INTEGRATED
FIRE MANAGEMENT PLAN
CAMP EDWARDS TRAINING SITE







MASSACHUSETTS ARMY NATIONAL GUARD

This Integrated Fire Management Plan (IFMP) meets all requirements as described in the Army Wildland Fire Policy Guidance and references therein, Army Regulation 200-3 (Natural Resources-Land, Forest and Wildlife Management), Army Regulation 420-90 Fire and Emergency Services, and the Executive Summary of this document. Furthermore, the undersigned do hereby agree to cooperate in the implementation of the Camp Edwards IFMP.

_____Date:_____
Adjutant General of Massachusetts
Office of the Adjutant General
Massachusetts National Guard

_____Date:_____
Director of Facilities and Engineering
Massachusetts Army National Guard

_____Date:_____
Environmental Program Manager
Massachusetts Army National Guard

_____Date:_____
Commander, Camp Edwards Training Center
Massachusetts Army National Guard
Camp Edwards, Massachusetts

_____Date:_____
Director of Plans, Operations, and Training
Massachusetts Army National Guard
Camp Edwards, Massachusetts

_____Date:_____
Natural Resource Manager
Massachusetts Army National Guard
Camp Edwards, Massachusetts

INTEGRATED FIRE MANAGEMENT PLAN

CAMP EDWARDS TRAINING SITE
MASSACHUSETTS ARMY NATIONAL GUARD

April 2006

Prepared by:

Daniel J. Grenier, M.S.
Fire Management Ecologist
The Nature Conservancy
Massachusetts Chapter
Plymouth, Massachusetts

And

Natural Resource Office
Environmental and Readiness Center
Massachusetts Army National Guard
Camp Edwards Training Site, Massachusetts

Reviewed by:

Massachusetts Army National Guard

Michael A. Ciaranca
Natural Resources Manager
Camp Edwards Training Site

John P. Kelly
Natural Resource Planner
Camp Edwards Training Site

The Nature Conservancy

Karen Lombard
Assistant Director of Conservation Science
Massachusetts Field Office

ACKNOWLEDGEMENTS

This Integrated Fire Management Plan is based upon the research, planning, documentation, prescribed burning and other field work of Dr. William A. Patterson III and his students at the University of Massachusetts. This plan expands previous fire management planning at Camp Edwards by Dr. William A. Patterson III and Charles Ruffner (2001).

We also recognize Joel Carlson, the former Fire Manager for the Massachusetts Chapter of The Nature Conservancy, for initiating the partnership that now exists between the MAARNG Natural Resource Office and The Nature Conservancy. This partnership has provided a framework for better planning and has allowed for the advancemnmet of fire management on Camp Edwards.

We would like to thank Andrew M. Beavers, Center for Environmental Management of Military Lands, Colorado State University Fort Collins, Colorado and the Environmental Office, Kansas Army National Guard, Topeka, KS as we adopted much of the format and content (applicable to the Camp Edwards Training Site) from their Integrated Fire Management Plan.

Thanks are also extended to Dr. Michael Ciaranca (MAARNG), John Kelly (MAARNG), Joel Carlson, and Karen Lombard (TNC) for their review and comments that aided in the completion of this integrated fire management plan.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

(AR) Army Regulations
(CETS) Camp Edwards Training Site
(CFM) Custom fuel models
(CFR) Code of Federal Regulations
(DCR) Massachusetts Department of Conservation and Recreation
(DEP) Department of Environmental Protection
(DFW) Massachusetts Division of Fisheries and Wildlife
(DoD) Department of Defense
(E) Endangered
(ESA) Endangered Species Act
(FEIS) Fire Effects Information System
(FMB) Fire Management Block
(FOFEM) First Order Fire Effects Model
(GIS) Geographic Information System
(ICS) Incident Command System
(IFMP) Integrated Fire Management Plan
(INRMP) Integrated Natural Resources Management Plan
(ITAM) Integrated Training Area Management Program
(JFHQ) Joint Force Headquarters
(LCTA) Land Condition Trend Analysis
(MAANG) Massachusetts Air National Guard
(MAARNG) Massachusetts Army National Guard
(MMR) Massachusetts Military Reservation
(MOS) Military Occupational Skill
(NEPA) National Environmental Policy Act
(NFDRS) National Fire Danger Rating System
(NPS) US Park Service
(NSTAR) NSTAR Electric
(NWCG) National Wildfire Coordinating Group
(NWCG ICS) National Wildfire Coordinating Group Incident Command System
(PAO) Public Affairs Office
(PTB) Position Task Book
(RTLA) Range Training Land Assessment
(SC) Special concern
(SCSF) Shawme-Crowell State Forest
(SFM) Standard fuel models
(SFR)
(SMZ) Smoke Management Zone
(SVS) Stand Visualization System
(T) Threatened
(TNC) The Nature Conservancy
(UMASS) University of Massachusetts at Amherst
(USAF) United States Air Force
(USCG) United States Coast Guard
(USDA) United States Department of Agriculture
(VA) Veterans Administration
(VDDT) Vegetation Dynamics Development Tool
(WFAS) The Wildland Fire Assessment System
(WL) Watch-list
(WUI) Wildland Urban Interface

EXECUTIVE SUMMARY

Natural communities within the Camp Edwards Training Site (CETS) are fire dependent systems shaped over thousands of years. With Euro-American influence, the natural fire regime has mostly been suppressed and replaced with infrequent human induced catastrophic fires. Further anthropogenic changes to the environment surrounding Camp Edwards has greatly accelerated in recent times with home building and population growth, creating a severe wildland urban interface. With this development it is imperative that the MAARNG and the surrounding communities address and plan for wildland fire.

It is the intent of the MAARNG and other stake holders that fire be reintroduced to this system using a landscape scale approach. It is critical to the success of this undertaking that wildland and prescribed fire planning is in place to ensure the most ecologically sound and safest approach to this endeavor.

The goal of the IFMP is to support the military mission of the Camp Edwards Training Site, to promote public safety and the protection of the surrounding community from wildland fire, while promoting the sustainable management of native biological systems by encouraging sound fire management planning, policy, and procedure and also to:

- **guide the decision making process so that safety, social, political, and resource values are evaluated and addressed the with appropriate management.**

- **provide a framework for fuels management through the use of prescribed fire.**

- **provide a platform for cooperation in planning and implementing a fire program within and across agency boundaries.**

Program operations in the plan include preparedness, prevention, fuels management, and suppression. Applicable resource goals and objectives for this Integrated Fire Management Plan are derived from the Camp Edwards Integrated Natural Resource Management Plan in conjunction with the Department of the Army wildland fire policy (i.e., AR 420-90 and AR 200-3). Current scientific knowledge (at the local and international scale), historical background, and operational standards have also been incorporated into this plan to accomplish resource and fire management goals and objectives. Guidance and management strategies contained within are subject to change as conditions dictate; new knowledge is obtained, or as determined by the MAARNG.

This plan is to function as a “living document” that evolves with scientific knowledge and operational protocols. On-going review and updates will consequently be prepared by the Massachusetts Army National Guard, Natural Resource Office Camp Edwards, or as deemed appropriate by the MANG-JFHQ..

1. INTRODUCTION

Natural communities found on the Camp Edwards Training Site (CETS) are fire dependant systems resulting from interactions with fire through time. With Euro-American influence, the natural fire regime has been suppressed and replaced with infrequent human induced catastrophic fires. Further anthropogenic changes to the environment surrounding Camp Edwards has greatly accelerated in recent times with home building and subsequent population growth, creating a severe wildland urban interface. Given this scenario, the Massachusetts Army National Guard (MAARNG) aims to proactively address and plan for wildland fire using a landscape-scale approach outlined in the Integrated Fire Management Plan (IFMP). The goal of the IFMP is to support the military mission of the Camp Edwards Training Site, to promote public safety and the protection of the surrounding community from wildland fire, while promoting the sustainable management of native biological systems by encouraging sound fire management planning, policy, and procedure.

1.1. Existing Conditions

The primary mission of Camp Edwards is to provide a viable training site that supports the mission of the MAARNG. With this, another important goal for the training site is good stewardship of the land. Training to accomplish the primary mission requires the use of weapons and techniques that may increase the likelihood of wildfire. Great care must be taken, on the fire-prone lands of Camp Edwards, to ensure the continued viability of these lands, both as a training resource and as an important part of the local ecosystem.

The Camp Edwards Training Site is also known as the Upper Cape Water Supply Reserve. It is a sole source aquifer for the upper Cape Cod area. Thus, all actions taken during fire management activities should be considered for the potential impacts to the groundwater.

1.2. Military Training

The majority of training at Camp Edwards revolves around small arms target practice and tactical maneuvers. Wildland fire impacts on ecosystems are well documented, but fire also directly influences military training and the military's ability to accomplish its mission through:

- Endangerment to the lives of soldiers - Soldiers training in the field are normally on foot with limited transportation. Fires that are driven by high winds could easily overtake soldiers, trapping them and ultimately causing injury or death.
- Explosive hazards - The explosive hazards inherent in military training in the field are multiplied when exposed to wildfire. Ammunition and unexploded ordinance on the ranges and in the training areas creates extremely hazardous conditions to personnel when personnel are in close proximity to a fire.
- Loss of access - Fires may result in a loss of access to training areas and ranges either during or after a fire. When notified of a wildfire, Range Control calls for a cease-fire and closes that particular range or training area. If the fire has escaped containment, adjacent areas may require evacuation as well.

- Disruption of training schedules - Cease-fire and closures of ranges/training areas due to wildfires create a ripple effect from the range scheduling office down to the units conducting training. Rescheduling an area cannot always be accomplished within a unit's required time frame.
- Destruction of targets/control systems - Wildfire damage to electronic targets and associated control systems on live-fire range complexes can be extremely costly. The time necessary to repair these systems causes the loss of valuable training opportunities.
- Destruction of vegetation - Vegetation is used by soldiers for cover, concealment and camouflage. Without this vegetation, training in the art of camouflage and concealment is rendered difficult or impossible. The absence of vegetation also promotes erosion, which in turn reduces trafficability. This creates unsafe driving conditions during inclement weather as well as hazards to dismounted soldiers.
- Costs - Wildfires can be costly and impose damages that siphon off training funds. Damage to off-post resources also result in both economic and political costs

1.3. Regulatory Requirements

Both federal and state policies, laws, and regulations apply to natural resources management at Camp Edwards. Several of particular importance (non-inclusive) to the IFMP are outlined below:

- Department of Defense (DoD) Instruction 4715.3 (Environmental Conservation Program) - provides guidelines on developing environmental programs on military installations.
- DoD Instruction 6055.6, 10 Oct 00 - the Department of Defense Fire and Emergency Service Program
- Army Wildland Fire Policy Guidance (Army Memorandum, 04 Sept 02)
- Army Regulation 200-1- provides guidelines on protection and enhancement of the environment.
- Army Regulation 200-2 - discusses the review environmental effects of Army actions.
- Army Regulation 200-3 - includes guidelines on conservation, management, and restoration of land and natural resources.
- Army Regulation 200-4 - prescribes Army policies, procedures, and responsibilities for meeting cultural resource compliance and management requirements. These policies are designed to ensure that Army installations make informed decisions regarding cultural resources under their control in compliance with public laws, in support of the military mission, and consistent with sound principles of cultural resource management.
- Camp Edwards Integrated Natural Resources Management Plan (INRMP; Ciaranca et al 2001)
- The Sikes Act (16 U.S.C. 670a *et seq*.), and the Sikes Act Improvement Amendments of 1997
- National Wildfire Coordinating Group's Wildland Fire Qualifications Subsystem Guide, PMS 310-1/NFES 1414 (Anonymous 2000)
- The National Environmental Policy Act (NEPA) - requires review of environmental consequences of federal actions.

- The Endangered Species Act (ESA) of 1973 - requires all federal agencies to carry out programs for the conservation of endangered and threatened species. In addition, each agency shall insure that any action authorized, funded or carried out, is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat. Endangered species have the highest biotic priority protection. If the candidate species is listed as federally endangered, threatened, or proposed for endangered or threatened status, the installation shall design and implement a management program that preserves and protects those species.
- Federal Water Pollution Control Act (i.e., the Federal Clean Water Act) as amended through P.L. 107–303, November 27, 2002
- Federal Clean Air Act set by the United States Environmental Protection Agency as amended in 1990
- Massachusetts General Laws Chapter 47, Acts of 2002 Environmental Performance Standards,
- The Massachusetts Endangered Species Act (M.G.L. Chapter 131A) - prevents a loss or take of state-listed rare species
- The Massachusetts Wetland Protection Act (M.G.L Chapter.131: Section 40)
- The Massachusetts Clean Air Act (M.G.L. Chapter 111: Section 142A Pollution or contamination of atmosphere; prevention; regulations; violation; enforcement)
- National Historic Preservation Act - Section 106 of the National Historic Preservation Act of 1966, as amended, requires installation commanders to identify, evaluate, and take into account the effects of undertakings on historic properties in accordance with the procedures outlined in 36 Code of Federal Regulations (CFR) Part 800. Section 106 also requires consultation with the State Historic Preservation Officer when an agency action may have an adverse impact on eligible and historic properties.

It is important to note that most of the laws and regulations guiding this IFMP currently fall under the Massachusetts Army National Guard directive, but that other policy set forth by neighboring entities on the MMR (i.e., the United States Coast Guard, PAVE PAWS, the United States Air Force, the Massachusetts Air National Guard) may also be relevant. The legal scope of this document may expand in the future.

1.4. General Responsibilities

Currently, (2006) the MAARNG Natural Resource Office carries the primary responsibility for the implementation and maintenance of all aspects of this IFMP. The MAARNG Natural Resource Office will ensure that the priorities and needs of the wildland fire program are communicated to all MMR stakeholders for appropriate action in order to achieve its goals and objectives. Other outside parties and agencies will be responsible only to the degree specified through a Memorandum of Understanding.

2. SITE BACKGROUND INFORMATION

2.1. General Description

The Massachusetts Military Reservation (22,000 acres) is located on Upper Cape Cod, lies approximately between 41°37'30" and 41°45'N latitude and 70°30' to 70°37'30"W

longitude (Figure 2.1) and is located in the towns of Bourne (western half) and Sandwich (east), with a small portion in Mashpee to the southeast (Figure 2.2). The town of Falmouth is to the southwest with the Cape Cod Canal to the northwest. Land occupied by the Army Corp of Engineers, which is adjacent to the Cape Cod Canal is also located to the northwest, while the Shawme-Crowell State Forest (SCSF) is to northeast. Occupants of the reservation include but are not limited to Camp Edwards, Otis Air National Guard Base, the Veterans Administration Cemetery, and the Coast Guard (Figure 2.2).

North of the MMR border, along the mid-Cape Highway (Rt. 6), the Shawme-Crowell State Forest, a 742-acre tract managed by the Massachusetts Department of Conservation and Recreation, buffers the town of Sandwich from activities on the Reservation. The State Forest extends approximately three miles along the northern border of the MMR. The Francis A. Crane Wildlife Management Area, a 1,400-acre, largely forested tract managed by the Massachusetts Division of Fisheries and Wildlife, acts as a buffer between the MMR and developed areas south of Route 151 on the southern boundary of the Reservation. Much of the western boundary of the MMR is either directly adjacent to Route 28, a four-lane highway, or is further buffered by the Town of Bourne Disposal Area, which is located between Route 28 and the MMR, southeast of the Bourne rotary. On the eastern boundary, adjacent land is rapidly being transformed from forestland to suburban and residential development along the Rt. 130 corridor in Sandwich and Mashpee.

2.2. Topography

The surface topography varies greatly between the northern, western, and southern areas of the MMR (Figure 2.3). The northern and western areas of the MMR are part of the Sandwich and Buzzards Bay glacial moraines, respectively. Large glacial deposits dominate this area with a high topographic relief of rolling hills and deep kettle holes. Slopes range from 0-15%, with a mean slope of 3.4%. The greatest change in topographic relief in this area of the MMR is approximately 90 feet. The highest point on Cape Cod, Pine Hill (318 feet above sea level), is situated in this western portion of the MMR, atop the Buzzards Bay Moraine.

In contrast, the southern portion of the MMR, which resides entirely within the Mashpee pitted outwash plain, has relatively low elevation (approximately 100 feet above sea level) and little topographic relief. Although slopes range from 0-15% in the outwash plain, the mean slope of 1.5% is considerably less than in the moraines. The majority of the outwash plain has a slope of 0-2%, with the exception of the approximately 20 kettle-holes within the area. Extreme grades in slope are encountered within these areas.

2.3 Geology

The geologic origin of Cape Cod dates back to approximately 12,000 years ago at the end of the Wisconsin Period of glaciation. During the retreat of the Laurentide ice sheet, moraines of glacial till were deposited by the Cape Cod Bay Lobe to form the Sandwich moraine, the main peninsula of the Cape, and by the Buzzards Bay Lobe, which formed the Buzzards Bay Moraine, the western edge of the Cape and the Elizabeth Islands (Strahler 1966) (Figure 2.3). The MMR is situated on the northwest corner of Cape Cod where these two moraines converge. Approximately 40% of MMR resides on the glacial moraines. As a

result, much of the geologic material forming MMR and Cape Cod is an amalgam of well-scoured rock fragments that originated in northern New England.

Figure 2.1. Location of the MMR, Barnstable County, Massachusetts

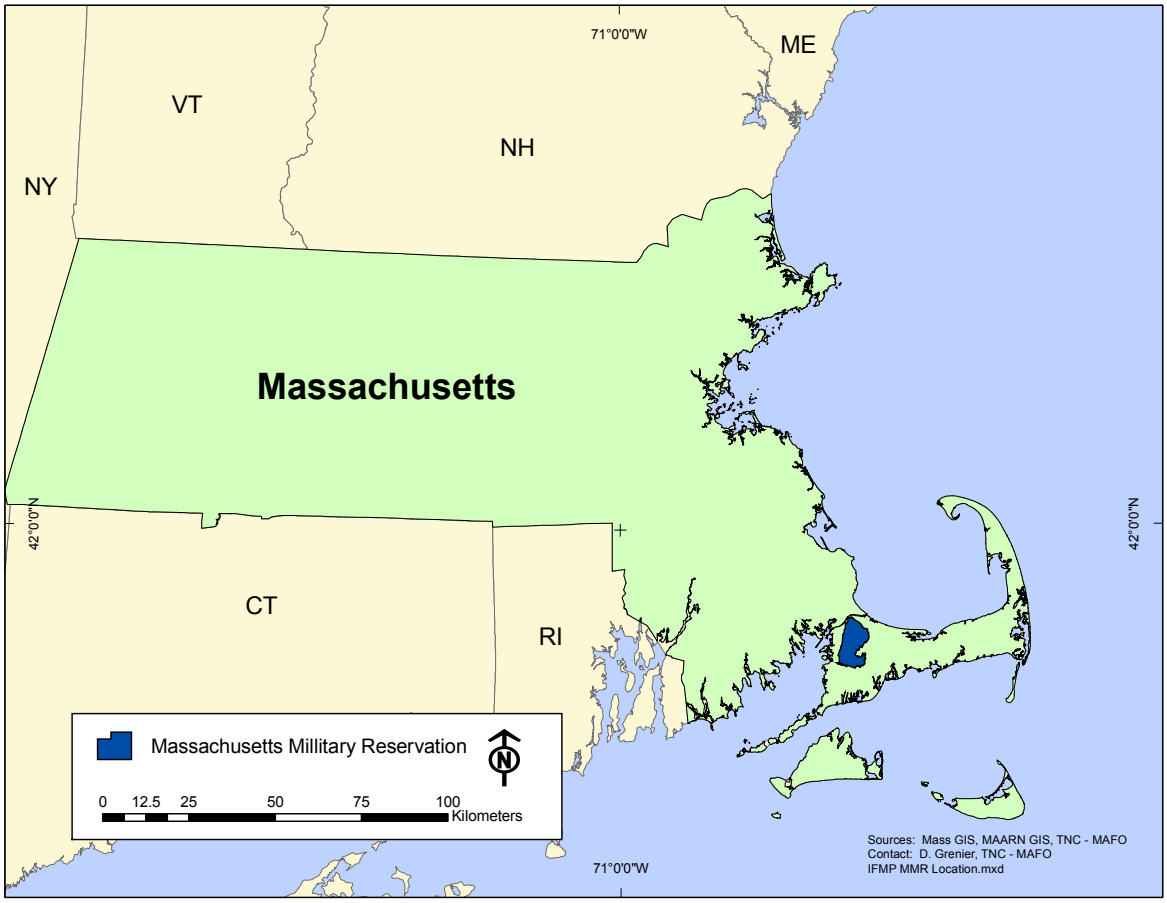


Figure 2.2. Current Occupancy, MMR 2006.

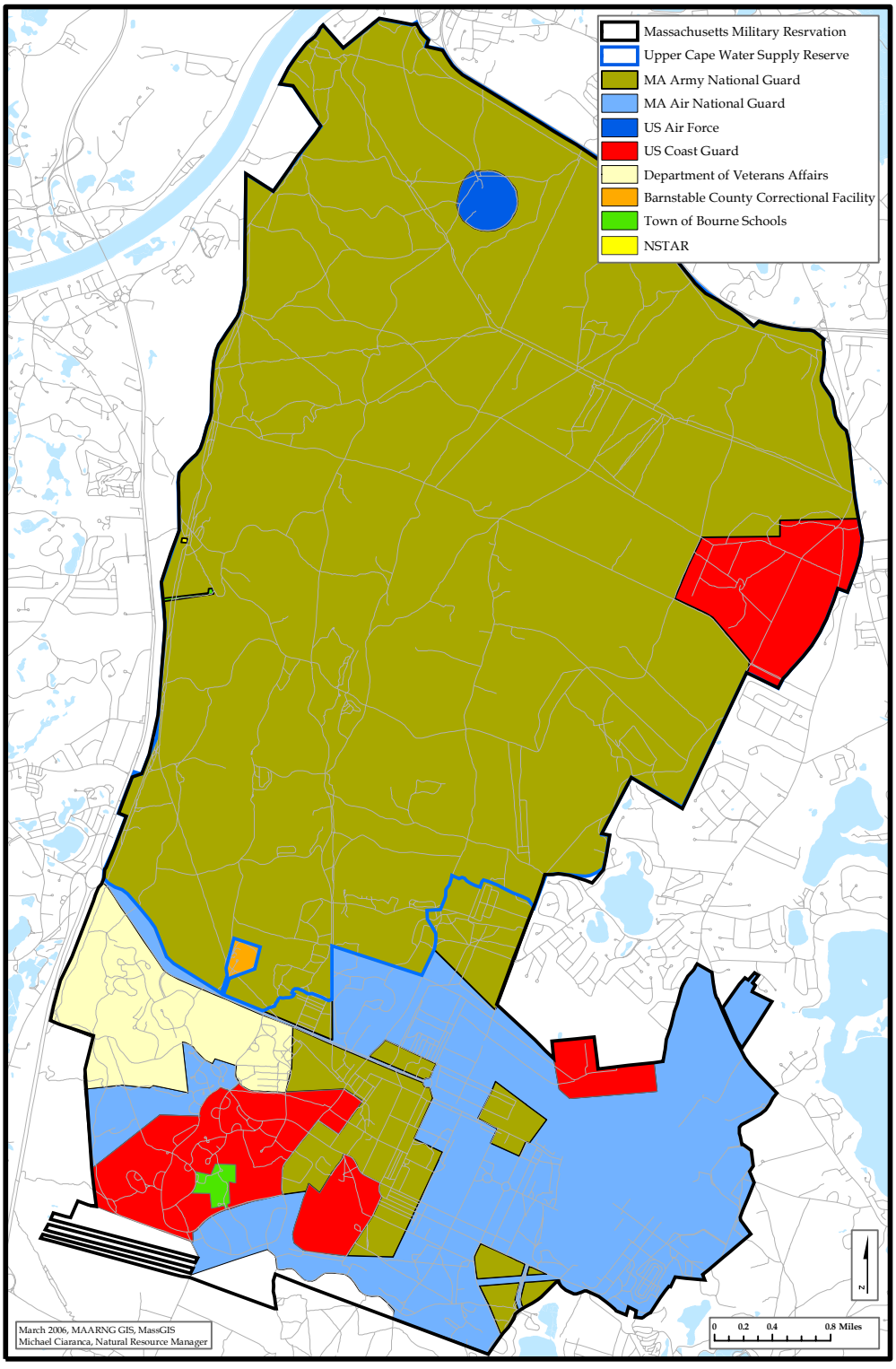
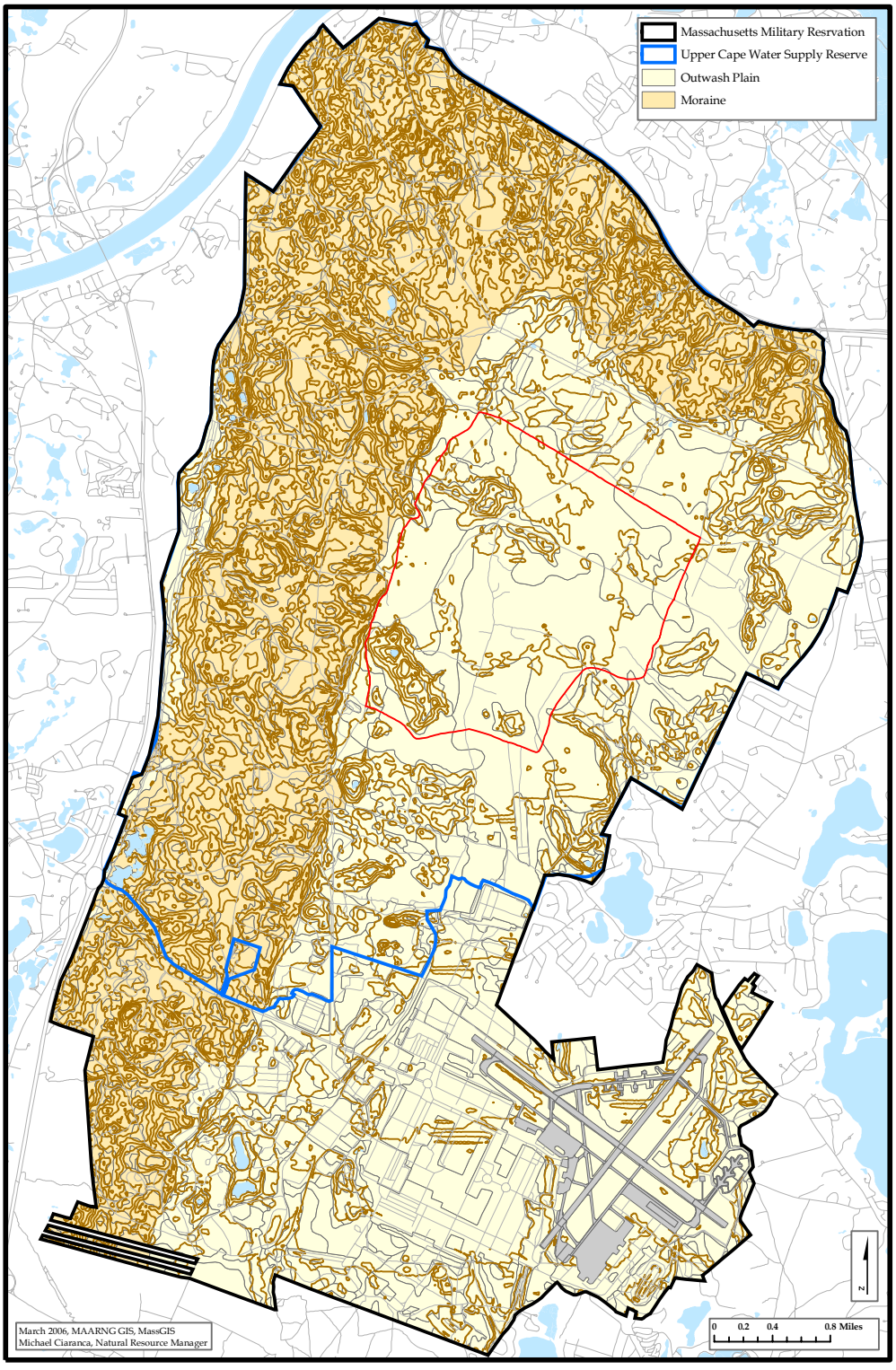


Figure 2.3. Topography and General Geology of the MMR.



As the Laurentide Ice Sheet melted and retreated over hundreds and thousands of years, rivers and streams of meltwater deposited material from the moraines southward to the ocean. Much of the loam and clay washed into the Atlantic Ocean while the sand, gravel, and cobble was deposited closer to the moraines, forming the Mashpee pitted outwash plain (Strahler 1966). This outwash plain is broad sloping land that forms the southern side of Cape Cod, extending from the terminal moraines to the Atlantic Ocean. The southeastern portion of MMR, approximately 60% of the land, is situated on the Mashpee pitted outwash plain. As a result, much of the soil in the area is a loose sand material.

Prior to the development of the Sandwich and Buzzards Bay moraines, the Laurentide ice sheet had advanced further south, creating the islands of Martha's Vineyard and Nantucket (Strahler 1966). During the period when the glacier retreated northward across what is now Cape Cod, large blocks of ice were left scattered throughout what would become the Mashpee pitted outwash plain. As the outwash plain was formed, soil was deposited around the blocks of glacial ice. The glacial ice eventually melted leaving deep, steep-sided cavities that are referred to as kettle-holes. Some of these kettle-holes filled with water, creating kettle-hole ponds or lakes.

2.4. Soils

The soils of the MMR can be classified in two categories- soils of the Sandwich and Buzzards Bay terminal moraines and soils of the outwash plain (see Ciaranca et al 2001 for a more complete discussion).

2.4.1. Soils of the Sandwich and Buzzards Bay Terminal Moraines

The soils of the Sandwich and Buzzards Bay terminal moraines are classified as rolling or hilly and containing many boulders. These excessively drained or well-drained soils are typically found on slopes ranging from 3-15% and on hills of glacial moraine areas. Plymouth-Barnstable complex soils and Plymouth loamy coarse sand (7,066 acres), and Barnstable-Plymouth complex soils (791 acres) comprise the entirety of the terminal moraine soils on the MMR. The Plymouth-Barnstable and Barnstable-Plymouth complex soils are mixtures of Plymouth, Barnstable, and other soils in varying proportions. These soils are typically composed of an inch of organic matter above highly permeable soil. The relatively high susceptibility of these soils to erosion is a management concern in area of steep slopes (US Department of Agriculture Soil Conservation Service 1993).

2.4.2. Soils of the Outwash Plains

The soils of the outwash plain are primarily Enfield silt loams and Merrimac sandy loams. Both of the Enfield and Merrimac loams have been classified as very deep well-drained soil commonly found in broad areas on outwash plains. These soils have been described at a range of slopes between 0 and 15% throughout outwash plains. Erosion is a management concern where these soils exist on moderate to steep slopes (US Department of Agriculture Soil Conservation Service 1993).

Other soil types that have been described on the outwash plain include Plymouth loamy coarse sand, Carver coarse sand, Hinckley gravelly sandy loam and gravelly sandy loam. These soils are often found on moderate or steep slopes of swales on outwash plains.

Like the Enfield and Merrimac loams, these soils are described as excessively drained, often resulting in high erodibility, especially at steeper slopes (US Department of Agriculture Soil Conservation Service 1993). Soil types associated with development on the outwash plain include sand and gravel pits from which sand or gravel have been removed, udipsamments smoothed, which are areas that have been leveled or smoothed during construction, and urban land that includes buildings and pavement (US Department of Agriculture Soil Conservation Service 1993).

2.5. Hydrology

Groundwater is contained in the unconsolidated glacial deposits, which form the Cape Cod Aquifer. Throughout the MMR, the water table averages about 120-150 feet beneath the surface. Recognizing community dependency on this resource and the vulnerability of the resource to human activities, the U.S. Environmental Protection Agency has designated the aquifer as a "*sole source aquifer"*, which is defined as a principal source aquifer that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer. Sole source aquifers have no alternative drinking water source(s) which could physically, legally, and economically supply all those who depend upon the aquifer for drinking water (Anonymous 2005a). The effectiveness with which precipitation contributes to groundwater recharge is dependent upon surface run-off, infiltration rates, and water-binding characteristics of the soil, the depth to the groundwater table, and the extent and nature of the vegetative cover. Potential recharge to the Cape Cod Aquifer from precipitation averages less than 50% (Strahler, 1972). A major reason for this water loss is evapo-transpiration. The loss of the IA soil layer (i.e. the soil layer composed of humidified organic material mixed with a mineral fraction that occurs at the surface or below the O horizon (Birkeland 1999)) to surface run-off is negligible because infiltration is rapid, and the soil has a low binding capacity.

2.6. Climate

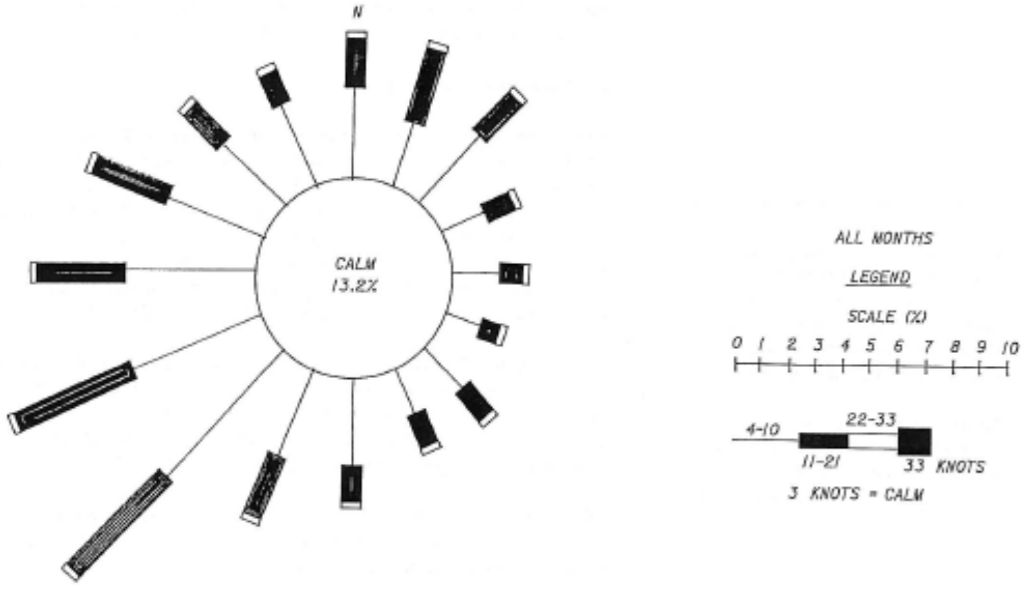
Cape Cod has a humid, continental climate characterized by a broad range of annual temperature with well-developed winter and summer seasons. Precipitation is ample in all months and favors the development of forests as the natural vegetation in the absence of any disturbances. Cape Cod vegetation, however, also exhibits a marine, or maritime, influence due to its proximity to the North Atlantic Ocean. Prevailing westerly winds bring the climate extremes of the North American continent to the Cape, but the ocean water tends to reduce the extremes of summer heat and winter cold, thus a moderating climate at the coast compared to inland southern New England (Strahler 1966).

Temperatures are more moderate on Cape Cod than further inland, with an average annual temperature of approximately 50 degrees F (Montgomery 1991). The daily mean maximum at MMR ranges from a low of 38°F in February to a high of 78°F in July, and the daily mean minimum ranges from a low of 23°F in February to a high of 63°F in July (Table 2.1) (Montgomery 1991).

The prevailing winds at the MMR are out of the southwest or west southwest from April through September and out of the northwest from November through March with spring being a transition season (Montgomery 1991). Figure 2.4 shows a wind rose

developed from 28 years of climatological data collected at Otis Air Force Base (Table 2.1). The lowest mean wind speeds (8 mph) occur in mid summer to early fall (July-September), and the highest (10) from early winter to early spring (December-May). Southwest winds during the spring and summer are due to a combination of sea breezes and the Bermuda high pressure cell. Sea breezes are important in delaying growth in plants due to cooler air than inland areas. Many of the higher wind speeds are due to the increased occurrence of winter storms ("nor'easters") that blow onto Cape Cod off the cold North Atlantic bringing high winds, driving rain and damp cold air.

