition potential has been assigned based on the monthly 50th percentile IC values. The subjective rating is part of the fire danger rating system used by the State of Minnesota Department of Environmental Quality (DEQ) (Example maps at http://www.ra.dnr.state.mn.us/fire/maps/fbi_q.html). The DEQ recognizes five fire danger rating classes based on IC. These five classes are as follows:

- Low: $0 \leq IC < 10$
- Moderate: $11 \leq IC < 20$
- High: $21 \leq IC < 30$
- Very high: $31 \leq IC < 40$
- Extreme: $41+ \leq IC$

3.1 Beaver MOA

The results of the ignition potential assessment for the Beaver MOA are presented below in Figure 3-1 and in Table 3-1.

Figure 3-1 shows that the median IC—the probability that a firebrand landing on receptive fuels will grow to a reportable size—is moderate during the Spring months prior to leaf break (March through May) and low during the remainder of the year.

Table 3-1 shows that during the month of greatest risk (April), the median P(I)—the probability that a firebrand landing on receptive fuels will ignite a fire (reportable or not)—is 33 percent on the average day, 67 percent on the 93rd percentile day, and 80 percent on the worst day. The median IC during the same month was somewhat lower: 19 percent on the average day, 43 percent on the 93rd percentile day, and 74 percent on the worst day.

The overall ignition potential (based on the month with the highest median IC) for the Beaver MOA is moderate.

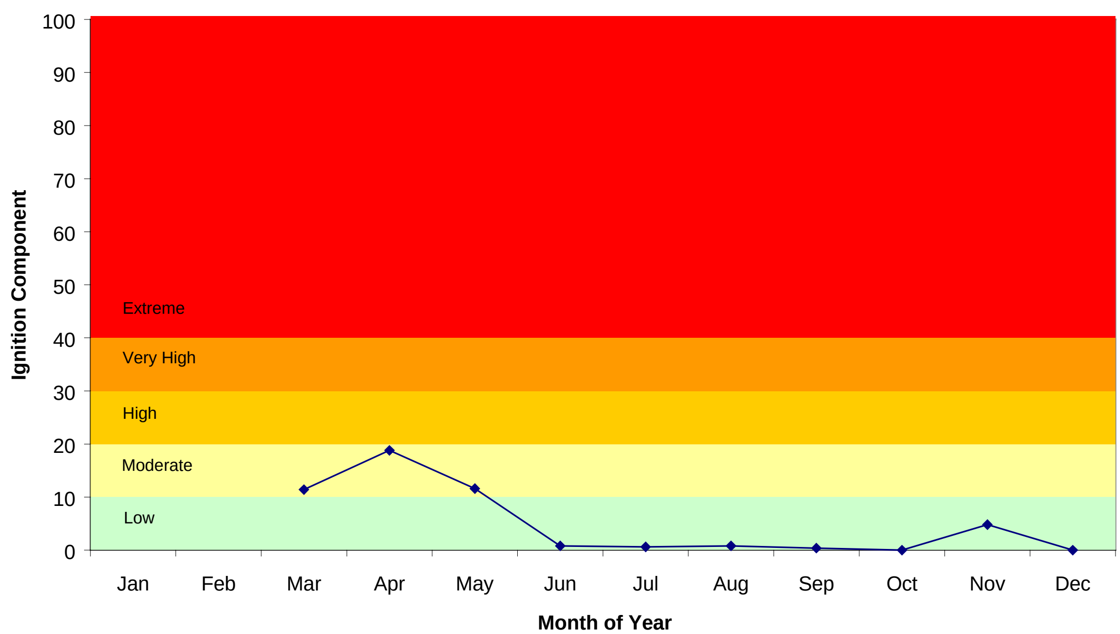


FIGURE 3-1
Median Ignition Component by Month of Year
Beaver MOA

TABLE 3-1

Probability of Ignition and Ignition Component Summary for Beaver MOA

Month	Number of Observations	Fuel Model	Percent Distribution (percent)	Probability of Ignition 50th (percent)	Probability of Ignition 93rd (percent)	Probability of Ignition 100th (percent)	Ignition Component 50th (percent)	Ignition Component 93rd (percent)	Ignition Component 100th (percent)
1	0	7C1PE3	20%	ND	ND	ND	ND	ND	ND
		7R1PE3	80%	ND	ND	ND	ND	ND	ND
		Composite	100%	ND	ND	ND	ND	ND	ND
2	0	7C1PE3	20%	ND	ND	ND	ND	ND	ND
		7R1PE3	80%	ND	ND	ND	ND	ND	ND
		Composite	100%	ND	ND	ND	ND	ND	ND
3	57	7C1PE3	20%	17	62	66	11	33	52
		7R1PE3	80%	17	62	66	12	36	56
		Composite	100%	17	62	66	11	35	55
4	446	7C1PE3	20%	32	67	79	18	43	74
		7R1PE3	80%	33	66	80	19	43	74
		Composite	100%	33	67	80	19	43	74
5	583	7C1PE3	20%	32	64	81	10	38	70
		7R1PE3	80%	24	64	81	12	41	73
		Composite	100%	32	64	81	12	40	72
6	556	7C1PE3	20%	17	51	68	4	15	33
		7R1PE3	80%	0	49	69	0	21	36
		Composite	100%	17	51	69	1	20	35
7	576	7C1PE3	20%	17	45	62	3	11	27
		7R1PE3	80%	0	42	61	0	18	30
		Composite	100%	17	45	62	1	17	29
8	562	7C1PE3	20%	23	45	62	4	13	28
		7R1PE3	80%	0	44	61	0	19	33
		Composite	100%	23	45	62	1	18	32
9	543	7C1PE3	20%	11	45	57	2	11	36
		7R1PE3	80%	0	42	56	0	18	43
		Composite	100%	11	45	57	0	17	42
10	526	7C1PE3	20%	0	40	68	0	9	25
		7R1PE3	80%	0	29	61	0	12	32
		Composite	100%	0	40	68	0	11	31
11	154	7C1PE3	20%	9	34	61	4	22	47
		7R1PE3	80%	9	34	62	5	23	45
		Composite	100%	9	34	62	5	23	45
12	10	7C1PE3	20%	0	17	16	0	7	7
		7R1PE3	80%	0	16	15	0	8	7
		Composite	100%	0	17	16	0	8	7

ND = No Data

3.2 Crypt MOA

The results of the ignition potential assessment for the Crypt MOA are presented below in Figure 3-2 and in Table 3-2.

Figure 3-2 shows that the median IC—the probability that a firebrand landing on receptive fuels will grow to a reportable size—is low for the entire year.

Table 3-2 shows that during the month of greatest risk (April), the median P(I)—the probability that a firebrand landing on receptive fuels will ignite a fire (reportable or not)—is 26 percent on the average day, 55 percent on the 93rd percentile day, and 74 percent on the worst day. The median IC during the same month was considerably lower: 12 percent on the average day, 36 percent on the 93rd percentile day, and 56 percent on the worst day.

The overall ignition potential (based on the month with the highest median IC) for the Crypt MOA is moderate.

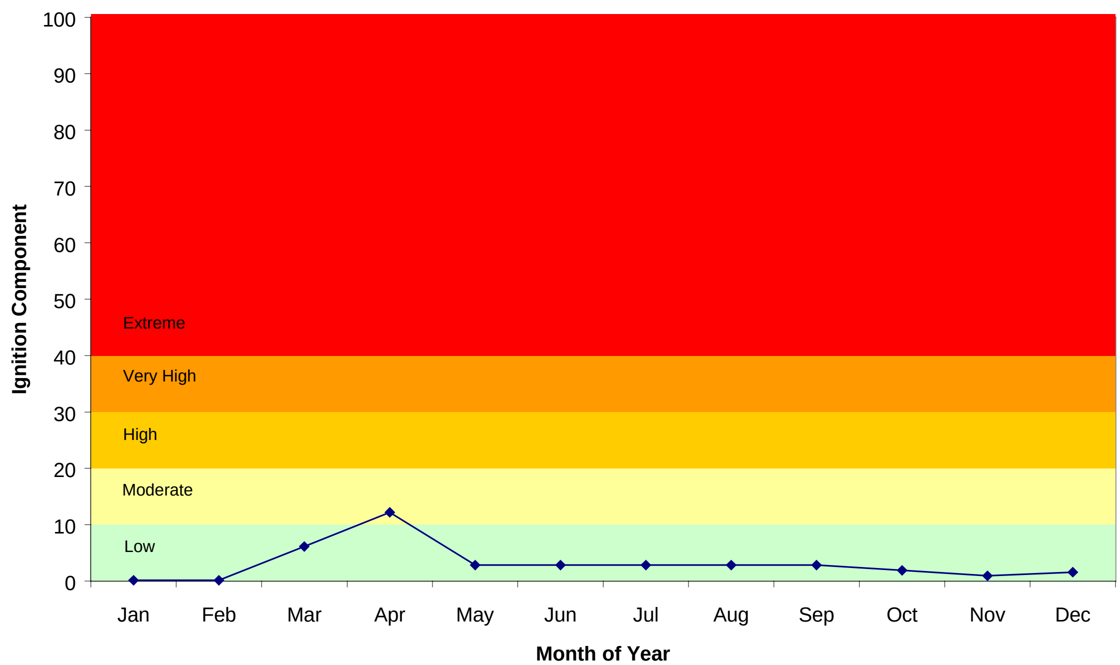


FIGURE 3-2
Median Ignition Component by Month of Year
Crypt MOA

TABLE 3-2

Probability of Ignition and Ignition Component Summary for Crypt MOA

Month	Number of Observations	Fuel Model	Percent Distribution (percent)	Probability of Ignition 50th (percent)	Probability of Ignition 93rd (percent)	Probability of Ignition 100th (percent)	Ignition Component 50th (percent)	Ignition Component 93rd (percent)	Ignition Component 100th (percent)
1	62	7L1PE3	95%	0	19	28	0	9	11
		7R1PE3	5%	5	20	28	3	11	14
		Composite	100%	5	20	28	0	9	11
2	72	7L1PE3	95%	0	26	41	0	14	26
		7R1PE3	5%	4	26	41	3	20	32
		Composite	100%	4	26	41	0	14	26
3	132	7L1PE3	95%	15	36	44	6	21	30
		7R1PE3	5%	15	36	44	9	25	36
		Composite	100%	15	36	44	6	21	30
4	399	7L1PE3	95%	26	55	74	12	36	56
		7R1PE3	5%	25	55	73	16	42	58
		Composite	100%	26	55	74	12	36	56
5	513	7L1PE3	95%	27	57	79	3	13	46
		7R1PE3	5%	0	56	78	0	27	65
		Composite	100%	27	57	79	3	14	47
6	511	7L1PE3	95%	28	53	70	3	15	30
		7R1PE3	5%	0	49	69	0	22	40
		Composite	100%	28	53	70	3	15	31
7	518	7L1PE3	95%	27	47	71	3	14	46
		7R1PE3	5%	0	44	71	0	20	43
		Composite	100%	27	47	71	3	14	46
8	493	7L1PE3	95%	27	47	66	3	15	37
		7R1PE3	5%	0	42	69	0	20	46
		Composite	100%	27	47	69	3	15	37
9	467	7L1PE3	95%	27	47	81	3	18	49
		7R1PE3	5%	0	44	80	0	25	52
		Composite	100%	27	47	81	3	18	49
10	451	7L1PE3	95%	19	47	64	2	19	40
		7R1PE3	5%	0	44	64	0	24	44
		Composite	100%	19	47	64	2	19	40
11	281	7L1PE3	95%	8	28	47	1	13	30
		7R1PE3	5%	0	28	42	0	18	33
		Composite	100%	8	28	47	1	13	30
12	67	7L1PE3	95%	8	22	24	2	8	11
		7R1PE3	5%	7	22	24	3	10	13
		Composite	100%	8	22	24	2	8	11

3.3 Dolphin MOA

The results of the ignition potential assessment for the Dolphin MOA are presented below in Figure 3-3 and in Table 3-3.