Figure 2.4. Otis Air National Guard Base Annual Wind Rose (from Montgomery 1991)



Total mean annual precipitation is about 48 inches at the MMR and is distributed fairly evenly throughout the year (Strahler 1966), although a precipitation maximum occurs during the winter months and a minimum occurs in May through July. Because of oceanic influences, rainfall on Cape Cod averages 3-4 inches more than the state average in the winter and is drier than the rest of the state in the summer (Montgomery 1991). Therefore, fires on the Upper Cape are most likely to occur in late spring and early summer, which are historically the driest times of the year. Although, on average, the late summer and early fall months are wetter than earlier in the year, periodic summer droughts (as in 1995 and in 1999-2002) deplete soil moisture and increase the potential for hard-to-extinguish ground and wildfires.

On a larger scale, New England weather and climate is generally considered quite varied, but patterns are observable. Global and region specific weather systems are recognized to play a large role in this variability (Zielinski and Keim 2003). The North Atlantic Oscillation is based upon the relationship between the Icelandic Low and the

Bermuda Azores High pressure systems. When both systems are very strong, a strong pressure gradient is produced between the two creating a jet stream that lies in-between. With this scenario, zonal flow is typically in the upper-level westerlies across New England. However, when both systems are weak (i.e., higher pressure for the Icelandic Low and lower pressure for the Bermuda Azores High), a high pressure system tends to form over Greenland, producing blocking patterns over New England (Zielinski and Keim 2003). The resulting contrast of air masses across the northeastern United States provides conditions for large storm events and lasting weather conditions (i.e., hurricanes, heat waves, and droughts). The El Niño-Southern Oscillation is another large fluctuating system that takes place in the ocean and atmosphere of the tropical Pacific. It is composed of El Niño and La Niña end member changes, which occur in sea level pressure and sea surface temperatures. The primary effect in New England with shifts in this circulation are an increase in winter temperatures (and an associated decrease in precipitation) related with El Niño years. Increases in temperature during El Niño typically range from 1 to 2° F; however, mean winter temperatures warming 5.7 to 5.9° F in southern New England have been recorded (Zielinski and Keim 2003).

Another important weather event in New England is the Nor'easter (Zielinski and Keim 2003). Typically, these are storms whose center of rotation is just off the coast and whose leading winds rotate on-land from the northeast. The resulting warm (relative to over-land temperatures) humid air moves onshore where the moisture precipitates out due to the drop in temperature. This produces heavy, cold coastal rains in the warmer months, and winter blizzards that affect the northeastern United States. They also can cause coastal flooding, coastal erosion, and gale force winds.

The Bermuda Azores High pressure systems, El Niño and La Niña, and Nor'easters can dramatically impact weather on upper Cape Cod. All of these sytems can have dramatic influence for wildfire occurrence and behavior.

Table 2.1 MMR Climatological Data: Oct 1942-April 1944, Nov 1948-Dec 1974.

Location: 41°39'N – 70°31'W Airfield Elevation: 132' Period of Record: Oct 42-April 44, Nov 48-Dec 74

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ALL/TOTAL
Extreme Max Temp	60	59	68	79	86	97	96	99	91	82	74	65	99
Average Max Temp	38	38	43	54	63	73	78	77	71	62	61	41	58
Average Temp	30	31	37	46	55	65	71	70	63	54	44	34	50
Average Min Temp	24	23	30	38	47	57	63	62	55	46	37	27	42
Extreme Min Temp	-7	-9	1	19	28	41	47	44	36	22	14	-10	-10
Heating Degree Days (Base 65°)	1076	971	876	573	310	71	6	14	114	340	621	947	5919
Cooling Degree Days (Base 65°)	0	0	0	0	4	69	193	160	58	5	0	0	489
No. Days >90° F	0	0	0	0	0	0	#	1	#	0	0	0	1
No. Days >80° F	0	0	0	#	1	6	13	10	3	#	0	0	33
No. Days <32° F	25	25	19	5	#	0	0	0	0	1	9	21	105
Average Daily Relative Humidity (%)	64	63	66	66	71	77	76	77	76	72	72	68	71
Average Dew Point Temperature	16	18	27	35	45	56	62	62	55	45	36	23	40
No. Days Measurable Precipitation	12	11	12	12	10	7	8	9	8	8	11	12	120
Average Rainfall (inches)	4.8	4.1	4.3	4.7	3.4	2.0	3.3	4.8	3.9	3.7	4.5	4.3	47.8
Average Snowfall (inches)	10.2	9.0	8.6	1.1	0	0	0	0	0	0.1	0.3	7.8	37.1
No. Days Thunderstorms	#	#	#	1	3	2	3	3	1	1	#	#	14
Prevailing Wind Direction	NW	NW	NW	WSW	WSW	SW	SW	SW	WSW	NW	NW	NW	WSW
Average Speed (Knots)	10	10	10	10	10	9	8	8	8	9	9	10	9
Peak Gust Speed (Knots)	60	59	54	48	45	38	40	41	73	51	53	54	73
Total Sky Cover (Tenths)	6	6	6	6	7	7	7	6	6	6	6	6	6
% Freq Cloud Ceiling and/or Vis <500'/1 MI	9	10	12	11	16	17	13	11	9	9	9	9	11
% Freq Cloud Ceiling and/or Vis <1000'/2 MI	15	16	18	17	22	26	24	23	17	16	16	16	19
% Freq Cloud Ceiling and/or Vis <3000'/3 MI	25	25	28	23	28	34	34	33	27	25	26	26	28

- less than ½ day Source: 102nd FIW Weather Office, Otis Air National Guard (Montgomery 1991)

2.7. Vegetation and Natural Community Classification

The plant communities of Camp Edwards are generally classified as mid to late successional forest with occasional early successional, disturbed areas, and wetlands including kettle-hole ponds. The climax plant community on Camp Edwards is likely an oak - pine forest with gray birch (*Betula populifolia*), American beech (*Fagus grandifolia*), and bitternut hickory (*Carya cordiformis*) (Foster and Motzkin 1999). Many of the plant communities at Camp Edwards have been influenced by several different disturbance types including fire, ice storms, frost, drought, insect outbreaks, hurricanes, tropical storms, and historic fuel wood cutting, grazing, and military training. Natural or human induced fires have also played an important role in creating and maintaining the plant communities on Camp Edwards (see Section 3).

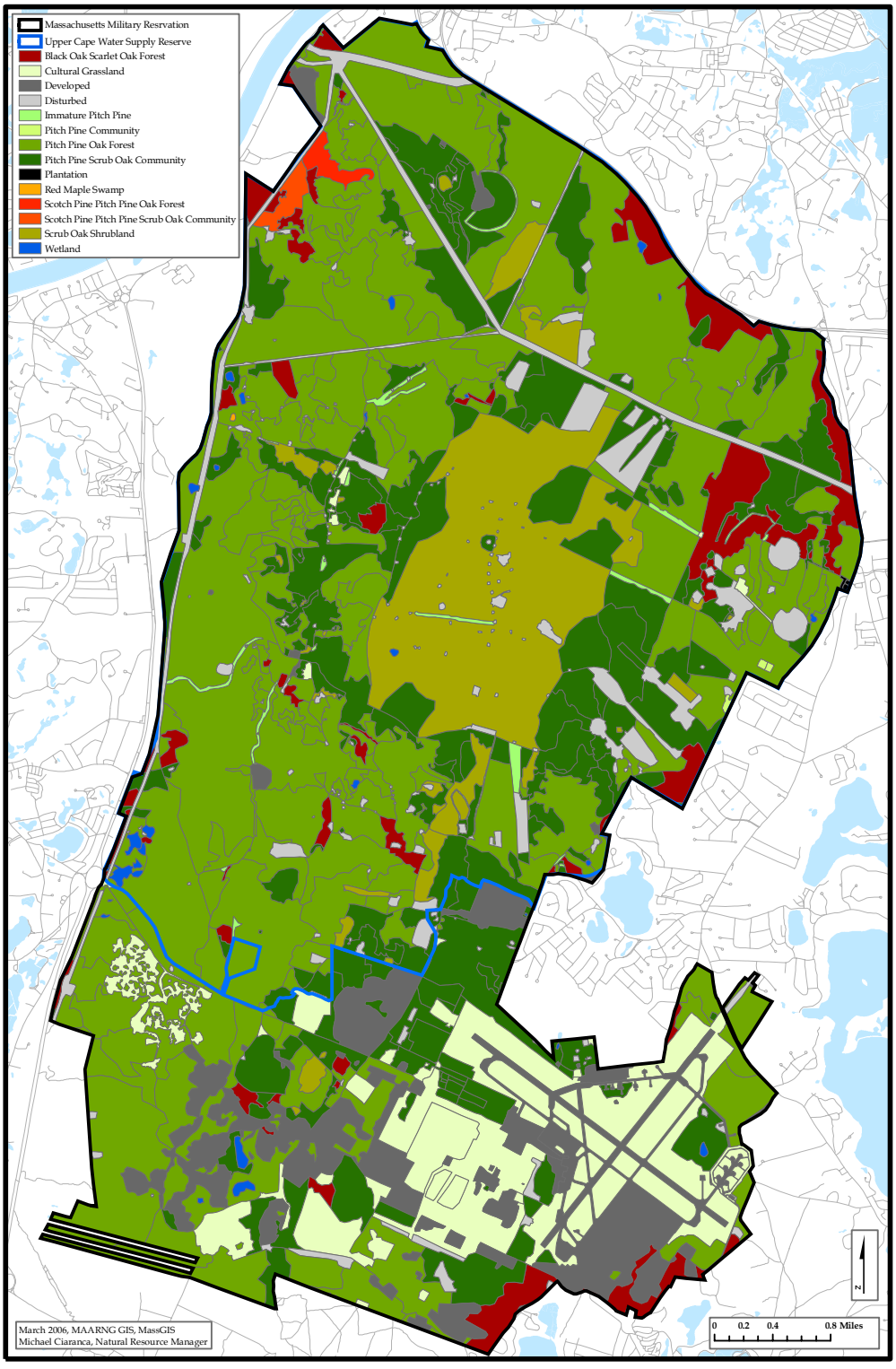
Plant community type description and classification has been, and continues to be, an ongoing process at the MMR. An initial floristic survey (Jenkins 1994) identified 433 vascular plants on the reservation. With the use of Range and Training Land Assessments (RTLA; see Ciaranca et al 2001, and IFMP Section 8 for a complete description) data, seven major plant communities adapted from TNC's Albany Pine Bush Reserve Classification System (Finton 1998) were identified at that time for the MMR.

As a result of annual RTLA plant surveys, the floral count has increased by 123 for a total of 556 species (Appendix B). Aerial photo interpretation was carried out by the Natural Resource Office of the Environmental and Readiness Center at Camp Edwards providing greater detail in terms of stand delineation, structure, overstory cover, and understory make-up. These data were then digitized and entered into a Geographic Information System (GIS). The updated information was then groundtruthed to provide for the most accurate vegetation classification attainable at that time. Using this new computer imagery in conjunction with a classification system created by the Massachusetts Department of Fish and Wildlife's Natural Heritage & Endangered Species Program for natural communities in Massachusetts (draft: Swain and Kearsley 2001), fourteen distinct community types were identified for the MMR (Figure 2.5). Descriptions of community types currently identified on the reservation are as follows (Ciaranca et al 2001):

Black Oak - Scarlet Oak Forest: Oaks dominate the tree canopy and the shrub layer is similar to pitch pine-mixed oak forest. The structure of the community varies with age from stands of immature hardwoods to more mature forest with a closed canopy and sparse understory. This community type can be maintained by regular light fire. The community type is found mainly in the North and Southcentral area and northeast corner of the Camp Edwards, but also adjacent to the air field in the southeast portion of the MMR.

Black oak (*Quercus velutina*) is the dominant canopy species with white oak (*Q. alba*) and red maple (*Acer rubrum*) as common associates. A sparse subcanopy may have species of recent disturbance such as grey birch (*Betula populifolia*), black cherry (*Prunus serotina*), and sassafras (*Sassafras albidum*), as well as species less tolerant of fire such as flowering dogwood (*Cornus florida*) or shadbush (*Amelanchier arborea*). Lowbush blueberries (*Vaccinium angustifolium* and *V. pallidum*), huckleberry (*Gaylussacia baccata*), and scrub oak (*Quercus ilicifolia*) form a fairly dense, but clumped low shrub layer, with

Figure 2.5. Natural Communities, MMR, Barnstable County, Massachusetts.



scattered maple-leaved viburnum (*Viburnum acerifolium*) and American hazelnut (*Corylus americana*). Sedges (*such as Carex pensylvanica*), bracken fern (*Pteridium aquilinum*), and pink lady's slipper (*Cypripedium acaule*) are often scattered in the open herbaceous layer.

Scrub Oak Shrubland: A shrubland dominated by scrub oak, with essentially no pitch pine, although within pitch pine - scrub oak areas. An important community type at the MMR as it functions as refuge for rare, as well as more common, lepidoptera species dependent on oaks. These shrubland areas are mainly concentrated in or adjacent to the Impact Area.

Scrub oak (*Quercus ilicifolia*) and dwarf chinquapin oak (*Q. prinoides*) dominate shrublands, with a variety of other heathland plants, including a significant component of graminoid cover and interspersed with patches of lichen. Characteristic plants besides scrub oak are huckleberry (*Gaylussacia baccata*), low bush blueberry (*Vaccinium angustifolium*), Pennsylvania sedge (*Carex pensylvanica*), little bluestem grass (*Schizachyrium scoparium*), and lichens (*Cladina* and *Cladonia* spp.).

Pitch Pine - Scrub Oak Community: Shrub dominated communities with scattered to dense trees and scattered openings. Shrubs are often very dense. Development of this community type is typically on droughty, low nutrient soils - usually deep, coarse, well-drained sands derived from glacial outwash. Pitch pine/ scrub oak communities are a fire maintained and fire dependent community; most species in the community recover well from fire. On the MMR, this vegetation type is generally found radiating around and out from the Impact Area.

Pitch pines form an open canopy above a shrub layer dominated by shrub oaks, scrub oak (*Quercus ilicifolia*) and sometimes dwarf chinquapin oak (*Q. prinoides*). Older oaks may form a nearly impenetrable understory 3-4 m (10-15 feet) tall, or may be more open and shorter. Huckleberries (*Gaylussacia baccata*) occur between the oak clones or under more open plants. Scattered openings of variable size support patches of heathland or grassland vegetation including lowbush blueberry (*Vaccinium angustifolium*), bearberry (*Arctostaphylos uva-ursi*), lichen patches, little bluestem grass (*Schizachyrium scoparium*), sedges (primarily *Carex pensylvanica* and *C. rugosperma*), and beach heather (*Hudsonia tomentosa*). Cow wheat (*Melampyrum lineare*) and mayflower (*Epigaea repens*) are typically found on edges within the community.

Pitch Pine - Oak Forest: Dry oak / pine forest and woodlands of moraines, till, outwash, southerly exposures, and rocky slopes that make-up the matrix forest of southeastern Massachusetts and the MMR. The proportions of different species are variable, and range from predominantly pine with scattered oaks to predominantly oak with scattered pines. The structure ranges from open canopy with a thick understory, to closed canopy with scattered clumps of shrubs. Pitch pine - oak forests have a canopy of pitch pine and tree oaks (black *(Quercus velutina),* scarlet *(Q. coccinea),* chestnut oak *(Q. prinus),* and white (*Q. alba*)), with blueberries

(*Vaccinium angustifolium* and *V. pallidum*), black huckleberry (*Gaylussacia baccata*) and other ericaceous shrubs forming an often continuous low shrub layer. Scattered patches of scrub oak (*Q. ilicifolia*) and bear oak (*Q. prinoides*) can be dense. Catbriar and other briars (*Smilax rotundifolia* and *Smilax* spp.) often make dense barriers around low, damp openings. The herb layer is generally sparse, with bracken fern (*Pteridium aquilinum*), wild sarsaparilla (*Aralia nudicaulis*), wintergreen (*Gaultheria procumbens*), Pennsylvania sedge (*Carex pensylvanica*), and, less commonly, pink lady's slipper (*Cypripedium acaule*). Occasional white pine (*Pinus strobus*) and red maple (*Acer rubrum*) contribute to the canopy.

Immature Pitch Pine: Areas of young dense thickets of immature pitch pine relatively low in species diversity. These areas are often found along roads, old firebreaks or other previously disturbed areas at the MMR.

Pitch Pine Community: This community type, unique to the MMR, is a result of the recolonization of areas which were once developed (i.e., buildings and other improvements). The overstory is dense pitch pine (*Pinus rigida*). The understory typically has sparse clumps of heath vegetation with bare soil and lichen.

Scotch Pine – Pitch Pine – Oak Forest: Similar in description and composition to the pitch pine – oak forest community type with scotch pine (*Pinus sylvestris*), a non-native introduced species, as an added component. Stands are found in the northwest corner of the reservation.

Scotch Pine – Pitch Pine – Scrub Oak Community: A pitch pine – scrub oak community type with the addition of scotch pine (*Pinus sylvestris*), a non-native introduced species, as an added component. Stands are observed in the northwest corner of the MMR

Plantation: Areas prior to the creation of the MMR that were frequently burned over, replanted and managed as pine, spruce, and fir plantations as part of SCSF. Plot data indicates that where pure stands occur, the understory devoid of vegetation and is a carpet of pine needles. Where stands are beginning to senesce, understory components consistent with native barrens systems are returning (Mike Ciaranca, personal communication).

Planted species include scotch pine (*P. sylvestris*), white pine (*P. strobus*), red pine (*P. resinosa*), Douglas fir (*Pseudotsuga menziesii*), balsam fir (*Abies balsamea*), Norway spruce (*Picea abies*), and larch (*Larix* spp.). Many of these stands are currently breaking-up and succeeding into other natural community types typical of the MMR (Mike Ciaranca, personal communication).

Cultural Grassland: A human created, and maintained open community dominated by grasses, primarily of conservation interest for the grassland bird community. The grassland areas of MMR are mainly concentrated in the cantonment area, former parade grounds, and areas surrounding the airfield used by the Air National Guard.

These areas are maintained by mowing and are dominated by graminoids, usually little blue stem grass (*Schizachyrium scoparium*), Pennsylvania sedge (*Carex pensylvanica*), and poverty grass (*Danthonia spicata*), and many non-native species. A mix of herbaceous species, such as goldenrods (*Solidago* and *Euthamia* spp.) and milk weeds (*Asclepias* sp) including butterfly weed (*A. tuberosa*) may also be present

Red Maple Swamp: Acidic forested swamps with red maple dominant in the overstory, often providing more than 90% of the canopy cover. A small stand is located in the northwest corner of the reservation.

A variable mixture of tree species co-occurs with red maple, including yellow birch (*Betula alleghaniensis*), black gum (*Nyssa sylvatica*), white ash (*Fraxinus americana*), white pine (*Pinus strobus*), American elm (*Ulmus americana*), hemlock (*Tsuga canadensis*), pin oak (*Quercus palustris*), and swamp white oak (*Q. bicolor*). Atlantic white cedar (*Chamaecyparis thyoides*) is a common associate in coastal areas. The shrub layer of red maple swamps is often dense and well-developed, generally with >50% cover but it can be variable. In eastern Massachusetts, sweet pepperbush (*Clethra alnifolia*) and swamp azalea (*Rhododendron viscosum*) are the dominant shrubs. Other common shrubs are highbush blueberry (*Vaccinium corymbosum*) and common winterberry (*Ilex verticillata*), which are often dominant, and spicebush (*Lindera benzoin*). In richer areas, northern arrow-wood (*Viburnum dentatum* var. *lucidum*), speckled alder (*Alnus incana* ssp. *rugosa*), nannyberry (*V. lentago*), and poison sumac (*Toxicodendron vernix*) also occur. The herbaceous layer is highly variable, but ferns are usually abundant. Cinnamon fern (*Osmunda cinnamomea*) is common; other ferns include sensitive fern (*Onoclea sensibilis*), royal fern (*Osmunda regalis*), marsh fern (*Thelypteris palustris*), and spinulose wood fern (*Dryopteris carthusiana*). Graminoids are common, mixed with a variety of herbaceous species. Some of the most common herbaceous species are skunk cabbage (*Symplocarpus foetidus*), false hellebore (*Veratrum viride*), spotted touch-me-not (*Impatiens capensis*), swamp dewberry (*Rubus hispidus*), marsh marigold (*Caltha palustris*), and the bugleweeds (*Lycopus* spp.).

Wetlands: Wet areas of the MMR contain the most diverse plant communities. In general, these wetland plant communities can be classified as having four concentric circular zones of vegetation. The first zone is the deepest area of the wetland where open water is present. This zone is often vegetated by floating plants including spotted bladderwort (*Utricularia purpurea*), water shield (*Brasenia schreberi*), and water-lily (*Nymphaea odorata*). The presence of this vegetation depends entirely upon the water levels in the wetlands since this type of vegetation is present only in the presence of standing water. Although in most cases zonation of wetland vegetation is stable, groundwater, rainfall, and climatic conditions can influence zonal location.

The zone of emergent vegetation surrounds the open water zone and is located in the more shallow water of the wetlands. Common emergent plant species are usually

grasses, including bur-reed (*Sparganium americanum*), wool grass (*Scirpus cyperinus*), and three-way sedge (*Dulichium arundinaceum*).

Beyond the shoreline of the wetlands lies a transitional zone that is occupied by many emergent species but is dominated by forbs. Lance-leaf violet (*Viola lanceolata*), northern bugleweed (*Lycopus uniflorus*), swamp candles (*Lysimachia terrestris*), beggar ticks (*Bidens frondosa*), hyssop-hedge-nettle (*Stachys hyssopifolia*), rush (*Juncus* spp.), and sedges (*Carex* spp.) are common throughout the forb zone.

As the wetland transitions into the surrounding forest community, a distinct shrub zone including highbush blueberry (*Vaccinium* spp.), swamp azalea (*Rhododendron viscosum*), hardhack (*Spirea tomentosa*), inkberry (*Ilex verticillata*), leatherleaf (*Chamaedaphne calyculata*), swamp dewberry (*Rubus hispidus*), and goldenrod (*Solidago* spp.) is present. Common tree species in this zone include red maple (*Acer rubrum*), pitch pine (*Pinus rigida*), and various oaks.

Developed: Areas on the MMR occupied by building and other human improvements. Vegetation is mostly absent.

Disturbed: Vegetated and non vegetative areas directly affected by military training and remediation activities (i.e., bivouacs, monitoring well sites).

Data analyses have shown that the flora of bivouac sites is significantly less diverse and more sparsely vegetated than surrounding plant communities. Scarlet oak, black oak, and pitch pine make up the overstory in bivouac areas. The understory is principally composed of grasses, such as autumn bentgrass (*Agrostis perennans*), barnyard-grass (*Echinochloa crusgalli*), and redtop (*Agrostis* sp.), with interspersed shrubs, including black cherry (*Prunus serotina*), arrow wood (*Viburnum recognitum*), huckleberry (*Gaylussacia baccata*), and blueberry (*Vaccinium spp*.).

Non-Mapped Vegetation: Small areas (< 1 acre) due to their size were excluded from the mapping exercises (i.e. aspen (*Populus* spp.) pockets). These small areas, which are currently not classified on the MMR, may be a consideration in fire management planning if their persistence is desired. These sites can often contain state listed rare plant species.

2.8. Wildlife

Extensive surveys have been conducted at Camp Edwards to inventory fauna and their associated habitat. A total of 528 macrolepidoptera species (Appendix C), 46 species of odonates (Appendix D), 92 bird species (Appendix E), 28 species of mammals (Appendix F), 12 reptile species (Appendix G), and 11 species of amphibians (Appendix G) have been identified to date. Data analyses has identified some species specific habitat use and associations within certain of the major animal groups found on the MMR relevant to fire management (*see* Ciaranca et al 2001 for greater detail.). For example, grasslands, open scrub oak shrubland, and partially closed pitch pine - scrub oak communities are found to provide significant habitat for many state-listed rare macrolepidoptera species. Also, several

bird species (i.e., eastern towhee, field sparrow, song sparrow, prairie warbler, whip-poor-will, and gray catbird) identified as regionally showing declines in population numbers (Scott Melvin, personal communication, *as cited by* Ciaranca et al 2001) are commonly observed in oak and pitch pine – scrub oak community types on the MMR. Given the general environment of wildland fire exclusion found within the state of Massachusetts, actively managing these early successional, fire associated habitats through prescribed fire is warranted to ensure the long-term continuation of these species in the state.

2.9. Special Elements

Access to habitat influences the distribution and abundance of all organisms (Elton 1927; Morrison et al 1992), and significantly influences survival, reproduction, and long-term population persistence (Kreb 1978; Block and Brennan 1993). Within the Cape Cod Ecoregion, the MMR is one of the few management areas that provides suitable habitat over a range of spatial scales. Given the general scientific consensus that species loss is principally driven by habitat loss (Hunter 1999) and the increasing development pressures found throughout Massachusetts, the role the MMR plays in biodiversity conservation appears ever increasing.

The Cape Cod Ecoregion has the highest number and one of the highest densities of state-listed rare plant and animal species within the 13 ecoregions in Massachusetts (Barbour et al. 1999). Within this ecoregion, the greatest number of state-listed rare species can be found at the MMR. Although no federally-listed threatened and endangered species have been observed on the MMR, 35 state-listed (i.e., endangered (E), threatened (T), and special concern (SC)) and 6 species on the unofficial watch-list (WL) have been identified (Appendix H).

2.10. Disturbance Types Other than Fire

Disturbances other than fire are also known to exist and have an important influence on the MMR. Brief descriptions of these major natural processes and human activities on the training facility are as follows:

2.10.1. Natural Disturbances

- Winds and hurricanes – Historically, hurricanes and major wind events have been one of the chief disturbance factors affecting Atlantic coastal areas of eastern North America. Southern New England experiences severe hurricanes every 50 – 100 years (Foster et al. 1997), creating heterogeneous damage that can reconfigure shorelines, create extensive windthrow in forested areas, and serve as an important source of landscape-level patterning.

- Insect outbreak - Insect infestation is another significant natural process affecting dynamics within many forested systems of North America. Research has shown that when time intervals between fires lengthen and exceed the mean tree longevity for the post-fire cohort, mechanisms of succession become important (Frelich and Reich 1995; Lesieur et al 2002; Grenier 2003; Grenier et al 2005). Without fires, forest structure and composition become closely related to secondary disturbances such as insect outbreaks and windthrow, which are common in eastern North American forests (Bergeron et al 2001).

  The Massachusetts Department of Conservation and Recreation maintains a database on areas influenced by insect defoliation throughout the state that currently dates back to 1961. Figures 2.6, 2.7, 2.8 highlight major defoliation events, which occurred on the MMR from the 1960's through the 1990's.

- Ice damage and extreme winter weather – During ice storms, the weight of accumulated ice causes trees to snap off or bend over to the ground. Large branches break within crowns and debris litters the landscape. The impact to forests varies greatly, both within forest stands and on the landscape scale. Topography, forest composition, and meteorological conditions typically influence the amount of damage. Blizzards have been known to break down branches, knock down trees, adding to fuel bed depth, but also causing fuel compaction in the Camp Edwards training area.

- Frost Pockets and topography - Low lying areas and cold air drainages that experience rapid and extreme nocturnal radiant cooling. Hilltops often drain cold air down slope, and these areas may experience severe frosts throughout the year, which kills off new growth of frost-intolerant scrub oak during the growing season (Schweitzer and Rawinski 1988; Figures 2.9, 2.10). Typically, *Pinus rigida/Vaccinium* woodland or graminoids, blueberry, and bracken fern dominate these frost influenced areas. The graminoid dominated frost pockets tend to be those affected by the most severe frost that even ericaceous plants are unable to withstand.

Figure 2.6. Insect Defoliation at the MMR in the 1960's and 1970's.

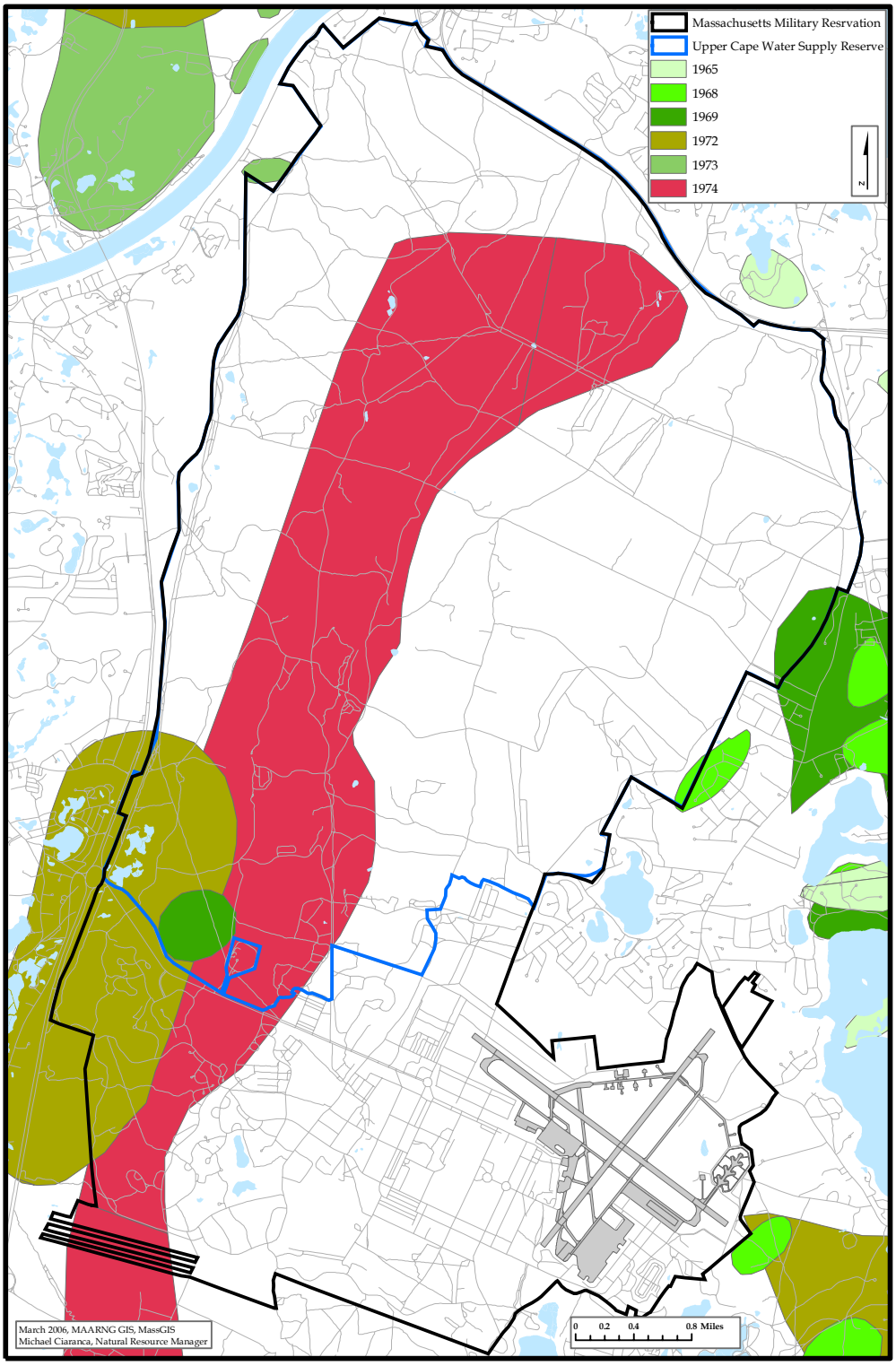


Figure 2.7. Insect Defoliation at the MMR in the 1980's.

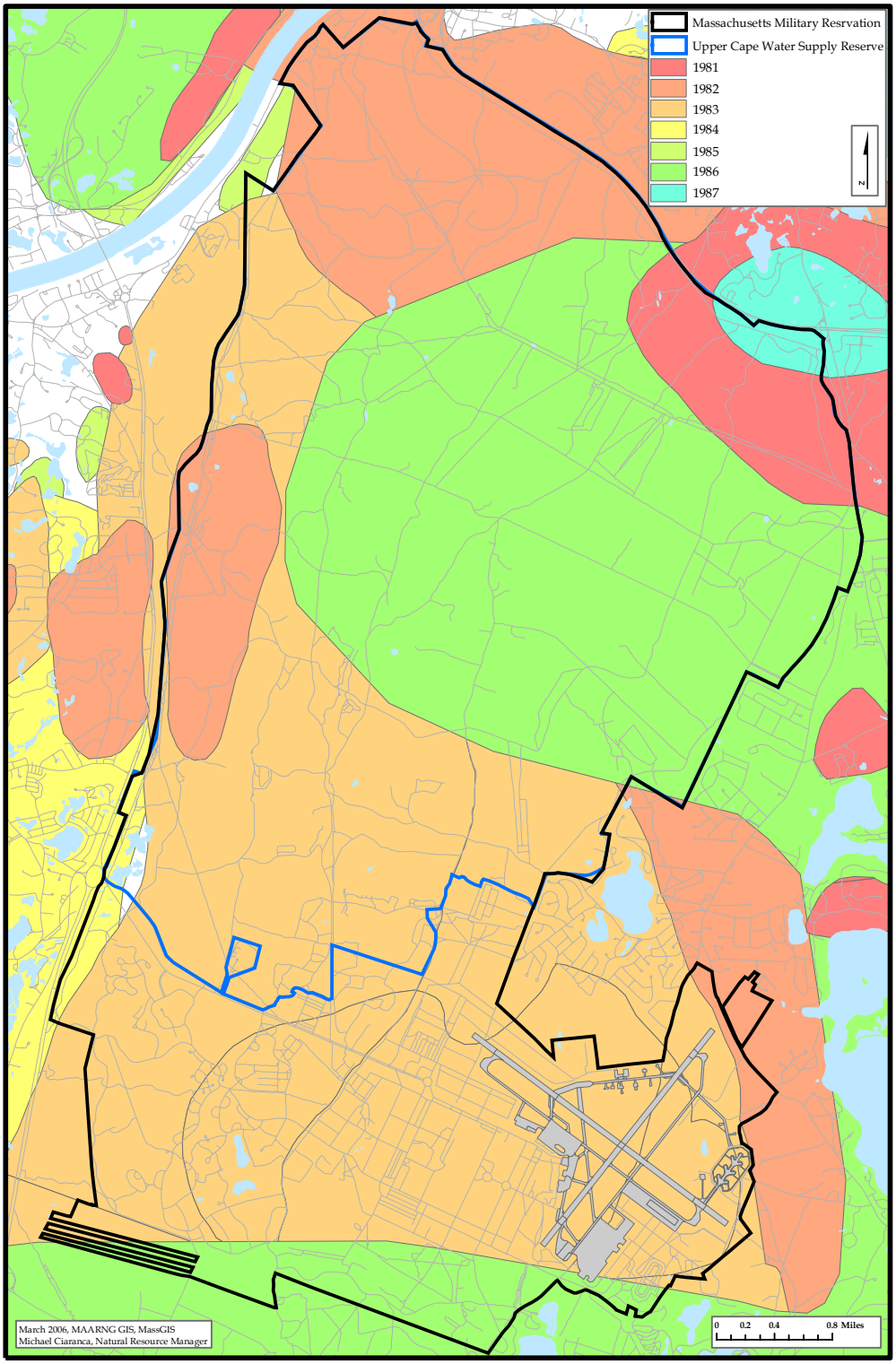


Figure 2.8. Insect Defoliation at the MMR in the 1990's.

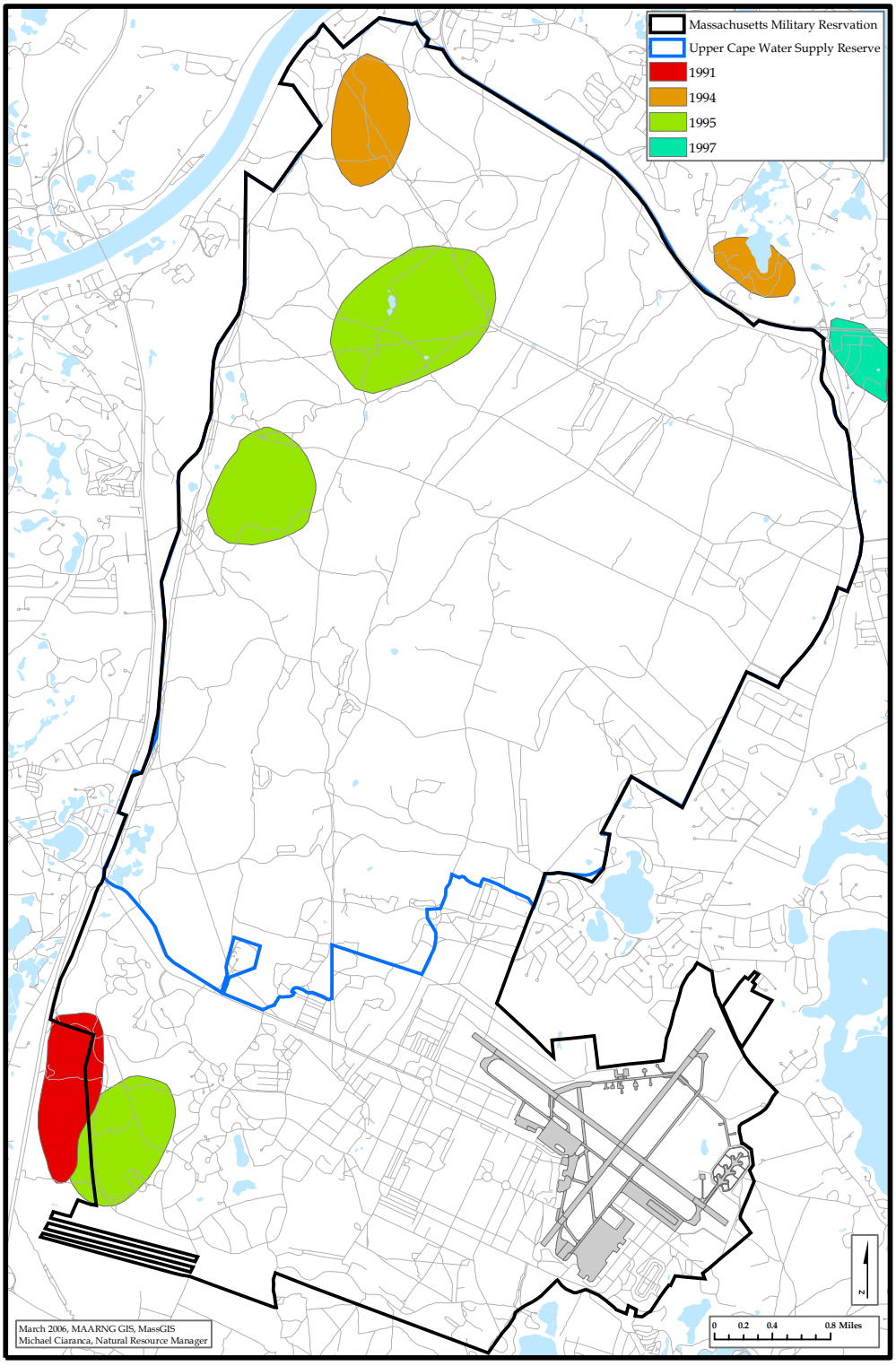


Figure 2.9. Time Series Photos Highlighting the Effects Frost Can Play Upon the Vegetation in Topographic Depressions on the MMR.

Figure 2.10. Time Series Photos Highlighting the Effects Frost Can Play Upon the Vegetation in Topographic Depressions on the MMR.

2.10.2. Anthropogenic Disturbances

- Agriculture – Farming was the main force driving the forest removal that created the widely open 19th century landscape much described for the northeastern United States (Cronon 1983; Foster 1999). It is important to note that a great deal of the re-forested land of modern day New England was at one time important agrarian areas. Past farming practices such as land clearance, fuel wood cutting, brush burning, ditch digging, stone wall building, and manuring have potentially had long term effects on vegetation. While no active tilling or manuring of soils is known to have occurred on Camp Edwards, large-scale land clearing for tree farming has been well documented (Figure 2.11). Sheep grazing occurred on a 10,000 acre site in the outwash plains area, and many areas in the northern half of the base were used as fuel wood lots by private citizens and also by Sandwich Glass Works (Ciaranca, personal communication). Fuel wood lots also existed in the southwest portion of the MMR in what is now Francis Crane Wildlife Management Area (Ciaranca, personal communication).

- Land development and military land use – Population growth and its associated residential and commercial construction are driving major alterations in the land cover and land use of Cape Cod. Over a forty year time period (1951-1990), the percentage of commercial and residential land cover has tripled on the Cape, the amount of forest cover has declined by almost 100 sq. miles (about 25% of the Cape), and the amount of agricultural land has declined by 75% (Stone 2005).

  The major development of lands on the MMR can be traced to 1935 (Anonymous 2005b). The Federal Government in conjunction with the state of Massachusetts constructed 63 buildings using over 600 workers between 1935 and 1940 to provide support for military training of national armed forces. An additional phase of expansion began in 1940 as a result of US involvement in World War II. During this time 1300 buildings were built to house 30,000 men within a one-year period. The Air Force also constructed numerous hangers on the south side of the airfield at Otis from 1951 to 1956 as a result of the Department of Defense response to Soviet atomic capability. In recent times (1960's and 1970's), long-range missile defense and detection systems have been constructed on the MMR as part of the United States air defense. These systems were dismantled during the 1980s thru the demolition of the support facilities in 2003-2005

  Military land use in the woods of what is present day MMR dates back to 1908 and continues today (Anonymous 2005b; Ciaranca, personal communications). Throughout the course of training on Camp Edwards, by the United States Army and the MAARNG, ranges have been used for firing various weapons including pistols, rifles, machine guns, rocket launchers, long-range artillery, mortars, and anti-aircraft weapons. In one example, impacts from weapons firing has been recorded through an aerial photo time series (Figure 2.12).

- Prescribed fire – Planned fire use for ecological benefit and troop training is relatively new on the MMR. An active program was started in the 1980's under the guidance of Dr. William Patterson III (UMASS) and continues today with direction provided by MAARNG Natural Resource Management personnel. An outline of current prescribed fire programmatic details on Camp Edwards is found in Section 5.3.

- Mechanical manipulations – A minimal amount of mechanical treatments has occurred on Camp Edwards including the flush cutting of some scrub oak dominated areas. Relief (on a small-scale) to forest understory, midstory, and overstory has also occurred on base when and were considered appropriate. Fire break construction and maintenance consists of vegetation removal with long-term, continuous mowing to create low heath-like vegetation cover.

Figure 2.11. Blueprint Showing Depression Era Work that Occurred on the Shawme State (Currently Shawme-Crowell) Forest.

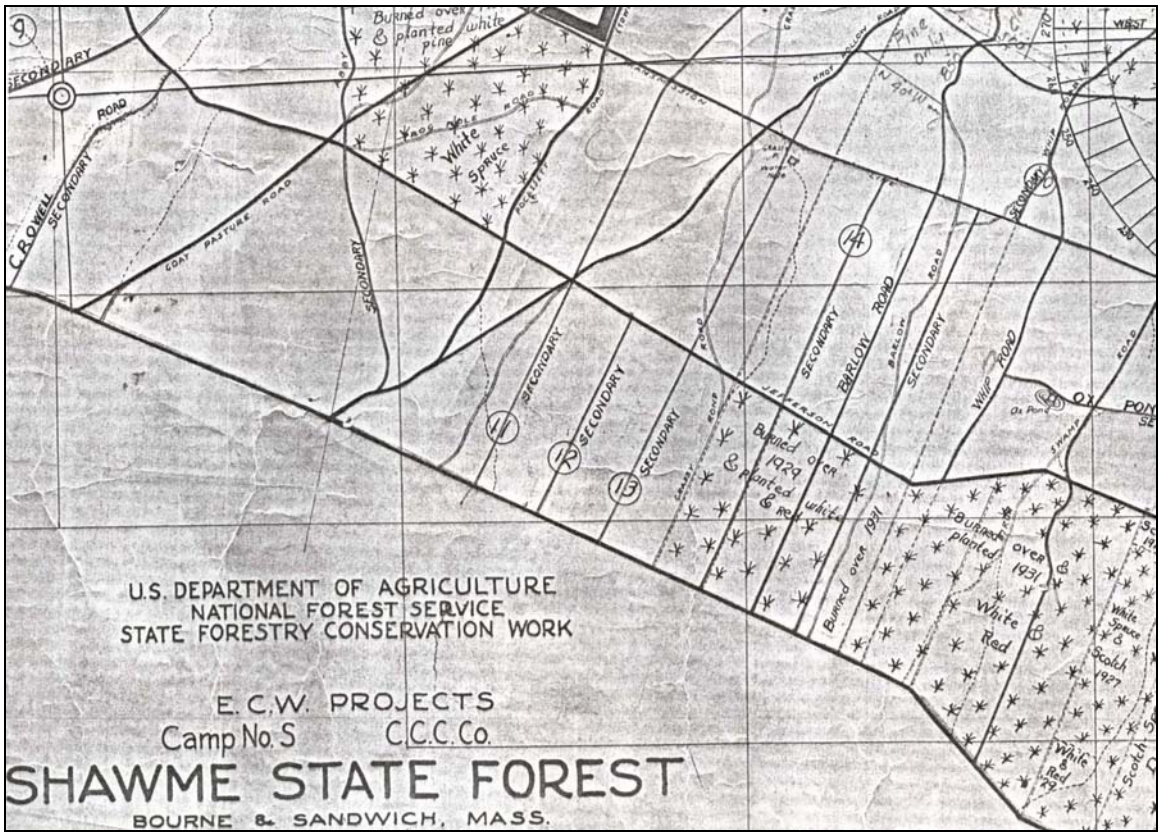
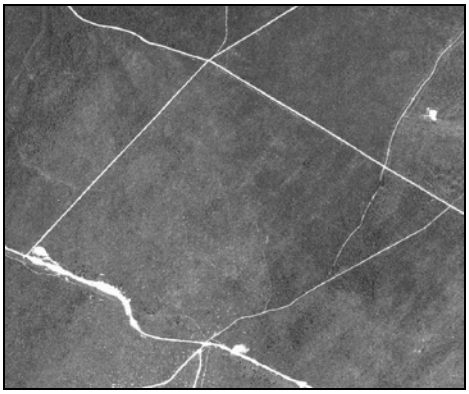
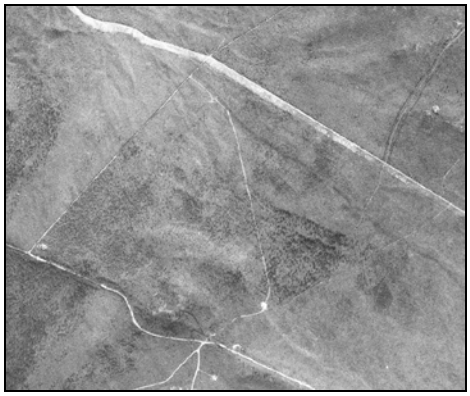


Figure 2.12. Time Series Photos Showing a Chronosequence of Land Use Impacts in the Northwest Corner of the Impact Area from 1943 - 2002.

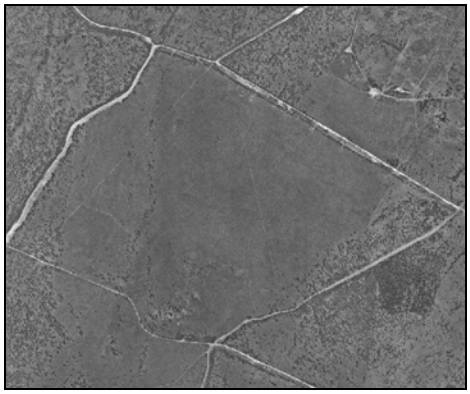


A) 1943



B) 1955

C) 1977



D) 1997

E) 2002

3. THE HISTORICAL ROLE OF FIRE AND FIRE ENVIRONMENT (Patterson and Ruffner 2001)

3.1. Fire History

Northeastern pine barrens are widely recognized as pyrogenic, early successional communities that depend upon recurring disturbances (mainly fire) for their long-term maintenance (Schweitzer and Rawinski 1988; Patterson 1994). Olsvig (1980) and Olsvig et al. (1979) discuss a disturbance/moisture gradient from more mature oak-pine forest through pine barrens to, in some cases, heathlands. In the past, individual barrens in the Northeast may have shifted back and forth along this gradient in response to varying fire regimes, but the extensive assemblage of specialized Lepidoptera occupying these barrens strongly suggests that such communities have existed for at least the last two centuries. Evidence for the existence of barrens prior to the settlement of New England by Europeans is equivocal (Motzkin et al. 1995, 1999; Patterson and Backman 1988; Patterson and Stevens 1995), but it is likely that fires, some undoubtedly set by Native Americans, created at least some barrens habitat in pre-settlement times (Schweitzer and Rawinski 1988).

The forests of the Upper Cape Cod region have been impacted both by natural and human caused fires throughout the historical period. Although detailed information is lacking for prehistoric fires, we assume, given the pyrogenic vegetation encountered by the Pilgrim settlers of the area, that fires did impact the forests of Cape Cod. Sedimentary charcoal from Mary Dunn Pond, in nearby Barnstable, suggests that fire was common in prehistoric pitch pine-oak forests (Ruffner and Patterson, *in preparation*). Human ignitions have accounted for the vast majority of all fires during the historical period. Only one lightning-caused fire was recorded (in 1843, see Table 3.1). One early deed (1658) for Native fields in Mashpee suggested that "The fields over the pond have been cleared and improved by the Indians as long as the oldest can remember" (Mass Archives 33 - 245-247). If we infer that the Natives used fire to clear and maintain agricultural fields, this quote suggests long-term use of fire on the landscape (Delcourt 1987, Patterson and Sassaman 1988, Hammett 1992, Clark and Royall 1994)

Table 3.1. Historic Fires Identified on the Upper Cape Cod.

Year	Location	Acreage	Cause/Comments	Reference
1603	Unknown location	unknown	Indian ignition to drive off sassafras hunters	Keene 1975, p 172
1633	Plymouth	unknown	Plymouth Colony Records concerning burning	Keene 1975
1754	Sandwich	unknown	Annual burning of woodlots by selectmen	Keene 1975
1768	N side of Herring River	unknown	Set by Elisha Bourne	Keene 1975
1772	Sandwich	unknown	Woodlots and sheep pasture lots burned	Keene 1975,Freeman 1858
1800	Pocasset Ironworks	unknown	Charcoaling	Sawyer 1988
1836	Pocasset>Sandwich	5760	Cut-over lands of Elisha Perry, esq.	Yarmouth Register April 20, 1836
1843	North Falmouth>West Barnstable	7680	Lightning- burned Sandwich Glass holdings	Yarmouth Register July 6, 1843
1866	Monument>Sandwich	4000	Railroad	Yarmouth Register May 18, 1866
1887	Bourne>Sandwich>Mashpee>Falmouth	25000	Burned woodlots across Sandwich plains area	Sandwich Observer May 17 1887
1906	Monument Beach Summer Colony	unknown		Sawyer 1988
1909	Bourne>Falmouth	10000	Maps in State Forester's Office, Boston	Sawyer 1988, p115; State Forester's Report 1909, p 44,51
1923	Bourne>Sandwich	17000	High tension wire	Sandwich Independent May 20, 1923; SFR 1923, p 16
1930	Barnstable County	16600	97 fires, average fire size 171 acres	SFR pg 20
1931	Sandwich	400	unknown	SFR
1932	Sandwich	1500	unknown	SFR p 12,21
1932	Sandwich	2500	3 separate fires merged into one	SFR
1935	Mashpee	1300	unknown	SFR
1936	Mashpee>Falmouth	400	unknown-aerial photograph of area	SFR, p 36-37
1937	Bourne>Falmouth April 14	700	3 fires in Sagamore, Bournedale, Bourne	R.A. Lovell, Sandwich Archives Manuscript
1937	Bourne April 18	400		ibid
1937	Mashpee April 26	250		ibid
1937	Bourne>Falmouth May 10	1500	18 fires on single day	ibid
1938	Sandwich April 27	5000	Impact Area ignition	ibid
1938	East Sandwich March 23	1500	3 separate fires	Boston Post
1940	Barnstable	unknown		
1946	Camp Edwards	50000	Incendiary in slash piles	Boston Post April 22, 1946
1959	Camp Edwards	3000	Impact area Ignition	MMR Report, 21 Sep 1983
1964	Sandwich/Bourne/Otis	1300	51 fires on May 9-10, Impact area ignition	Sandwich Fire Department
1982	Camp Edwards	2280	Impact Area ignition	Shawme-Crowell Maps

Table 3.1- continued

1985	Camp Edwards	300	Impact Area ignition 3 March	Shawme-Crowell Records
1985	Camp Edwards	900	Impact Area ignition 7 June	Shawme-Crowell Records
1985	Camp Edwards	700	Impact Area ignition 9 June	Shawme-Crowell Records
1986	Camp Edwards	100	Impact Area ignition	Sandwich Fire Department
1986	Camp Edwards	1334	Impact Area ignition	Shawme-Crowell Maps
1987	Camp Edwards	120	Impact Area ignition 1 March	Shawme-Crowell Records
1987	Camp Edwards	300	Impact Area ignition 26 March	Shawme-Crowell Records
1987	Camp Edwards	120	Impact Area ignition 11April	Range Control Daily Log Reports
1987	Camp Edwards	110	Impact Area ignition 8 June	Range Control Daily Log Reports
1987	Camp Edwards	100	C-Training Area	Range Control Daily Log Reports
1988	Camp Edwards	1480	Pave Paws Site	Range Control Daily Log Reports
1988	Camp Edwards	100	C-16 Training Area	Range Control Daily Log Reports
1989	Camp Edwards	170	Impact Area ignition 2 April	Shawme-Crowell Records
1990	Camp Edwards	125	Impact Area ignition 28 April	Shawme-Crowell Records
1990	Camp Edwards	400	Impact Area ignition	Range Control Daily Log Reports
1992	Camp Edwards	420	Impact Area ignition	Range Control Daily Log Reports
1993	Camp Edwards	275	Impact area ignition	Range Control Daily Log Reports
1994	Camp Edwards	150	Impact Area ignition 24 March	Shawme-Crowell Records
1996	Camp Edwards	250	Impact area ignition	Range Control Daily Log Reports
1996	Camp Edwards	300	Impact area ignition	Range Control Daily Log Reports
1996	Camp Edwards	125	Impact area ignition	Range Control Daily Log Reports
1997	Camp Edwards	700	Impact area ignition	Range Control Daily Log Reports
1997	Camp Edwards	400	Impact area ignition	Range Control Daily Log Reports

The first fire recorded by Europeans on Cape Cod was set in 1603 by Native Americans in an effort to drive off sassafras hunters (Keene 1975). Surprisingly few wildfires are reported on Cape Cod during the period of early Colonial settlement (Table 3.1). We might suspect fire to be a chosen mode of land clearance by the settlers, yet no specific references to extensive fires exist for this period. Reducing the occurrence of wildfires, however, was certainly on the minds of the Plymouth Colony elders who, by 1633, had enacted several laws against "fyring any lands in common" citing "That whereas many have sustayned great damage by the indiscreet fyring of the wood, it is by these present orders forbidden to set fire of them except between the middest of the month of September and the middest of the month of March" (PCR Vol 1 - pg 23). In another early attempt at fire management, selectmen of the Town of Sandwich implemented the practice of annually burning portions of the woods to reduce wildfire hazard through the mid 1700s with the last such entry occurring in 1754 (Lovell 1984). Plymouth Colony records dating to 1760 refer to similar activities there.

Despite efforts to reduce wildfire hazard, large catastrophic fires struck the region repeatedly. The first fire in Barnstable County to be recorded in Colonial records occurred in 1768 on the north side of Herring River (now Cape Cod Canal), apparently set by Elisha Bourne (Keene 1975). In 1772 a notable fire struck the "woodlot" and "sheep pasture" areas of Sandwich. While no estimate of the size was recorded, it must have impacted a large area given the large loss of an estimated 10,000 head of sheep (Freeman 1858).

Fires were recorded somewhat more frequently during the 19th century with major fires occurring every 21.8 ± 5.9 years (mean ± SE; Table 3.1). These fires were large in extent, averaging 10,730 acres in size with the largest being 25,000 acres. All documented fires of the 1800s were apparently human-caused with one exception; the lightning ignition of 1843 which burned through cut-over lands of the Sandwich Glass Works (Yarmouth Register 1843). With expanding farming and industrial activities on the Cape, it is doubtful that these were the only fires that occurred on Cape Cod during this period. Those found in the historical record probably only represent the largest and most notable fires of the 19th century.

The first half of the 20th century (1900-1950) witnessed unprecedented growth on Cape Cod with the development of summer beach colonies and expanding military operations at the MMR leading to a higher fire incidence (Table 3.1). On average, large fires burned forests of the Upper Cape every 3.3 years during this period. Despite the fire prevention and control efforts of the Commonwealth, the average size of these fires was still high (7,271.9 ± 3,389 acres), although somewhat smaller than those of the 19th century. Investigations published after the fires fail to identify the cause of most, although it was speculated by the District Fire Warden that many fires were incendiary in nature (Crowell 1932). Others were certainly started by military activities, often beginning in the Impact Area after artillery training or, in the case of the disastrous 1946 fires, by German POW's burning slash piles (Table 3.1).

Fire frequency increased dramatically on the military reservation after 1950 with increased use of the training areas. Large fires (> 1000 acres) occurred more frequently than in previous periods (one every 3.8 ± 1.6 years), but the average size of fires larger than 1000 acres decreased after 1950 to 746 ± 207 acres. All of these large fires were the result of artillery fire in

the Impact Area. During this period, many smaller fires caused by small-arms fire, incendiary explosions, and even cooking fires occurred across the training areas. Better records exist for the period 1975-1997 and thus more complete statistics are available. On average, 23.5 ± 3.2 fires occurred annually (Figure 3.1) with fires recorded in every month of the year (Figure 3.2). High fire occurrence years were 1980, 1990, 1991, and 1993 (Figure 3.1). This may be a consequence of higher numbers of troops training during these years and/or years with unusual drought conditions. Palmer drought index records for Cape Cod over the past 100 years indicate that during 1980-1982, several months with PDSI at or near -3.0 were identified, which is indicative of severe drought. Nineteen eighty-nine to1990 and 1992-1993 had wet, warm winters, but very dry (PDSI ≤-2.0) growing season months. Fire weather conditions appear to have been optimal for ignition and spread during the years 1980, 1990, 1991, and 1993. These years reflect wet summer and fall conditions followed by very dry springs. This scenario provides for ample growth and build-up of fuels during the previous growing season followed by dry spring conditions when fire danger is highest.

During this period (1975-1997), fire occurrence by month was fairly predictable with many fires occurring during March and April when the deciduous species have not yet leafed out. However, the higher occurrence of fires in May and June appears to correlate with the higher numbers of National Guard troops in annual training during these months (CPT Morin, Range Control Officer). Since 1997, all artillery and mortar weapons fire has been banned at Camp Edwards; resulting in lessening the influence of human induced ignitions within the Impact Area. Also, as a result of the same weapons ban, artillery simulators (i.e., pyrotechnics) have not been used throughout the rest of the Camp Edwards training site, again lessening the influence of human induced ignitions (Mike Ciaranca, personal communication). However, many smaller, non-reported fires have occurred related to tracer round firing on small arms ranges located outside of the impact area.

3.2. Fire Weather

Although fires can burn in barrens areas whenever the ground is free from snow, the occurrence of large fires of high intensity is linked closely to the occurrence of either dry, windy weather in the spring, or severe drought accompanied by high winds in the late summer or fall. Historical records show that most fires occur in the spring before leaf-out. Cured fine fuels, strong northwest winds, very low humidity (<25%) following the passage of cold fronts, and low live fuel moisture in pitch pine, can result in extreme fire behavior in barrens fuels. Little advance drying is required, and large fires have burned within a few days of substantial rainfall. For specifics on prescribed fire weather, see Section 5.3.

The winds on Cape Cod in general and at the MMR in particular vary according to season (see Section 2.6 on climate). In the winter, winds out of the northeast bring cold, moist air and increased precipitation that reduces fire danger during winter months. In the summer the prevailing winds are out of the southwest. Cold fronts with winds out of the northwest off the continental land mass of North America bring colder, drier air, and most important to fire management, strong winds during the passage of the front. The high winds often associated with strong frontal systems can quickly turn a small, manageable fire into a major wildfire, especially during dry periods. At the meso-scale, the location of the MMR between Cape Cod Bay and

Canal to the north, Buzzards Bay to the west, and Vineyard and Nantucket Sounds to the south, results in highly unpredictable wind shifts as onshore breezes develop on warm, clear days (i.e., those most likely to support fire occurrence and spread). Cold air over Cape Cod Bay combines with the knob and kettle topography to cause late spring and early summer frosts in depressions. In these areas, mortality of newly developing leaves substantially increases the risk of fire spread into mid-to-late June (Figures 2.9, 2.10).

Weather monitoring on the MMR occurs in multiple locations. One weather station is located at the Otis Air National Guard Base airfield. Additionally the Volpe Center, a NOAA Fog research station, is located in the central cantonment area of the MMR. There are also two portable weather stations located at the Facilities Engineers Building in the cantonment area and at Range Control.

3.3. Fuels

Fuel complexes of barrens habitats, like those on Camp Edwards, are characterized by an abundance of fine fuels - chiefly the litter of oaks and pitch pine plus thatch from sedges and bracken fern that dry and ignite quickly. Older stands of scrub oak and ericaceous shrubs have a high proportion of attached dead branches and standing stems that contribute to the intensity of fires that can move quickly through surface litter. In the spring, the low moisture content of pitch pine needles contributes to the potential for torching of individual pitch pine and the crowning of canopies in dense stands of pine (William Patterson III, personal communication). The presence of volatile oils in the foliage of huckleberry and scrub oak allows intense fires to burn in barrens areas even during the summer. However, higher humidity and lower wind speed result in lower rates of spread for growing-season burns compared to fires burning in the spring or fall. Intense wildfires may consume most of the standing woody stems of shrubs, but fires of lower intensity, including most prescribed fires, will top-kill but not consume stems. Abundant standing dead material and rapid accumulation of oak litter can result in fires occurring in the next 3-5 years that are almost as intense as the initial fire. A second fire will consume much of the dead woody material created by the first. Subsequent fires are substantially reduced in intensity, until the interval between fires increases to 10-to-15 years or more (i.e., following two initial burns, a new custom fuel model should be developed to predict fire behavior within treated areas over the next decade).

The effects fuels have on the ignition, spread, intensity, and duration of a fire, vary according to their size, condition (live or dead, and for dead - sound or rotten), species, amount, spatial arrangement, and moisture content. In order to apply fuel classifications to problems in fire behavior, a means of quantifying the effects of fuel properties on fire behavior is necessary. In response to this need, the U.S. Forest Service has devised the Fire Behavior Prediction System, with 13 fuel models that simulate fuel complexes for which various fuel properties have been determined (Andrews 1986; Andrews and Chase 1989). Within this system, the option exists to develop custom fuel models for individual areas with unique fuels. Anderson (1982) developed standard fuel models, while custom fuel models were created for

Figure 3.1. Fire Incidents (1975-1998) By Year for the MMR.

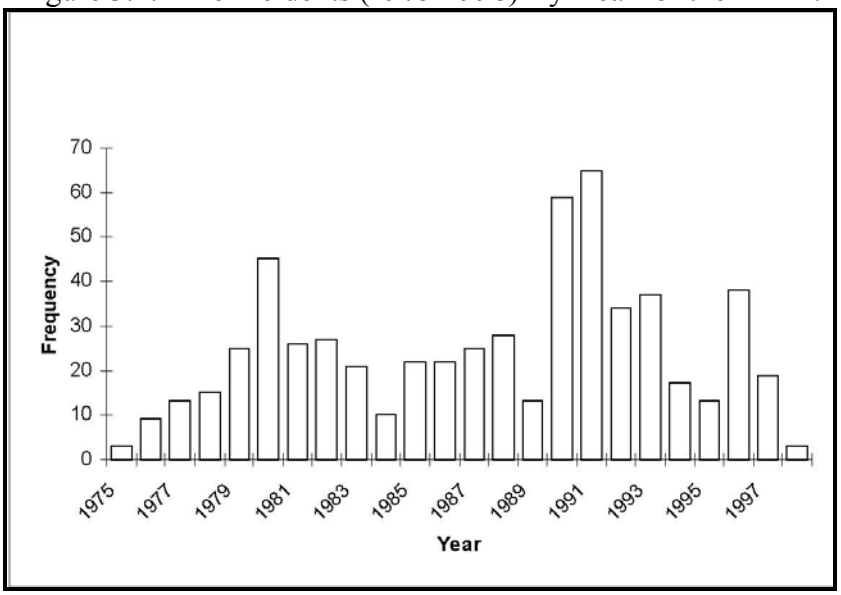


Figure 3.2. Fire Incidents (1975-1998) By Month for the MMR

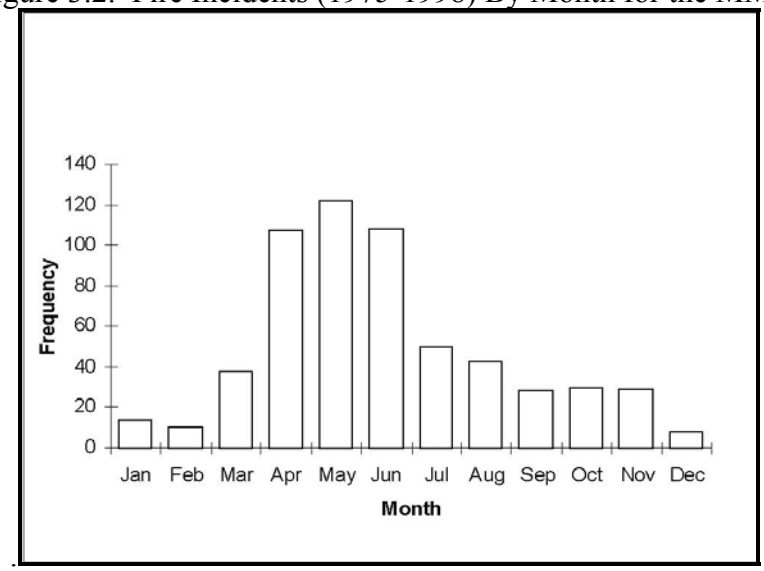


Table 3.2. Fuel Model Parameters Used for Fire Behavior Predictions at Camp Edwards.

Fuel Model Code	Typical Fuel Complex	Fuel Loading (*t/ac*)					SAV Ratio (1/ft)[b]		
		1 Hour	10 Hours	100 Hours	Live Herb	Live Woody	Dead 1hr	Live Herb	Live Woody
	Grass and grass-dominated								
1	Short grass (1 foot)	0.74	0	0	0	0	3500	0	0
2	Timber (grass and understory)	2	1	0.5	0	0.5	3000	1500	0
3	Tall grass (2.5 feet)	3.01	0	0	0	0	1500	0	0
	Chaparral and shrub fields								
4	Chaparral (6 feet)	5.01	4.01	2	0	5.01	2000	0	1500
5	Brush (2 feet)	1	0.5	0	0	2	2000	0	1500
6	Dormant brush, hardwood slash	1.5	2.5	2	0	0	1750	0	0
7	Southern rough	1.13	1.87	1.5	0	0.37	1750	0	1550
	Timber litter								
8	Closed timber litter	1.5	1	2.5	0	0	2000	0	0
9	Hardwood litter	2.92	0.41	0.15	0	0	2500	0	0
10	Timber (litter and understory)	3.01	2	5.01	0	2	2000	0	1500
	Slash								
11	Light logging slash	1.5	4.51	5.51	0	0	1500	0	0
12	Medium logging slash	4.01	14.03	16.53	0	0	1500	0	0
13	Heavy logging slash	7.01	23.04	28.05	0	0	1500	0	0
	Custom								
14	Mixedwood forest	6.17	0.12	0.3	0	0.36	2000	0	1500
15	Pitch pine - scrub oak forest	6.44	0.78	0.69	0	0.36	2000	0	1500
16	Pitch pine - scrub oak thicket	1.84	2.48	2.44	0	2.44	2438	0	2000
17	Scrub oak	5.33	1.12	0.18	0	1.46	2000	2250	1500

[a] The same heat content value was applied to both live and dead fuel categories.

Table 3.2. continued.

Fuel Model Code	Typical Fuel Complex	Heat Content (BTU/lb)[a]	Fuel Bed Depth (*ft*)	Moisture of Extinction Dead fuels (%)
	Grass and grass-dominated			
1	Short grass (1 foot)	8000	1	12
2	Timber (grass and understory)	8000	1	15
3	Tall grass (2.5 feet)	8000	2.5	25
	Chaparral and shrub fields			
4	Chaparral (6 feet)	8000	6 0	20
5	Brush (2 feet)	8000	2	20
6	Dormant brush, hardwood slash	8000	2.5	25
7	Southern rough	8000	2.5	40
	Timber litter			
8	Closed timber litter	8000	0.2	30
9	Hardwood litter	8000	0.2	25
10	Timber (litter and understory)	8000	1	25
	Slash			
11	Light logging slash	8000	1	15
12	Medium logging slash	8000	2.3	20
13	Heavy logging slash	8000	3	25
	Custom			
14	Mixedwood forest	8176	1.25	25
15	Pitch pine - scrub oak forest	8040	0.52	24
16	Pitch pine - scrub oak thicket	8932	2.5	25
17	Scrub oak	8170	0.98	23

areas of similar Cape Cod vegetation. These models are generally applicable and have been used on Camp Edwards (W.A. Patterson, unpublished data; Table 3.2). Descriptions of the standard fuel models used for predictive purposes in fire behavior at Camp Edwards are found in Andrews 1986 and Andrews and Chase 1989. Custom fuel models utilized on Camp Edwards are as follows (*see also* Section 4.5, Fire Management Planning Tools, for information on new fire behavior modeling tools):

CFM 1 - Hardwoods and Mixed Woods - This fuel model includes most of the training area surrounding the Impact Area. This model is generally comprised of oak hardwood stands with some stands having a mixture of oak-pitch pine in the overstory. Understories range from open herbaceous growth under fairly pure oak stands to high amounts of ericaceous shrubs in mixed stands. Surface fires move slowly through these stands if fuels are moderately cured with little potential for crowning of pitch pine. Under dry conditions, severe burns can occur if fires enter the duff that accumulates under oak litter. Most of the mature timber stands in the northern training areas of Camp Edwards represent areas burned during the 1946 fires, which have not been as intensely disturbed since.

CFM 2 - Pitch Pine-Scrub Oak Forest - This fuel model includes substantial portions of Camp Edwards training areas and is characterized by stands of pitch pine having greater than 60% canopy closure with scrub oak dominating the under story. Fires in this model can burn rapidly and intensely in areas with high fuel loads of dead scrub oak branches and ericaceous shrubs. With high winds, ladder fuels allow fires to crown out in the pitch pine overstory. Based on stand ages (C. Ruffner, field reconnaissance), many of these areas apparently regenerated after fires in the 1950s and 1960s. Intense fires can convert mixed woods to PP-SO Forest or Thickets (see below)

CFM 3 - Pitch Pine-Scrub Oak Thicket - This fuel model includes stands burned in the past 10-15 years and has a substantial thicket of scrub oak underneath widely scattered pitch pine. Fires in this fuel model can burn very rapidly with high flame lengths and torching of isolated pitch pines. Extreme fire behavior can result from a high volume of dead scrub oak branches and, during the growing season, from flammable green leaves.

CFM 4 - Scrub oak - This fuel model is found on portions of the Impact Area burned by wildfires in the 1980s, as well as on some small arms ranges. High volumes of dead stems and branches allow extreme fire behavior when prolonged dry periods and high winds produce high rates of spread and long flame lengths.

3.4. Wildfire Fuel Load Modeling

The MAARNG GIS Office has developed a coarse-scale, GIS based wildfire fuel load assessment built on current vegetation, time-since-fire, slope, and area dryness (Figure 3.3). Given the reservation's long-term fire history (Table 3.1) and the current environment of fire exclusion, the model's purpose is to evaluate the current fuel load potential for

wildfire on the MMR. The tool will ultimately be used to direct fire planning and land management actions to those areas estimated to have the greatest fuel loads.

It is important to note that wildfire risk modeling, while representing a "best knowledge and science" application, provides no guarantees for or against a fire event. For example, an area will be unaffected by a fire because it is identified as a low fuel loads. In fact, many fire frequency studies throughout North America have shown that the hazard of burning remains constant with time. The age of the forest does not influence the probability of burning (Grenier et al 2005; Reed and Johnson 2004; Bergeron et al 2001; Weir et al 2000; Johnson and Gutsell 1994). Regardless, modeling exercises provide a useful starting point when considering management direction and fire frequency on the macro-scale.