Figure 3-3 shows that the median IC—the probability that a firebrand landing on receptive fuels will grow to a reportable size—is high to very high during the dry summer months and low to moderate during the remainder of the year.

Table 3-3 shows that during the month of greatest risk (August), the median P(I)—the probability that a firebrand landing on receptive fuels will ignite a fire (reportable or not)—is 68 percent on the average day, 90 percent on the 93rd percentile day, and 100 percent on the worst day. The median IC during the same month was considerably lower: 34 percent on the average day, 56 percent on the 93rd percentile day, and 93 percent on the worst day.

The overall ignition potential (based on the month with the highest median IC) for the Dolphin MOA is very high.

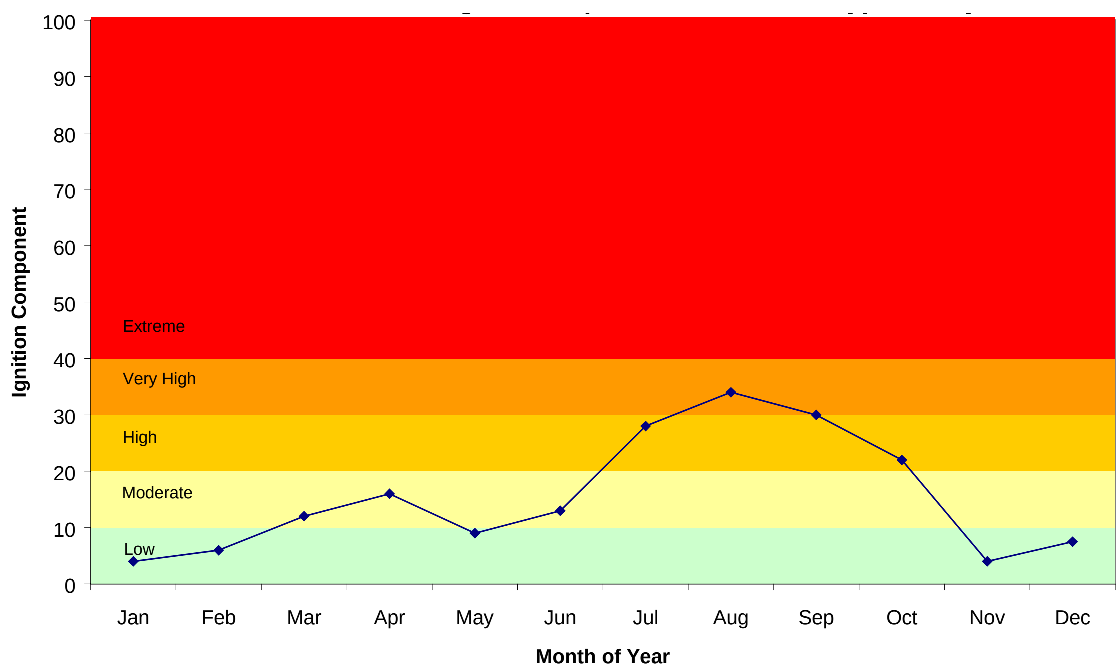


FIGURE 3-3
Median Ignition Component by Month of Year
Dolphin MOA

TABLE 3-3

Probability of Ignition and Ignition Component Summary for Dolphin MOA

			Percent	Probability of Ignition			Ignition Component		
	Number of	Fuel	Distribution	50th	93rd	100th	50th	93rd	100th
Month	Observations	Model	(percent)	(percent)	(percent)	(percent)	(percent)	(percent)	(percent)
1	403	7G3PE3	100%	8	38	61	4	23	38
		Composite	100%	8	38	61	4	23	38
2	341	7G3PE3	100%	11	36	45	6	21	33
		Composite	100%	11	36	45	6	21	33
3	355	7G3PE3	100%	22	48	69	12	31	55
		Composite	100%	22	48	69	12	31	55
4	353	7G3PE3	100%	23	58	77	16	42	62
		Composite	100%	23	58	77	16	42	62
5	386	7G3PE3	100%	34	73	87	9	30	58
		Composite	100%	34	73	87	9	30	58
6	461	7G3PE3	100%	48	74	96	13	37	54
		Composite	100%	48	74	96	13	37	54
7	446	7G3PE3	100%	65	88	101	28	51	75
		Composite	100%	65	88	101	28	51	75
8	485	7G3PE3	100%	68	90	100	34	56	93
		Composite	100%	68	90	100	34	56	93
9	489	7G3PE3	100%	60	90	101	30	55	80
		Composite	100%	60	90	101	30	55	80
10	414	7G3PE3	100%	49	85	100	22	52	81
		Composite	100%	49	85	100	22	52	81
11	356	7G3PE3	100%	16	52	75	4	21	40
		Composite	100%	16	52	75	4	21	40
12	395	7G3PE3	100%	15	50	68	8	22	31
		Composite	100%	15	50	68	8	22	31

3.4 Falls MOA

The results of the ignition potential assessment for the Falls MOA are presented below in Figure 3-4 and in Table 3-4.

Figure 3-4 shows that the median IC—the probability that a firebrand landing on receptive fuels will grow to a reportable size—is low to moderate for most of the year.

Table 3-4 shows that during the month of greatest risk (April), the median P(I)—the probability that a firebrand landing on receptive fuels will ignite a fire (reportable or not)—is 26 percent on the average day, 55 percent on the 93rd percentile day, and 74 percent on the worst day. The median IC during the same month was considerably lower: 12 percent on the average day, 36 percent on the 93rd percentile day, and 56 percent on the worst day.

The overall ignition potential (based on the month with the highest median IC) for the Falls MOA is moderate.

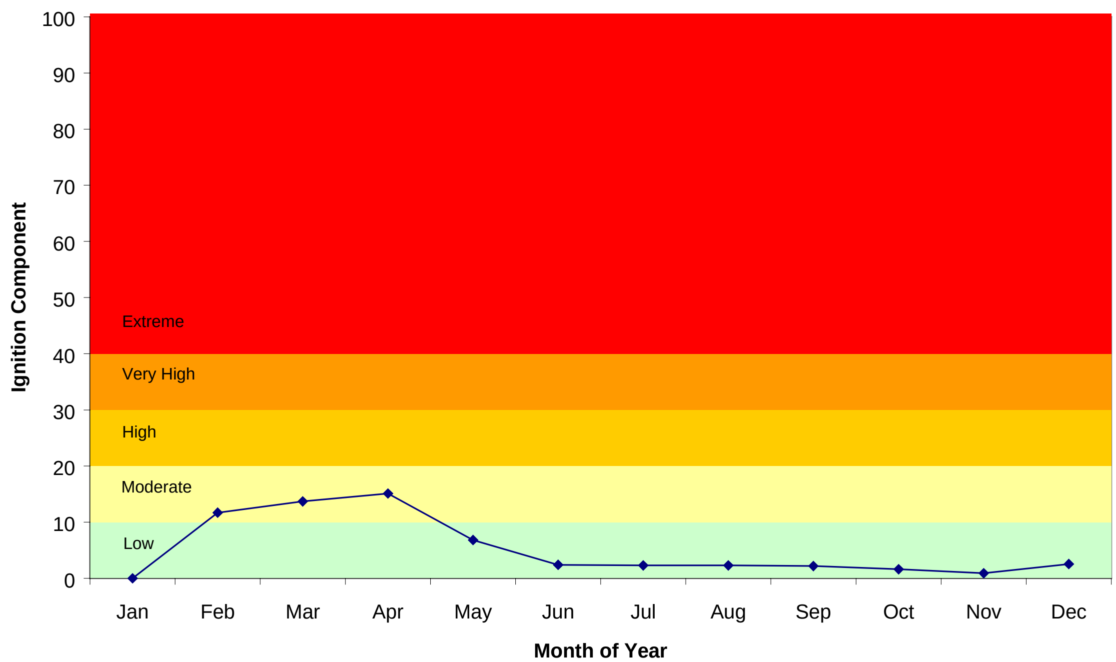


FIGURE 3-4
Median Ignition Component by Month of Year
Falls MOA

TABLE 3-4

Probability of Ignition and Ignition Component Summary for Falls MOA

Month	Number of Observations	Fuel Model	Percent Distribution (percent)	Probability of Ignition 50th (percent)	Probability of Ignition 93rd (percent)	Probability of Ignition 100th (percent)	Ignition Component 50th (percent)	Ignition Component 93rd (percent)	Ignition Component 100th (percent)
1	18	7L1PE3	60%	0	11	12	0	5	6
		7R1PE3	30%	0	11	13	0	8	9
		7C1PE3	10%	0	11	13	0	7	8
		Composite	100%	0	11	13	0	6	7
2	24	7L1PE3	60%	24	35	36	11	24	25
		7R1PE3	30%	24	34	36	13	26	27
		7C1PE3	10%	25	35	37	12	25	26
		Composite	100%	25	35	37	12	25	26
3	266	7L1PE3	60%	24	48	58	13	32	46
		7R1PE3	30%	24	48	58	15	34	51
		7C1PE3	10%	24	48	58	14	33	51
		Composite	100%	24	48	58	14	33	48
4	598	7L1PE3	60%	27	56	65	14	38	51
		7R1PE3	30%	28	57	65	17	42	62
		7C1PE3	10%	28	56	66	16	40	60
		Composite	100%	28	57	66	15	39	55
5	605	7L1PE3	60%	30	58	72	5	31	54
		7R1PE3	30%	19	57	73	10	34	59
		7C1PE3	10%	30	57	73	8	32	59
		Composite	100%	30	58	73	7	32	56
6	594	7L1PE3	60%	28	57	69	3	15	36
		7R1PE3	30%	0	53	71	0	22	44
		7C1PE3	10%	28	55	74	6	17	39
		Composite	100%	28	57	74	2	17	39
7	620	7L1PE3	60%	28	50	67	3	15	33
		7R1PE3	30%	0	49	66	0	21	38
		7C1PE3	10%	28	51	66	5	16	33
		Composite	100%	28	51	67	2	17	35
8	618	7L1PE3	60%	28	47	69	3	12	38
		7R1PE3	30%	0	44	69	0	19	43
		7C1PE3	10%	24	46	69	5	14	39
		Composite	100%	28	47	69	2	14	40
9	598	7L1PE3	60%	27	47	58	3	12	26
		7R1PE3	30%	0	44	56	0	20	32
		7C1PE3	10%	23	45	57	4	13	28
		Composite	100%	27	47	58	2	15	28
10	617	7L1PE3	60%	19	47	62	2	9	21
		7R1PE3	30%	0	42	59	0	17	30
		7C1PE3	10%	20	45	57	4	11	23
		Composite	100%	20	47	62	2	12	24
11	527	7L1PE3	60%	13	38	58	1	16	28
		7R1PE3	30%	0	32	56	0	18	33
		7C1PE3	10%	11	34	56	3	17	31
		Composite	100%	13	38	58	1	17	30

TABLE 3-4 (continued)

Probability of Ignition and Ignition Component Summary for Falls MOA

Month	Number of Observations	Fuel Model	Percent Distribution (percent)	Probability of Ignition 50th (percent)	Probability of Ignition 93rd (percent)	Probability of Ignition 100th (percent)	Ignition Component 50th (percent)	Ignition Component 93rd (percent)	Ignition Component 100th (percent)
12	129	7L1PE3	60%	8	29	39	2	16	28
		7R1PE3	30%	7	29	38	4	17	28
		7C1PE3	10%	8	30	38	3	17	28
		Composite	100%	8	30	39	3	16	28

3.5 Goose MOA

The results of the ignition potential assessment for the Goose MOA are presented below in Figure 3-5 and in Table 3-5.

Figure 3-5 shows that the median IC—the probability that a firebrand landing on receptive fuels will grow to a reportable size—is high to very high during the dry summer months and low to moderate for the rest of the year.