4. FIRE MANAGEMENT STRATEGIES

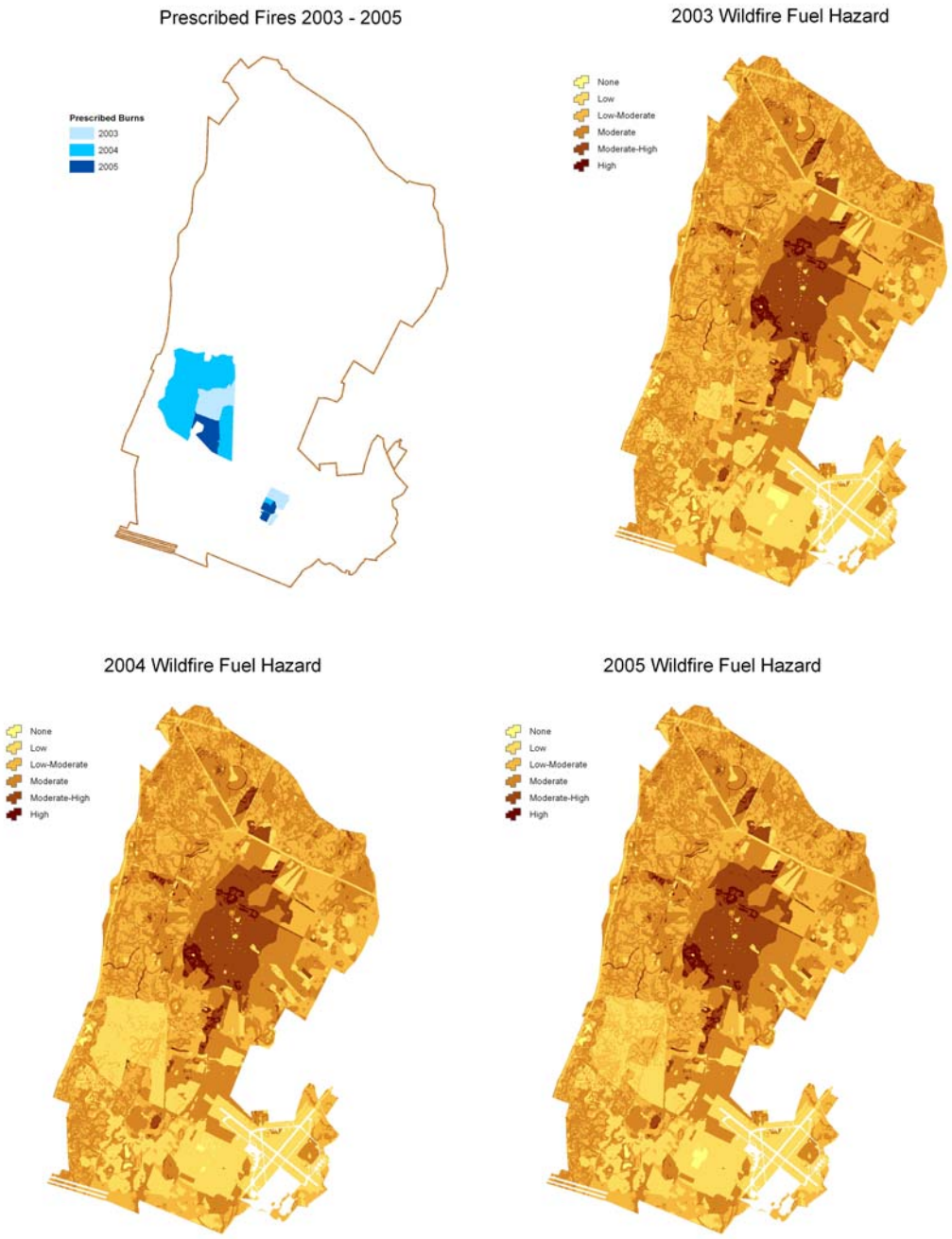
4.1. General Management Justifications and Considerations

Natural resource management at Camp Edwards is based upon an ecosystem level approach. Management actions generated from the current understanding of ecological interactions and processes are necessary to sustain ecosystem structure and function over the long-term (Ecological Society of America 1996, *as cited by* Ciaranca et al 2001). Such a landscape scale, systems oriented strategy functions as an ideal solution to the management of military lands. It ensures the diversity of training grounds required for proper soldier training and readiness and the long-term integrity of natural communities.

General wildland fire policy for the MMR is to control fires due to the potential for damage to resources, the protection of property, and to avoid potential liability from property loss and threats to human safety. However, an integral part of wildland fire management at Camp Edwards includes proactive steps at both the local and landscape scale. Many of the vegetation types at the MMR are classified as fire associated early successional communities and result from past wildfires or other human caused disturbances. In fact, many of the largest fires occurring in Massachusetts, in the last 30 years, have originated within Camp Edwards (see Section 3). Some have threatened surrounding developments and communities, all of which are expanding rapidly along the installation boundary. Given this history, prudent fuel management strategies are warranted to reduce wildfire intensity in case of occurrence (see Sections 4.3 and 5 for an outline and discussion of program components).

Scientists and land managers additionally recognize that these unique fire prone systems, sometimes referred to as “pine barrens”, serve as habitat to many rare plants and animals. These systems have quickly become fragmented as a result of land development. The MMR is one of the few remaining pine barrens communities in the northeastern United States where land management through prescribed fire remains a viable option. Using fire as a tool has the advantage of replicating the natural role of fire in regenerating barrens vegetation and

Figure 3.3. Wildfire Fuel Load Assessment, MMR, August, 2005.



retarding succession. This is an ecosystem management approach suggested to aid in the maintenance of biodiversity and vital ecological processes to which endemic species have adapted to through time (Franklin 1993, Hunter 1999; Bergeron et al 2001). The Natural Resource Office, working in the MAARNG Environmental and Readiness Center, oversees and administers the conservation program that protects the endangered species and historical sites on the CETS. One of the primary wildfire protection priorities is installation natural and cultural resources, thus it is necessary to integrate fire and natural/cultural resource management planning with military preparedness and training.

All fire planning efforts must consider what impacts fire pre-suppression and suppression activities will have on the natural/cultural resources they are designed to protect. Firefighting strategies must minimize impacts to, natural and cultural resources, such as rare and endangered species habitat, watersheds, and historical and archaeological sites.

4.2. Wildland Fire Management Goals

The primary goal of the IFMP is to support the INRMP by enhancing ecosystem integrity and training opportunity at Camp Edwards on a sustainable basis. Other goals and objectives include:

Goal 1. Protect and provide safety for lives and facility resources at the MMR and adjacent communities during fire activities.

- Restore and maintain existing and historical firebreaks to enhance the effectiveness of wildfire suppression and wildland fuel reduction activities.
- Reduce wildland fuel loads with the use of prescribed fire and other fuel treatment techniques.
- Provide wildland fire prevention education to those of the MMR and surrounding neighbors.

Goal 2. Restore and maintain the ecological processes that have occurred historically across the MMR landscape to promote viable plant and animal populations and communities.

- Revert and restore plant and animal communities to varied stages of early ecological succession with the use of prescribed fire and other vegetation management techniques.
- Maintain these varied stages of ecological succession with the use of prescribed fire and other vegetation management techniques.
- Ensure that specific plant and animal community targets compliment the overall ecological health and diversity of the southeastern Massachusetts region.
- Ensure that prescribed fire and vegetation management techniques are conducted to maintain healthy and diverse plant and animal populations.
- When possible conduct large scale landscape level treatments (greater than 300 acres in size) to mimic the ecological results of historic large scale natural disturbances in southeastern Massachusetts.

Goal 3. Establish an informed and effective fire management program that will facilitate the accomplishment of Fire Management Goals 1 and 2.

- Establish and maintain a cadre of staff that has experience and training in fire management techniques and practices.
- Conduct fire management planning that uses best available information to refine fire management goals and objectives over time.
- Monitor the success of fire management activities using the Range and Training Land Assessment (RTLA, formerly Land Condition Trend Analysis) in addition to other methods as needed.
- Ensure that the users of the MMR and surrounding towns are kept informed on the fire management activities at the MMR and of the benefits associated with these activities.
- Ensure that the capacity to execute fire management goals and objectives is established and maintained through a combination of direct action and partnering with other organizations.

4.3. Wildland Fire Management Options

Fire management strategies specific to Camp Edwards at the MMR include wildland fire suppression, wildland fire use, prescribed fire, non-fire fuel application, vegetation conversion, no action policy, and emergency rehabilitation and restoration. Descriptions and considerations of these potential management options follow:

Wildland Fire Suppression: Extinguishing or confining a fire.

Complete fire suppression was a policy followed at the MMR in the early 1980's with limited success. Dozens of ignitions annually produced wildfires that grew to several hundred acres in size before containment. Experience elsewhere on Cape Cod and Plymouth County suggests that the occurrence of catastrophic, large fires can be delayed but not eliminated through a policy of prevention, detection, and suppression. Larger fires may take place at longer intervals through complete suppression, but may be greater in intensity. Long intervals between major fires actually heighten danger to the public, as people forget that fires occur and do not control flammable accumulations of fuels around structures. The rapid growth of residential areas on the perimeter of a large area of highly flammable vegetation is a paramount concern to public officials and emergency preparedness organizations throughout the Upper Cape area. Fire must be suppressed in residential areas adjacent to Camp Edwards. However, large tracts of unbroken and highly flammable fuels within the Reservation require active fuels management, if for no other reason than to protect private property adjacent to Camp Edwards. The ecological impacts of fire suppression are somewhat irrelevant if we "assume" that wildfires will eventually burn through the area. Wildfire occurrence has been the case for the better part of 200 years at what is now the MMR and the result has been the maintenance of fire adapted natural communities.

Wildland Fire Use: The application of the appropriate management response to unintentionally and naturally-ignited wildland fires to accomplish specific resource management objectives.

Wildland fire use as a management strategy is not currently utilized at the MMR. Naturally occurring wildfires are rare; however, wildfire like scenarios can arise from fires caused by military activity. As the acceptance of fire management on the reservation expands, greater consideration will be given to the use of wildland fire and its potential in controlling other wildland fires. MMR fire fighters and those of the surrounding communities must be informed and trained on how to use this technique while still meeting their mandate of protecting public interest.

Prescribed Fire: This option is the intentional application of fire to achieve ecosystem management objectives utilizing an approved natural resources fire management site specific burn plan.

Present scientific thought suggests that basing land management actions upon structuring processes, such as fire, aids in maintaining naturally occurring community composition and structure (Franklin 1993; Hunter 1999; Bergeron 2001; Bergeron 2002). Prescribed fire is a land management approach that more closely replicates the natural disturbance regime of pine barren communities. The generation of smoke, which can affect areas adjacent to the MMR, and the potential for escaped fires impacting areas outside intended management units, requires skillful planning and application.. Camp Edwards, and partner organizations have acquired much experience with applying prescribed fire to the landscape (Table 4.1), and much has been learned about how to maximize success and minimize adverse effects. The prescribed fire program at Camp Edwards has gained support of the National Guard Bureau, the National Park Service, the United States Fish and Wildlife Service, the Massachusetts Departments of Environmental Protection, the Massachusetts Department of Conservation and Recreation, the Massachusetts Division of Fisheries, Massachusetts Wildlife's Natural Heritage and Endangered Species Program, and surrounding local fire departments. The program has also received support from non-governmental organizations such as The Nature Conservancy and the Massachusetts Audubon Society.

Non-Fire Fuel Application: Mechanical manipulation or removal of fuels to reduce the probability of ignition of fire (i.e. Mechanical treatments - lopping, chipping, harvesting, mowing, etc.).

Mechanical treatment has most often involved the use of machinery to cut, chop, and or grind vegetation. Where soils are not disturbed, native species usually re-sprout and produce, for a few years, young vigorous stands that are somewhat less flammable. Mechanical treatments compact fuel beds reducing the intensity of fires that might burn on treated areas. However, fine fuels are not removed, and the potential for fire burning through treated areas is not completely eliminated. Some floral components need mineral soil exposure through a process that does not till (i.e. disturb) the soil for germination and propagation.

Table 4.1. Prescribed Fire Activity, Camp Edwards Training Area, 1983-2005.

Date	Location	Area Burned (acres)
1983	–	370
1984	–	126
1985	–	494
1989	–	600
1990	–	404
1991	–	10
1993	–	400
1994	–	45
2000	–	88
3/1/2000	NW corner of IA	40
3/23/2000	NW corner of IA	40
3/28/2003	MMR Cantonment, Area 1, Sub-Unit A & B	40
5/15/2003	MMR Camp Edwards, Training Area Buffer	20
5/16/2003	MMR Camp Edwards, A2	223
11/10/2003	MMR Cantonment, Area 1, Sub-Unit D, E, & F	50
11/10/2003	Cantonment 1	50
5/14/2004	A-4	186
5/18/2004	Cantonment 1	1
5/19/2004	Cantonment 1	1
5/20/2004	Cantonment 1	3
6/3/2004	A-3/1 East	5
6/4/2004	A-3/1 East	1
6/8/2004	A-3/1 East	58
6/9/2004	A-3/1 East	222
6/24/2004	A-1/3 West	200
10/7/2004	BA-3 East	40
10/8/2004	BA-3 East	40
5/10/2005	Cantonment Area	1
5/11/2005	Cantonment Area	3
5/12/2005	Cantonment Area	3
5/19/2005	Cantonment Area	15
5/20/2005	Cantonment Area	5
6/8/2005	BA-3	20
6/9/2005	BA-3	149
6/24/2005	B Range	2
	Total:	**3955**

At Camp Edwards, one constraint to mechanical treatment is unexploded ordinance, primarily within the Impact Area and associated ranges. Non-fire fuel applications such as mechanical treatments have potential for reducing fire hazard on portions of the MMR, but initial treatments would likely proceed slowly and follow up would be required as vegetation re-establishes and new fuels accumulate. It is likely a combination of mechanical with prescribed fire would be used. This combination in general reduces fire behavior and may allow burning in ares that otherwise could not be treated with prescribed fire.

Vegetation Conversion: Reducing probability of wildfire through conversion to less flammable vegetation (i.e., natural succession).

This is a fire management strategy attempted through the early decades of the twentieth century with little success. An active planting program at Myles Standish State Forest in Plymouth resulted in no more than 10% of the landscape being converted to less flammable white (*Pinus strobus)* and red pine (*P. resinosa*). Attempts to plant deciduous species, especially poplar (*Populus spp*.), were less successful. A similar planting attempt occurred at the MMR (former Shawme-Crowell State Forest Area) during the Depression of the 1930s (*see* Figure 2.20). Wildfires destroyed many young plantations, which often could not compete with flammable native vegetation. Lack of suitability of many of the less flammable species to the dry, nutrient poor soils of the MMR would require costly soil preparation and amendment. Insect and disease outbreaks in unhealthy stands have and would likely continue to cause failure of plantations. Conversion would be costly both ecologically and economically. Ecologically, many of the rarer plant, insect, and bird species that occupy barrens areas do not fair well in more densely forested landscapes, thus the value of the MMR as rare species habitat would decline.

Emergency Rehabilitation and Restoration: A management response to the potential for resource harm from the management options discussed above; all post-fire stabilization and restoration activities fall within this umbrella.

This action would facilitate or prevent resource harm immediately following wildfires by augmenting soils or doing planting to protect areas from resource damage such as erosion. This activity is not a true fire management option but a response to the effects of a wildfire or similar action that has the potential to destabilize natural resources (i.e., erosion).

No Action Policy: Reducing wildfire by taking no direct management action.

This is a benign neglect concept, where the hazard of fire may be reduced if management actions (i.e., disturbance) do not occur and pyrogenic vegetation is left to naturally succeed to less flammable vegetation types. Foster and Motzkin (1999) suggest that the climax plant community on Camp Edwards is an oak - pine forest with gray birch (*Betula populifolia*), American beech (*Fagus grandifolia*), and bitternut hickory (*Carya cordiformis*); which is far less pyrogenic. However, this type of action would not provide for the biodiversity goals stated within the INRMP and likely those of the resource agencies of the state of Massachusetts.

4.4. Fire Management Blocks, Smoke Management Zones and Burn Units

4.4.1. Fire Management Blocks

Delineation of Fire Management Blocks (FMB) at Camp Edwards is based upon numerous influences including vegetation composition/fuel type, topographic features, training area configurations, reservation boundaries, desired ecological effects, safety for people and property, common management objectives at the local scale and other management constraints (Figure 4.1). Block descriptions, dominant management objectives, and pre-selected strategies to accomplish zone specific targets are as follows:

Fire Management Block A:

Description – Fire Management Block A is 2230 acres in size and located along the western side of Camp Edwards along route 28 in the Town of Bourne (Figure 4.1). FMB-A lies in glacial moraine deposits, with pitch pine – oak forest as the dominant vegetation community in the block (83 % of the block; Table 4.2). Pitch pine – scrub oak community, immature pitch pine, and some small disturbed and developed areas make up a very minor portion of the vegetation cover in the block. The dominant fuel models in the block include CFM 1, 2, and 3. Alternatively, past prescribed burn plans have used SFM 8, 4, 6, and 9 to model fire spread and flame height. Training Areas A-1 through A-6, unit BA-3, and unit BA-4 are located with FMB-A.

Management Objective - General management objectives for this block are to, initially, conduct growing season burns to develop a patch work of early successional habitat and to conduct dormant season burns to reduce fuel loads, the duff layer, and for overall maintenance. Growing season burns will open up the canopy that will in turn aid in the creation of early successional habitat. These burns will create standing dead wood, which is lacking in this system, and snags to provide habitat for a variety of flora and fauna. Site specific objectives will be addressed in unit specific burn plans.

Fire Management Block B:

Description – Fire Management Block B, 3119 acres in size, is found in the northwest corner of Camp Edwards, in the Town of Bourne, closest to the Cape Cod Canal (Figure 4.1). The most complex topography on Camp Edwards is found in this block, which is part of the Sandwich and Buzzards Bay terminal moraines. Pitch pine – oak forest is the prevailing block vegetation cover (68 %), though pitch pine – scrub oak community, black oak – scarlet oak forest, scrub oak shrubland, and Scotch pine dominated stands make-up minor components (Table 4.2). The main fuel models for this block include CFM 1, 2, and 3. Training Areas B-7 through B-12 are included in the block.

Management Objective - General management objectives for this block are to, initially, conduct growing season burns to maintain the current patch work of early successional habitats and to conduct dormant season burns to reduce

fuel loads, the duff layer, and for overall maintenance. Growing season burns will maintain the canopy openings and early successional habitats. These burns will create standing dead wood, which is lacking in this system, and snags that provide habitat for a variety of flora and fauna. Dormant season burns will maintain the hardwood component of this management block. Site specific objectives will be addressed in unit specific burn plans.

Fire Management Block C:

Description – Fire Management Block C is 2023 acres, and lies on the moraine in the northeastern portion of Camp Edwards in the Town of Sandwich, with its northern border adjacent to Route 6, the mid-Cape Highway (Figure 4.1). Pitch pine – oak forests form the primary vegetation cover in the block (62 % of the block); however, pitch pine – scrub oak communities, black oak – scarlet oak forests, scrub oak shrublands, and disturbed areas are also present (Table 4.2). Important fuel models include CFM 2, 3, and SFM 6. Training Areas C-13 through C16 are included in this block.

Management Objective - General management objectives for this block are to, initially, conduct growing season burns to maintain the patch work of early successional habitats and to conduct dormant season burns to reduce fuel loads, the duff layer, and for overall maintenance. Growing season burns will maintain the canopy openings and early successional habitats. These burns will create standing dead wood, which is lacking in this system, and snags that provide habitat for a variety of flora and fauna. Dormant season burns will maintain the hardwood component of this management block. Site specific objectives will be addressed in unit specific burn plans.

Fire Management Block D:

Description – Management Block D is a 2546 acre, narrow, horseshoe shaped section wrapping around to the northern, southern, and western margins of the Impact Area (Figure 4.1). The block rests within the towns of Bourne and Sandwich. Its main vegetation cover is pitch pine – oak forest (42 %), though pitch pine scrub oak community (31 %), scrub oak shrubland, black oak – scarlet oak forest (10 %), cultural grassland (.4 %), and sandplain heathland (9 %) are also important cover types (Table 4.2). Fuel models linked to this block include CFM 2, 3, and 4, but SFM 5 and 6 should also be considered. The small arms range areas and the BA-5 training areas are included in this management block.

Management Objective - General management objectives for this block are to conduct growing season burns to maintain the patch work of early successional habitats and to conduct dormant season burns to reduce fuel loads, the duff layer, and for overall maintenance. Several areas within this block will need management similar to the objectives stated for the previously

mentioned blocks. These objectives will be addressed in unit specific burn plans.

Fire Management Block E:

Description – Management Block E rests on the eastern side of Camp Edwards in the Town of Sandwich along Route 130 (Figure 4.1). Its total area is 1037 acres. The major vegetation types include pitch pine – oak forest (43 %), sandplain heathland (18 %), and pitch pine – scrub oak community (28 %), while pitch pine community, cultural grassland, and disturbed areas function as minor vegetative components (Table 4.2). Custom Fuel Models 2 and 3 are the dominant models in this block. Standard Fuel Models 5 and 6 also are significant. Several small arms ranges, a Coast Guard facility, and two antenna farms (one subsurface and one above ground) occur within this management block.

Management Objective - General management objectives for this block are to conduct growing season burns to maintain the patch work of early successional habitats and to conduct dormant season burns to reduce fuel loads, the duff layer, and for overall maintenance. Site specific objectives will be addressed in unit specific burn plans.

Fire Management Block F:

Description – Fire Management Block F is located in the southeast corner of Camp Edwards, Sandwich, Massachusetts and totals 1734 acres. Soils in the management block the sandy soils of the outwash plain. The major vegetation types are pitch pine – scrub oak community (48 %), pitch pine – oak forest (23 %), and developed areas (12.5 %; Table 4.2). Minor vegetation classes in the block include cultural grassland, scrub oak shrubland, black oak – scarlet oak forest, and disturbed areas. Custom Fuel Models 2, 3, and 4 are the primary fuel models. Training areas BA-1, BA-2, BA-6, and the 1800 area are found in this block.

Management Objective - General management objectives for this block are to conduct dormant season burns to top kill pitch pine – scrub oak community flora, primarily scrub oak. Other objectives are to conduct growing season burns to maintain the patch work of early successional habitats and to conduct dormant season burns to reduce fuel loads, the duff layer, and for overall maintenance. Hardwood areas of this block will be maintained by burning during the dormant season. Site specific objectives will be addressed in unit specific burn plans.

Fire Management Block G:

Description – Fire Management Block G is a disjunct management area measuring 572 acres and abuts Otis Airfield in the Mashpee outwash plains. The major vegetation classes include cultural grassland (47 % of the block), sandplain heathland (23 %), pitch pine – scrub oak community (8%), and

developed areas (22 % of the block; Table 4.2). Significant fuel models include SFM 1, 2, 5 and 6, and CFM 2 and 3. Training areas 1100, 1200, 1300, 1500, 1600, 1700, and 2800 are within block G.

Management Objective - General management objectives for this block are to conduct growing season burns in late May through early June to stimulate grassland species growth, remove thatch layer, to kill small woody vegetation, and for overall maintenance. Site specific objectives will be addressed in unit specific burn plans.

Fire Management Block IA:

Description – Fire Management Block IA (2197 acres) encompasses the Impact Area of Camp Edwards and is located approximately in the center of the base and within the towns of Bourne and Sandwich (Figure 4.1). Vegetation is mainly composed of scrub oak shrubland (67 % of the block), though pitch pine – oak forest, pitch pine – scrub oak community, immature pitch pine and disturbed areas are included (Table 4.2). Custom Fuel Model 4 is the most important in the management block.

Management Objective - General management objectives for this block are to conduct dormant or early season burns to top kill scrub oak (90%) and to kill pitch pine saplings. Other objectives are to conduct growing season burns to maintain the patch work of early successional species and to conduct dormant season burns to reduce fuel loads, the duff layer, and for overall maintenance. Site specific objectives will be addressed in unit specific burn plans.

Table 4.2. Estimates of Vegetation Cover By Community Class in Acres And Percent Cover with Corresponding Fuel Models for the Fire Management Blocks Identified for Camp Edwards. (It is important to note that vegetation classification may function as a broad-scale guide when modeling fire behavior, but is not a surrogate to direct fuel measurement. Cautions should be taken when consulting this table as measurable variability in vegetation and other existing conditions exists at the micro-scale).

	Fuel Model		FMB-A		FMB-B		FMB-C		FMB-D	
Vegetation Cover	Growing Season	Dormant Season	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Black oak-scarlet oak forest	SFM 5	SFM 6	66.2	3	106.3	3.4	197.1	9.7	241	9.5
Cultural grassland	SFM 2	SFM 1	39.9	1.8	0	0	0	0	10	0.4
Developed	NB 1*	NB 1*	15.5	0.7	37	1.2	15.9	0.8	1.2	0
Disturbed	NB 9*	NB 9*	27.1	1.2	24.2	0.8	28.8	1.4	12.9	0.5
Immature pitch pine	SFM 5	SFM 5	22.1	1	4.2	0.1	8.6	0.4	44.2	1.7
Pitch pine community	SFM 8	SFM 8	0	0	0	0	0	0	0	0
Pitch pine-oak forest	CFM 2, SFM 6	CFM 2	1847.9	82.9	2107.2	67.6	1252.2	61.9	1070.2	42
Pitch pine-scrub oak community	CFM 2 & 3	CFM 2 & 3[a]	147.6	6.6	543.6	17.4	350.1	17.3	797	31.3
Plantation	SFM 8 & 10[b]	SFM 8 & 10[b]	0	0	0	0	0.1	0	0.1	0
Red maple swamp	SFM 8[c]	SFM 8[c]	0	0	1	0	0	0	0	0
Sandplain heathland	SFM 5	SFM 6	39.4	1.8	165.1	5.3	55.1	2.7	219.7	8.6
Scotch pine-pitch pine oak forest	CFM 1	CFM 1	0	0	42.3	1.4	0	0	0	0
Scotch pine-pitch pine scrub oak community	CFM 2	CFM 2	0	0	43.7	1.4	0	0	0	0
Scrub oak shrubland	CFM 4	CFM 4	0	0	35.2	1.1	112.4	5.6	147.4	5.8
Wet area	NB 8*	NB 8*	23.9	1.1	9.2	0.3	2.7	0.1	2.5	0.1
Total			2229.6	100	3119	100	2022.9	100	2546.3	100

* Nonburnable model (see Scott & Burgan 2005)

[a] SFM 7 could also be used for ROS, and SFM 4 for flame length.

[b] SFM 10 is considered only during later stages of succession when the stand is falling apart.

[c] Attention should be paid to drought years and shrub layer availability for burning.

Table 4.2 continued.

Vegetation Cover	Fuel Model		FMB-E		FMB-F		FMB-G		FMB-IA	
	Growing Season	Dormant Season	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Black oak-scarlet oak forest	SFM 5	SFM 6	82.3	7.9	45.1	2.6	0	0	2.8	0.1
Cultural grassland	SFM 2	SFM 1	6.8	0.7	25.9	1.5	267.8	46.8	0.1	0
Developed	NB 1*	NB 1*	1.6	0.2	216.3	12.5	127.3	22.2	0	0
Disturbed	NB 9*	NB 9*	1	0.1	43.4	2.5	0	0	29.3	1.3
Immature pitch pine	SFM 5	SFM 5	0	0	1.4	0.1	0	0	16.9	0.8
Pitch pine community	SFM 8	SFM 8	6.8	0.7	0	0	0	0	0	0
Pitch pine-oak forest	CFM 2, SFM 6	CFM 2	441.3	42.5	481.3	27.8	0.1	0	144.7	6.6
Pitch pine-scrub oak community	CFM 2 & 3	CFM 2 & 3[a]	291.7	28.1	838.2	48.3	43.4	7.6	520.9	23.7
Plantation	SFM 8 & 10[b]	SFM 8 & 10[b]	3.2	0.3	0	0	0	0	0	0
Red maple swamp	SFM 8[c]	SFM 8[c]	0	0	0	0	0	0	0	0
Sandplain heathland	SFM 5	SFM 6	186.2	18	2.4	0.1	133.8	23.4	1.7	0.1
Scotch pine-pitch pine oak forest	CFM 1	CFM 1	0	0	0	0	0	0	0	0
Scotch pine-pitch pine scrub oak community	CFM 2	CFM 2	0	0	0	0	0	0	0	0
Scrub oak shrubland	CFM 4	CFM 4	15.3	1.5	78.7	4.5	0	0	1479.7	67.3
Wet area	NB 8*	NB 8*	1.2	0.1	0.9	0.1	0	0	1.4	0.1
Total			1037.3	100	1733.6	100	572.4	100	2197.4	100

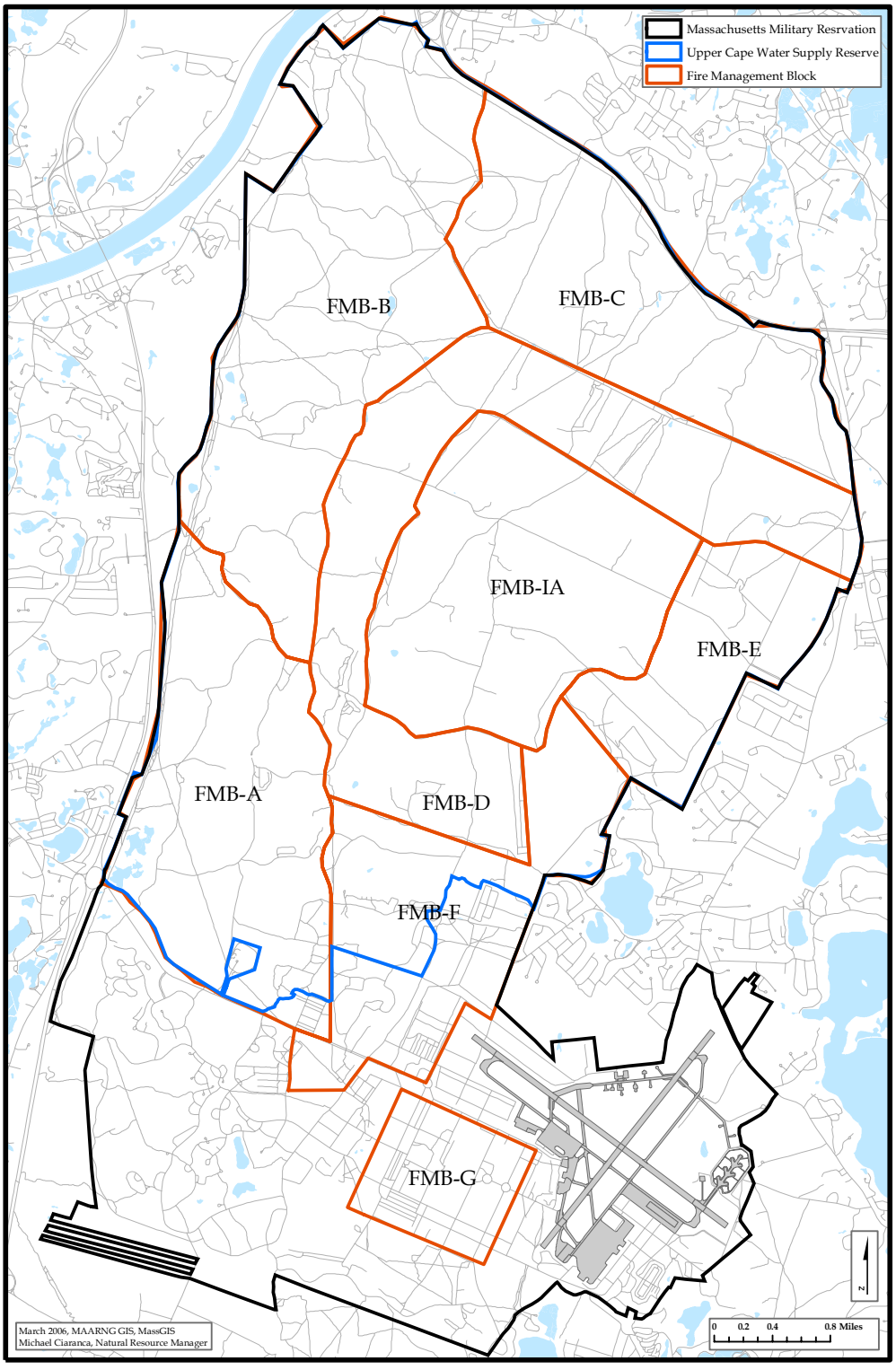
* Nonburnable model (see Scott & Burgan 2005)

[a] SFM 7 could also be used for ROS, and SFM 4 for flame length.

[b] SFM 10 is considered only during later stages of succession when the stand is falling apart.

[c] Attention should be paid to drought years and shrub layer availability for burning.

Figure 4.1. Fire Management Blocks, MMR.



4.4.2. Smoke Management Zones

Wildland fire is essential in creating and maintaining many functioning ecosystems, and achieving other land use objectives, however, combustion byproducts are produced by fires that are harmful to human health. Balancing public health interests with ecological integrity is, consequently, the challenge land managers face when using fire to meet natural resource management goals. Awareness of smoke production, transport, and effects in conjunction with knowledge and implementation of control strategies maximizes the effectiveness of using fire as a tool. The purpose of smoke management on Camp Edwards is to prevent health and safety hazards by minimizing the amount of smoke entering sensitive areas (i.e., populated areas, hospitals, nursing homes, etc.) to avoid significant deterioration of air quality, and to eliminate visibility impacts on roadways or runways. Compliance with laws and regulations set by the U.S. Environmental Protection Agency (i.e., the Federal Clean Air Act) and the state of Massachusetts Department of Environmental Protection (i.e., the Massachusetts Clean Air Act) is foremost in all management planning and implementation. Over-arching control strategies include:

- Avoidance – using meteorological conditions when planning burns to avoid smoke impinging on smoke sensitive areas.

- Dilution – controlling the amount of emissions for dispersion to assure tolerable concentrations of smoke in designated areas.

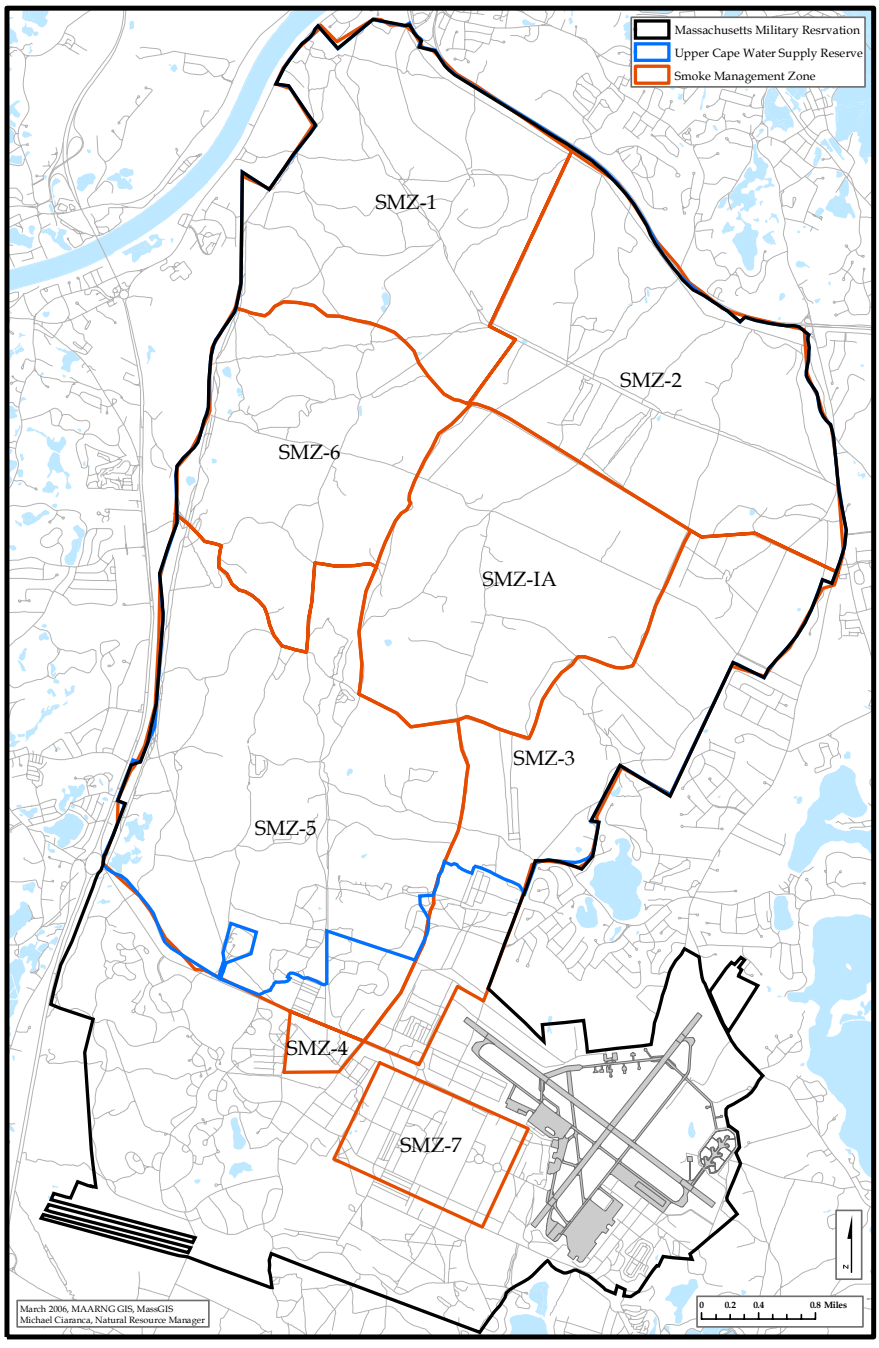
- Emissions reduction - using techniques to minimize the smoke output per unit area and decrease the contribution to regional haze as well as intrusions into smoke sensitive areas.

To aid in the success of smoke management on Camp Edwards, Smoke Management Zones (SMZ) were created that identify preferred wind direction when planning prescribed fire for a given area (Figure 4.2). These parameters serve as a guide to fire planners and managers when identifying the proper control strategies necessary for local scale management success.

4.4.3. Fire Management by Unit

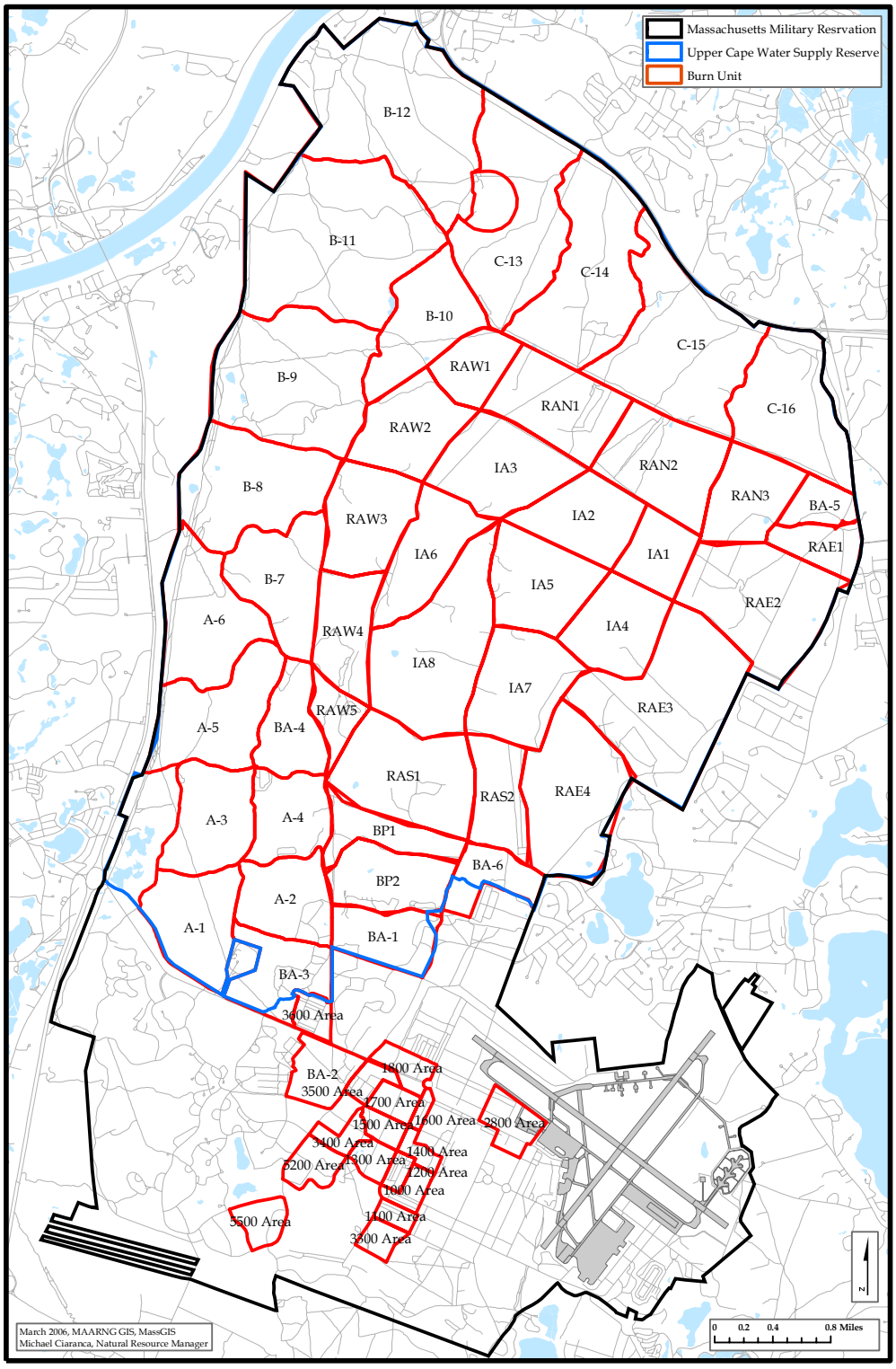
Burn unit boundaries within a given FMB, in general, reflect present training subsections (i.e. A-1 through A-6, B-7 through B-12, and C-13 through C-16; Figure 4.3). Site specific burn plans will reflect the training unit organization in most cases. In most instances, a management objective for a given unit will be dictated by the FMB it falls within. Specific planning for those areas outside of the current training ground configuration will be considered when required.

Figure 4.2. Smoke Management Zones, MMR



Smoke Management Zone	Preferred Wind Direction
SMZ-1	West → North
SMZ-2	Northwest → East
SMZ-3	North → Southwest
SMZ-4	Any Direction
SMZ-5	Southeast → Northwest
SMZ-6	South → North
SMZ-7	Any Direction
SMZ-IA	Any Direction

Figure 4.3. Prescribed Fire Burn Units, MMR



4.5. Fire Management Planning Tools

Many planning and analytical tools are available to help in refining fire management activities. Some of the tools commonly utilized by land and fire managers in the United States are described below (non-inclusive):

4.5.1. Fire Danger Rating

The National Fire Danger Rating System - The National Fire Danger Rating System (NFDRS), currently used on Camp Edwards, is a set of computer programs and algorithms that allow land management agencies to estimate fire danger for a given rating area. NFDRS characterizes fire danger by evaluating the approximate upper limit of fire behavior in a fire danger rating area during a 24-hour period. Calculations of fire behavior are based on fuels, topography, and weather, or what is commonly called the fire triangle. NFDRS output gives relative ratings of the potential growth and behavior of any wildfire. Fire danger ratings are guides for initiating presuppression activities and selecting the appropriate level of initial response to a reported wildfire in lieu of detailed, site- and time-specific information. It links an organization's readiness level (or pre-planned fire suppression actions) to the fire problems of the day.

4.5.2. Software and Spreadsheets

ArcGIS – ArcGIS is a geographic information system that is used to view and analyze data from a geographic perspective. It manages, analyzes, and disseminates geographic knowledge; allowing the visualization of features and feature relationships (Anonymous 2005c).

Behave by Remsoft © - An interactive, commercial software package that calculates fire behavior for the purposes of wildfire management. Behavior parameters are calculated by entering in fuel, weather, and terrain descriptions. Behave by Remsoft is the only commercial software package that calculates fire behavior using both Canadian and US fire behavior prediction systems (Anonymous 2004a).

BehavePlus - BehavePlus is a software application (USDA Forest Service freeware) to predict wildland fire behavior for fire management purposes. It is designed for use by fire and land managers who are familiar with fuels, weather, topography, wildfire situations and the associated terminology (Andrews et al 2005).

FARSITE - FARSITE is a fire behavior and growth simulator used by Fire Behavior Analysts from many US government agencies and taught at National Wildfire Coordinating Group Training Course S493 (Finney 1998). It incorporates the existing models for surface fire, crown fire, spotting, post-frontal combustion, and fire acceleration into a 2-dimensional fire growth model, and is designed for use by professionals familiar with fuels, weather, topography, wildfire situations and the associated terminology.

FIREMON - FIREMON is an inventory and fire effects monitoring package that provides fire managers with sampling methods, data storage, and a data analysis package (Anonymous 2005d).

FlamMap – FlamMap is a fire behavior mapping and analysis program that computes potential fire behavior characteristics (rates of spread, flame length, etc.) over an entire FARSITE landscape with constant weather and fuel moisture conditions (Hunter 2004).

FOFEM - FOFEM (a First Order Fire Effects Model) is a computer program for predicting tree mortality, fuel consumption, smoke production, and soil heating caused by prescribed fire or wildfire (Reinhardt 2003).

Fuel Management Analyst – Fuel Management Analyst is a suite of commercially produced programs that calculates fuel loading using the planar intercept or photo series methods, develops fuels profiles, compares photos and data side-by-side, uses stand inventory data to generate canopy fuel weights, canopy bulk density and canopy base height, and performs a fire behavior and effects assessment based on surface and canopy fuels (Anonymous 2004b).

NEXUS – NEXUS is an Excel spreadsheet linking surface and crown fire prediction models; NEXUS is useful for evaluating alternative treatments for reducing crown fire risk and assessing the potential for crown fire activity (Scott 1999).

Stand Visualization System - The Stand Visualization System (SVS) generates graphic images depicting stand conditions represented by a list of individual stand components (i.e., trees, shrubs, and down material using detailed geometric models of individual trees and other stand components). The images produced by SVS provide a readily understood representation of stand conditions and help communicate silvicultural treatments and forest management alternatives to a variety of audiences (Smith 2001).

VDDT - The Vegetation Dynamics Development Tool (VDDT) is a user-friendly, Windows-based computer tool which provides a modeling framework for examining the role of various disturbance agents and management actions in vegetation change (Anonymous 2005e). It allows users to create and test descriptions of vegetation dynamics, simulating them at the landscape level.

VSMOKE-GIS – VSMOKE-GIS is a steady-state Gaussian plume smoke dispersion model that estimates the effects of a prescribed forestry burn on air quality and visibility. Using VSMOKE, air quality specialists with a background in atmospheric dispersion modeling are able to provide forest managers with information useful in evaluating the visibility risks of a given prescribed fire. This decision-support system consists of a graphical user interface, written in Arc/Info Arc Macro Language, and is linked to a FORTRAN computer program (Harms and Lavdas 1997).

Wildland Fire Situation Analysis - Wildland Fire Situation Analysis is a decision analysis process required when the documentation of suppression decisions needs to occur because one the following conditions have taken place: 1) wildland fire escapes initial actions or is

expected to exceed initial action; 2) a wildland fire being managed for resource benefits exceeds prescription parameters in the fire management plan; or 3) a prescribed fire exceeds its prescription and is declared a wildland fire. The Wildland Fire Situation Analysis software can be a valuable decision support tool to work through the documentation of the suppression decisions made by the agency administrator (Anonymous 2005f).

4.5.3. Databases and Websites

E.V. Komarek Fire Ecology Database (http://www.ttrs.org/info/fedbintro.htm) - The E.V. Komarek Fire Ecology Database is comprised of bibliographic citations for a broad collection of fire ecology literature (Anonymous 2005g). All papers from the Proceedings of the Tall Timbers Fire Ecology Conferences, 1-21, are in the database and include an abstract for each entry. Extensive fire-related research materials collected by E.V. Komarek and H.L. Stoddard, founders of Tall Timbers Research Station, also contribute to the database. Topics include fire ecology, prescribed fire, wildfires, fire histories and case studies, and ecology of the southeastern United States.

Fire Effects Information System (FEIS; http://www.fs.fed.us/database/feis/index.html/) – The Fire Effects Information System is a web database that provides up-to-date information about fire effects on plants, animals, and natural communities. The FEIS database contains synoptic descriptions, taken from current English-language literature of almost 900 plant species, approximately 100 animal species, and 16 Kuchler plant communities found on the North American continent (Anonymous 2005h).

Managing Fuels in Northeastern Pine Barrens Web Site (http://www.umass.edu/nrc/nebarrensfuels/) – Informational site about fuel management in pine barren habitats of the Northeastern United States. The website was created as a Joint Fire Science Program funded grant (Project Number 01C-3-1-05) with William A. Patterson III, University of Massachusetts Amherst and David W. Crary, Jr., Fire Management Officer, Cape Cod National Seashore functioning as principal investigators (Iwamoto 2005).

National Wildfire Coordinating Group's Web Site (http://www.nwcg.gov/) - The purpose of the National Wildfire Coordinating Group (NWCG) is to coordinate programs of participating wildfire management agencies (federal, state agencies and the Nature Conservancy) so as to avoid wasteful duplication and to provide a means of constructively working together. NWCG's goal is to provide more effective execution of each agency's fire management program. The group provides a formalized system to agree upon standards of training, equipment, qualifications, and other operational functions (Anonymous 2005i).

The Wildland Fire Assessment System (WFAS; http://www.fs.fed.us/land/wfas/) - The Wildland Fire Assessment System is an internet-based information system that provides a national view of weather and fire potential, including national fire danger and weather maps and satellite-derived "Greenness" maps (Burgan et al 1997).

5. WILDLAND FIRE MANAGEMENT PROGRAM COMPONENTS

5.1. Wildland Fire Suppression

All unplanned wildland fires are to be suppressed in a safe, prompt, aggressive, and cost effective approach with minimum damage to resources using appropriate managerial strategies. Strategies include:

- Life, property, and other resources will be protected from unwanted fire. Firefighter and public safety are the highest priority on the MMR.

- All wildland fire will be suppressed in the most cost efficient manner considering safety, management objectives, and other constraints (i.e., a quick and aggressive initial attack which results in minimal fire spread and resource damage.)

- Agreements will be pursued with other agencies to facilitate wildland fire management on and adjacent to the MMR. The Massachusetts National Guard Environmental and Readiness Center will continue to foster local, regional, and national cooperation with reservation related fire management.

- The implementation of outreach programs such as FIREWISE will be considered to work with adjacent landowners and communities. Educating neighbors on the wildland/urban interface to lessen the potential adverse impacts of wildland fire on life, property, and natural resources is a main concern for the MMR.

- Existing fuel breaks and access routes will be maintained to provide safe access, anchor points, and escape routes for suppression resources.

- Within designated sensitive habitats on Camp Edwards, national and state policy will be adhered to, to limit negative environmental impacts. This includes restricting the use of heavy equipment and fire retardant to life threatening situations unless prior approval from Camp Edwards Natural Resource Office is obtained.

Priority in fire control planning will be based upon providing for protection to sensitive areas (such as those at the wildland/urban interface) and existing infrastructure. Firefighter safety will be top concern in all scenarios. Individuals not involved in suppression will be evacuated if needed.

Equipment and tools selected for use in suppression should be those that minimize environmental impact. Minimum impact suppression strategies will be used to protect all resources. Containment will include the use of natural and established barriers when at all feasible (see Section 6.4 for more details).

Methods selected for suppression work on Camp Edwards should create minimal resource damage while achieving incident stabilization. Heavy equipment must remain on designated roads unless authorization is provided by the Army National Guard Natural Resource Office. Suppression methods (i.e., direct versus indirect attack) that impact fragile

habitats should be weighed carefully against the need to protect life and property within and adjacent to the reservation.

Wildfire evaluation should include an assessment of the threat to state and federally (if applicable) listed flora and fauna and their associated habitats. If critical habitats on Camp Edwards are potentially threatened, consultation will be sought from the Army National Guard Natural Resource Office or a designated representative from the Massachusetts National Guard Environmental and Readiness Center.

Sites affected by fire suppression activities or by the fire will be rehabilitated as necessary, based upon an approved action plan authorized by the Army National Guard Natural Resource Office.

Modifying fuels through prescribed fire (see Section 5.3) and maintaining fuel breaks provides additional support toward wildland fire suppression through the defensible barriers and the "buying of time" for suppression forces to arrive.

Preparedness is the work accomplished prior to a fire occurrence to ensure that the appropriate response can be carried out. Some preparation activities include budget planning, equipment acquisition, equipment maintenance, equipment inventory, personnel training, prescribed burn planning, and assessment of the annual fire potential. The objective on Camp Edwards is to have a well trained and equipped fire management operation ready to manage all fire situations. All ongoing preparedness efforts are to be coordinated by the Army National Guard Natural Resource Office or delegate of the Massachusetts National Guard Environmental and Readiness Center.

Camp Edwards will adhere to the requirements of the National Wildfire Coordinating Group (NWCG) qualification and certification system (Anonymous 2000; see Section 6 for more detail). Personnel engaged in fire suppression and prescribed fire duties will meet standards set by the NWCG as practical and as dictated by the Department of Defense doctrine. Annual refresher training in basic wildland fire fighting should be offered annually to the applicable Camp Edwards associates. Additional training should also be pursued from surrounding agencies when available (i.e., sponsored training by the NPS, TNC, DCR, and the New York State Wildland Firefighting Academy). Qualification task books will be used to document the MMR personnel wildland firefighting qualifications and experience. The coordination of training needs through outside organizations will be conducted by the Army National Guard Natural Resource Office.

Fire detection is coordinated through Camp Edwards Range Control and the Commonwealth of Massachusetts, which provides aerial fire and tower detection statewide through contract and agreements. This IFMP does not discriminate between human caused and natural ignitions. All wildfire will be suppressed; however, detection will include a determination of fire cause. Anthropogenic initiated fires will require investigation and documentation by proper law officials following state and federal protocol. Reporting, documentation, and dissemination of all information related to fire incident on the MMR is the responsibility of the Army National Guard Natural Resource Office or representative of

the Massachusetts National Guard Environmental and Readiness Center. Outside local, state, and federal agencies may be used to investigate wildland fire arson or a fire incident involving structures.

Greater detail on standards for wildland fire management and response at Camp Edwards is outlined in the *Wildland Fire Response Plan* (Appendix A).

5.2. Wildland Fire Use

Wildland fire use as a management strategy is not currently implemented at the MMR. Social obstacles throughout most of New England currently prohibit the use of wildland fire to meet specific land management objectives. As wildland fire management becomes a more established concept in the northeastern United States further consideration of this strategy may be more relevant.

5.3. Prescribed Fire

Prescribed fire can be a useful tool for restoring and maintaining natural conditions and processes at multiple scales. The ultimate use of fire on the MMR is to create a range of forest conditions that emulates the results of the historic fire regime for this general area. Management activities will not be designed to achieve some discrete past condition or "snapshot in time". Instead, the goal is to generally replicate the size, pattern, and intensity of historic disturbances and therefore maintain an ecological system at lower risk to biotic agents and catastrophic fire that at the same time maintains biodiversity and can provide areas for troop training.

5.3.1 Permits and Notification

All prescribed fire activity on Camp Edwards will comply with applicable federal, state, and local laws and regulations. The Massachusetts Department of Environmental Protection requires application and review to meet air pollution control regulations (*310 CMR 7.07(3)(f) – Air Pollution Control*) under a burn plan for ecological management and wildland fuel hazard reduction. Camp Edwards was issued a five year permit from the Massachusetts Department of Environmental Protection in 2002 (Appendix I). Conditions dependent upon compliance of this permit include:

- No prescribed fire shall be conducted from July 1 through September 15 of each calendar year.
- Ignitions are to be conducted between the hours of 9:00 am through 5:00 pm with all burns being in "burn down mode" between 5:00 pm and 9:00 am.
- Total allowable acreage burned per calendar year is limited to 600. Additional burnable acreage is contingent upon DEP approval.
- Burning activities must be carried out during periods of good atmospheric lift without causing nuisance to surrounding communities.
- Smoke minimizing starters or starting aids must be used.
- Prescribed burning must be conducted under provisions 13, Chapter 48, of Massachusetts General Law - setting open air fires; conditions and restrictions; penalty for violation (http://www.mass.gov/legis/laws/mgl/48-13.htm).

- Proper smoke management practices must be exercised to determine appropriate burn unit size and ignition methods.
- Prescribed burn plans must be properly reviewed and approved before implementation.

Notification protocol is also stipulated in the permitting process (Appendix J). A cover letter summarizing the intent to conduct a prescribed fire must be sent to the Massachusetts Department of Environmental Protection, Bureau of Waste Prevention, Southeastern Region at a minimum of ten days but not greater than 20 days prior to activities. Fire Management Zones and associated burn units, management objectives, and operational windows must be described in the correspondence. In addition, the Massachusetts Department of Environmental Protection, Bureau of Waste Prevention, Compliance and Enforcement Section, Southeastern Regional Office requires notification by fax (FAX # 508-947-6557) of the intent to conduct a prescribed fire no more than 48 hours prior to ignition.

The fire department and the board of health in the towns of Sandwich, Bourne, Mashpee, and Falmouth must also be notified of the intent to conduct a prescribed fire. A mass media (i.e., newspaper and/or radio) advertisement to the public must also be made at least one month prior to any prescribed burn. A second mass media ad must also be made no more than 48 hours before any ignition occurs.

An annual summary of prescribed fire activity must be prepared by the MAARNG Natural Resource Office highlighting the number of fires, total acres burned, acres burned by fuel type, resources utilized, and the general effects of annual fire management work in meeting programmatic objectives. The report will be submitted to the Massachusetts Department of Environmental Protection by January 15th of each year to meet air quality control permit compliance.

5.3.2. Training Standards

Prescribed burns will be executed by NWCG qualified personnel with general direction provided by a NWCG qualified burn boss (Anonymous 2000), unless otherwise directed by the post commander, fire chief in representation of the post, or DoD directive. All other required positions and responsibilities, laid out within each site-specific burn plan, will be assigned by the burn boss or through the general chain-of-command or incident command system (NWCG ICS). Detail related to training standards for the CETS is further outlined in Section 6.

5.3.3. Fire Planning and Prescription

Burn plans and prescriptions will be prepared by a qualified fire planner using a systematic decision making process containing measurable objectives and all necessary environmental compliance documents and permits (Appendix K). Methodology (i.e., ignition tactics, holding, smoke mitigation, mop-up, etc…) and resource requirements will also be considered and laid out given site location and specific burn objectives. Prescriptions will address required (i.e., weather and fuel conditions that cannot be modified) and guidance (i.e., factors that can be modified through management activity) parameters in view of weather, fuel moisture, and fire behavior. Contingency actions to be taken in the event that

the prescription is exceeded will also be included in the planning (see Section 5.5 and Appendix A). Final review of all fire planning will be completed by the MAARNG Natural Resource Office and the delegated burn boss before any on-the-ground implementation occurs.

5.3.4. Prescribed Fire Complexity

Determination of prescribed fire complexity shall be based on an assessment of technical difficulty and potential consequences. Complexity shall be used to delegate approval authority, set standards for personnel staffing and skill requirements, and to determine the level of burn plan detail. Prescribed fire projects should be classified as high, moderate, or low complexity based upon a pre-planning assessment using a prescribed fire complexity rating worksheet (Appendix L). Burn complexity will be determined by the MAARNG Natural Resource Office or its designee and shall be made in the context of existing or potential social, political, economic, biological, and/or legal consequences.

- High Complexity - Complex prescribed fires are defined as those where prescribed burning occurs under particularly challenging conditions and/or constraints. This classification includes prescribed fires where the difficulty of achieving resource management objectives is high, or where the consequences of project failure may be serious.

- Moderate Complexity - This classification includes prescribed fires where the difficulty of achieving resource management objectives is not particularly high or complicated, and where the consequences of project failure are less serious and can be mitigated.

- Low Complexity - Prescribed fires of low complexity are defined as those where few constraints, other than the normal prescription parameters, exist. This classification includes prescribed fires where achieving resource management objectives is routine and the probable consequences of project failure are low.

5.3.5. Fire Weather

In general, the climate at MMR and Cape Cod is marked by changeable weather, ocean-moderated daily and seasonal temperature variation, and similar amounts of precipitation year round (Table 2.1). Average monthly precipitation varies from 2-3.3 inches in early summer to almost 5 inches in January and August. Average wind speed is from 8-10 knots, with the highest speed occurring during the winter months. Winds come from the northwest October through March and switch to the south or southwest during the late spring and summer months (Montgomery 1991). Historically, the most dangerous wildfires have occurred during dry windy weather in the spring before leaf-out or are associated with drought and high winds in the late summer or fall. Fire managers need, in particular, to be aware that the location of the site between Cape Cod Bay, Nantucket Sound and Buzzards Bay results in highly unpredictable wind shifts as onshore breezes develop on warm, clear days. General climatic conditions and fire weather are described more fully in sections 2.6 and 3.2.

Weather (regional and local) and fuel moisture conditions will be monitored closely (a minimum of one week prior to ignition) to ensure prescription parameters will be met for safety and ecological benefit. When all criteria fall within the prescribed ranges, an ignition date will be selected based upon the current and predicted fire weather forecasts obtained through the National Weather Service Forecast Office (National Oceanic & Atmospheric Administration website: http://www.erh.noaa.gov/box/firewx.shtml.). A "spot weather forecast" by the National Weather Service (tel # 508-823-1900, Fire Weather Program Manager) will be requested on the burn day prior to ignition with all prescription parameters re-checked to determine if all elements remain within the approved tolerances. Minimum on-site weather observations/measurements required for a spot weather forecast include dry bulb temperature, relative humidity, and surface wind speed and direction. Information will also be requested on possible alerts for large-scale changes in predicted weather, wind direction, and timing of incoming weather systems. On-site weather will also be monitored with a belt weather kit, beginning one hour before ignition and continuing at half-hour intervals (or as required by the burn boss) during burn activities or as conditions require until mop-up is completed.

Additional site sources for weather observations include the Otis Air National Guard Base Weather Operations, portable weather stations at Range Control and Facilities Engineers, and the Volpe Center (NOAA fog research facility).

5.3.6. Ignition

If all pre-approved prescription parameters are met, a test fire will be ignited to determine fire behavior conditions on-site given the current weather. If the conditions are not satisfactory, the test fire will be suppressed and the prescribed burn re-scheduled when conditions appear more favorable. If the conditions are satisfactory, the burn will continue, following the burn plan. Ignition operations and firing crews will be directed by the burn boss (chain-of-command) in order to accommodate current and expected fire weather and behavior.

A suite of starting aids is available for ignition team use at Camp Edwards including drip torches, fusées, various sized flares, and very pistols. The Massachusetts Army National Guard has also outlined procedures for helicopter support in prescribed fire operations (Appendix O). Mass aerial ignition operations become more feasible with the use of a mounted Plastic Sphere Dispenser in a helicopter. The Plastic Sphere Dispenser distributes polystyrene spheres partially filled with potassium permanganate crystals. Ethylene glycol is injected into each sphere producing a delayed chemical reaction that causes fuel ignition. With proper operator training, this ignition option will safely allow for larger scale operations on Camp Edwards with better control of flame production and fire intensity.

5.3.7. Fire Monitoring

Fire monitoring will be used to evaluate the degree in which burn objectives are met. Burn day monitoring will be conducted by a designated fire effects monitor, who will collect data related to burn day weather conditions and fire behavior. Extensive pre- and post-burn monitoring is also done on Camp Edwards (see Section 8) to quantify the effects of fire management on the reservation.

5.3.8. Communications

Overall communication coordination will be managed and monitored by the MAARNG Range Control to ensure proper tracking of burn activities and for compliance with federal communication regulations. Hand-held radios will be used for on-site communication between the burn boss, the ignition crew, and the holding crew. In the event of an emergency, communication will be funneled through to MAARNG Range Control via chain-of-command. Coordination of all off-site emergency dispatch will be managed through Range Control and the incident hierarchy.

5.3.9. Contingencies

Comprehensive contingency plans for fire operations are covered in individual burn plans and in the Wildland Fire Response Plan (Appendix A). Jurisdiction and responsibility details for Camp Edwards are also outlined in the Wildland Fire Response Plan, as well as communication procedures, assembly areas, water access points, and fire road designations and restrictions in the event of an escape or wildland fire.

5.3.10. Air Quality and Smoke Management

The decision to use a specific smoke management technique is influenced by many considerations. Some concerns include public and fire fighter safety, maintaining control of the fire, compliance with environmental regulations, minimizing nuisance and hazard smoke, minimizing operational costs, and maximizing land management objectives of the burn. It is important to note that there are many times that these concerns may be in conflict with burn objectives, but that the goal of reducing smoke emissions may be of the utmost importance for long-term programmatic success of fire management on Camp Edwards.

Two approaches available to the burn boss for managing the effects of smoke on air quality on the MMR are: 1) use of techniques that reduce the emissions produced for a given area treated, 2) redistribution of the emissions through meteorological scheduling.

Reducing Emissions

- Reduce the area burned –Mosaic burning techniques (i.e., excluding certain areas due to moisture or other management reasons) and the isolation of fuels that could smolder over long periods. This may not be the ideal approach on the macro-scale given the fire adapted vegetation found on Camp Edwards, but is worth consideration;

- Reduce fuel load through mechanical means – The amount of fuel removed from a site proportionally reduces emissions. This technique is used with some success on Camp Edwards and with great success on other sites in the northeastern United States.

- Reduce fuel consumed – By burning when moisture is high in large woody fuels smoldering can be decreased, possibly resulting in lower smoke emissions. Attempting to schedule a burn prior to major precipitation can also reduce the potential for long lasting smoldering.

- Burn before new fuels appear – Planning prescribed fire before litter fall or green-up can reduce emissions by providing less fuel available for consumption.

- Increase combustion efficiency –. Increasing combustion efficiency, or shifting the majority of the consumption away from the smoldering phase and into the more efficient flaming phase, reduces smoke emissions. Using backing fire and burning under dry conditions are two methods consistently used on Camp Edwards that increase combustion efficiency. Rapid mop-up (avoidance technique) post fire increases the effectiveness of these techniques by reducing the smoldering consumption of large fuels such as stumps and snags.

  Mass ignition, the rapid ignition of a large area, has also been shown to be effective in increasing combustion efficiency, and is being considered for further use on Camp Edward via aerial ignition. Mass ignition can shorten the duration of the smoldering phase of a fire and reduce the amount of fuel consumed by the rapid burning of dry surface fuels. A very strong convection column is created that draws heat away from the fuelbed and prevents drying and pre-heating of larger, moister fuels. The strong smoke plume created also results in greater smoke dispersal.

Redistributing Emissions

- Burn when dispersion is good – Reduce smoke concentrations by diluting smoke through a greater volume of air.

- Avoid sensitive areas – Burn when the wind is blowing away from sensitive areas.

- Burn more frequently – Burn more frequently so that fuels do not accumulate, thus reducing emissions on each burn.

Smoke management guidelines and procedures for prescribed and wildland fire evolve continuously. Methods can be used alone or in combination, at burn boss discretion, to reduce smoke.

5.3.11. Wildland Fire Response

All ignitions will stop in the event of an escape, with suppression efforts initiated by the burn boss. If the burn exceeds the initial suppression efforts and size limitations specified within the prescribed burn plan, the burn will be declared a wildland fire. Suppression actions are then to be initiated and directed by a qualified Type III or IV Incident Commander. Guidelines for wildland fire suppression at Camp Edwards are outlined in the *Wildland Fire Response Plan* (Appendix A).

5.4. Non-fire Fuel Applications

Mechanical manipulation of fuels such as vegetation chopping, chipping, and thinning have been used as a successsful management tool at many pine barren sites found in the northeastern United States (i.e., the Waterboro Pine Barrens and the Albany Pine Bush). These types of actions have occurred on a relatively small scale at Camp Edwards. The application of non-fire treatments, such as mechanical tree thinning, is worth further

consideration on the CETS given the appropriate local-scale conditions. Such an approach may prove helpful when the application of prescribed fire on the landscape falls behind goals or may be essential in some cases to meet specific pre-defined management objectives.

5.5. Firebreak and Fuels Management

Firebreak and fuels management involves the alteration of fuels to reduce the likelihood of a fire starting or to reduce its effects if one does start. Firebreak and fuels management include the construction of fuel breaks and firebreaks and recognized fuel modification programs (i.e., prescribed burns, mechanical/chemical treatments, mowing, and livestock grazing). These techniques may improve access for fire apparatus, increase water resources available on-site, adjust target placement, and provide buffer or safety zones. Firebreak and fuels management will be coordinated among all CETS land managers to include appropriate National Environmental Policy Act (NEPA) documentation, and Section 7 and Section 106 consultation, as required.

Coordination is essential as firebreak and fuels management activities may result in restricted operations and total or partial closure of the training ranges. A work plan will be developed for any firebreak and fuels management projects needed. This process will ensure that firebreak and fuels management projects can be completed and will eliminate conflicts between the required maintenance of the ranges and military training activities. The CETS Range Control and the MAARNG Natural Resource Office shall collaborate to develop work plans facilitating maintenance of all required wildland fire infrastructure.

5.6. Emergency Rehabilitation and Restoration

Rehabilitation is a long-term, post-fire effort to repair a landscape not likely to recover naturally from fire damage; and to restore or establish a healthy, stable ecosystem where native species are well represented. After a fire incident (wildland or prescribed), rehabilitation steps may be necessary. It should be stated, however, that the most effective rehabilitation is through the planned use of minimum impact suppression techniques or prescribed fire application.

When required on Camp Edwards, rehabilitation will be initiated by the Army National Guard Natural Resource Office (Appendix A and site specific burn plan). Actions will be directed towards minimizing or eliminating the effects of suppression or prescribed fire actions and reducing latent danger caused by the fire. Some of these actions could include:

- Backfilling control lines, scarifying soils, and seeding.
- Installing water bars and constructing drain dips on control lines to prevent erosion.
- Installing check dams to reduce erosion potential in water courses.
- Restoring visual aesthetics by screening control lines, hiding cut surfaces, and cutting stumps.
- Removing all flagging, equipment, and litter.
- Restoring incident command facilities to their natural condition.
- Re-plant to restore impacted areas using only native plant species.

Rehabilitation actions should be taken directly after the wildland or prescribed fire to stabilize and prevent unacceptable degradation to natural resources. The monitoring of rehabilitated areas should be addressed through time (short-term and long-term) to ensure success, and address unforeseen problems that may occur throughout the process.

6. TRAINING AND SAFETY

Training is the key to safe and successful wildfire and prescribed fire incidents. With out training for planned and unplanned fire events, public and firefighter safety may be compromised. Safety is the first and highest priority and will never be compromised by other objectives. Safety is the responsibility of everyone assigned to a wildfire or prescribed fire incident. Safety is an attitude that must be promoted at all operational levels. Once personnel are committed to an incident, those resources become the highest value to be protected.

Fighting wildfires is inherently dangerous, and firefighters risk injury or even death in these operations. Nationally wildland firefighter fatalities occur nearly every year. In addition to the danger from the fire itself, the need to use cutting tools, mobile apparatus, heavy equipment, and aircraft add to the risk involved. If firefighters know how to recognize potentially hazardous situations and how to mitigate them, they can reduce or eliminate much of that risk.

Because of inherent risk, 10 Standard Fire Orders were developed in 1957 to prevent firefighter injuries and fatalities and have recently been updated. Also developed were 18 "Watch Out" situations (Table 6.1). These 18 situations are more specific and cautionary than the Standard Fire Orders. If firefighters follow the 10 Standard Fire Orders and are alerted to the 18 Watch Out Situations, risk to fire fighters can be reduced.

6.1. Training Requirements

Training will be established to provide standardization for directorates and organizations that are responsible for fire fighting, wildfire, and prescribed fire duties. Training and qualification requirements will be established for wildland firefighting personnel including planning, prevention, suppression, and supervision duties. Any CETS organization or Directorate intending to provide personnel for wildfire incidents will be expected to meet the requirements described in this program.

The training program, qualification, and certification process are the foundations of a safe fire program. Only qualified personnel will be assigned fire fighting duties. All assigned wildland fire personnel, whether on wildfires or prescribed fires, must meet National Wildfire Coordinating Group (NWCG) training standards, as outlined in the PMS

Table 6.1. Standard Fire Orders and Watch Out Situations.