Table 3-5 shows that during the month of greatest risk (August), the median P(I)—the probability that a firebrand landing on receptive fuels will ignite a fire (reportable or not)—is 68 percent on the average day, 90 percent on the 93rd percentile day, and 100 percent on the worst day. The median IC during the same month was considerably lower: 33 percent on the average day, 58 percent on the 93rd percentile day, and 92 percent on the worst day.

The overall ignition potential (based on the month with the highest median IC) for the Goose MOA is very high.

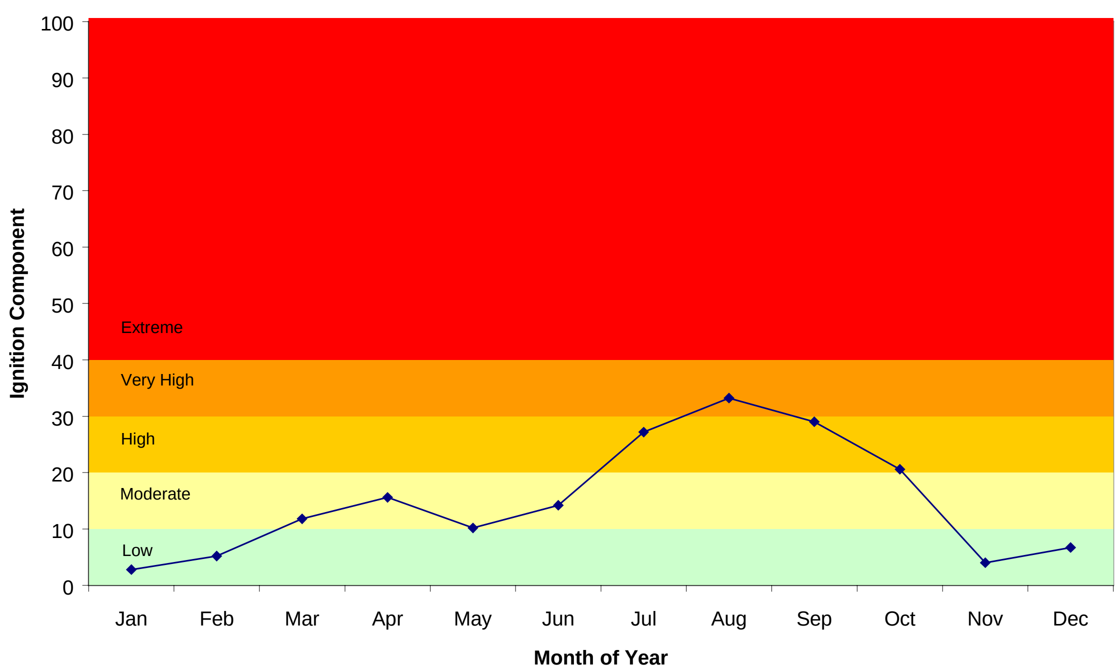


FIGURE 3-5
Median Ignition Component by Month of Year
Goose MOA

TABLE 3-5
Probability of Ignition and Ignition Component Summary for Goose MOA

Month	Number of Observations	Fuel Model	Percent Distribution (percent)	Probability of Ignition 50th (percent)	Probability of Ignition 93rd (percent)	Probability of Ignition 100th (percent)	Ignition Component 50th (percent)	Ignition Component 93rd (percent)	Ignition Component 100th (percent)
1	185	7C2PE1	60%	8	38	61	4	23	38
		7T2PE1	20%	9	38	62	1	19	35
		7F2PE1	20%	3	37	60	1	28	48
		Composite	100%	9	38	62	3	23	39
2	187	7C2PE1	60%	11	36	45	6	21	33
		7T2PE1	20%	12	37	45	3	19	31
		7F2PE1	20%	11	36	45	5	22	45
		Composite	100%	12	37	45	5	21	35
3	158	7C2PE1	60%	22	48	69	12	31	55
		7T2PE1	20%	22	49	70	10	27	55
		7F2PE1	20%	22	46	60	13	44	62
		Composite	100%	22	49	70	12	33	56
4	214	7C2PE1	60%	23	58	77	16	42	62
		7T2PE1	20%	24	59	77	13	39	55
		7F2PE1	20%	24	55	60	17	59	76
		Composite	100%	24	59	77	16	45	63
5	278	7C2PE1	60%	34	73	87	9	30	58
		7T2PE1	20%	35	71	86	7	24	50
		7F2PE1	20%	35	73	85	17	37	68
		Composite	100%	35	73	87	10	31	58
6	478	7C2PE1	60%	48	74	96	13	37	54
		7T2PE1	20%	48	74	95	10	30	51
		7F2PE1	20%	48	74	91	22	44	62
		Composite	100%	48	74	96	14	37	55
7	573	7C2PE1	60%	65	88	100	28	51	75
		7T2PE1	20%	66	88	100	19	47	73
		7F2PE1	20%	65	87	100	33	65	100
		Composite	100%	66	88	100	27	53	80
8	569	7C2PE1	60%	68	90	100	34	56	93
		7T2PE1	20%	68	90	100	28	50	81
		7F2PE1	20%	67	88	100	36	73	100
		Composite	100%	68	90	100	33	58	92
9	558	7C2PE1	60%	60	90	100	30	55	80
		7T2PE1	20%	60	90	100	24	49	79
		7F2PE1	20%	60	88	100	31	75	100
		Composite	100%	60	90	100	29	58	84
10	382	7C2PE1	60%	49	85	100	22	52	81
		7T2PE1	20%	49	85	100	13	44	81
		7F2PE1	20%	48	81	100	24	64	97
		Composite	100%	49	85	100	21	53	84

TABLE 3-5 (continued)

Probability of Ignition and Ignition Component Summary for Goose MOA

			Percent	Probability of Ignition			Ignition Component		
	Number of	Fuel	Distribution	50th	93rd	100th	50th	93rd	100th
Month	Observations	Model	(percent)	(percent)	(percent)	(percent)	(percent)	(percent)	(percent)
11	166	7C2PE1	60%	16	52	75	4	21	40
		7T2PE1	20%	15	49	78	3	13	32
		7F2PE1	20%	15	52	77	5	25	48
		Composite	100%	16	52	78	4	20	40
12	151	7C2PE1	60%	15	50	68	8	22	31
		7T2PE1	20%	15	51	69	4	18	23
		7F2PE1	20%	15	50	68	7	31	46
		Composite	100%	15	51	69	7	23	32

3.6 Hart MOA

The results of the ignition potential assessment for the Hart MOA are presented below in Figure 3-6 and in Table 3-6.

Figure 3-6 shows that the median IC—the probability that a firebrand landing on receptive fuels will grow to a reportable size—is very high to extreme during the dry summer months and low to moderate for the rest of the year.

Table 3-6 shows that during the month of greatest risk (August), the median P(I)—the probability that a firebrand landing on receptive fuels will ignite a fire (reportable or not)—is 67 percent on the average day, 95 percent on the 93rd percentile day, and 100 percent on the worst day. The median IC during the same month was also very high: 56 percent on the average day, 94 percent on the 93rd percentile day, and 100 percent on the worst day.

The overall ignition potential (based on the month with the highest median IC) for the Hart MOA is extreme.

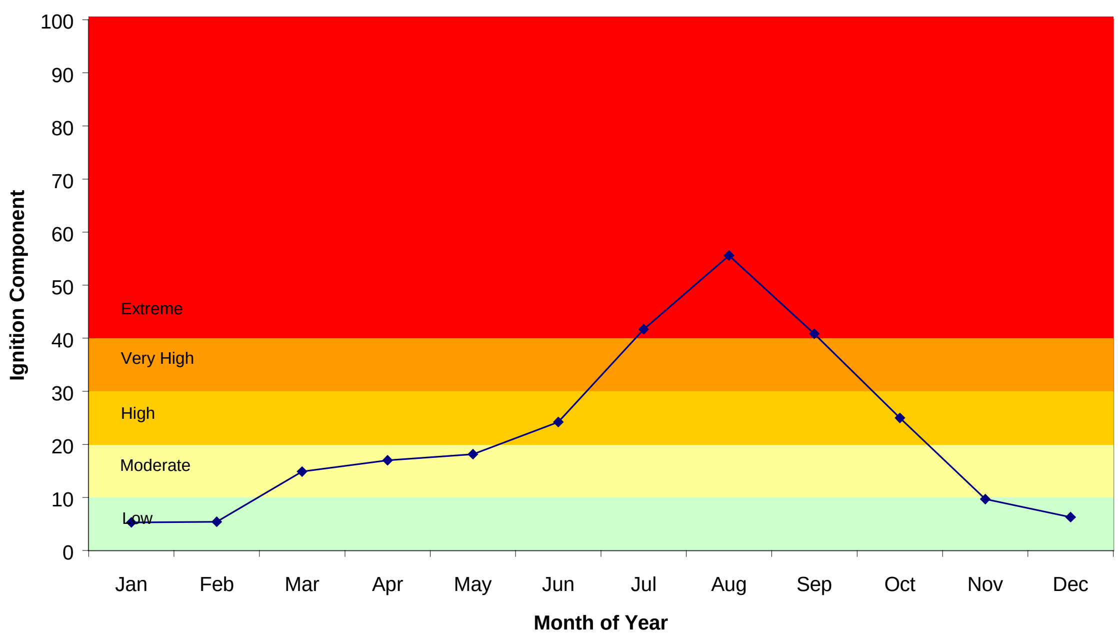


FIGURE 3-6
Median Ignition Component by Month of Year
Hart MOA

TABLE 3-6
Probability of Ignition and Ignition Component Summary for Hart MOA

			Percent	Probability of Ignition			Ignition Component		
Month	Number of Observations	Fuel Model	Distribution (percent)	50th (percent)	93rd (percent)	100th (percent)	50th (percent)	93rd (percent)	100th (percent)
1	246	7F1PE2	70%	12	39	64	6	32	71
		7T1PE2	25%	12	39	74	3	28	56
		7C1PE2	5%	13	39	74	7	32	61
		Composite	100%	13	39	74	5	31	67
2	231	7F1PE2	70%	12	39	54	6	25	46
		7T1PE2	25%	12	39	54	4	23	44
		7C1PE2	5%	12	39	54	7	25	47
		Composite	100%	12	39	54	5	25	46
3	201	7F1PE2	70%	24	50	65	16	50	72
		7T1PE2	25%	24	54	69	12	39	72
		7C1PE2	5%	23	53	69	16	43	72
		Composite	100%	24	54	69	15	47	72
4	259	7F1PE2	70%	27	53	71	18	54	87
		7T1PE2	25%	26	60	87	14	45	77
		7C1PE2	5%	26	59	88	18	48	85
		Composite	100%	27	60	88	17	52	84
5	313	7F1PE2	70%	37	70	85	21	54	84
		7T1PE2	25%	37	73	86	11	44	65
		7C1PE2	5%	36	72	85	14	47	69
		Composite	100%	37	73	86	18	51	79
6	463	7F1PE2	70%	50	76	89	28	62	95
		7T1PE2	25%	49	78	95	14	51	87
		7C1PE2	5%	49	78	95	22	56	90
		Composite	100%	50	78	95	24	59	93
7	525	7F1PE2	70%	59	82	97	44	92	100
		7T1PE2	25%	66	92	100	36	73	100
		7C1PE2	5%	66	92	100	40	75	100
		Composite	100%	66	92	100	42	86	100
8	510	7F1PE2	70%	52	76	90	60	97	100
		7T1PE2	25%	67	95	100	45	86	100
		7C1PE2	5%	67	94	100	47	87	100
		Composite	100%	67	95	100	56	94	100
9	491	7F1PE2	70%	50	76	94	44	89	100
		7T1PE2	25%	60	89	100	33	71	99
		7C1PE2	5%	60	89	100	36	73	99
		Composite	100%	60	89	100	41	84	100

TABLE 3-6 (continued)

Probability of Ignition and Ignition Component Summary for Hart MOA

			Percent	Probability of Ignition			Ignition Component		
Month	Number of Observations	Fuel Model	Distribution (percent)	50th (percent)	93rd (percent)	100th (percent)	50th (percent)	93rd (percent)	100th (percent)
10	414	7F1PE2	70%	45	70	85	28	82	100
		7T1PE2	25%	48	82	100	17	59	96
		7C1PE2	5%	48	82	100	23	61	96
		Composite	100%	48	82	100	25	75	99
11	254	7F1PE2	70%	19	56	81	11	46	80
		7T1PE2	25%	19	62	84	6	38	68
		7C1PE2	5%	18	62	83	10	40	68
		Composite	100%	19	62	84	10	44	76
12	205	7F1PE2	70%	13	41	56	7	26	61
		7T1PE2	25%	13	41	62	4	23	37
		7C1PE2	5%	13	40	60	8	25	41
		Composite	100%	13	41	62	6	25	54

3.7 Hog MOA

The results of the ignition potential assessment for the Hog MOA are presented below in Figure 3-7 and in Table 3-7.