10 STANDARD FIRE ORDERS

1. Keep informed on fire weather conditions and forecasts.
2. Know what your fire is doing at all times.
3. Base all actions on current and expected behavior of the fire.
4. Identify escape routes and safety zones, and make them known.
5. Post lookouts when there is possible danger.
6. Be alert. Keep calm. Think clearly. Act decisively.
7. Maintain prompt communications with your forces, your boss, and adjoining forces.
8. Give clear instructions and be sure they are understood.
9. Maintain control of your forces at all times.
10. Fight fire aggressively, having provided for safety first.

18 WATCH OUT SITUATIONS

1. Fire not scouted and sized up.
2. In country not seen in daylight.
3. Safety zones and escape routes not identified.
4. Unfamiliar with weather and local factors influencing fire behavior.
5. Uninformed on strategy, tactics, and hazards.
6. Instructions and assignments not clear.
7. No communication link between crew members and supervisors.
8. Constructing line without safe anchor point.
9. Building line downhill with fire below.
10. Attempting frontal assault on fire.
11. Unburned fuel between you and the fire.
12. Cannot see main fire, not in contact with anyone who can.
13. On a hillside where rolling material can ignite fuel below.
14. Weather gets hotter and drier.
15. Wind increases and/or changes direction.
16. Getting frequent spot fires across the line.
17. Terrain or fuels make escape to safety zones difficult.
18. Taking a nap on or near the fireline

310-1, Wildland Fire Qualifications Guide, parts 1 & 2, or those determined acceptable by the incident or training site commander. The fitness requirement for CETS firefighters is passing the Army Physical Training test or those standards determined acceptable by the incident or training site commander. This standard will be reviewed prior to the next update of this IWFMP. All personnel engaged in actual fireline operations (in the vicinity of the fire) must have completed S-130, Firefighter Training; S-190, Introduction to Fire Behavior, Your Fire Shelter, and Standards for Survival; and I-100, Introduction to Incident Command System (ICS) or be deemed by the incident or training site commander to have the acceptable skills and knowledge. It is encouraged that trained personnel be required to complete an annual four-hour refresher course S-132, Standards for Survival. All personnel will have NWCG certified training (Tables 6.2, 6.3, 6.4) or similar trainings (NFPA) for tasks they are assigned.

Position task books (PTB) are used to document performance. PTBs are NWCG published booklets that apply to a specific position in the ICS. A PTB contains all critical tasks that are required to perform a given job. These booklets will be used by wildfire managers and supervisors to track an individual's training experience. Successful completion of all tasks required of the position will be the basis for recommending certification for a specific position and trainee advancement in the ICS.

Individuals will not be assigned to duties for which they lack training and/or certified experience. All personnel dispatched or assigned to wildfires or prescribed fires will be qualified for the fire position assigned, unless assigned as trainees under the direct supervision of higher qualified personnel.

Unless otherwise noted, the maximum time allowed for maintaining training currency is five years for all positions. For example, the currency requirement for a Task Force Leader is to have functioned in a satisfactory manner in the last five years as a Task Force Leader or above. Currency requirements for positions may be met by performing the particular position or any higher position, and any specified lower or similar duties. This type of position experience will be considered as qualifying only if the individual has previously met all training and prerequisite experience requirements for the position. Serving in a position for which the individual is qualified will maintain the currency of a prerequisite position, providing that the individual was previously qualified in that position. Refresher training is also a way to maintain currency.

If currency is not maintained it is the responsibility of personnel for recertification in cases where position qualifications have been lost as a result of a lack of current experience. A key component in the certification or recertification process is the subjective evaluation by management of an individual’s capability to perform in a position. Certification can be maintained if an individual can demonstrate any mitigating issues that can show that they have either maintained or relearned skills necessary to accomplish the given task.

CETS firefighters or outside cooperating agencies shall meet the required wildland fire fighter training and physical fitness requirements outlined within each respective agency’s established policies or training program. Training opportunities offered by the

CETS will be shared with outside cooperative agencies for cross-leveling and sharing of training opportunities within the area, such as other states National Guard, state and local fire departments, and nongovernmental agencies.

6.2. Fitness Requirements

The fitness level that personnel shall meet is ICS position dependent (Table 6.5). Personnel assigned to wildfire or prescribed fire duties are required to meet the following standards for physical fitness or those deemed acceptable by the incident or training site commander.

Arduous duties involve fieldwork requiring physical performance over an extended period of time, calling for above-average endurance and superior conditioning. These duties may include a demand for extraordinarily strenuous activities in emergencies under adverse environmental conditions and over extended periods of time. Requirements include running, walking, climbing, jumping, twisting, bending, and lifting more than 50 pounds; the pace of work typically is set by the emergency situation.

Moderate duties involve field work requiring complete control of all physical faculties and may include considerable walking over irregular ground, standing for long periods of time, lifting 25 to 50 pounds, climbing, bending, stooping, squatting, twisting, and reaching. Occasional demands may be required for moderately strenuous activities in emergencies over long periods of time. Individuals usually set their own work pace.

Light duties mainly involve office work with occasional field activity characterized by light physical exertion. Activities may include climbing stairs, standing, operating a vehicle, and long hours of work, as well as some bending, stooping, or light lifting. Individuals almost always can govern the extent and pace of their physical activity.

None. Duties are normally performed in a controlled environment, such as an incident base or camp.

Table 6.2. Incident Command System and Wildland Firefighter Training Courses.

ICS Courses

I-100 Introduction to ICS
I-200 Basic ICS
I-300 Intermediate ICS
I-400 Advanced ICS
I-401 ICS for Executives

Skill Courses

S-000 Agency Specific Training
S-110 Wildland Fire Suppression Orientation Principles for Non-Operations Personnel (optional)
*S-l30 Firefighter Training
*S-l90 Introduction to Fire Behavior
S-200 Initial Attack Incident Commander
S-201 Fire Supervision – 2nd Edition
S-203 Introduction to Information Officer
*S-205 Fire Operations in the Urban Interface
S-211 Portable Pumps and Water Use
S-212 Power Saws
S-216 Driving for Fire Service
*S-2l7 Interagency Helicopter Training Guide
S-230 Crew Boss (Single Resource)
S-231 Engine Boss (Single Resource)
S-232 Dozer Boss (Single resource)
S-233 Tractor/Plow Boss (Single Resource)
S-234 Firing Methods and Procedures
S-235 Felling Boss (Single Resource)
S-244 Field Observer
S-258 Communications Equipment/Procedures
*S-590 Fire Behavior Analyst
S-260 Fire Business Management
S-270 Basic Air Operations
*S-27l Helibase Manager
*S-290 Intermediate Fire Behavior
S-300 Incident Commander Extended Attack
S-301 Dynamic Unit Leadership
S-320 Unit Leader
S-330 Task Force/Strike Team LDR
*S-336 Fire Suppression Tactics
S-339 Division/Group Supervisor
*S-378 Air Attack Group Supervisor
S-390 Fire Behavior Calculations
S-401 Effective Management
S-402 Liaison Officer
S-403 Information Officer
S-404 Safety Officer
S-420 Command and General Staff
S-443 Infrared Interpreter
S-445 Training Specialist
*S-470 Air Operations Branch Director
*S-490 Advanced Fire Behavior Calculations
S-520 Advanced Incident Management
S-620 Area Command

*Indicates a course that contains critical knowledge and skills required for safe operations on a wildfire. Training in these courses or an agency equivalent course is mandatory. Lack of these skills has contributed to the cause of many accidents within the wildfire arena.

Table 6.3. Wildland Firefighter Training Qualification Requirements.

FIREFIGHTERS/AUXILIARY OPERATIONS TRAINING

COURSE & TITLE

FIREFIGHTER 2 (FFT2)
S-130 Firefighter Training
S-190 Introduction to Fire Behavior
I-200 Basic Incident Command Sys

FIREFIGHTER 1 (FFT1)
S-210/200 Fire Supervision
S-211 Portable Pump & Water Use
S-212 Wildfire Power saws

CREW BOSS (CRWB) Single Resource
S-230 Crew Boss
S-234 Firing Methods & Procedures
S-260 Fire Business Mgt Principles
S-270 Basic Air Operations
S-290 Intermediate Wildland Fire Behavior

STRIKE TEAM LEADER (STLD)
S-200 Initial Attack Incident CMD

TASK FORCE LEADER (TFLD)
S-336 Fire Suppression Tactics
S-390 Intro to Wildland Fire Behavior
I-333 Strike Team Leader
I-330 Task Force, Strike Team Leader
S-205 Fire Operations in the Urban Interface
HELICOPTER AIR OPS
S-270 Basic Air Operations

FIREFIGHTER COMMAND/STAFF TRAINING

COURSE & TITLE

DIV/GROUP SUPERVISOR (DIVS)
I-339 Div/Group Supervision
I-375 Air Support Group Supervisor

OPERATION SEC CHIEF 2 (OSC2)
S-401 Effective Management
I-420 Command & General Staff
I-400 Incident Command
I-430 Operations Section Chief

OPERATION SEC CHIEF 1 (OSC1)
S-520 Advanced Incident Mgt

INCIDENT COMMANDER 4 (ICT4)
CRWB QUALIFIED

INCIDENT COMMANDER 3 (ICT3)
TLFD QUALIFIED
S-300 Incident Cmd Multiple Resources

INCIDENT COMMANDER 2 (ICT2)
DIVS QUALIFIED
I-400 Incident Commander

AREA COMMANDER (ACDR)
All operations training
All Command/Staff training
S-620 Area Command

Table 6.4. Prescribed Fire Qualifications.

Prescribed Fire Crewmember (FFT2)

Prerequisite Qualification:	None
Required Training:	S-130 Basic Firefighter S-190 Introduction to Fire Behavior
Physical Fitness Level:	Arduous

Ignition Specialist (RXI2)

Prerequisite Qualification:	Any single resource boss
Required Training:	None
Physical Fitness Level:	Moderate to Arduous (Agency established)

Ignition Specialist (RXI1)

Prerequisite Qualification:	RXI2
Required Training:	None
Physical Fitness Level:	Moderate to Arduous (Agency established)

Burn Boss (RXB2)

Prerequisite Qualification:	RXI2 and ICT4
Required Training:	S-390
Physical Fitness Level:	Moderate (Agency established)

Burn Boss (RXB1)

Prerequisite Qualification:	RXB2 and ICT3
Required Training:	S-490
Physical Fitness Level:	Moderate (Agency established)

Prescribed Fire Manager (RXM2)

Prerequisite Qualification:	RXB2
Required Training:	None
Physical Fitness Level:	Moderate (Agency established)

Prescribed Fire Manager (RXM1)

Prerequisite Qualification:	RXB1
Required Training:	None
Physical Fitness Level:	Moderate (Agency established)

Fire Use Manager (FUMA)

Prerequisite Qualification:	RXB1 or ICT2
Required Training:	S-580
Physical Fitness Level:	Moderate

By NWCG standards the Pack Test is used to determine whether individuals are fit enough to perform wildland firefighting duties. The Pack Test is preferred, but is discretionary on CETS, and is where an individual carries a backpack a prescribed level distance within a prescribed time as follows:

Arduous: Individual must carry a 45-lb backpack 3 miles in 45 minutes or less.

Moderate: Individual must carry a 25-lb backpack 2 miles in 30 minutes or less.

Light: Individual must hike 1 mile in 15 minutes with no pack.

The fitness requirement for CETS firefighters is passing the Army Physical Training test or again those determined acceptable by the incident or training site commander.

6.3. Staffing

All wildfires at CETS are responded to by the Otis Air National Guard Base fire department and surrounding community fire departments as called upon. CETS range personnel or Environmental Office staff may also respond to wildfires, but there is no requirement for a minimum staffing level at CETS. When in use, the minimum staffing level for the CETS brush engine is two (2) crew members, less than this is strictly prohibited.

Positions found in the ICS organizational system can be divided into three types: Non-Operational Technical Specialists, Skilled Operational positions and Aviation Pilots (Tables 6.5 and 6.6).

Non-Operational Technical Specialists, are personnel with special knowledge or skills who are activated for regionally significant wildfire incidents and only when needed. These Technical Specialists are normally not required on the fireline and are used at base camps or support facilities. These jobs are typically found in the normal daily operations of the MAARNG. Personnel that can staff these Technical Specialist positions normally have a daily job where their Civil Service classification or Military Occupation Skills (MOS) match the position named in the ICS. No minimum ICS qualifications are prescribed in this program because these personnel normally perform the same duties during an incident that they perform in their everyday job and are not near the fireline. Most Technical Specialists are certified in their field or profession. The ICS positions below are listed with the acceptable civil service or military position listed on the same line. These are the only positions that may be substituted for formal ICS training:

Table 6.5. ICS Positions - Non-Operational Technical Specialists.

Agency Representative:	Commander, Director or Public Affairs Officer (PAO)
Information Officer:	PAO
Base/Camp Manager:	Commanders or Operations/Maintenance/Range Officers
Logistics Section Chief:	Supply or Director of Logistics (DOL) Representative
Claims Specialist:	Staff Judge Advocate (SJA) Representative
Commissary Manager:	Unit Food Service Officer/NCO or DOL
Medical Unit Leader:	Division Surgeon, Senior Medical Officer
Communications Unit Leader:	Signal Officer or Operations Officer
Compensation/Claims Unit Leader:	SJA
Compensation-for-Injury Manager:	Civilian Personnel Assistance Office (CPAC) and SJA
Cost Unit Leader:	Director of Resource Management (DRM)
Demobilization Unit Leader:	Commander or Operation/Range Officer
Display Processor:	PAO or Operations/Range Officer
Ordering Manager:	Unit /Organizational Supply or DOL
Documentation Unit Leader:	Management Assistant or Secretary
Equipment Manager:	Unit Organizational/Supply, Maintenance and DOL
Equipment Time Recorder:	Owning unit or organization DOL/DPW
Facilities Unit Leader:	Operations/Range Officer or Director of Public Works (DPW)
Finance/Admin Section Chief:	Agency/Organizational Management Assistant or DRM
Food Unit Leader:	Unit Food Service Officer/NCO or DOL
Security manager:	Military Police, Surrounding Community Law Enforcement
Service Branch Director:	Commander, Director, Operations/Range Officer
Personnel time Recorder:	Organizational Management Assistance/Time Keepers
Procurement Unit Leader:	Unit/Organizational Supply or DOL
Receiving/Distribution Manager:	Unit/Organizational Supply or DOL
Staging Area Manager:	Operations/Range Officer
Status/Check-In Recorder:	Management Assistant or Time Keeper
Supply Unit Leader:	Unit/Organizational Supply
Support Branch Director:	Operation/Maintenance/Range Officer or DOL/DPW
Geographic Information System (GIS):	GIS Manager, or other skilled technician.

There are no fitness requirements for non-operation technical specialist positions unless participating on the fireline. For all non-operation technical specialists whose skills are needed on the fireline, the physical fitness level shall be light (see section 6.2).

Skilled Operational Positions are fireline or fire area jobs unique to wildland fire suppression. They require specific skills and knowledge and are those positions not normally found in other civil service positions. Personnel should be assigned to positions in which they have demonstrated successful performance. The following positions (Table 6.6) require skill qualification training, detailed in Table 6.7, to qualify for Wildland firefighting and ICS positions. Personnel with basic qualifications may be assigned in a trainee position provided they are directly supervised by someone fully qualified in that position.

Table 6.6. ICS Positions - Skilled Operational Positions

Advanced Firefighter/Squad Boss (FFT1)
Aircraft Base Radio Coordinator (ABRO)
Air Operations Branch Director (AOBD)
Air Support Group Supervisor (ASGS)
Air Tactical Group Supervisor (ATGS)
Area Command Aviation Coordinator (ACAC)
Area Commander (ACDR)
Assistant Area Commander (ACPC)
Base / Camp Manager (BCMG)
Crew Representative (CREP)
Crew Boss (Single Resource) (CRWB)
Deck Coordinator (DECK)
Demobilization Unit Leader (DMOB)
Dispatch Coordinator (CORD)
Dispatch Recorder (EDRC)
Division / Group Supervisor (DIVS)
Documentation Unit Leader (DOCL)
Dozer Boss (Single Resource) (DOZB)
Engine Boss (Single Resource) (ENGB)
Equipment Time Recorder (EQTR)
Felling Boss (single Resource) (FELB)
Field Observer (FOBS)
Finance / Administration Section Chief Type 1 & Type 2 (FSC1 & FSC2)
Firefighter (FFT2)
Fire Behavior Analyst (FBAN)
Fire Effects Monitor (FEMO)
Fire Use Manager (FUMA)
Firing Boss (Single Resource) (FIRB)
Ground Support Unit Leader (GSUL)
Helibase Manager Type 1 & Type 2 (HEB1 & HEB2)
Helicopter Boss – Single Resource (HELB)
Helicopter Coordinator (HLCO)
Helicopter Crew Member (HECM)
Helicopter Manager – Call when needed (HCWN)
Human Resource Specialist (HRSP)
Ignition Specialist Type 1 & Type 2 (RXI1 & RXI2)
Incident Commander Type 1, 2, 3, 4, & 5 (ICT1, ICT2, ICT3, ICT4, ICT5)
Incident Officer Type 1, 2, & 3 (IOF1, IOF2, & IOF3)
Initial Attack Dispatcher (IADP)
Liaison Officer (LOFR)
Long Term Fire Analyst (LTAN)
Operations Section Chief Type 1 & 2 (OSC1 & OSC2)
Personnel Time Recorder (PTRC)
Planning Section Chief Type 1 & 2 (PSC1 & PSC2)
Prescribed Burn Boss Type 1, 2, & 3 (RXB1, RXB2, & RXB3)
Prescribed Fire Manager Type 1 & 2 (RXM1 & RXM2)
Procurement Unit Leader (PROC)
Resource Unit Leader (RESL)
Safety Officer Type 1, 2, & 3 (SOF1, SOF2, & SOF3)
Single Engine Air Tanker Manager (SEMG)
Situation Unit Leader (SITL)
Staging Area Manager (STAM)
Status / Check-in Recorder (SCKN)
Strike Team Leader Dozer (STDZ)
Strike Team Leader Crew (STCR)
Strike Team Leader Engine (STEN)
Strike Team Leader Tractor/Plow (STPL)
Supervisory Dispatcher (EDSP)
Supply Unit Leader (SPUL)
Support Branch Director (SUBD)
Support Dispatcher (EDSD)
Take Off and Landing Coordinator (TOLC)
Task Force Leader (TFLD)
Time Unit Leader (TIME)
Tractor/Plow Boss (Single Resource) (TRPB)
Training Specialist (TNSP)

Table 6.7. Wildland Firefighter Training Qualifications Requirements for Assigned Personnel.

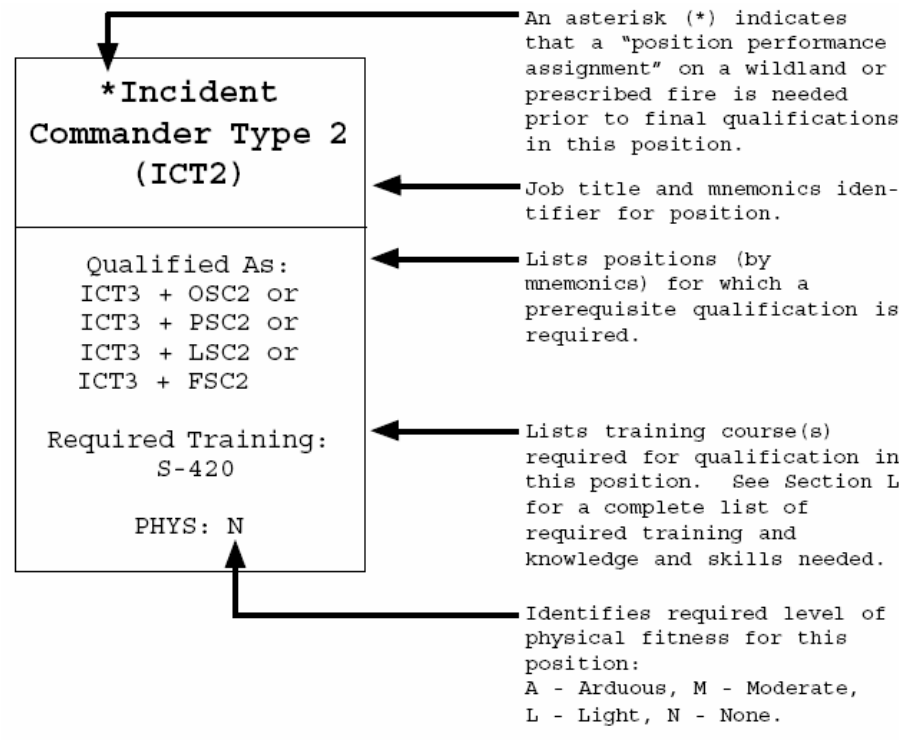


Table 6.7. continued.

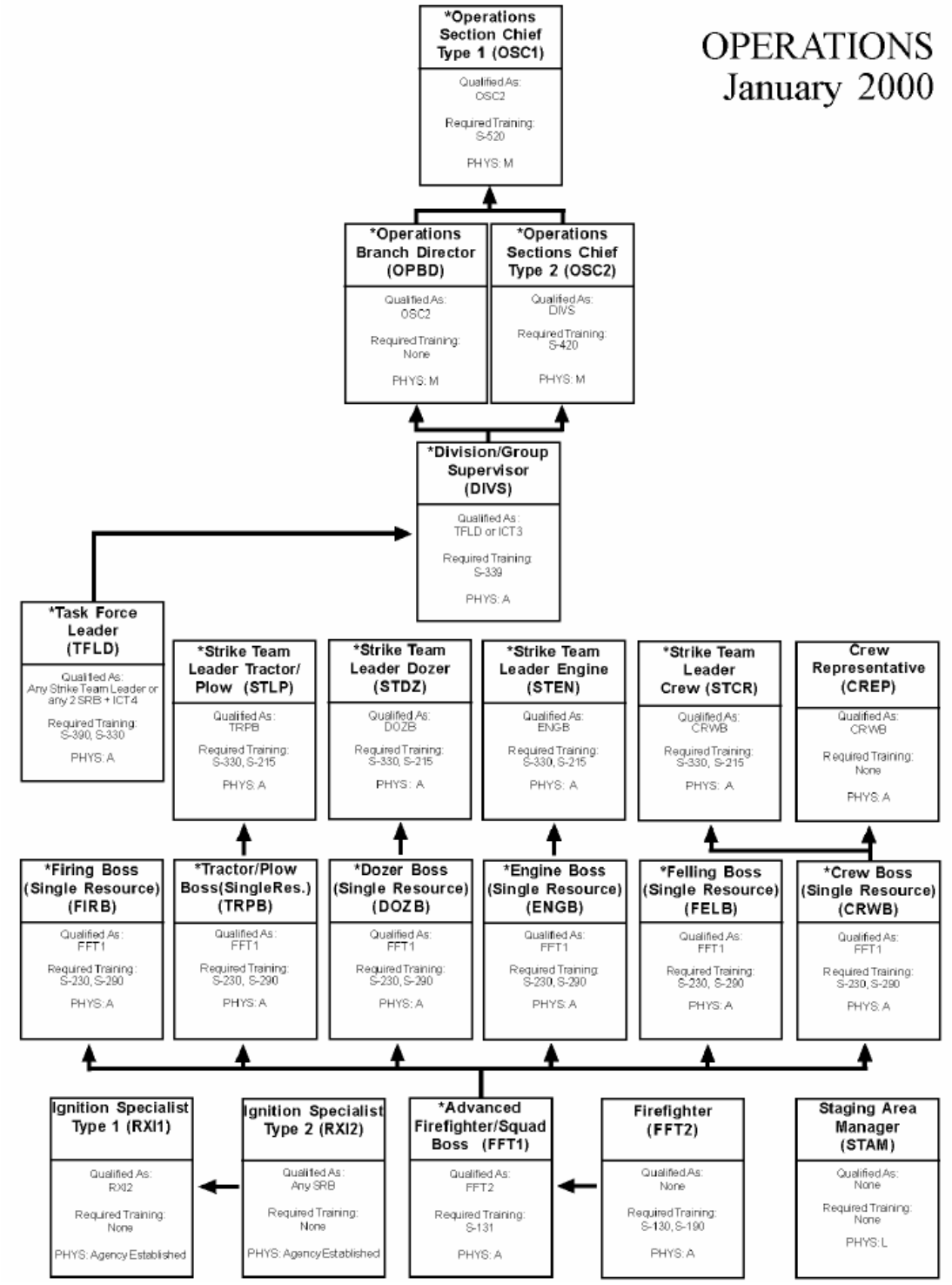
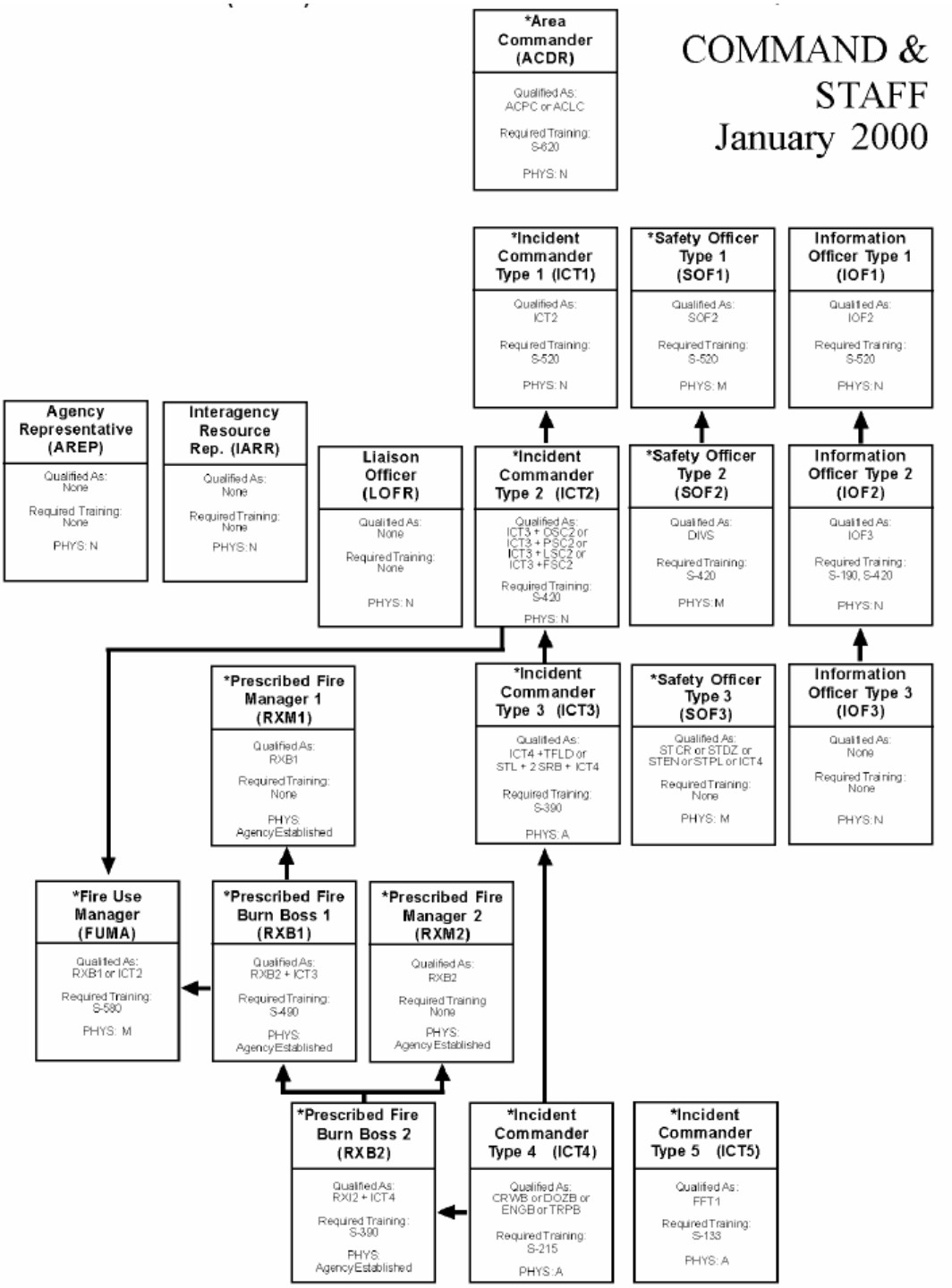


Table 6.7. continued.



6.4. Equipment and Supplies

A cache of fire fighting equipment and supplies will be established and kept in a constant state of readiness for prescribed fire and suppression. The centralized fire cache facility is at the CETS Facilities Engineers, Bldg 2808. The fire cache will be equipped to outfit ten (10) firefighters. Personal Protective Equipment (PPE) allocated to Camp Edwards personnel who keep their PPE with them will count towards the cache minimum. All PPE must meet or exceed National Fire Protection Association (NFPA) 1977 Standard on Protective Clothing and Equipment for Firefighters (current edition). The fire cache will also maintain a limited supply of fire equipment. It will be the responsibility of the Natural Resource Office to ensure that these caches are properly stocked. A list of suggested equipment is listed in Table 6.8.

Table 6.8. Minimum Fire Cache Resources.

Equipment	Number
Personal Protective Equipment (PPE)	10
Fire Hand Tools	10
Chain Saws	2
Fire Pumps	1 slip on, 2 portable pumps
Type 6 Engine	1 (Appendix N)
Drip Torches	5
Fusees (case)	1
Fire Shelters	10
Weather Belt Kits	2

The fire cache will be annually inventoried and inspected in order to ensure the equipment is ready to meet the objectives of this plan.

Camp Edwards shall ensure that the fire response vehicle (brush engine) is available and operating in a constant state of readiness. The minimum requirement is one brush engine with a minimum 250 gallon capacity.

It is mandatory that all fire fighting personnel be equipped with proper PPE for fighting wildfires. A list out lining mandatory PPE for individuals engaged in fire fighting activities is provided in Table 6.9.

All firefighters will determine and comply with the host agency's requirements regarding PPE on prescribed fire or suppression assignments or utilize their own agency's requirements if more restrictive.

All firefighters will utilize hearing protection when working with high noise-level equipment, such as chainsaws, pumps, helicopters, air tankers, etc.

Chainsaw users (sawyers and swampers) will wear additional safety equipment including approved chaps, gloves, hard hat, eye and ear protection when operating chainsaws.

An approved dust/smoke mask is recommended when in heavy smoke and dust environments. Use of a dust/smoke mask is not a PPE requirement.

Nomex face and neck protection (shrouds) are not required PPE. They should be deployed only in impending flash fuel or high radiant heat situations and not routinely worn throughout an operational period as there is the potential to increase heat stress.

PPE clothing will be cleaned or replaced whenever soiled, particularly with oils. PPE will be replaced when the fabrics fire resistance capability is in question.

6.5. Wildfire and Prescribed Fire Hazards

Unexploded ordinance (UXO) occurs within the CETS Impact Area and should be considered when planning for and suppressing prescribed or wild fire. Outside the Impact Area, personnel should take reasonable precautions when any metal object is encountered during a wild or prescribed fire. Under no circumstances should any metal object be touched, moved, or otherwise disturbed. All such objects should be flagged and immediately reported to the incident commander and Range Control. Although not as hazardous as UXO, trip flares and smoke grenades are still dangerous, and caution should be taken if discovered. These items should also be marked and reported to the incident commander and range control.

Blank ammunition, generally not considered hazardous, should be noted when conducting fire operations on any military installation. Other hazardous items presenting a safety concern when conducting fire operations on the CETS are razor wire, communications line, fighting emplacements (fox holes) holes, bunkers, tent stakes, posts, and log cribs.

Table 6.9. Mandatory Personal Protective Equipment (PPE).

Mandatory PPE

1. Hard hat w/ chin strap, (Nomex face shroud optional)

2. Eye Protection goggles

3. Nomex or Indura cotton shirt (or one piece jumpsuit)

4. Nomex or Indura cotton pants (or one piece jumpsuit)

5. Leather gloves

6. Fire shelter (approved and inspected at least annually)

7. 8" Leather boots, No steel toe, Vibram sole (Army issued combat boots are acceptable)

Line Gear

1. Fireline pack

2. Canteen (2 quarts minimum)

3. Ear plugs

4. First aid kit

5. 1 MRE

6. Headlamp with batteries

7. Flagging

8. Fuses

9. File

10. Programmed Radio

*All PPE must meet or exceed National Fire Protection Association (NFPA) 1977 Standard on Protective Clothing and Equipment for Firefighters (current edition).

7. Public Affairs and Community Involvement

The PAO and general public will be notified prior to prescribed fires as outlined in Section 5.3.1 and Appendix J. Other protocols also exist for public notification related to any unusual occurrence at the base, such as a wildfire or the effects of a wildfire that would have the potential to cause alarm. The three tiered system, outlined below, is based upon the time interval prior to or after the unusual occurrence. Door-to-door mailings may also be sent out when conducting prescribed fire near private homes adjacent to base boundaries.

Unusual Occurrence Protocol

- Protocol A: Up to 12 hours (or more) prior to event
- Protocol B: Short notice notification from 12 hours to 1 hour prior to event
- Protocol C: Post event notification – unplanned event notification conducted immediately after occurrence

Protocol A: Up to 12 hours (or more) prior notice. Camp Edwards contacts E&RC to conduct notification (refer to List A (Table 7.1) for contact information)).

Fax/email:

- MMR Commands, MANG JF Headquarters **- List A** (Table 7.1)
- All Cape Cod & Plymouth Police and Fire stations **- List B** (Table 7.2) and **List C** (Table 3)
- State police; Bourne Barracks, Framingham **- List C** (Table 7.3)
- Barnstable County Sheriff & Jail **- List D** (Table 7.4)
- All Cape Cod & Plymouth town administrators **- List E** (Table 7.5)
- SMB Selectmen representatives **-List F** (Table 7.6)
- Environmental Protection Agency, Department of Environmental Protection, Environmental Officer **- List G** (Table 7.7)
- Cape Cod and Plymouth media: radio and newspapers **- List H** (Table 7.8) and **List I** (Table 7.9)

Protocol B: Short notice: Up to 1 hour prior to event. Conducted by Camp Edwards directly - **List J** (Table 7.10)

Phone calls will be made to:

- MANG JF Headquarters
- 102nd FW Command Post
- Barnstable County Sheriff Dispatch & Jail
- State police; Bourne Barracks, Framingham
- Otis Fire Dept
- Local radio stations
- D Troop MSP – Wireless 911 Dispatch
- E&RC will follow up protocol A

Protocol C: Unplanned event; post event notification after action. To be initiated by Camp Edwards.

Camp Edwards will conduct ASAP after an unusual occurrence at Camp Edwards

- Phone calls will be made by Camp Edwards using Protocol B list
- E&RC will follow up with Protocol A (with after action statement)

Table 7.1. MMR Command Contact List.

List A
Massachusetts Military Reservation Commands

6th Space Warning Squadron	Last	**First**		**Title**	**Phone**	**Fax**	**email**
	Hamilton	Paul	Lt. Col.	Commander	508-968-7327		paul.hamilton@capecod.af.mil
U.S. Coast Guard							
	Ostebo	Thomas	CAPT	Commander	508-968-6300	508-968-6693	tostebo@ascapecod.uscg.mil
Headquarters Camp Edwards							
	Wujciak	Steven	COL	Post Commander	508-968-5885	508-968-5906	Steven.Wujciak@MA.ngb.army.mil
	Cordeiro	Randall	LTC	Deputy Post Commander	508-968-5883		Randall.Cordeiro@MA.ngb.army.mil
102nd Fighter Wing							
	Worcester	Paul	Lt. Col.	Commander	508-968-4667	508-968-4665	paul.worcester@maotis.ang.af.mil
253rd Combat Communications							
	Warde	Sandra	Col.	Commander			Sandra.Warde@maotis.ang.af.mil
MANG Joint Operations Center (JOC)							
					508-233-7213		

Table 7.2. Contact List for Fire Departments Adjacent To the MMR.

List B
Fire Departments

Town	Chief	Phone	Fax	Email	Location
Bourne	Charles Klueber	508-759-4412	508-759-9585	fire@townofbourne.com	Upper Cape
Otis			508-968-4730	del.stevenson@maotis.ang.af.mil	Upper Cape
Falmouth	Paul Brodeur	508-495-2500	508-495-2519	falfire@town.falmouth.ma.us	Upper Cape
Mashpee	George Baker	508-539-1454	508-539-1453	gbaker@ci.mashpee.ma.us	Upper Cape
Sandwich	Dennis Newman	508-888-0525	508-833-8010	fire@townofsandwich.net	Upper Cape
Cotuit	Paul Frazier	508-428-2210	508-428-0202	none	Mid Cape
COMM	John Farrington	508-790-2375	508-790-2385	commfire@capecod.net	Mid Cape
West Barnstable	John Jenkins	508-362-3241	508-362-3683	westbarnstablefiredept@verizon.net	Mid Cape
Barnstable	Robert Crosby	508-362-3313	508-362-8444	rcrosby@barnstablefire.org	Mid Cape
Hyannis	Harold Brunelle	508-775-1300	508-778-6448	info@hyannisfire.org	Mid Cape
Yarmouth	Randall Sherman	508-398-2212	508-760-4858	csherman@yarmouth.ma.us	Mid Cape
Dennis	Mark Dellner	508-398-2242	508-398-5925	mdellner@town.dennis.ma.us	Mid Cape
Harwich	Wilfred Remillard	508-430-7546	508-432-5685	harwichchief@hotmail.com	Lower Cape
Brewster	Roy Jones	508-896-7018	508-896-4245	fire_chief@town.brewster.ma.us	Lower Cape
Chatham	Michael Ambriscoe	508-945-2324	508-945-5120	firechief@town.chatham.ma.us	Lower Cape
Orleans	Steven Edwards	508-255-0050	508-240-0855	fire@town.orleans.ma.us	Lower Cape
Eastham	Glenn Olson	508-255-2324	508-240-5932	firechief@eastham-ma.gov	Lower Cape
Wellfleet	Alan Hight	508-349-3754	508-349-0318	ahight@cape.com	Lower Cape
Truro	Thomas Prada	508-487-7548	508-487-6708	chief@trurofirerescue.org	Lower Cape
Provincetown	Michael Trovato	508-487-7023	508-487-7007	ptfire@provincetown-ma.gov	Lower Cape
Wareham		508-295-2973	508-295-1333		Off Cape
Onset		508-295-2122	508-295-5930		Off Cape
Plymouth	James Pierson	508-830-4213	508-830-4174		Off Cape

Table 7.3. Police Department Contact List for Bordering/Surrounding MMR Communities

List C
Police Departments

Town	Chief	Phone	Fax	Email	Location
Massachusetts State Police--Communications	**Lt. Mike Kelly**	**508 820 2677**	**508-759-2221**	*********MUST CONTACT********	
Bourne	John Ford	508-759-4453	508-759-4454	policeadm@townofbourne.com	Upper Cape
Falmouth	David Cusolito	508-457-2527	508-457-2566	webmaster@falmouthpoliceorg	Upper Cape
Mashpee	Rodney Collins	508-539-1480	508-539-1415	rcollins@mashpeepd.com	Upper Cape
Sandwich	Michael Miller	508-888-3343	508-888-4163	police@townofsandwich.net	Upper Cape
Massachusetts State Police--Troop D			508-923-9010		Upper Cape
Barnstable	John Finnegan	508-775-0387	508-790-0062		Mid Cape
Yarmouth	Peter Carnes	508-775-0445	508-775-4997	pcarnes@yarmouth.ma.us	Mid Cape
Dennis	Mike Whalen	508-760-6262	508-394-5750	mwhalen@town.dennis.ma.us	Mid Cape
Harwich	William Mason	508-430-7541	508-432-2530	wmason@town.harwich.ma.us	Lower Cape
Brewster	James Ehrhart	508-896-7011	508-896-4525	jehrhart@town.brewster.ma.us	Lower Cape
Chatham	Kevin Fitzgibbons	508-945-1213	508-945-2791	kcolvin@town.chatham.ma.us	Lower Cape
Orleans	Jeffrey Roy	508-255-0117	508-240-1374	jroy@town.orleans.ma.us	Lower Cape
Eastham	Richard Hedlund	508-255-0551	508-255-5412	policechief@eastham-ma.gov	Lower Cape
Wellfleet	Richard Rosenthal	508-349-3702	508-349-7683	chief@wellfleetpd.org	Lower Cape
Truro	John J. Thomas	508-487-8730	508-487-8736	chief@truropolice.org	Lower Cape
Provincetown		508-487-1213	508-487-4077	policechief@provincetown-ma.gov	Lower Cape
Wareham	Thomas A. Joyce	508-295-1473			Off Cape
Plymouth	Robert Pomeroy	508-830-4218	508-830-4227	plypd@four.net	Off Cape
Massachusetts State Police--Middleboro Shift Commander		(508) 923 4014			
Massachusetts State Police--Framingham, Dispatch		508-820-2121	508-820-2150		
Massachusetts Intelligence Fusion Center		508-820-2129	508-820-2128		

Table 7.4. Barnstable County Jail Contact Information.

List D
Barnstable County Jail

		Phone	Fax	email
Barnstable County Jail	Sheriff Jim Cummings	508-563-4341	508-563-4574	jcummings@bsheriff.net

Table 7.5. Administrator Contact Data for Towns Bordering the MMR.

List E
Town Administrators

Town	Administrator	Phone	Fax	Email	Location
Bourne	Thomas Guerino	508-759-0620	508-759-0620	tguerino@townofbourne.com	Upper Cape
Falmouth	Robert Whritenour	508-457-2573	508-457-2573	rwhritenour@town.falmouth.ma.us	Upper Cape
Mashpee	Joyce M. Mason	508-539-1403	508-539-1403	jmmason@ci.mashpee.ma.us	Upper Cape
Sandwich	George Dunham	508-888-8655	508-888-8655	townhall@townofsandwich.net	Upper Cape
Barnstable	John Klimm	508-862-4610	508-790-6226	john.klimm@town.barnstable.ma.us	Mid Cape
Yarmouth	Robert Lawton	508-398-2231	508-398-2365	rlawton@yarmouth.ma.us	Mid Cape
Dennis	Robert Canevazzi	508-394-8300	508-394-8309	rcanevazzi@town.dennis.ma.us	Mid Cape
Harwich	Wayne Melville	508-430-7513	508-430-5039	wmelviile@town.harwich.ma.us	Mid Cape
Chatham	William Hinchey	508 945-5100	508-945-3550	shurteau@town.chatham.ma.us	Lower Cape
Brewster	Charles Sumner	508-896-3701, ext 134	508-896-8089	csumner@town.brewster.ma.us	Lower Cape
Eastham	Sheila Vanderhoef	508-240-5900	508-240-1291	svanderhoef@eastham-ma.gov	Lower Cape
Orleans	John Kelley	508-240-3700, ext. 415	508-240-3703	jkelley@town.orleans.ma.us	Lower Cape
Wellfleet	Timothy Smith	508-349-0300	508-349-0305	tcsmith@cape.com	Lower Cape
Provincetown	Keith Bergman	508-487-7000, ext 510	508-487-9560	townmanager@provincetown-ma.gov	Lower Cape
Truro		349-7004 x10	508-349-5505	townadm@truro-ma.gov	Lower Cape
Plymouth	Mark Sylvia	508-747-1620 ext. 100	508-830-4140	townmanager-selectmen@townhall.plymouth.ma.us	Off Cape

Table 7.6. Contact Information for Town Selectmen Representing Municipalities Near The MMR.

List F
SMB Selectmen

Last	First	Title	Mail Address	Town	State	Zip	Phone	Fax	E-Mail
Zuern	Linda	Selectman	Town Hall, 24 Perry Avenue	Buzzards Bay	MA	02532	508-759-0600	508-759-0620	Lzuern@townofbourne.com
Valeila	Virginia	Selectman	Town Hall, 59 Town Hall Square	Falmouth	MA	02540	508-548-7611	508-457-2511	valiela@meganet.net
Green	George F.	Selectman	16 Great Neck Road North	Mashpee	MA	02649	508-539-1400 x510	508-539-1403	bos@ci.mashpee.ma.us
Dexter	Douglas S.	Selectman	130 Main Street	Sandwich	MA	02563	508-888-4910	508-833-8045	dexterbusfinance@aol.com

Table 7.7. State and Federal Environmental Agency Contact Information.

List G
Environmental Agencies

Agency	Last	First	Title	Phone	Fax	Email
Environmental Protection Agency	Murphy	Jim	Community Involvement Coordinator	617-918-1028	617-918-1029	murphy.jim@epa.gov
Department of Environmental Protection	Grillo	Ellie	Community Involvement Coordinator	508-946-2866	508-947-6557	ellie.grillo@state.ma.us
Environmental Management Commission	Begley	Mark	Environmental Officer	508-968-5127	508-968-5128	mark.begley@state.ma.us

Table 7.8. Contact Coordinates for Newspapers Covering News and Issues on Cape Cod.

List H
News Papers

Newspapers—Regional

Paper	Phone	Fax	Email	Notes
Barnstable Patriot	508-771-1427	508-790-3997		Published weekly on Thursdays, Deadline: Monday, 5 p.m.
The Cape Codder (lower Cape)	508-247-3200	508-247-3201		Published weekly, Thursdays, Deadline: Monday, 5 p.m.
Cape Cod Times	508-888-5454	508-888-5443	alehmert@capecodonline.com	Deadlines: ads- 3 business days prior, editorials, at least one week prior
Memorial Press Group	508-746-5555	508-747-2148	newsroom@mpgnews.com	

Newspapers—Local

Paper	Phone	Fax	Email	Notes
The Upper Cape Codder and The Register (mid Cape)	508-247-3200	508-247-3201		Weekly, Thursdays, Deadline: Monday, 5 p.m.
The Enterprise	508-548-4700	508-540-8407	walford@capenews.net	Falmouth—bi weekly, Tuesday and Friday, All others—weekly, Fridays, Deadlines: press releases-one week prior,

Table 7.9. Contact Data for Radio Broadcasting Companies Transmitting on Cape Cod.

List I

Radio Station	Station Name	News/Program Director	Town	Phone	Fax	Email
Boch Broadcasting						
	WCOD (Adult-Contemporary) 106.1 FM	Judith Goetz		508-775-5678	508-862-6329	
	WTWV (Adult Alternative) 101.1 FM					
	WXTK (Talk Radio) 95.1 FM					
	WDVT (Star Hit Music) 93.5 FM					
Makkay Group Broadcasting						
	WCIB (Adult Contemporary) 101.9 FM	Bill Lowell		508-548-3102	508-778-9651	
	WPXE (Album-Rock) 102.9 FM			508-428-7103		
	WRZE (Dance Music) 96.3 FM					
	WATD (Adult Contemporary) 95.9 FM	Christine James	Marshfield	781-837-1169	781-837-1825	
	WKKL (Alternative) 90.7 FM	Meg McManus	West Barnstable	508-375-4030	508-375-4020	
	WKPE (Rock) 104.7 FM	Dan Towers	Orleans	508-771-2998	508-255-9787	
	WPLM (Adult Contemporary) 99.1 FM	Tony Arden	Plymouth	508-746-1390	508-830-1128	
	WMVY (Adult Alternative) 92.7 FM	Deborah Medwin	Vineyard Haven	508-693-5000	508-693-8211	
	WOMR 92.1 FM		Provincetown	800-921-9667	508-487-5524	info@womr.org
	WQRC (Contemporary) 99.9 FM	Matt Pitta ext. 104	Hyannis	508-771-1224	508-775-2605	
	WOCN 103.9 FM	same	same	same	same	
	WCAI/WNAN (public radio) 90.1 FM	Jay Allison	Woods Hole	508-548-9600	508-548-5517	cainan@wgbh.org

Table 7.10. Immediate notification list for unusual occurrences on the MMR.

List J
Immediate Notification List

Contact	Phone
MANG Joint Operations Center (JOC)	508-233-7213
102nd FW Command Post	508-968-4386
USCG Air Sta Officer of the Day (OOD/JOOD)	508-968-6330/6331
6 SWS Operations Center	508-968-3291
Barnstable County Jail	508-563-4341
Barnstable County Sheriff Dispatch	508-375-6111
Massachusetts State Police-Bourne	508-759-4488
Otis Fire Dept.	508-968-4020
WCIB, WXTK, WCOB	877-266-5102
WQRC	800-396-6397
D Troop MSP – Middleborough, Wireless 911 Dispatch	508-947-8087
Framingham SP Dispatch	508-820-2121
Massachusetts Intelligence Fusion Center	508-820-2129

8. INTERAGENCY COOPERATION

The importance of interaction with partner organizations for both short and long-term programmatic success cannot be overstated. Current partners assisting in the Camp Edwards fire management activities include the National Park Service (NPS), Department of Environmental Protection (DEP), the Massachusetts Department of Conservation and Recreation (DCR), the Massachusetts Division of Fisheries and Wildlife (DFW), the University of Massachusetts at Amherst (UMASS), the Otis Air National Guard Base Fire Department, The Nature Conservancy (TNC), the Massachusetts Audubon Society, as well as other state, municipal, and non-governmental groups. Camp Edwards remains open to collaborating with other outside organizations that may have interest and/or expertise in fire management on the camp and elsewhere on the MMR.

Cooperative agreements with various federal, state, and local agencies generally provide that resources of each agency are available to assist in initial attack fire suppression actions, aircraft and other resource use, and further fire management efforts. A *Memorandum of Understanding,* or the like, should exist between the MMR and each outside organizations providing aid with fire management on the reservation for clarification of responsibilities by all parties involved.

9. ORGANIZATION AND BUDGET

The primary agency responsible for wildfire suppression on the MMR is the Otis Air National Guard Base (ANGB) Fire Department. However, on Camp Edwards, Range Control oversees the Camp Edwards Training Area and has the initial responsibility of reporting and responding to all training area wildfires. When arriving to a wildfire incident, on Camp Edwards, the Otis ANGB fire department assumes command and control.

There is also a mutual aid agreement in place with the surrounding communities. If responding to a wildfire on the MMR (Camp Edwards), the initial fire department on scene assumes control unless otherwise agreed upon by all responding department chiefs.

During a prescribed fire, the burn boss is in control of prescribed fire activities. A minimum of one representative of the Otis ANGB fire department will be on site during all prescribed fires. If the prescribed fire becomes an incident or wildfire outside of the given prescription, command and control is relinquished to the Otis ANGB officer on scene with Range Control notified of the transition. The Otis ANGB Fire Department will then make the determination to call in other assets if needed.

There are no direct budget streams for fire management on Camp Edwards at this time. Manning and equipment come from various funding streams including environmental and training directorates, and as a result of in-kind services.

10. MONITORING AND EVALUATION

Monitoring activities on Camp Edwards are built upon the Integrated Training Area Management Program (ITAM); the U.S. Army standard for sustaining the capability of installation lands to support military training while assuring the protection to cultural and natural resources, the compliance with statutory regulations, and the integration of

environmental planning into operational protocol. The Range and Training Land Assessment (RTLA), formerly the Land Condition Trend Analysis Program (LCTA), is the ecological monitoring component of the ITAM, which serves to characterize and monitor installation natural resources in both time and space via a random stratified permanent plot sampling system (Figure 10.1). Originally made up of 30 core permanent plots, the system has expanded to currently include a total of 246 plots to account for underrepresented community types and disturbed sites. Data obtained from RTLA surveys are integrated with information gathered from other corresponding components of the ITAM (for example, cultural resources surveys, wetlands surveys, endangered species surveys, water quality monitoring; see Ciaranca et al. 2001 for a complete description of the ITAM program), as well as satellite imagery and aerial photography to portray a total picture of the natural and cultural resources of the Camp Edwards training site.

The RTLA plot surveys are conducted each year, from June to August, during the peak of the growing season for plants at Camp Edwards. The peak in bird migration and some small mammal breeding, however, typically occurs in the spring, prior to or at the beginning of the surveys; consequently, the timing of fauna specific surveys is adjusted accordingly. In order to establish a sampling regime to allow for appropriate habitat comparisons, sampling rotations were created. The RTLA plant data are analyzed for species frequency, diversity, stem density, canopy structure, and rates of succession. The RTLA mammal data are analyzed for species richness, diversity, abundance, sex ratio, population size, trap success, and capture success, while the RTLA bird data are analyzed for species abundance and diversity. Data are summarized using Microsoft Access and/or Microsoft Excel, and analyzed using an assortment of question dependent statistical techniques by means of a variety of statistical software (i.e., MS Excel, SYSTAT, or SuperANOVA). The plot gathered data are also paired with other spatial data in a GIS to gain new insight into relationships, patterns, and trends not visible with traditional statistical methods.

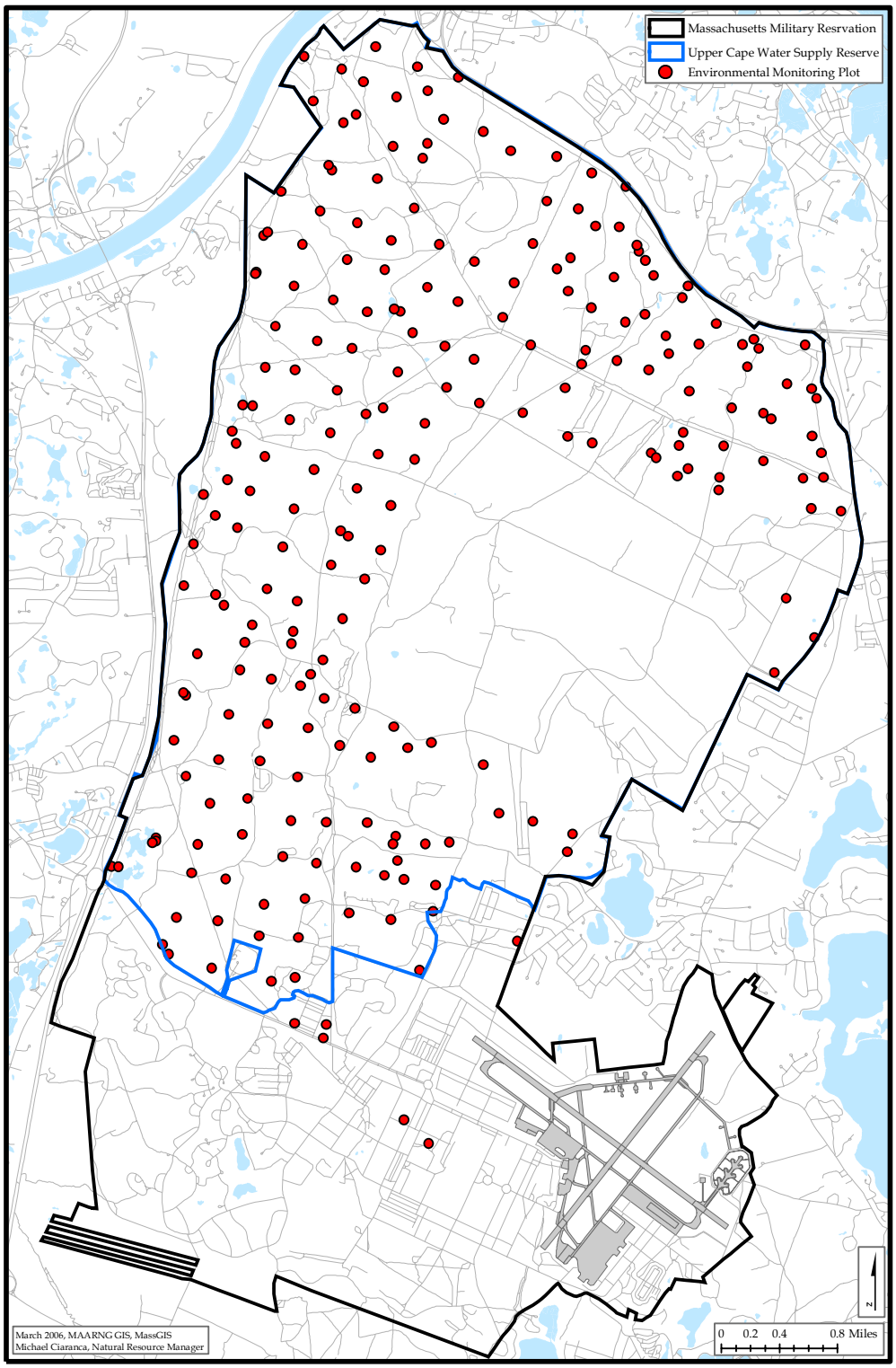
The intrinsic benefit derived from the RTLA monitoring program is that it provides a scientifically valid baseline, which addresses natural resource issues holistically in time and space (i.e., ecosystem management). This baseline grants the ability to focus the timing and scale of fire management activities based on threat to life and property, troop training, and land health. Successes and shortcomings of fire management activities (i.e., fire effects) are also quantitatively measurable with the RTLA system and allow for adaptive steps for future fire use. Further details of RTLA monitoring can be found in the US Army Construction Engineering Research Laboratories (1992) and U.S. Army Environmental Center (1997a).

Other monitoring and research conducted outside of the RTLA is also established on Camp Edwards. A Whip-poor-will (*Caprimulgus vociferus*) survey, habitat use, and home range project has been developed to address a general population decline. Due to the Whip-poor-will nocturnal habits and the consequent lack of information for the species, deriving pertinent data that can be used for conservation and management on the MMR, and other suitable sites throughout the species range, is increasingly important. Through individual point counts, leg banding, radio tagging, and nest monitoring, the focus of this on-going study is to determine species habitat use on the MMR and to ascertain individual and general home ranges.

Another similar study being conducted on the Camp Edwards is on eastern box turtle (*Terrapene carolina carolina*) habitat selection and hibernation thermal ecology. This is a state-listed species of special concern; consequently, its proper management is of great importance to the MMR. Project goals are to determine the characteristics of the microhabitats in which the turtles are located, to quantify the daily movements and home ranges of the turtles, and to attempt to determine the abundance of eastern box turtles throughout the various habitats of the MMR. To accomplish this, marked turtles are radio monitored over the long-term and micro-habitats monitored at turtle locations (i.e., dominant plant species, slope, aspect, litter depth, general metrological conditions). Data loggers have also been placed at turtle burrows to monitor and compare temperatures of the burrow to the outside. These data will be used to identify the range of temperatures box turtles experience during hibernation as well as the exact date and time the box turtles emerge from hibernation in the spring. Current management practices focus on managing large unfragmented tracts of land to provide for the diverse habitat required by each species.

Additional fire specific monitoring outside of the RTLA protocol is also conducted at Camp Edwards. Weather is monitored closely prior to a burn day to assess conditions in terms of safety and potential ecological benefit. During prescribed burns, fire behavior is recorded digitally and with film for a qualitative account during fire events. Weather is also closely monitored throughout burns to ensure activities remain within prescription and to ensure safety. Post-burn summaries (Appendix M) are generated, which assess the influence of certain management activities such as fire and smoke behavior, weather, and first order fire effects (i.e., those effects that are concerned with the direct or immediate consequences of fire, such as biomass consumption, crown scorch, bole damage, and smoke production). Other supplementary monitoring protocols are also being assessed that would allow for improvement to documentation processes, better evaluation of success or failure of a prescribed burn, and better evaluation of potential of future efforts on the MMR.

Figure 10.1. Environmental Monitoring Plots, Camp Edwards, MMR



LITERATURE CITED

Anderson, H, E. 1982. Aids to determining fuel models for estimating fire behavior. USDA For. Serv. Intermountain Forest and Range Exp. Sta. Gen. Tech. Rep. INT-122.

Andrews, P.L. 1986. BEHAVE: Fire behavior prediction and fuel modeling system-: BURN subsystem, part 1, Gen.- Tech., Rep. INT-194. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. pp. 130.

Andrews, P.L., and C.H. Chase. 1989. BEHAVE: Fire behavior prediction and fuel modeling system-BURN subsystem, part 2, Gen. Tech. Rep. INT-260. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. pp. 93.

Andrews, P.L., C.D. Bevins, and R.C. Seli. 2005. Behave plus fire modeling system: Version 3.0 user's guide. RMRS-GTR-106WWW. U.S. Department of Agriculture, Forest Service. pp. 142.

Anonymous 2000. National interagency incident management system: wildland and prescribed fire qualification system guide. NFES 1414/PMS 310-1. National Wildfire Coordinating Group. pp. 117.

Anonymous. 2004a. Behave by Remsoft: fire prediction at its best. Remsoft Incorporated. Available from http://remsoft.com/products.php?id=14 [updated 2005; cited 18 July 2005].

Anonymous 2004b. Fuel Management Analyst: an easy to use tool set for wildland fire managers. Available from http://www.fireps.com/fmanalyst/index.htm [updated 27 October 2001; cited 18 July 2005].

Anonymous. 2005a. Sole source aquifer protection program overview. U.S. Environmental Protection Agency. Available from http://www.epa.gov/ogwdw/swp/ssa.html [updated 14 February 2005; cited 25 April 2005].

Anonymous. 2005b. MMR history. The Massachusetts Military Reservation, Massachusetts National Guard Environmental & Readiness Center. Available from http://www.eandrc.org/mmrhistory1.htm [updated 2005; cited 5 December 2005].

Anonymous. 2005c. ArcGIS 9: ArcGIS desktop media kit. Environmental Systems Research Institute, Inc. (ESRI), Redlands, California. pp. 124.

Anonymous. 2005d. FIREMON: fire effects monitoring and inventory protocol. Joint Fire Sciences Program. Available from http://fire.org/firemon/ [updated 22 April 2005; cited 18 July 2005].

Anonymous. 2005e. Introducing the Vegetation Dynamics Development Tool (VDDT). ESSA Technologies Inc. Vancouver, BC. Available from http://www.essa.com/downloads/vddt/index.htm [updated 2005; cited 18 July 2005].

Anonymous. 2005f. Wildland Fire Situation Analysis. U.S. Department of Agriculture, Forest Service. Available from http://www.fs.fed.us/fire/wfsa/index.htm [updated 28 July 2005; cited 28 July 2005].

Anonymous. 2005g. E.V. Komarek Fire Ecology Database. Tall Timbers Research Station, Tallahassee, Florida. Available at http://www.talltimbers.org/info/fedbintro.htm [updated 2005; cited 18 July 2005].

Anonymous. 2005h. Fire effects information system. U.S. Department of Agriculture, Forest Service. Available from http://www.fs.fed.us/database/feis/index.html [updated 10 June 2005; cited 18 July 2005].

Anonymous. 2005i. The National Wildfire Coordinating Group's Home Page. Available from http://www.nwcg.gov/ [updated 2005; cited 18 July 2005].

Bergeron, Y., S. Gauthier, V. Kafka, P Lefort, and D. Lesieur. 2001. Natural fire frequency for the eastern Canadian boreal forest: Consequences for sustainable forestry. Can. J. For. Res. 31: 1-8.

Bergeron, Y., A. Leduc, B. Harvey, and S. Gauthier. 2002. Natural fire regime: a guide for sustainable management of the boreal forest. Silva Fenn. 36: 81-95

Birkeland, P. W. 1999. *Soils and geomorphology (3rd edition).* Oxford University Press, New York, New York.

Block, W.M., and L.A. Brennan. 1993. The habitat concept in ornithology: Theory and application. Pp. 35-91 in *Current ornithology* 11, ed. D.M. Powers. New York: Plenum Press.

Burgan, R.E., P.L. Andrews, L.S. Bradshaw, C.H. Chase, R.A. Hartford, and D.J. Latham. 1997. WFAS: wildland fire assessment system, Fire Management Notes, 57:14-17.

Ciaranca, Michael A., J.P. Kelly, M. Larese-Casanova, and D. Cray. 2001. Camp Edwards Training Site: Integrated Natural Resources Management Plan. Camp Edwards Environmental Protection Office, Massachusetts Army National Guard.

Clark, J.S., and P.D. Royall. 1994. Transformation of a northern hardwood forest by aboriginal (Iroquois) fire - Charcoal evidence from Crawford Lake, Ontario, Canada. The Holocene 5:1-9.

Cronon,W. 1983. *Changes in the land: Indians, colonists, and the ecology of New England*. Hill and Wang, New York, New York, pp. 241.

Crowell, L. 1932. Fires on Cape Cod. New Bedford Sunday Standard, New Bedford, MA. May 1, 1932.

Delcourt, H.R. 1987. The impact of prehistoric agriculture and land occupation on natural vegetation. TREE 2 - 39-44.

Ecological Society of America. 1996. The report of the Ecological Society of America Committee on the Scientific Basis for Ecosystem Management.

Elton, C.S. 1927. *Animal Ecology*. London: Methuen.

Finney, M. A. 1998. FARSITE: Fire Area Simulator-model development and evaluation. Res. Pap. RMRS-RP-4, Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 47 p.

Finton, A.D. 1998. Succession and plant community development in pitch pine–scrub oak barrens of the glaciated northeast United States. M.S. Thesis, Univ. of Massachusetts, Amherst, MA, 179 pp.

Foster, D. R. 1999. Thoreau's Country: journey through a transformed landscape. Harvard University Press, Cambridge, MA, 270 pp.

Foster, D. R., and G. Motzkin. 1999. Historical influences on the landscape of Martha's Vineyard: Perspectives on the management of the Manuel F. Correllus State Forest. Harvard Forest Paper No. 23. Harvard University.

Foster, D.R., J.D. Abner, J.M. Melillo, R.D. Bowden, and F.A. Bazzazz. 1997. Forest response to disturbance and anthropogenic stress. BioScience 47: 437-445.

Franklin, J. 1993. Preserving biodiversity: species, ecosystems, or landscapes? Ecological Applications 2: 202-205.

Freeman, F. [1858] 1965. The History of Cape Cod. Parnassus Imprints, Yarmouthport, MA. Reprint of 1858 edition.

Frelich, L.E. and P.B. Reich. 1995. Spatial patterns and succession in a Minnesota southern-boreal forest. Ecol. Monogr. 65: 325-346.

Grenier, D. 2003. Historique des feux au nord du Témiscamingue, Québec. Mémoire de maîtrise en biologie, Université du Québec en Abitibi-Témiscamingue. pp. 47.

Grenier, D.J., Y. Bergeron, D. Kneshaw, and S. Gauthier. 2005. Fire frequency for the transitional mixedwood forest of Timiskaming, Quebec, Canada. Can. J. For. Res. 35: 656-666.

Hammett, J.E. 1992. The shapes of adaptation - Historical ecology of anthropogenic landscapes in the southeastern United States. Landscape Ecology 7: 121-135.

Harms, M. F., and L.G. Lavdas. 1997. Users Guide to VSMOKE-GIS for Workstations. Southern Research Station Research Paper SRS-6. 49p.

Hunter, M.L. Jr. (Ed.). 1999. *Maintaining Biodiversity in Forest Ecosystems*. Cambridge University Press, Cambridge, UK, pp. 698.

Hunter, M. 2004. FlamMap: What is it? Systems for Environmental Management, Missoula, MT. Available from http://fire.org/nav.mas?pages=flammap&mode=1 [updated 27 May 2004; cited 18 July 2005].

Iwamoto, K. 2005. Managing fuels in northeastern barrens. Department of Natural Resources and Conservation, University of Massachusetts Amherst. Available from http://www.umass.edu/nrc/nebarrensfuels/index.html [updated 22 June 2005; cited 18 July 2005].

Jenkins, J. 1994. A Floristic Survey of Camp Edwards, Barnstable County, Massachusetts. White Creek Field School.

Johnson, E.A., and S.L. Gutsell. 1994. Fire frequency models, methods, and interpretations. Adv. Ecol. Res. 25: 239-287.

Keene, B.B. [1937] 1975. *History of Bourne from 1622 to 1937*. C.W. Swift, Yarmouthport, MA. Reprint of 1937 edition.

Krebs, C.J. 1985. *The experimental analysis of distribution and abundance.* 3rd edition. Harper and Row, New York. pp. 694.

Lesieur, D., S. Gauthier, and Y. Bergeron. 2002. Fire frequency and vegetation dynamics for the south-central boreal forest of Quebec, Canada. Can. J. For. Res. 32: 1996-2009.

Lovell, R.A. 1984. Sandwich - A Cape Cod Town. Sandwich Archives and Historical Center. Sandwich, MA.

Morrison, M.L., B.G. Marcot, and R.W. Mannan.. 1992. *Wildlife habitat relationships: Concepts and applications*. University of Wisconsin Press, Madison, WI.

Montgomery J.M., Consulting Engineers Inc. October 1991. Environmental Management Analysis Program for the Massachusetts Military Reservation. James M. Montgomery Inc, Wayzata, MN.

Motzkin, G., D.R. Foster, A. Allen, J. Harrod, and R. Boone. 1995. Controlling site to evaluate history - vegetation patterns of a New England sand plain. Ecological Monographs 66: 345-365.

Motzkin, G.M., W.A. Patterson and D.R. Foster. 1999. A regional historical perspective on uncommon plant communities - pitch pine-scrub oak in the Connecticut Valley of Massachusetts. Ecosystems 2: 255-273.

Olsvig, L.S., J.F. Cryan, and R.H. Whittaker. 1979. Vegetational gradients of the pine plains and barrens of Long Island, New York. In Forman, R.T.T. 1979. Pine Barrens - Ecosystems and Landscape, New York - Academic Press, p. 265.

Olsvig, L.S. 1980. A comparative study of Northeastern Pine Barrens vegetation. Ph.D. Dissertation, Cornell University, Ithaca, N.Y.

Patterson, W.A. III. 1994. The Waterboro barrens - fire and vegetation history as a basis for ecological management of Maine's unique scrub oak-pitch pine barrens ecosystem. Department of Forestry and Wildlife Management, University of Massachusetts, Amherst, MA.

Patterson, W. A. III. and A. E. Backman. 1988. Fire and disease history of forests. pp. 603-632 in B. Huntley and T. Webb III (eds.), Handbook of Vegetation Science, Vol, 7-Vegetation History. Kluwer Academic Publishers.

Patterson, W.A. III. and C.M. Ruffner. 2000. Fire management plan for the Massachusetts Military Reservation, Sandwich, Massachusetts. Department of Forestry and Wildlife Management. University of Massachusetts at Amherst.

Patterson, W.A. III. and C.M. Ruffner. 2001. Fire management plan for the Massachusetts Military Reservation, Sandwich, Massachusetts. Department of Forestry and Wildlife Management. University of Massachusetts at Amherst.

Patterson, W.A. III. and K.E. Sassaman. 1988. Fires in the prehistory of New England. *In* Holocene human ecology in northeastern North America. *Edited by* G.P. Nicholas. Plenum Publishing, New York. pp. 107-135.

Patterson, W.A. III. and A. Stevens. 1995. Pitch pine "barrens" of the Connecticut River Valley of Massachusetts. Department of Forestry and Wildlife Management, University of Massachusetts, Amherst, MA.

Reed, W.J., and E.A. Johnson. 2004. Statistical methods for estimating historical fire frequency from multiple fire-scar data. Can. J. For. Res. 34: 2306-2313.

Reinhardt, E. D. 2003. Using FOFEM 5.0 to estimate tree mortality, fuel consumption, smoke production and soil heating from wildland fire. 2nd International Wildland Fire Ecology and Fire Management Congress. Orlando, Florida. 16-20 November.

Schweitzer, D.F. and T.J. Rawinski. 1988. Element stewardship abstract for Northeastern pitch pine/ scrub oak barrens. The Nature Conservancy, Boston, MA.

Scott, J. H. 1999. NEXUS: A system for assessing crown fire hazard. Fire Management Notes 59: 20-24.

Scott, Joe H. and R.E. Burgan. 2005. Standard fire behavior fuel models: a comprehensive set for use with Rothermel's surface fire spread model. Gen. Tech. Rep. RMRS-GTR-153. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. pp. 72.

Smith, D. 2001. Stand Visualization System: a product of the USDA Forest Service, Pacific Northwest Research Station. Available from http://www.fs.fed.us/pnw/svs/ [updated 27 September 2001; cited 18 July 2005].

Stone, T. 2005. Cape Cod: Land cover and ecology. Woods Hole Research Center. Available from http://www.whrc.org/capecod/index.htm [updated 2005; cited 01 December 2005].

Strahler, A. N. 1966. *A geologist's view of Cape Cod*. Parnassus Imprints. Orleans, Massachusetts.

Strahler, A.N. 1972. The environmental impact of groundwater use in Cape Cod. Association for the Preservation of Cape Cod, Orleans, MA

Swain, P. and J. Kearsley. 2001. Classification of the natural communities of Massachusetts. Natural Heritage & Endangered Species Program of the Massachusetts Division of Fisheries and Wildlife, Westborough, MA. Available from http://www.mass.gov/dfwele/dfw/nhesp/nhclass.htm [updated 15 November 2002; cited 23 May 2005.

U.S. Army Construction Engineering Research Laboratories. 1992. D. Tazik, S.D. Warren, V.E. Diersing, R.B. Shaw, R.J. Brozka, C.F. Bagley, W.R. Whitworth. U.S. Army Land Condition-Trend Analysis (LCTA) Plot Inventory Field Methods. Tech Rep. N-92/03. Champaign, Illinois.