Figure 3-7 shows that the median IC—the probability that a firebrand landing on receptive fuels will grow to a reportable size—is moderate for the majority of the year.

Table 3-7 shows that during the month of greatest risk (April), the median P(I)—the probability that a firebrand landing on receptive fuels will ignite a fire (reportable or not)—is 32 percent on the average day, 60 percent on the 93rd percentile day, and 92 percent on the worst day. The median IC during the same month was much lower: 16 percent on the average day, 38 percent on the 93rd percentile day, and 54 percent on the worst day.

The overall ignition potential (based on the month with the highest median IC) for the Hog MOA is moderate.

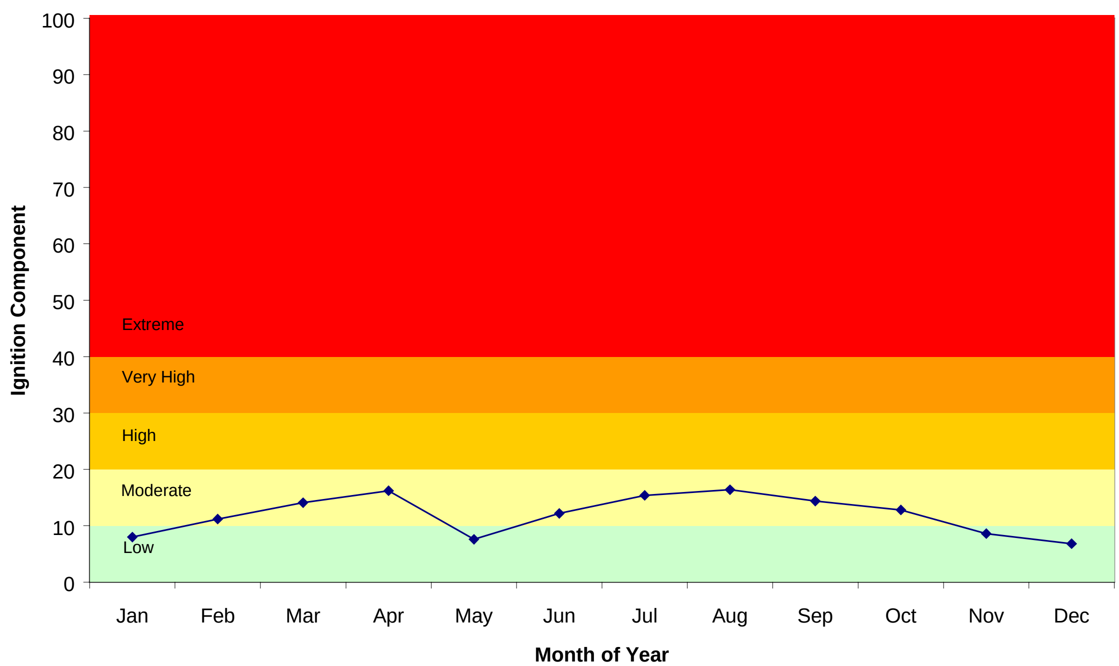


FIGURE 3-7
Median Ignition Component by Month of Year
Hog MOA

TABLE 3-7

Probability of Ignition and Ignition Component Summary for Hog MOA

			Percent	Probability of Ignition			Ignition Component		
	Number of	Fuel	Distribution	50th	93rd	100th	50th	93rd	100th
Month	Observations	Model	(percent)	(percent)	(percent)	(percent)	(percent)	(percent)	(percent)
1	559	7C2PE3	60%	17	44	67	8	25	43
		7R2PE3	20%	17	44	68	8	27	48
		7H2PE3	20%	17	44	67	8	24	41
		Composite	100%	17	44	68	8	25	44
2	482	7C2PE3	60%	24	51	72	11	30	52
		7R2PE3	20%	24	51	72	12	32	55
		7H2PE3	20%	24	52	72	11	29	51
		Composite	100%	24	52	72	11	30	52
3	571	7C2PE3	60%	26	58	74	14	36	56
		7R2PE3	20%	26	57	73	15	38	60
		7H2PE3	20%	26	58	74	14	35	52
		Composite	100%	26	58	74	14	36	56
4	494	7C2PE3	60%	32	60	92	16	38	55
		7R2PE3	20%	32	59	92	17	41	55
		7H2PE3	20%	32	59	92	16	37	52
		Composite	100%	32	60	92	16	38	54
5	489	7C2PE3	60%	23	52	68	7	23	36
		7R2PE3	20%	16	51	66	7	26	40
		7H2PE3	20%	25	52	66	10	24	36
		Composite	100%	25	52	68	8	24	37
6	483	7C2PE3	60%	30	51	63	12	24	33
		7R2PE3	20%	28	49	64	13	28	37
		7H2PE3	20%	30	50	65	12	25	32
		Composite	100%	30	51	65	12	25	34
7	517	7C2PE3	60%	36	57	86	15	28	57
		7R2PE3	20%	35	57	87	17	32	61
		7H2PE3	20%	36	57	87	15	28	53
		Composite	100%	36	57	87	15	29	57
8	480	7C2PE3	60%	38	64	81	16	32	43
		7R2PE3	20%	37	64	83	18	37	47
		7H2PE3	20%	40	64	82	16	33	45
		Composite	100%	40	64	83	16	33	44
9	480	7C2PE3	60%	34	59	75	14	31	43
		7R2PE3	20%	32	59	74	16	34	50
		7H2PE3	20%	34	60	74	14	31	44
		Composite	100%	34	60	75	14	32	45

TABLE 3-7 (continued)

Probability of Ignition and Ignition Component Summary for Hog MOA

Month	Number of Observations	Fuel Model	Percent Distribution (percent)	Probability of Ignition 50th (percent)	Probability of Ignition 93rd (percent)	Probability of Ignition 100th (percent)	Ignition Component 50th (percent)	Ignition Component 93rd (percent)	Ignition Component 100th (percent)
10	515	7C2PE3	60%	32	56	68	12	29	40
		7R2PE3	20%	31	55	68	15	32	46
		7H2PE3	20%	31	56	68	13	28	41
		Composite	100%	32	56	68	13	29	41
11	501	7C2PE3	60%	21	48	68	8	25	42
		7R2PE3	20%	20	48	68	10	27	42
		7H2PE3	20%	22	48	69	9	24	42
		Composite	100%	22	48	69	9	25	42
12	536	7C2PE3	60%	15	45	58	7	24	35
		7R2PE3	20%	16	45	59	7	25	40
		7H2PE3	20%	16	44	57	6	23	35
		Composite	100%	16	45	59	7	24	36

3.8 Juniper MOA

The results of the ignition potential assessment for the Juniper MOA are presented below in Figure 3-8 and in Table 3-8.

Figure 3-8 shows that the median IC—the probability that a firebrand landing on receptive fuels will grow to a reportable size—is high during the dry summer months and low to moderate for the rest of the year.

Table 3-8 shows that during the month of greatest risk (August), the median P(I)—the probability that a firebrand landing on receptive fuels will ignite a fire (reportable or not)—is 59 percent on the average day, 84 percent on the 93rd percentile day, and 99 percent on the worst day. The median IC during the same month was relatively high: 34 percent on the average day, 71 percent on the 93rd percentile day, and 98 percent on the worst day.

The overall ignition potential (based on the month with the highest median IC) for the Juniper MOA is very high.

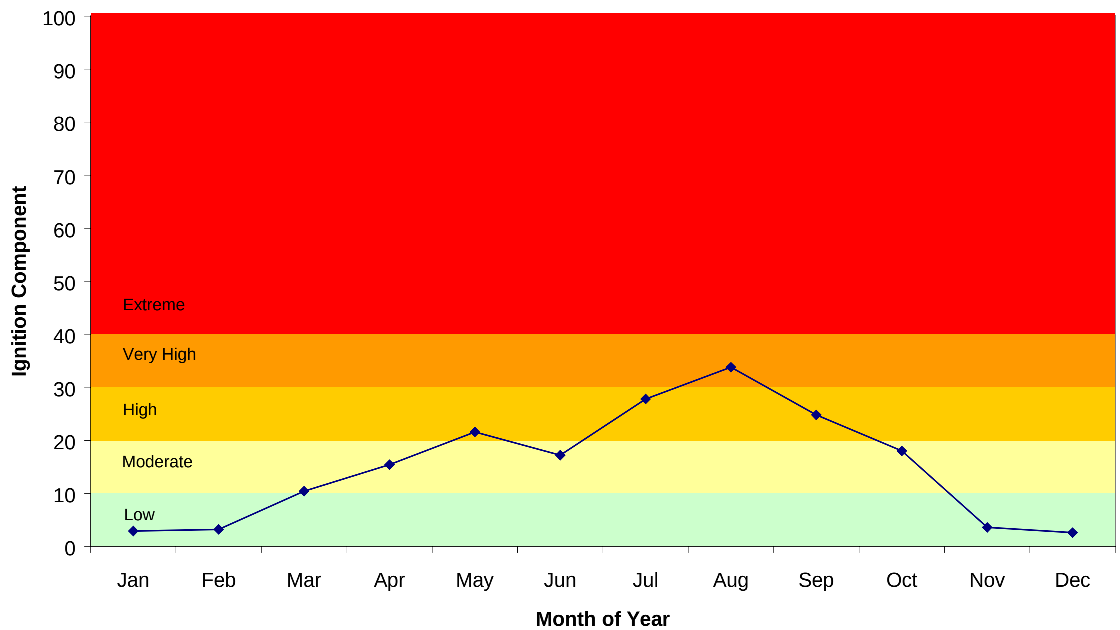


FIGURE 3-8
Median Ignition Component by Month of Year
Juniper MOA

TABLE 3-8

Probability of Ignition and Ignition Component Summary for Juniper MOA

Month	Number of Observations	Fuel Model	Percent Distribution (percent)	Probability of Ignition 50th (percent)	Probability of Ignition 93rd (percent)	Probability of Ignition 100th (percent)	Ignition Component 50th (percent)	Ignition Component 93rd (percent)	Ignition Component 100th (percent)
1	197	7F2PE1	60%	9	31	52	3	26	53
		7T2PE1	40%	10	32	54	2	23	32
		Composite	100%	10	32	54	3	25	45
2	165	7F2PE1	60%	9	29	41	4	21	31
		7T2PE1	40%	9	28	42	2	19	27
		Composite	100%	9	29	42	3	20	29
3	184	7F2PE1	60%	14	39	54	12	47	70
		7T2PE1	40%	15	45	70	8	41	59
		Composite	100%	15	45	70	10	44	66
4	264	7F2PE1	60%	18	44	56	17	54	73
		7T2PE1	40%	18	53	72	13	46	68
		Composite	100%	18	53	72	15	51	71
5	311	7F2PE1	60%	29	51	71	24	59	81
		7T2PE1	40%	30	59	81	18	53	69
		Composite	100%	30	59	81	22	57	76
6	493	7F2PE1	60%	41	68	99	22	44	75
		7T2PE1	40%	41	69	100	10	27	70
		Composite	100%	41	69	100	17	37	73
7	598	7F2PE1	60%	57	83	98	33	69	96
		7T2PE1	40%	58	84	100	20	55	84
		Composite	100%	58	84	100	28	63	91
8	584	7F2PE1	60%	57	82	98	37	77	100
		7T2PE1	40%	59	84	99	29	62	94
		Composite	100%	59	84	99	34	71	98
9	561	7F2PE1	60%	49	76	98	28	68	100
		7T2PE1	40%	50	78	100	20	57	85
		Composite	100%	50	78	100	25	64	94
10	420	7F2PE1	60%	38	73	98	22	60	87
		7T2PE1	40%	38	75	100	12	49	83
		Composite	100%	38	75	100	18	56	85
11	258	7F2PE1	60%	10	42	58	4	51	68
		7T2PE1	40%	11	51	69	3	42	63
		Composite	100%	11	51	69	4	47	66
12	214	7F2PE1	60%	7	28	38	3	21	36
		7T2PE1	40%	9	29	38	2	18	32
		Composite	100%	9	29	38	3	20	34

3.9 Lake Andes MOA

The results of the ignition potential assessment for the Lake Andes MOA are presented below in Figure 3-9 and in Table 3-9.

Figure 3-9 shows that the median IC—the probability that a firebrand landing on receptive fuels will grow to a reportable size—is low to moderate for the entire year.

Table 3-9 shows that during the month of greatest risk (April), the median P(I)—the probability that a firebrand landing on receptive fuels will ignite a fire (reportable or not)—is 29 percent on the average day, 63 percent on the 93rd percentile day, and 82 percent on the worst day. The median IC during the same month was lower: 16 percent on the average day, 46 percent on the 93rd percentile day, and 65 percent on the worst day.

The overall ignition potential (based on the month with the highest median IC) for the Lake Andes MOA is moderate.

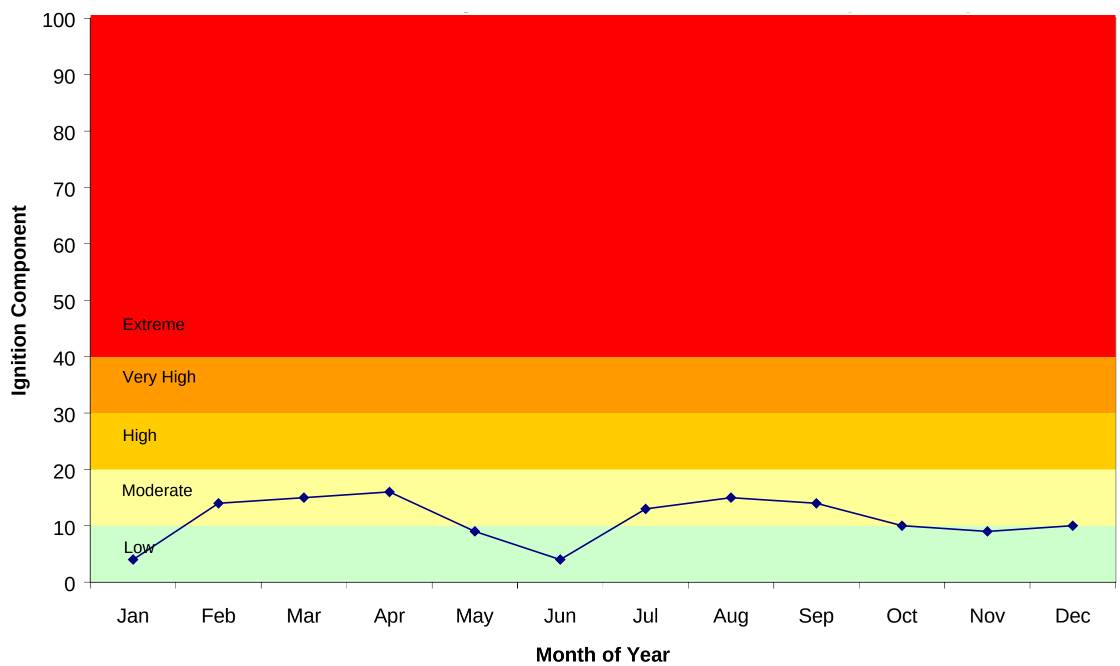


FIGURE 3-9
Median Ignition Component by Month of Year
Lake Andes MOA

TABLE 3-9

Probability of Ignition and Ignition Component Summary for Lake Andes MOA

Month	Number of Observations	Fuel Model	Percent Distribution (percent)	Probability of Ignition 50th (percent)	Probability of Ignition 93rd (percent)	Probability of Ignition 100th (percent)	Ignition Component 50th (percent)	Ignition Component 93rd (percent)	Ignition Component 100th (percent)
1	88	7L1PE2	100%	11	36	49	4	22	34
		Composite	100%	11	36	49	4	22	34
2	77	7L1PE2	100%	25	51	56	14	34	40
		Composite	100%	25	51	56	14	34	40
3	150	7L1PE2	100%	27	61	77	15	40	54
		Composite	100%	27	61	77	15	40	54
4	316	7L1PE2	100%	29	63	82	16	46	65
		Composite	100%	29	63	82	16	46	65
5	406	7L1PE2	100%	30	60	74	9	34	60
		Composite	100%	30	60	74	9	34	60
6	428	7L1PE2	100%	38	66	90	4	27	51
		Composite	100%	38	66	90	4	27	51
7	473	7L1PE2	100%	42	77	93	13	38	63
		Composite	100%	42	77	93	13	38	63
8	478	7L1PE2	100%	41	76	94	15	43	74
		Composite	100%	41	76	94	15	43	74
9	471	7L1PE2	100%	39	77	97	14	43	93
		Composite	100%	39	77	97	14	43	93
10	411	7L1PE2	100%	33	63	90	10	38	70
		Composite	100%	33	63	90	10	38	70
11	192	7L1PE2	100%	24	51	76	9	32	67
		Composite	100%	24	51	76	9	32	67
12	101	7L1PE2	100%	20	42	60	10	28	51
		Composite	100%	20	42	60	10	28	51

3.10 Rivers MOA

The results of the ignition potential assessment for the Rivers MOA are presented below in Figure 3-10 and in Table 3-10.

Figure 3-10 shows that the median IC—the probability that a firebrand landing on receptive fuels will grow to a reportable size—is low to moderate for the entire year.

Table 3-10 shows that during the month of greatest risk (April), the median P(I)—the probability that a firebrand landing on receptive fuels will ignite a fire (reportable or not)—is 31 percent on the average day, 60 percent on the 93rd percentile day, and 74 percent on the worst day. The median IC during the same month was lower: 17 percent on the average day, 42 percent on the 93rd percentile day, and 62 percent on the worst day.

The overall ignition potential (based on the month with the highest median IC) for the Rivers MOA is moderate.

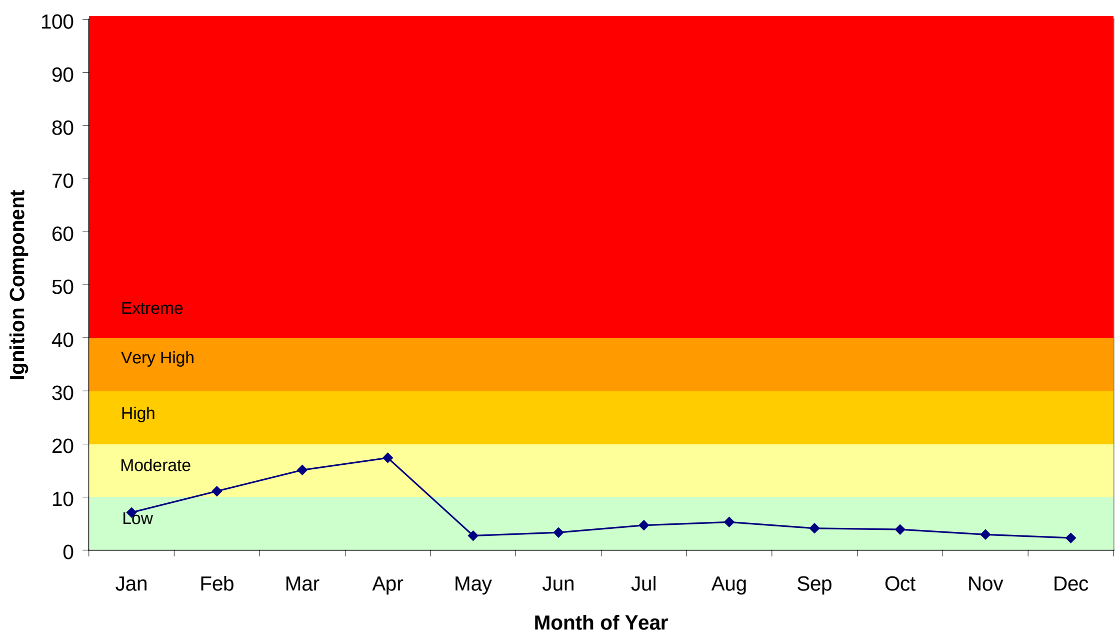


FIGURE 3-10
Median Ignition Component by Month of Year
Rivers MOA

TABLE 3-10

Probability of Ignition and Ignition Component Summary for Rivers MOA

			Percent	Probability of Ignition			Ignition Component		
	Number of	Fuel	Distribution	50th	93rd	100th	50th	93rd	100th
Month	Observations	Model	(percent)	(percent)	(percent)	(percent)	(percent)	(percent)	(percent)
1	466	7C2PE2	50%	15	43	67	7	27	44
		7R2PE2	30%	15	42	66	8	30	47
		7L2PE2	10%	15	42	68	5	24	41
		7H2PE2	10%	14	42	67	7	26	42
		Composite	100%	15	43	68	7	27	44
2	427	7C2PE2	50%	21	53	70	11	37	61
		7R2PE2	30%	21	54	69	12	38	61
		7L2PE2	10%	20	53	71	9	33	57
		7H2PE2	10%	20	54	70	11	36	60
		Composite	100%	21	54	71	11	37	61
3	535	7C2PE2	50%	25	56	74	15	39	67
		7R2PE2	30%	24	55	74	16	42	68
		7L2PE2	10%	25	55	74	13	35	66
		7H2PE2	10%	24	56	74	15	37	64
		Composite	100%	25	56	74	15	39	67
4	525	7C2PE2	50%	31	59	74	17	41	62
		7R2PE2	30%	31	59	73	19	44	63
		7L2PE2	10%	31	60	73	15	38	56
		7H2PE2	10%	31	59	73	17	41	60
		Composite	100%	31	60	74	17	42	62
5	480	7C2PE2	50%	17	51	69	3	12	27
		7R2PE2	30%	0	47	69	0	20	35
		7L2PE2	10%	27	53	69	3	7	26
		7H2PE2	10%	25	52	71	9	21	36
		Composite	100%	27	53	71	3	15	30
6	457	7C2PE2	50%	23	51	67	4	10	29
		7R2PE2	30%	0	44	66	0	18	27
		7L2PE2	10%	28	53	68	3	6	25
		7H2PE2	10%	28	54	68	10	19	34
		Composite	100%	28	54	68	3	13	29
7	457	7C2PE2	50%	34	68	90	6	24	42
		7R2PE2	30%	0	69	90	0	29	52
		7L2PE2	10%	38	69	91	4	20	38
		7H2PE2	10%	37	68	90	13	29	45
		Composite	100%	38	69	91	5	26	45

TABLE 3-10 (continued)

Probability of Ignition and Ignition Component Summary for Rivers MOA

			Percent	Probability of Ignition			Ignition Component		
	Number of	Fuel	Distribution	50th	93rd	100th	50th	93rd	100th
Month	Observations	Model	(percent)	(percent)	(percent)	(percent)	(percent)	(percent)	(percent)
8	436	7C2PE2	50%	40	66	83	7	27	40
		7R2PE2	30%	0	66	83	0	29	48
		7L2PE2	10%	38	66	84	4	23	36
		7H2PE2	10%	40	66	84	14	32	44
		Composite	100%	40	66	84	5	28	42
9	466	7C2PE2	50%	28	57	80	5	21	47
		7R2PE2	30%	0	56	80	0	26	48
		7L2PE2	10%	31	58	80	4	19	44
		7H2PE2	10%	31	57	80	12	26	49
		Composite	100%	31	58	80	4	23	47
10	447	7C2PE2	50%	28	56	69	5	17	30
		7R2PE2	30%	0	54	69	0	23	36
		7L2PE2	10%	28	56	67	3	16	28
		7H2PE2	10%	0	54	68	0	22	34
		Composite	100%	28	56	69	4	19	32
11	381	7C2PE2	50%	17	51	64	4	16	25
		7R2PE2	30%	0	49	64	0	20	29
		7L2PE2	10%	19	50	63	2	14	22
		7H2PE2	10%	20	50	62	8	21	36
		Composite	100%	20	51	64	3	18	27
12	389	7C2PE2	50%	11	41	62	3	18	34
		7R2PE2	30%	0	36	61	0	21	37
		7L2PE2	10%	13	42	64	2	16	30
		7H2PE2	10%	14	42	64	6	19	32
		Composite	100%	14	42	64	2	19	34

3.11 Shirley MOA

The results of the ignition potential assessment for the Shirley MOA are presented below in Figure 3-11 and in Table 3-11.

Figure 3-11 shows that the median IC—the probability that a firebrand landing on receptive fuels will grow to a reportable size—is low for the entire year.

Table 3-11 shows that during the month of greatest risk (April), the median P(I)—the probability that a firebrand landing on receptive fuels will ignite a fire (reportable or not)—is 22 percent on the average day, 45 percent on the 93rd percentile day, and 66 percent on the worst day. The median IC during the same month was lower: 12 percent on the average day, 29 percent on the 93rd percentile day, and 52 percent on the worst day.

The overall ignition potential (based on the month with the highest median IC) for the Shirley MOA is moderate.

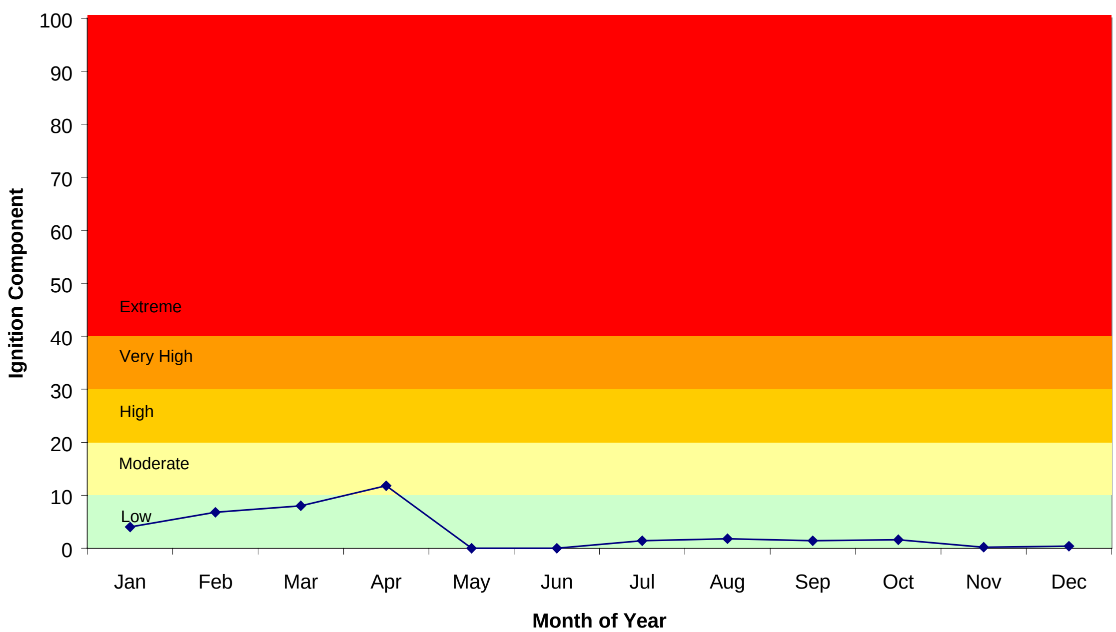


FIGURE 3-11
Median Ignition Component by Month of Year
Shirley MOA

TABLE 3-11

Probability of Ignition and Ignition Component Summary for Shirley MOA

Month	Number of Observations	Fuel Model	Percent Distribution (percent)	Probability of Ignition 50th (percent)	93rd (percent)	100th (percent)	Ignition Component 50th (percent)	93rd (percent)	100th (percent)
1	642	7R2PE3	80%	9	37	59	4	23	48
		7H2PE3	20%	8	37	59	4	21	46
		Composite	100%	9	37	59	4	23	48
2	571	7R2PE3	80%	12	39	61	7	25	45
		7H2PE3	20%	12	39	62	6	22	45
		Composite	100%	12	39	62	7	24	45
3	610	7R2PE3	80%	15	44	66	8	28	49
		7H2PE3	20%	14	44	66	8	25	43
		Composite	100%	15	44	66	8	27	48
4	564	7R2PE3	80%	22	44	66	12	30	53
		7H2PE3	20%	22	45	66	11	27	50
		Composite	100%	22	45	66	12	29	52
5	580	7R2PE3	80%	0	28	49	0	12	24
		7H2PE3	20%	0	37	54	0	15	25
		Composite	100%	0	37	54	0	12	24
6	593	7R2PE3	80%	0	0	47	0	0	19
		7H2PE3	20%	0	37	51	0	13	24
		Composite	100%	0	37	51	0	3	20
7	607	7R2PE3	80%	0	32	69	0	13	28
		7H2PE3	20%	20	45	70	7	17	35
		Composite	100%	20	45	70	1	14	29
8	596	7R2PE3	80%	0	49	73	0	21	39
		7H2PE3	20%	25	51	74	9	20	37
		Composite	100%	25	51	74	2	21	39
9	592	7R2PE3	80%	0	45	71	0	20	47
		7H2PE3	20%	20	48	72	7	20	43
		Composite	100%	20	48	72	1	20	46
10	615	7R2PE3	80%	0	39	61	0	16	37
		7H2PE3	20%	23	45	65	8	18	37
		Composite	100%	23	45	65	2	16	37
11	565	7R2PE3	80%	0	29	54	0	13	26
		7H2PE3	20%	3	40	56	1	16	26
		Composite	100%	3	40	56	0	13	26
12	605	7R2PE3	80%	0	29	54	0	17	33
		7H2PE3	20%	6	33	54	2	16	30
		Composite	100%	6	33	54	0	17	32

3.12 Snoopy MOA

The results of the ignition potential assessment for the Snoopy MOA are presented below in Figure 3-12 and in Table 3-12.

Figure 3-12 shows that the median IC—the probability that a firebrand landing on receptive fuels will grow to a reportable size—is moderate in the Spring and low for the rest of the year (no data for Winter).

Table 3-12 shows that during the month of greatest risk (April), the median P(I)—the probability that a firebrand landing on receptive fuels will ignite a fire (reportable or not)—is 28 percent on the average day, 58 percent on the 93rd percentile day, and 81 percent on the worst day. The median IC during the same month was lower: 18 percent on the average day, 45 percent on the 93rd percentile day, and 61 percent on the worst day.

The overall ignition potential (based on the month with the highest median IC) for the Snoopy MOA is moderate.

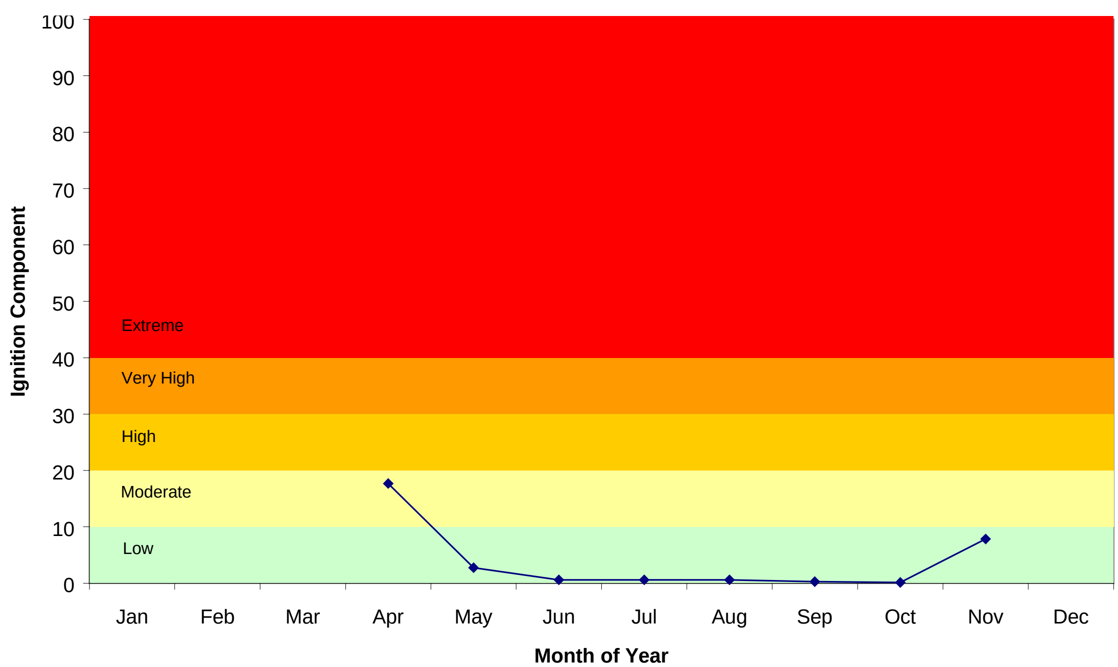


FIGURE 3-12
Median Ignition Component by Month of Year
Snoopy MOA

TABLE 3-12

Probability of Ignition and Ignition Component Summary for Snoopy MOA

			Percent	Probability of Ignition			Ignition Component		
	Number of	Fuel	Distribution	50th	93rd	100th	50th	93rd	100th
Month	Observations	Model	(percent)	(percent)	(percent)	(percent)	(percent)	(percent)	(percent)
1	0	7R1PE3	85%	ND	ND	ND	ND	ND	ND
		7C1PE3	15%	ND	ND	ND	ND	ND	ND
		Composite	100%	ND	ND	ND	ND	ND	ND
2	0	7R1PE3	85%	ND	ND	ND	ND	ND	ND
		7C1PE3	15%	ND	ND	ND	ND	ND	ND
		Composite	100%	ND	ND	ND	ND	ND	ND
3	2	7R1PE3	85%	ND	2	0	ND	1	0
		7C1PE3	15%	ND	2	0	ND	1	0
		Composite	100%	ND	2	0	ND	1	0
4	252	7R1PE3	85%	28	58	81	18	46	68
		7C1PE3	15%	28	57	81	16	44	68
		Composite	100%	28	58	81	18	45	68
5	578	7R1PE3	85%	5	59	81	2	30	68
		7C1PE3	15%	25	60	82	7	28	67
		Composite	100%	25	60	82	3	30	68
6	584	7R1PE3	85%	0	47	66	0	20	34
		7C1PE3	15%	23	51	68	4	12	25
		Composite	100%	23	51	68	1	19	33
7	610	7R1PE3	85%	0	44	56	0	19	36
		7C1PE3	15%	23	45	57	4	13	25
		Composite	100%	23	45	57	1	18	34
8	597	7R1PE3	85%	0	44	64	0	19	35
		7C1PE3	15%	20	45	62	4	13	31
		Composite	100%	20	45	64	1	18	34
9	594	7R1PE3	85%	0	33	47	0	14	23
		7C1PE3	15%	11	39	51	2	9	19
		Composite	100%	11	39	51	0	13	22
10	483	7R1PE3	85%	0	27	51	0	12	35
		7C1PE3	15%	6	35	52	1	10	31
		Composite	100%	6	35	52	0	12	34
11	86	7R1PE3	85%	15	34	45	8	18	26
		7C1PE3	15%	14	35	46	7	18	23
		Composite	100%	15	35	46	8	18	26
12	0	7R1PE3	85%	ND	ND	ND	ND	ND	ND
		7C1PE3	15%	ND	ND	ND	ND	ND	ND
		Composite	100%	ND	ND	ND	ND	ND	ND

ND = No Data

3.13 Steelhead MOA

The results of the ignition potential assessment for the Steelhead MOA are presented below in Figure 3-13 and in Table 3-13.

Figure 3-13 shows that the median IC—the probability that a firebrand landing on receptive fuels will grow to a reportable size—is low to very low for the entire year.

Table 3-13 shows that during the month of greatest risk (April), the median P(I)—the probability that a firebrand landing on receptive fuels will ignite a fire (reportable or not)—is 21 percent on the average day, 54 percent on the 93rd percentile day, and 74 percent on the worst day. The median IC during the same month was much lower: 9 percent on the average day, 37 percent on the 93rd percentile day, and 58 percent on the worst day.

The overall ignition potential (based on the month with the highest median IC) for the Steelhead MOA is low.

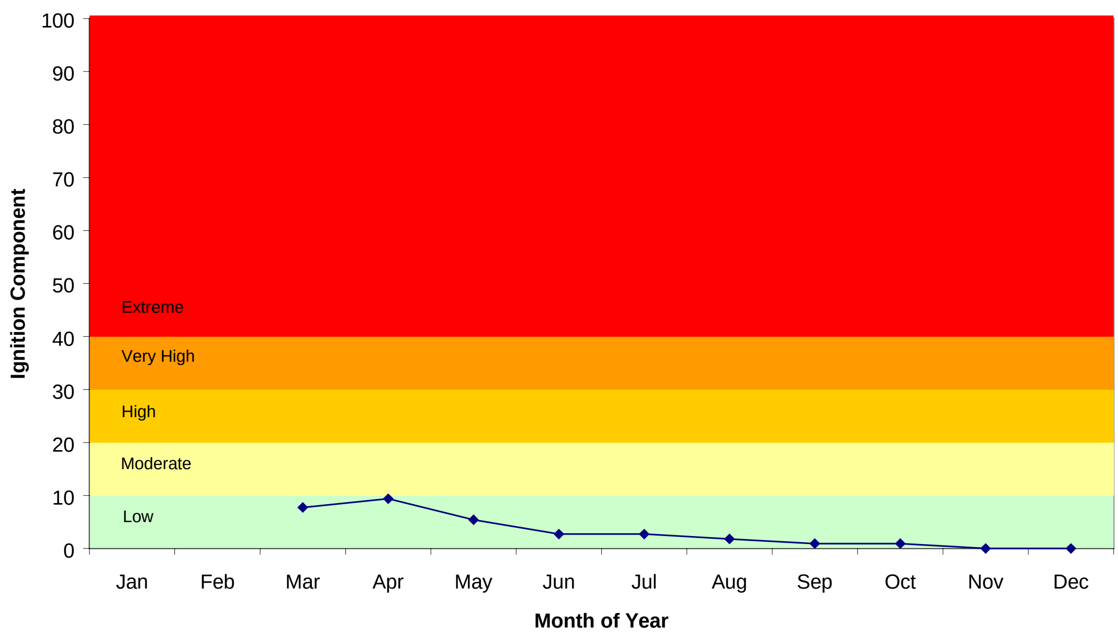


FIGURE 3-13
Median Ignition Component by Month of Year
Steelhead MOA

TABLE 3-13

Probability of Ignition and Ignition Component Summary for Steelhead MOA

			Percent	Probability of Ignition			Ignition Component		
Month	Number of Observations	Fuel Model	Distribution (percent)	50th (percent)	93rd (percent)	100th (percent)	50th (percent)	93rd (percent)	100th (percent)
1	0	7L1PE3	90%	ND	ND	ND	ND	ND	ND
		7R1PE3	10%	ND	ND	ND	ND	ND	ND
		Composite	100%	ND	ND	ND	ND	ND	ND
2	0	7L1PE3	90%	ND	ND	ND	ND	ND	ND
		7R1PE3	10%	ND	ND	ND	ND	ND	ND
		Composite	100%	ND	ND	ND	ND	ND	ND
3	115	7L1PE3	90%	18	53	69	8	30	53
		7R1PE3	10%	17	53	68	10	36	52
		Composite	100%	18	53	69	8	31	53
4	456	7L1PE3	90%	21	54	74	9	36	58
		7R1PE3	10%	21	54	73	13	41	61
		Composite	100%	21	54	74	9	37	58
5	500	7L1PE3	90%	30	62	87	5	36	68
		7R1PE3	10%	18	61	87	9	41	67
		Composite	100%	30	62	87	5	37	68
6	439	7L1PE3	90%	28	57	73	3	15	35
		7R1PE3	10%	0	52	74	0	22	43
		Composite	100%	28	57	74	3	16	36
7	369	7L1PE3	90%	28	53	77	3	13	29
		7R1PE3	10%	0	51	71	0	22	36
		Composite	100%	28	53	77	3	14	30
8	366	7L1PE3	90%	27	47	77	2	13	23
		7R1PE3	10%	0	42	78	0	18	33
		Composite	100%	27	47	78	2	13	24
9	318	7L1PE3	90%	13	40	69	1	12	30
		7R1PE3	10%	0	32	69	0	13	31
		Composite	100%	13	40	69	1	12	30
10	312	7L1PE3	90%	13	28	47	1	3	5
		7R1PE3	10%	0	0	39	0	0	16
		Composite	100%	13	28	47	1	3	6
11	191	7L1PE3	90%	0	29	47	0	5	20
		7R1PE3	10%	0	20	34	0	8	24
		Composite	100%	0	29	47	0	5	20
12	0	7L1PE3	90%	ND	ND	ND	ND	ND	ND
		7R1PE3	10%	ND	ND	ND	ND	ND	ND
		Composite	100%	ND	ND	ND	ND	ND	ND

ND = No Data

3.14 Volk MOA

The results of the ignition potential assessment for the Volk MOA are presented below in Figure 3-14 and in Table 3-14.

Figure 3-14 shows that the median IC—the probability that a firebrand landing on receptive fuels will grow to a reportable size—is moderate during the Spring months and low for the rest of the year.

Table 3-14 shows that during the month of greatest risk (April), the median P(I)—the probability that a firebrand landing on receptive fuels will ignite a fire (reportable or not)—is 28 percent on the average day, 59 percent on the 93rd percentile day, and 77 percent on the worst day. The median IC during the same month was much lower: 15 percent on the average day, 39 percent on the 93rd percentile day, and 56 percent on the worst day.

The overall ignition potential (based on the month with the highest median IC) for the Volk MOA is moderate.

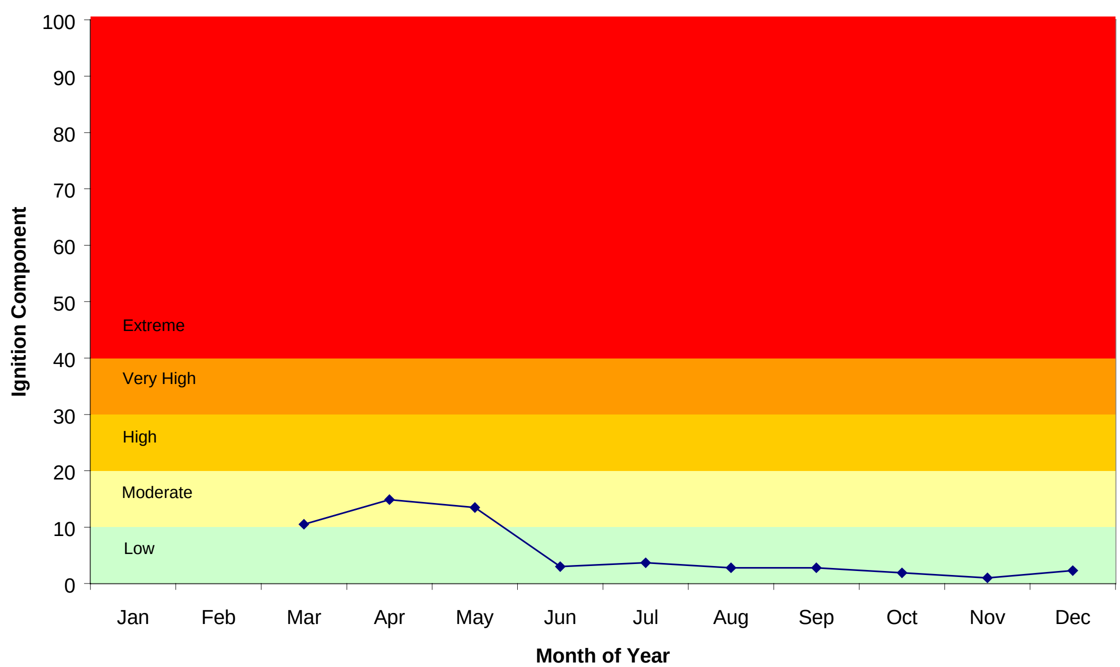


FIGURE 3-14
Median Ignition Component by Month of Year
Volk MOA

TABLE 3-14
Probability of Ignition and Ignition Component Summary for Volk MOA

			Percent	Probability of Ignition			Ignition Component		
Month	Number of Observations	Fuel Model	Distribution (percent)	50th (percent)	93rd (percent)	100th (percent)	50th (percent)	93rd (percent)	100th (percent)
1	0	7L1PE3	80%	ND	ND	ND	ND	ND	ND
		7C1PE3	10%	ND	ND	ND	ND	ND	ND
		7R1PE3	10%	ND	ND	ND	ND	ND	ND
		Composite	100%	ND	ND	ND	ND	ND	ND
2	0	7L1PE3	80%	ND	ND	ND	ND	ND	ND
		7C1PE3	10%	ND	ND	ND	ND	ND	ND
		7R1PE3	10%	ND	ND	ND	ND	ND	ND
		Composite	100%	ND	ND	ND	ND	ND	ND
3	189	7L1PE3	80%	22	49	56	10	30	42
		7C1PE3	10%	22	48	56	12	31	41
		7R1PE3	10%	22	49	57	13	31	45
		Composite	100%	22	49	57	11	30	42
4	593	7L1PE3	80%	28	59	77	15	38	55
		7C1PE3	10%	28	59	77	16	40	60
		7R1PE3	10%	28	59	76	17	42	60
		Composite	100%	28	59	77	15	39	56
5	606	7L1PE3	80%	33	60	74	13	35	49
		7C1PE3	10%	32	60	74	14	36	55
		7R1PE3	10%	32	59	73	17	39	58
		Composite	100%	33	60	74	14	36	51
6	594	7L1PE3	80%	31	57	76	3	16	40
		7C1PE3	10%	28	57	75	6	18	40
		7R1PE3	10%	0	54	76	0	24	45
		Composite	100%	31	57	76	3	17	41
7	618	7L1PE3	80%	30	53	71	4	15	32
		7C1PE3	10%	28	52	72	5	17	32
		7R1PE3	10%	0	51	71	0	22	36
		Composite	100%	30	53	72	4	16	32
8	619	7L1PE3	80%	28	47	69	3	12	30
		7C1PE3	10%	23	45	68	4	12	31
		7R1PE3	10%	0	45	71	0	19	36
		Composite	100%	28	47	71	3	13	31
9	596	7L1PE3	80%	27	47	63	3	11	24
		7C1PE3	10%	23	46	63	4	12	26
		7R1PE3	10%	0	46	64	0	19	31
		Composite	100%	27	47	64	3	12	25
10	617	7L1PE3	80%	19	46	57	2	10	20
		7C1PE3	10%	17	44	57	3	11	23
		7R1PE3	10%	0	39	56	0	17	25
		Composite	100%	19	46	57	2	11	21

ND = No Data

TABLE 3-14 (continued)

Probability of Ignition and Ignition Component Summary for Volk MOA

Month	Number of Observations	Fuel Model	Percent Distribution (percent)	Probability of Ignition 50th (percent)	Probability of Ignition 93rd (percent)	Probability of Ignition 100th (percent)	Ignition Component 50th (percent)	Ignition Component 93rd (percent)	Ignition Component 100th (percent)
11	502	7L1PE3	80%	13	33	57	1	12	29
		7C1PE3	10%	9	32	57	2	13	30
		7R1PE3	10%	0	25	56	0	15	30
		Composite	100%	13	33	57	1	12	29
12	44	7L1PE3	80%	9	21	24	2	9	16
		7C1PE3	10%	8	21	25	3	10	17
		7R1PE3	10%	9	21	24	4	10	17
		Composite	100%	9	21	25	2	9	16

SECTION 4
Conclusions

For the purposes of this investigation, the primary measure of ignition potential is the ignition component on an average day during the single month in each MOA with the highest fire danger. The ignition component is the probability that a firebrand landing on receptive fuels will grow to a reportable size fire of ¼ acre or more. It is a function of the probability that a firebrand will ignite a fire, and the rate of spread of the fire under a given set of terrain, fuel, and weather conditions.

Using this definition, the ignition potential in the 14 Phase I MOAs may be characterized as follows:

Ignition potential	MOA Name	Median Ignition Component*
Low	Steelhead	9
Moderate	Beaver	19
	Snoopy	18
	Rivers	17
	Hog	16
	Lake Andes	15
	Falls	15
	Volk	15
	Shirley	12
	Crypt	12
Very High	Dolphin	34
	Juniper	34
	Goose	33
Extreme	Hart	56

* During month of highest fire danger

SECTION 5

References

Bradshaw, L.S., J.E. Deeming, R.E. Burgan, J.D. Cohen (compilers). 1984. The 1978 National Fire-Danger Rating System: Technical Documentation. General Technical Report INT-169.

Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1984. 44 pp.

Addendum 1:

Wildland Fire Ignition Potential Assessment for the Pike West Military Operation Area

Prepared for

CH2M HILL

July 2000

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Portland, Oregon

SECTION 1
Introduction

This document is a supplement to a draft technical report on fire ignition potential within National Guard Military Operation Area (MOA)'s entitled *Wildland Fire Ignition Potential Assessment for Phase 1 National Guard Military Operations Areas in the United States*, dated July 2000. This supplement contains information on the Pike West MOA, which was inadvertently omitted in the draft report.

This supplement briefly summarizes the location and area of the Pike West MOA (Section 1), and the methods used to evaluate the ignition potential of the Pike West MOA (Section 2). The results of the assessment of ignition potential in the Pike West MOA are discussed in Section 3. Maps of the area and a disk copy of the calculations are included in Appendixes A and B, respectively.

TABLE 1
Location Summary of Pike West MOA for Phase I Investigation

Region	MOA Name	Area (sq. mi.)	States	Counties
Great Lakes	Pike West	4,344	MI	Alpena, Presque Isle, MI

SECTION 2

Methods of Analysis

The methodology used to assess the fire risk in the Pike West MOA includes the following tasks:

- Task 1—Map the vegetation conditions and fire weather stations located in and around the MOA.
- Task 2—Characterize the fuel models found within the MOA.
- Task 3—Characterize the fire weather conditions within the MOA using up to 20 years of historical data for representative stations.
- Task 4—Compute fire danger rating parameters that are used to assess fire risk—including the Ignition Component (IC) and the Spread Component (SC)—for each day and year of historical weather data. Calculate the Probability of Ignition [P(I)] using the predicted daily IC and SC values.
- Task 5—Aggregate the data by month of year, and compute the 50^{th}, 93^{rd}, and 100^{th}-percentile values for the IC and P(I) for each month of the year.

TABLE 3

NFDRS Fuel Model Assignments for the Pike West MOA

MOA	Vegetation Cover Type	Percent Coverage	Corresponding Fuel Model
Pike West (MI)	1: Agriculture	10%	7L1PE3
	7:Oak - Hickory	10%	7R1PE3
	10:Maple-beech-birch	10%	7R1PE3
	11: Aspen-Birch	40%	7R1PE3
	13:White-red-jack pine	30%	7C1PE3

TABLE 4

Summary of Representative WIMS Weather Stations for the Pike West MOA

MOA	WIMS Station Number	Selection Criteria			Rank (Order of Use)
		Proximity to MOA (Distance)	Representative Vegetation?	Data Completeness (Years Missing)	
Pike West	202301	At boundary	Yes	15	3
	202701	Outside	Yes	19	5
	202902	At boundary	Yes	No	1
	201599	Outside	Yes	16	4
	201504	Outside	Yes	1	2
	202301	At boundary	Yes	15	3

SECTION 3

Results

The results of the fire risk assessment for the Pike West MOA are presented in Figure 3-1, with tabular data presented in Tables 3-1.

3.1 Pike West MOA

Figure 3-1 shows that the median IC—the probability that a firebrand landing on receptive fuels will grow to a reportable size—is moderate during the Spring months prior to leaf break (March through May), and low for the remainder of the year.

Table 3-1 shows that during the month of greatest fire risk (April), the median P(I)—the probability that a firebrand landing on receptive fuels will ignite a fire (reportable or not)—is 24 percent on the average day, 61 percent on the 93rd percentile day, and 77 percent on the worst day. The ignition component—the probability that the fire once ignited will grow to a reportable size of ¼ acre or more—during the same month was somewhat lower: 14 percent on the average day, 43 percent on the 93rd percentile day, and 64 percent on the worst day.

The overall ignition potential (based on the month with the highest median IC) for the Pike West MOA is moderate.

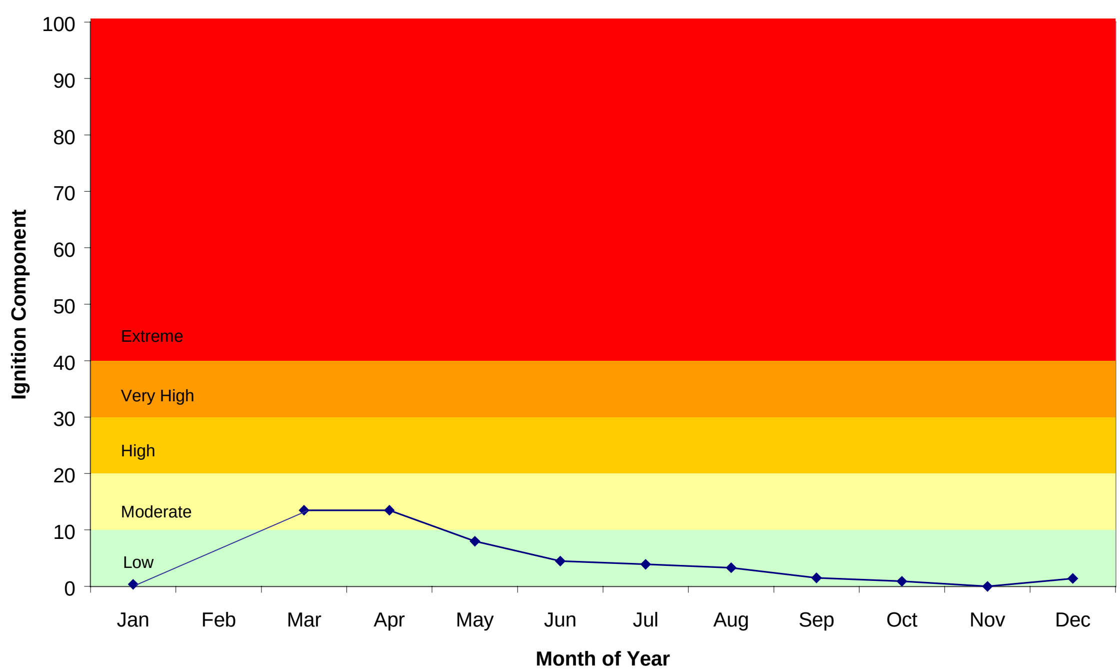

FIGURE 3-1
Median Ignition Component by Month of Year – Pike West MOA

TABLE 3-1
Probability of Ignition and Ignition Component Summary for Pike West MOA

			Percent	Probability of Ignition			Ignition Component		
Month	Number of Observations	Fuel Model	Distribution (percent)	50th (percent)	93rd (percent)	100th (percent)	50th (percent)	93rd (percent)	100th (percent)
1	11	7C1PE3	60%	2	11	7	1	7	4
		7L1PE3	30%	0	12	8	0	5	2
		7R1PE3	10%	1	11	7	1	8	4
		Composite	100%	2	12	8	0	7	3
2	0	7C1PE3	60%	ND	ND	ND	ND	ND	ND
		7L1PE3	30%	ND	ND	ND	ND	ND	ND
		7R1PE3	10%	ND	ND	ND	ND	ND	ND
		Composite	100%	ND	ND	ND	ND	ND	ND
3	142	7C1PE3	60%	24	55	64	14	35	47
		7L1PE3	30%	24	55	64	12	31	46
		7R1PE3	10%	24	55	64	15	36	47
		Composite	100%	24	55	64	14	34	47
4	555	7C1PE3	60%	23	61	77	14	44	65
		7L1PE3	30%	24	60	76	12	41	60
		7R1PE3	10%	24	61	76	15	44	65
		Composite	100%	24	61	77	14	43	64
5	619	7C1PE3	60%	31	62	77	9	35	57
		7L1PE3	30%	34	61	76	6	34	59
		7R1PE3	10%	17	60	76	8	38	62
		Composite	100%	34	62	77	8	35	58
6	589	7C1PE3	60%	32	57	74	6	16	39
		7L1PE3	30%	31	57	75	3	13	36
		7R1PE3	10%	0	56	73	0	25	42
		Composite	100%	32	57	75	5	16	38
7	578	7C1PE3	60%	28	52	81	5	13	39
		7L1PE3	30%	28	54	81	3	11	37
		7R1PE3	10%	0	51	81	0	22	45
		Composite	100%	28	54	81	4	13	39
8	537	7C1PE3	60%	23	45	65	4	12	30
		7L1PE3	30%	27	47	68	3	11	25
		7R1PE3	10%	0	42	66	0	18	32
		Composite	100%	27	47	68	3	12	29
9	496	7C1PE3	60%	11	40	71	2	11	32
		7L1PE3	30%	13	41	69	1	9	30
		7R1PE3	10%	0	37	69	0	16	35
		Composite	100%	13	41	71	2	11	32
10	488	7C1PE3	60%	6	34	56	1	7	23
		7L1PE3	30%	13	38	57	1	4	21
		7R1PE3	10%	0	0	52	0	0	26
		Composite	100%	13	38	57	1	5	23
11	269	7C1PE3	60%	0	26	40	0	7	24
		7L1PE3	30%	0	28	38	0	4	20
		7R1PE3	10%	0	14	33	0	7	24
		Composite	100%	0	28	40	0	6	23
12	31	7C1PE3	60%	4	12	13	2	5	7
		7L1PE3	30%	0	12	13	0	4	6
		7R1PE3	10%	3	12	12	2	5	7
		Composite	100%	4	12	13	1	5	7

ND: No data