U.S. Army Construction Engineering Research Laboratories. 1992. D. Tazik, S.D. Warren, V.E. Diersing, R.B. Shaw, R.J. Brozka, C.F. Bagley, W.R. Whitworth. U.S. Army Land Condition-Trend Analysis (LCTA) Plot Inventory Field Methods. Tech Rep. N-92/03. Champaign, Illinois.

US Army Construction Engineering Research Laboratories. 1995. Price, D. L., A.B Anderson, W.R. Whitworth, and P.J. Guertin. Land Condition Trend Analysis Summaries. Tech. Rep. 95/39. Champaign, Illinois.

U.S. Army Environmental Center. 1997. Land Condition Trend Analysis II (LCTA II). 5-7 August 1996 Workshop Results.

U.S. Department of Agriculture Soil Conservation Service. 1993. Soil Survey of Barnstable County, Massachusetts. In cooperation with Massachusetts Agricultural Experiment Station.

Weir, J.M.H., E.A. Johnson, and K. Miyanishi. 2000. Fire Frequency and the spatial age mosaic of the mixedwood boreal forest in Western Canada. Ecol. Appl. 10: 1162-1177.

Zielinski, G.A., and B.D. Keim. 2003. *New England Weather, New England Climate*. University Press of New Hampshire, Lebanon, New Hampshire. pp. 276.

APPENDIX A. WILDLAND FIRE RESPONSE PLAN

TABLE OF CONTENTS

A.1 INTRODUCTION

A.1.1. Purpose and Scope

The purpose of this fire response plan is to guide response to wildland fires at Camp Edwards Training Site (CETS) at the Massachusetts Military Reservation (Reference A1). The primary objective is to prevent unplanned ignitions through sound preventive measures. This document establishes procedures and outlines tasks for fire prevention, suppression and after action review with the goal of fire control and the protection of natural and cultural resources from wildfires. In the event that a fire is reported at Camp Edwards, the operating procedures in this document will be implemented.

This plan describes the most likely organizational structures for controlling a range of possible fire scenarios. The plan outlines needed resources, the most likely deployment of personnel and equipment, and identifies minimum staffing levels. The fire response plan also addresses initial attack, extended attack, and major fire attack and includes, but is not limited to the following:

a. Detection and reporting procedures.
b. Descriptions of organizational functions and delineation of responsibilities.
c. Type of equipment and number of personnel needed.
d. Description of support services needed.
e. Notification and operating procedures.
f. Radio frequency assignment (Reference A7).
g. Map showing topography, wetlands, potential staging areas, access gates (Reference A1).
h. Rosters of interagency resources and ordering procedures.
i. Special concerns/needs (i.e., biological sensitive areas, impact areas, unexploded ordnance (UXO)).

The provisions outlined in this document are applicable to personnel assigned to the Camp Edwards Training Site (CETS), and all military units utilizing CETS as well as the Otis Air National Guard Base Fire Department. The CETS Commander and senior unit commanders, regardless of service or component, whose unit has been allocated the use of CETS, will ensure compliance with this document. All officers and noncommissioned officers will familiarize themselves with the contents of this document or receive a fire prevention briefing prior to use of the Camp Edwards range facilities.

This document is an appendix to the Camp Edwards Integrated Fire Management Plan (IFMP). Background on fire management history, goals and ecology of the Camp Edwards Training Site can be found in the IFMP.

A.1.2. Responsibilities

a. Natural Resource Manager, Environmental and Readiness Center. The Natural Resource Manager oversees the operations of the Natural Resource Office and is responsible for setting priorities and developing budgetary requirements for natural resources and

wildland/prescribed fire programs. The Natural Resource Manager is also responsible for integrating this management to provide for a more usable but environmentally sound training site and opportunities for the Massachusetts National Guard.

b. **CETS Range Officer**. The CETS Range Officer is responsible for ensuring compliance with any restrictions on training that result from high fire dangers and immediate response to any wildland fires while Range Control personnel are on site.

c. **Unit Commanders and Division Chiefs**. Commanders, managers and supervisors at all levels of CETS are responsible for ensuring unit personnel are familiar with and comply with the provisions of this document and applicable regulations and fire prevention restrictions. They will also provide qualified personnel to support wildland fire suppression if so needed.

d. Otis Air National Guard Base Fire Department. The Otis Air National Guard Fire Chief is the proponent for the CETS fire protection program. The Fire Chief acts as the Authority Having Jurisdiction (AHJ) who sets policy and has safety oversight.

A.1.3. Environmental Considerations

The Camp Edwards Training Site is also known as the Upper Cape Water Supply Reserve. It is a sole source aquifer for the upper Cape Cod area. All actions taken during any fire scenario (for example the use of foam or retardant) should be considered for the potential impacts to ground water and the reserve. Fire suppression activities (including mechanized vehicles and construction of fire line) should be minimized near wetlands.

The CETS is home to 35 Massachusetts state listed species. As such the MA Natural Heritage and Endangered Species Program designated the site a state priority habitat (under revision in 2006). With this designation, care should be taken to minimize landscape impacts when deciding on tactics for suppressing wildfires. Although many of the natural communities at CETS are fire-adapted and require fire for their maintenance, wildfires pose a significant threat to buildings and infrastructure as well as to natural and cultural resources. Large severe wildfires may impact rare species, soils, water, air quality, and aesthetics. Ground disturbing activities, such as bulldozing and constructing fire line, pose significant threats to known and unknown archaeological sites and may actually increase fuel loads in the future by encouraging the excessive seeding-in of pitch pine. These activities may also increase natural community fragmentation which has proven to be detrimental to populations of flora and fauna.

A.2 FIRE PREVENTION ACTIONS

A.2.1 Introduction

One of the primary objectives of this document is to integrate fire management actions with military training requirements and range operations. The prevention of fires is the responsibility of every individual training and/or working at Camp Edwards Training Site. Fire prevention and the ability to control the spread of fires are critical for the Army's

use of the area as a training range. Fire management actions are designed to reduce conflicts between necessary military training activities and the conservation of natural and cultural resources.

A.2.2 Ignition Control

The intent of rules governing the use of weapons systems and pyrotechnics is to protect loss of training days, endangered species, natural community structure, and life and property. While training at CETS, units must use extra caution during training exercises. Soldiers must be aware of and adhere to fire danger-rating restrictions from Range Control when conducting training that may be an ignition source for wildfires.

A.2.3 Education

Soldiers will be briefed prior to training about fire prevention, and protection of cultural and natural resource. The fire prevention briefing ensures that important fire prevention information is provided to all CETS users.

A.2.4 Enforcement

Existing military training regulations and SOPs cover training activities and restrictions based on potential fire danger. Range Control safety staff has primary responsibility for ensuring that all regulations governing fiel training or weapons firing and SOPs are adhered to. Range Control and fire department personnel have the authority to stop any training activity for noncompliance with training regulations and for actions that can cause wildfire in conditions of fire danger concern.

A.3. PRE-SUPPRESSION PLANNING

A.3.1. Minimum Staffing Requirements

a. All wildfires at CETS are responded to by the Otis Air National Guard Base Fire Department. In accordance with their wildland fire policy, they will maintain an appropriate level of fire preparedness.

b. CETS range personnel or Natural Resource Office staff may also respond to wildfires, with a minimum of two personnel. It is strictly prohibited for a single individual to respond to a wildland fire on the CETS.

c. When in use, the minimum staffing level for the CETS type 6 engine is two (2) crew members. Under no circumstances will a firefighter ever be assigned to respond to a wildfire as a single individual.

A.3.2. Training

a. DoD Policy requires that all Range Control and other military personnel engaged in wildfire suppression and prescribed fire duties meet the National Wildfire Coordinating

Group (NWCG) standards for wildland firefighters or those deemed appropriate by the Incident Commander (IC) or Fire Chief.

b. CETS firefighters, Otis Air National Guard Base Fire Department, or outside cooperating agencies shall meet the required wildland training and physical fitness requirements outlined within each respective agency's established policies, guidelines or training program. The fitness requirement for CETS firefighters is passing the Army Physical Training test or those deemed appropriate by the IC, Fire Chief, or CETS Commander.

c. Individuals will not be assigned to duties for which they lack training and/or certified experience. All personnel dispatched or assigned to wildfires or prescribed fires will be qualified for the fire position assigned, unless assigned as trainees under the direct supervision of higher qualified personnel at all times or otherwise assigned by the IC.

d. CETS fire marshall or wildland fire manager will administer and manage an effective qualification and certification program and will monitor all employee's wildland fire development (training and experience) to ensure accurate qualification and certification standards. All personnel engaged in wildland firefighting activities must satisfactorily complete the following suppression skills courses: S-130, Firefighter Training; S-190, Introduction to Fire Behavior; and I-100, Introduction to Incident Command System (ICS) or those deemed appropriate by the IC, Fire Chief or CETS Commander.

e. CETS fire marshall or wildland fire manager will coordinate with the Otis Air National Guard Base Fire Department training officer and other local agencies to develop the wildland fire training.

A.3.3. Fire Equipment and Supplies

a. Equipment: Required fire suppression equipment must be operational 100% of the time. If required fire suppression equipment is not operational, CETS will make amending the situation a top priority. This requirement pertains to all types of firefighting equipment, water resources, and personnel. Emergency contingency plans must be developed by CETS to ensure that this requirement is met or that the CETS is notified in the event that Otis Air National Guard Base Fire Department cannot effectively respond to fires at CETS.

b. Fire Cache Supplies: The centralized fire cache facility is at the CETS Facilities Engineers Building. The fire cache facility will be equipped to outfit ten firefighters with the appropriate Personnal Protective Equipment (PPE) as described in the CETS Integrated Fire Management Plan. A full list of mandatory PPE is listed in the IFMP in Table 6.9. PPE allocated to the Natural Resource Office and Range Control personnel who keep their PPE with them will count towards the cache minimum. Range Control, Natural Resources, and Otis Air National Guard Base Fire Department personnel will ensure that proper PPE is worn at all times when actively engaged in firefighting duties. Personal safety and prevention of injuries is the first priority in every fire management activity.

The fire cache will also maintain a limited supply of fire equipment as determined by the Natural Resources Office and appropriate CETS or Otis Air National Guard Base Fire Department personnel. The Natural Resources Office and appropriate CETS or Otis Air National Guard Base Fire Department personnel will conduct periodic checks, at least once annually, to ensure all resources are in place, and will identify and immediately correct any deficiencies.

A.3.4. Fire Vehicles

a. The Otis Air National Guard Base Fire Department shall ensure that a fire response vehicle (brush breaker) is operating and available in a constant state of readiness. Otis will also maintain a minimum of one brush breaker with a minimum 250 gallon capacity for use in initial attack.

b. The CETS will maintain at least one Type 6 engine for initial attack of wildfires and fire management activities (prescribed fires). The engines should meet the minimum standards for a Type 6 engine set forth by the National Wildfire Coordinating Group.

Pump Rating:	30 GPM at 100 psi
Tank Capacity:	150-400 gal
Hose:	1 inch diameter= 300’
	1 ½ inch diameter= 300’
Personnel:	2

c. Personnel operating fire response vehicles shall be qualified and licensed to operate emergency vehicles that require special certification. The Otis Air National Guard Base Fire Department shall support vehicle qualification and the training program for CETS staff when appropriate.

d. CETS personnel will perform weekly preventive maintenance inspections of vehicles and pumps to ensure operational readiness during fire season (March through June) and monthly inspections year round. All discrepancies shall be identified and coordinated for priority repair/replacement.

d. The Type 6 engine will be stationed at the CETS Facilities Engineers building (Bldg 2808). It will only be used for non-firefighting duties if those using it for this purpose are the designated initial attack crew members for the day and are trained and qualified to operate this equipment.

e. Fire vehicles can use water from nearby ponds, fire hydrants, wash rack, the water supply point, tenders, or as directed by IC to fill their tanks.

A.4. FIRE DETECTION AND REPORTING

a. **Detection**. Early fire detection is critical to an effective initial attack of wildfires on Army training lands. Any agency, unit leader, or individual noticing a fire is responsible for

reporting it as soon as it is detected.

b. **Reporting and Notifications**. Any person witnessing a fire or detecting smoke must report it to the Otis Air National Guard Base Fire Department and Range Control via direct phone line or radio contact. A call to 911 should be a last resort. Notification of fire managers and responders will be initiated by the first alerted agency. The report should include fire location, fire size, best access to fire and a rendezvous point for Suppression Resources to enter the training area and begin suppression activities. *Contact numbers are found in Reference A2.*

c. **Range Operations Procedures**. Upon detection of a fire, unit range Officers in Charge (OIC) will immediately initiate a "cease fire" order and notify Range Control staff, giving the location and size of the fire. Units will not be allowed to resume training until the fire is extinguished or upon approval by a Range Officer and Senior Fire Officer, such as Otis Air National Guard Base Fire Department Chief.

a. Impact Area Fire - If the fire is located in the impact area, **notify all units** to come to an immediate cease fire so suppression resources can enter the impact area. All units have to acknowledge Range Control once the range has returned to "Cold" Status.

b. Fire outside the impact area - If the fire is located outside the impact area, call and immediate cease fire only on those positions/ ranges that will have an effect on the safety of personnel responding to or fighting the fire. The range OIC will verify safety fans.

c. Fires on or near Ranges E, S-E and S-W - If the fire is located on or near Ranges E, S-E or S-W, and units are occupying the Ranges, instruct the units to immediately place all M31A1 Target Mechanisms (pop-ups) in the "UP" Position to preclude damage by fire. If there are no using units on these ranges it will be the responsibility of the Range Control Operations to accomplish this action.

d. **Range Operations Response Team**. One Vehicle will be dispatched with two Range Operations Soldiers, 2 portable radios with Range Control net and Range Control Administrative Net frequency's and one vehicle mounted radio. The Response team objective is to report on conditions (fire location, size, best access, weather conditions, hazards or concerns). The report on conditions should be communicated to Range Control over the Range Control Administrative Net (38.50 MHz) or to Otis Air National Guard Base Fire Department at 173.5875 MHz. If personnel on scene are qualified engine operators and having provided for safety first, suppression activities should be initiated if so equipped.

e. **Command and Control Procedure**

1. Otis Air National Guard Base Fire Department:
    a. if notified first, notifies range operations
    b. coordinates control of the fire upon arrival at the scene

c. coordinates request for military assistance with the Range Operations Response Team.
d. requests mutual aid if needed.
e. if the fire is in the impact area, advises Range Control Response Team of road networks and areas that can be used safely by the fire fighting units.
f. provides Range Operations Response Team with an estimate of total acreage burned.
g. is the only authority that can declare the fire officially out.

2. Senior Range Operations Responder:
a. remains with the Otis Air National Guard Base Fire Department until the fire is declared out.
b. coordinates requests for military assistance from the Otis Air National Guard Base Fire Department with Range Operations.
c. keeps Range Operations advised on the status and location of the fire.
d. discusses the status of cease fires with the Otis Air National Guard Base Fire Department and advises Range Operations on the ranges that can be safely returned to hot status during fire fighting.

3. Range Operations Response Team:
a. one Range Operation Responder remains with the Fire Department at all times and provides assistance until the fire is declared out.
b. uses the Range Operations Administrative net for radio communications.
c. verifies the location of the fire and reports findings to Range Control to include the best route for the fire department to reach the fire.
d. coordinates a location to meet the Senior Fire Officer and apparatus, meets and then briefs them accordingly, and directs them to the fire.
e. if the fire is in the impact area, contacts range control and requests permission to enter the impact area to ensure that all ranges have ceased fire.
f. other Range Operation Responders assist as directed. If possible, firefighters in the impact area will be accompanied by Explosive Ordnance Disposal Team.
g. coordinates helicopter support, heavy equipment, fuel and food needs, needs of the Public Affairs Office, and the Camp Edwards Fire Marshal.
h. keeps range operations OIC/NCOIC informed.
i. notifies range operations when all personnel and equipment have cleared the impact area and makes sure all impact area gates are secured.

A.5. FIRE SUPPRESSION ACTIONS

A.5.1. Fire Suppression

The objective of fire suppression is to attack and suppress wildfires at minimum effort and cost while protecting values at risk and minimizing the impacts from suppression activities. For purposes of this plan, a wildfire is defined as a free burning and unwanted fire requiring suppression action. Wildfire suppression is an emergency operation and takes

precedence over all other operations, including training, with the exception of safeguarding human life. In some cases, a wildfire at CETS can be controlled with a single attack response vehicle; in others, large numbers of firefighters, fire apparatus, and equipment may be required.

A.5.2. Fire Management Strategies

Fire management policy for CETS training lands will be to implement a suppression strategy for all unplanned ignitions. The Army recognizes three levels of suppression response: confine, contain, and control. The difference among these strategies is subtle in many cases, but the consequences can be substantial. The definitions are as follows:

1. **Confine**: to restrict the wildfire within boundaries established either prior to or during the fire. These identified boundaries will confine the fire, with "no action being taken" (line construction, bucket drops, etc.) to suppress the fire.
2. **Contain**: to restrict a wildfire to a defined area, using a combination of natural and constructed barriers that will stop the spread of the fire under the prevailing and forecasted weather conditions until out. This means "some action has been taken" (line construction, bucket drops, etc.) to suppress the fire.

3. **Control**: to aggressively fight a wildfire through the skillful use of personnel, equipment, and aircraft to establish fire lines around a fire to halt the spread and to extinguish all hot spots until out.

All three strategies require continuous observation of fire behavior. When possible, fires will be managed in a control mode to minimize fire size and associated impacts. Considerations of contain and confine strategies will be incorporated to provide for human safety and/or other aspects. Suppression strategy considerations include:

1. always providing first for firefighter and public safety.
2. the use of natural and man-made barriers to help in the rapid control of incidents to reduce exposure of fire fighting personnel to hazard areas.
3. basing the appropriate method of attack on fire behavior and available suppression resources.
4. assessing the environmental impacts resulting from suppression activities so they are outweighed by the values at risk.
5. assigning priority protection to all known sensitive habitat and archaeological sites.
6. providing for the protection of capital investments on and immediately surrounding the training area.

A.5.3. Fire Management Options/Alternatives

a. Fire suppression alternatives range from immediate and aggressive suppression to no attack. As presented, the alternatives set standards for selection of the appropriate option by the IC. Further, they provide basic guidance and parameters within which the IC makes initial strategies and tactical decisions.

b. In the event of potential fire escape from CETS land, the IC must consult with the owner or manager of the adjacent lands to select a fire management option based on an evaluation of local conditions. The most appropriate level of suppression will be chosen by the IC depending upon the anticipated consequences and management objectives for the area likely to burn.

c. Options are not "set in stone" when applied to specific areas. Rather, the application of the options must be flexible and subject to revision as conditions change, such as formulation of specific land use objectives, environmental considerations, and availability of new data.

d. During the critical portion of the fire season, most fires will receive an aggressive initial attack. If the fire escapes initial attack and requires more than a modest commitment to contain it, an extended attack and an escaped fire analysis will be conducted to determine the level of suppression justified by the values at risk. Minimizing acres burned must be balanced with suppression costs.

A.5.4. Description of Management Options

A.5.4.a. **Critical Suppression Management Option (Control):** This option was specifically created to differentiate the protection of human life and inhabited property from natural resource protection. Unquestioned priority over all other fires is automatically given to sites (areas) identified in this option.

1. Policy: This designation is for those areas where fire presents a real and immediate threat to human safety and designated physical urban developments. Fires burning in these areas will be immediately and aggressively suppressed.

2. Objectives:
(a) Protect human life and inhabited property.
(b) Place highest priority on the allocation of suppression forces to sites (areas) that qualify for this option.
(c) Limit damage from fire to the minimum achievable.

3. Operational Considerations: Areas designated by this option are restricted to sites and immediate surrounding areas. Managers are encouraged to exercise restraint in the designation of physical urban developments, limiting the application of this option to those sites which are currently or routinely occupied as a residence, or of such high economic or cultural value that fire could cause irretrievable loss. Requests for mutual aid assistance to augment fire suppression efforts are made as necessary.

A.5.4.b. **Full Suppression Management Option (Control**): Areas assigned this designation will receive the best fire protection available. All fires in these areas will receive aggressive initial attack and aggressive suppression efforts until the fire is declared out. This option was designed for the protection of natural/cultural sites, high resource value areas, and resources that require wildland fire protection, but do not involve the protection of human life and habitation.

1. Policy: Fires burning under this designation will be controlled through immediate and aggressive action.

2. Objectives:
(a) Regardless of fire weather or behavior, control all fires at the smallest acreage possible.
(b) Minimize disruption by fire of designated, planned, or ongoing human activities in the area.
(c) Environmental impacts resulting from suppression activities will be commensurate with the values at risk.

3. Operational Considerations: Only fires in the critical protection area receive a higher priority for suppression resources. Incorporate priority protection to all known sensitive habitats and archeological sites.

A.5.4.c. Limited Suppression Management Option (Confine): This category recognizes locations where a 'let it burn' policy is desirable or the values at risk do not warrant the high expenditure of suppression funds. Suppression actions are outlined to the extent necessary to keep a fire within the designated area or to protect critical sites within the area. On the CETS this designation can apply if IC deems so; for example letting an area burn to a given fire break or conducting back firing operations to suppress the fire within a defined area.

1. Policy: Confine fires and prevent undesirable escape from this area.

2. Objectives:
(a) Reduce overall fire suppression costs.
(b) Allow fire to burn unimpeded to the fullest extent possible.
(c) Prevent fire activity in this area from violating fire management policies and objectives in adjoining areas.

3. Operational Considerations**:** Careful monitoring of fire behavior and fire weather conditions is essential within this area. When escape of a fire from this area appears imminent, the IC will implement a strategic control plan using natural and man-made barriers to control the fire.

A.5.4.d. Modified Suppression Management Option (Contain): This option provides for a level of protection between "Full" and "Limited." The intent is to provide the IC with an alternative for those areas that require a relatively high level of protection during critical burning periods, but a lower level of protection when the risks of large damaging fires is diminished. Its intent is to reduce suppression costs and increase resource benefits during the entire fire season through its two distinct operational responses to fire.

1. Policy: Contain all fires using aggressive initial attack unless otherwise directed by the IC or adjacent landowner upon completion of a modified initial attack analysis. Manage fires to consider resource management objectives in a cost-effective manner.

2. Objectives:
(a) Reduce suppression costs on escaped fires through minimum force commitments and indirect suppression tactics.
(b) Allow fire to help achieve land management objectives.
3. Operational Considerations**:** When a fire escapes containment, the fire will be evaluated by the IC, to determine further fire strategy and to coordinate immediate request for mutual aid assistance to augment fire suppression efforts as required.

A.6. SPECIAL CONSIDERATIONS FOR SUPPRESSION ON CETS LANDS

A.6.1. Minimum Impact Suppression Techniques

a. Because CETS is a sensitive resource area from both a natural community and water supply perspective, the Incident Commander (IC) needs to select suppression tactics commensurate with the fire's existing or potential behavior, yet leaving minimal environmental impact. This is referred to as Minimum Impact Suppression Tactics (MIST). Minimum impact suppression places an increased emphasis on suppressing a wildfire while minimizing the effects of suppression measures on the vegetation, soils, and watershed.

b. Minimum impact suppression tactics will not override considerations for safety, containment, or control of the wildfire. However, they will be used to the maximum extent possible within these constraints. MIST will not affect these suppression responses.

A.6.2. Protection of Cultural Resources

Activities or management practices involving ground disturbance of any kind may have the potential to impact cultural resources on Camp Edwards. Any activities causing ground disturbance on the CETS must be evaluated by the MAARNG Cultural Resource Manager. These activities must be reviewed in the context of the MAARNG Integrated Cultural Resource Management Plan, cultural resource sensitivity areas for the Camp Edwards Training Site.

A.7. INITIAL AND EXTENDED ATTACK

A.7.1. Initial Attack (Refer to Operation Decision Chart, Initial Attack Plan, Reference A3)

a. Immediate, safe, and aggressive attack is the primary response to all fires at CETS. Within the confines of due care for personnel safety, the resource values of the area and the hazardous fuels justify the fullest commitment to containment and control of all fires. The goal of the initial attack actions is to limit damage to values at risk while minimizing fire area and preventing escape. If any wildfire suppression strategy other than full control is to be utilized in initial attack, the rationale must be documented as part of the Army's Wildland Fire Incident Report (WFIR) or National Fire Incident Reporting System (NFIRS).

b. Upon notification that a fire has been detected, Range Control and/or the Otis Air National Guard Base Fire Department will dispatch appropriate fire fighting resources to respond to the location of the fire. Upon arrival at the site, fire fighting personnel will assess the fire conditions and determine fire control strategies, including the equipment and personnel requirements necessary to execute initial attack operations. The first arriving unit will assume command and control of all fire fighting activities until properly relieved. At this time the fire will be evaluated as "Routine", "Serious", or "Critical".

i. Routine: Wildland fires that can be handled by the initial attack unit and a brush breaker.
ii. Serious: Wildland fires that may require the assistance of additional resources or aerial resources.
iii. Critical: Wildland fires that will require the assistance of mutual aid and pose a critical threat to loss of high value resources and/or potentially may leave the installation.

c. Once on the fire scene, the initial attack responder or the IC may decide that additional personnel are required to fight the wildfire. Military personnel may assist in initial attack efforts provided they are directly supervised by qualified firefighters and proper personal protective equipment (PPE) has been issued. In this event, the primary mission of the unit OICs will shift from training to assisting with fire fighting. Once military resources have been committed to fire fighting, they are under the operational control of the IC. This does not preclude unit commanders from rotating personnel and equipment as needed in coordination with the IC. The IC directs the overall employment of fire fighting resources to control and extinguish the fire.

d. The individual with the highest level of wildfire qualification/training will act as the initial attack IC until relieved by a more highly qualified individual of the fire department. Under normal situations, Range Control personnel will be the first responders until the Otis Air National Guard Base Fire Department arrives.

e. The closest forces (i.e., the nearest available appropriate fire resource) will be used to respond to an incident. The use of closest resources must be covered by cooperative agreements or other mutual aid agreements with adjacent agencies or fire protection organizations. In most cases the Range Control staff and the Otis Air National Guard Base Fire Department will be the first responders whenever CETS Range Control staff is not on-site.

f. Types of Attack.

(1) Direct Initial Attack (IA). Direct initial attack by initial attack crews can suppress fires at the point of origin while still small and prevent fires from spreading. Direct attack requires approaching the fire and therefore can only be used on fires of low or moderate intensity.

(2) Indirect Attack. Indirect attack is the use of ground crews or aircraft to create control lines in front of fire before it arrives. In areas with heavier fuel loads or when the fire is exhibiting intense behavior, indirect attack incorporating offset hand lines, roads, and pre-constructed firebreaks can be used as an approach. Unless conditions of the particular incident determine otherwise, fuel within compartments isolated by barriers or control lines may be expeditiously back fired (burned out to cause fuel starvation) to reduce chances of fire escape.

g. Command and organization of fire operations will be under the Incident Command System (ICS) or National Incident Management System (NIMS).

h. The Fire Chief or the Senior Fire Officer (SFO), as the Incident Commander (IC), will establish a command post when the fire incident is serious or critical.

i. In the event the fire escapes initial attack, the IC will implement an extended attack plan or major fire plan (Refer to Extended Attack Plan, Reference A4; Major Fire Situation, Reference A5).

j. The IC will initiate action requesting mutual aid or other support from external fire or related agencies in accordance with established cooperative agreements when required.

k. Once resources have been committed to fire fighting, they are under the control of the IC. The IC directs the overall employment of firefighting resources to contain and extinguish the fire.

l. The use of military personnel not normally assigned to Range Control or the Natural Resource Office will only be authorized under the most extreme circumstances. When these personnel are utilized, military personnel will be under the control of a qualified fire department officer. The IC will notify CETS Operations when requesting military assistance for combating major fires. The primary mission of the unit commanders detailed to firefighting will shift from training to fire control.

m. Fires with potential for escape from and/or fires started adjacent to the CETS boundary that have potential to carry into CETS justify the fullest commitment to aggressive containment and control. CETS shall work with adjacent landowners to control fires before they encroach upon or escape the CETS boundary.

n. Fires that are adjacent to CETS will be monitored and resources will be allocated to suppression at the discretion of the Fire Chief or CETS staff.

A.7.2. Extended Attack

a. Extended attack occurs when a fire has not been contained or controlled by the initial attack forces and continues until transition to a higher level fire that requires an incident management team, or until the fire has been contained or controlled.

b. Once a fire has expanded beyond the capabilities of the on-site resources, or it is apparent that it will exceed these capabilities, the initial attack IC must request assistance. Fire managers must be activated and additional resources must be deployed to expand the suppression assets and fire organization under the Incident Command System (ICS). Extended attack operations require an ICS to be established and can be tailored to the incident, as well as an Escaped Fire Situation Analysis to guide the re-evaluation of suppression strategies.

c. Operational decision charts have been developed to assist the initial attack IC in the decision making process when a fire is first reported (see References A.3 - A.6).

d. Regardless of the firefighting force composition, at least one senior member of the CETS will be present within the incident command structure to provide information and act as a liaison between CETS and the IC.

e. All fires will be contained, controlled, and mopped up to the standards defined by the IC. Fires that are not 100% mopped up will be patrolled regularly by CETS Range Operations until all smokes are out.

A.7.3. Fire Suppression Decision Making

The flow charts in References A3-A6 illustrate the appropriate actions to be taken given differing fire situations. They are intended to aid the Incident Commander during a wildfire response. The possible wildfire situations are:

a. Initial Attack: This flow chart depicts the decision process designed for resources responding to an initial attack of a wildfire. This chart will aid the initial attack IC in responding to a wildfire. See Reference A.3.

b. Extended Attack: This flow chart depicts the decision process designed for resources responding to an extended attack of a wildfire. This chart will aid the extended attack IC in responding to a wildfire. See Reference A.4.

c. Major Fire Situation: This flow chart depicts the decision process designed for resources responding to an attack of a wildfire that the extended attack resources are unable to contain. See Reference A.6.

d. Monitoring Procedures**:** (Non-Army Fires Outside Of Installation Boundary). This flow chart depicts the decision process designed for resources responding to an initial or extended attack of a wildfire that has started off CETS land. See Reference A.6.

A.8. COMMUNICATIONS (For notification list, see Reference A2; and for Radio Frequencies, see Reference A7)

a. Communication between firefighting resources on a fire incident is critical to the safe and effective suppression of wildfires. All ground resources must be able to communicate with each other, and military and civilian aircraft must have communication with each other and ground resources.

b. The Otis Air National Guard Base Fire Department maintains a central dispatcher for normal fire protection. This will be the dispatcher for use on wildland fires involving the Otis Air National Guard Base Fire Department. When CETS Range Control staff suppresses a fire without additional aid, they will communicate internally.

c. During extended attack, an IC will be required to develop a Communication Plan that outlines radio communication requirements for ground and air operations. Radio frequencies of other cooperative agencies shall be made available to the Otis Air National Guard Base Fire Department and CETS for use during mutual aid response.

d. Effective firefighting communications is based on providing the IC with the communications means and procedures that will ensure the ability to fulfill the specified fire mission requirements. These requirements must be fulfilled under a variety of conditions. The scope of these conditions involves the following:

1. Ability to conduct routine operations required for normal fire management.
2. Ability to employ and control a wide variety of firefighting personnel and material resources in the fire suppression effort.
3. Ability to perform requirements (1) and (2) simultaneously within resource limits and degree of fire severity.
4. Ability to coordinate laterally with other military, federal, and civilian emergency and fire support agencies in consideration of contingencies which may require mutual effort.

e. The telephone is the primary means of communications between fixed agency facilities. Telephone communications are used between the Range Control and other non-mobile units.

f. Radio is the primary means of communications between the fixed base facilities and mobile fire response vehicles, helicopters, or ground forces. Fixed locations possessing radio equipment may use such means (provided they know the proper radio frequency assignments) as an alternate to telephone.

g. The IC may employ a significant number of multi-agency resources for major fires. Telephone and radio will be the primary means of communication for the ICS. During initial attack, the CETS Range Control staff or Otis Air National Guard Base Fire Department will establish an internal radio network as the primary means for control and coordination of forces once deployed. Radio will become the primary means of communication once a response has been activated. CETS has access to several radio networks for this purpose.

h. The CETS Range Control staff will support the ICS with internal radio equipment assets (including portable and air-to-ground). Range Control maintains continuous operation of

their radio network and must be prepared to transmit information relating to geographic location of fires or other information useful to the IC and firefighting forces.

i. On large fires, or fires outside the installation boundary, outside agencies and aircraft using different frequencies and radio systems may become involved in firefighting efforts. Otis Air National Guard Base Fire Department has radio facilities for external communications on mutual aid radio networks with local, state, and federal agencies.

j. Radio Networks.

1. CETS Range Control: This network is used by the CETS Range Control staff for internal communications throughout CETS. This will be the primary network used by CETS Range Control staff on wildfire incidents.

2. Otis Air National Guard Base Fire Department: This radio network provides the means for the Fire Chief to exercise command, control, and administration over all agencies/organizations in direct support. It provides the primary means for assignment and dispatch of selected firefighting support vehicles, forces, and resources. The network may function as an alternate to the CETS networks when radio facilities assigned to those networks fail or do not provide adequate radio coverage.

k. Otis Air National Guard Base Fire Department dispatchers will all:

1. be familiar with the CETS IWFMP and Wildfire Response Plan.
2. know how and who to notify in the event of wildfire.
3. know who to call if additional resources are required.
4. ensure emergency radio traffic is kept to a minimum.
5. dispatch initial attack response crews and activate helicopter support as required.

l. The Otis Air National Guard Base Fire Department dispatcher will also be familiar with documentation and proper entries on the Wildfire Incident Report Form or provide completed National Fire Incident Reporting System (NFIRS) documentation.

m. Radio frequency assignment lists at CETS for the CETS Range Control staff, CETS Natural Resource staff, and Otis Air National Guard Base Fire Department are listed in Reference A.7.

n. Public Inquiries. All public inquiries about the fire will be referred to the Public Affairs Office (PAO). If PAO personnel are not available, the Range Operations will field the inquiry acknowledging only that there is a fire and that further details will be announced by the Camp Edwards Command Section of the PAO when available.

A.9. UNEXPLODED ORDNANCE

Unexploded Ordnance (UXO) has been found at CETS in the past and is still a concern, primarily in the impact area. Personnel should take reasonable precautions if they encounter

any metal objects in the field. Under no circumstances should any metal objects found on the ground be touched, moved, or otherwise disturbed. If it is believed that an object may be a piece of **unexploded** ordnance, it should be immediately reported to Range Control.

A.10. MUTUAL AID SUPPORT AGREEMENTS

CETS maintains mutual aid agreements with the Massachusetts Department of Conservation and Recreation's Bureau of Forest Fire Control as well as other local fire departments including Bourne, Sandwich, Falmouth, and Mashpee Fire Departments. These have been established to provide for multiple agency response and cooperative assistance between agencies. Existing agreements shall be updated and reviewed as required by CETS commander or the commander's designee and or the OTIS Air National Guard Fire Department.

A.11. POST FIRE ACTIONS

A.11.1. Documentation

All wildfire incidents will be documented in accordance with CETS record management policy. Documentation of all wildfires is necessary to ensure accurate fire history and to assist fire managers in future fire management planning. The CETS Range Control and the Natural Resource Office will maintain all wildfire records. Fire records will be kept in a database as part of long term land management records. It is important that fire records not be disposed of. Fire records will not be subject to any limitations on recordkeeping and will be kept indefinitely.

A.11.2. CETS Wildland Fire Incident Report

a. All wildfires on CETS land must be reported to Range Control and the Natural Resources Office by the most expeditious means available. After the fire is out, each wildfire incident will be logged in and assigned a fire number and officially documented on the standard CETS Wildland Fire Incident Report (WFIR) form (Reference A8). Otis Air National Guard Base Fire Department is required to use the National Fire Incident Reporting System (NIFRS). This documentation must be obtained from Otis Air National Guard Base Fire Department and attached to the Army's' WFIR form as practical.

b. The WFIR form is used to track location, size, and cause, and is necessary to compile a fire history to conduct fire trend analysis for future input and use in Geographical Information Systems (GIS). GIS technology provides another tool for analyzing historical fire data that identifies when and where fires occurred, number of acres burned, the cost, number of firefighters, and how fires were started.

c. The Natural Resource Office will review all WFIR forms for accuracy and proper completion. When complete, the Natural Resource Office will store all WFIR forms for record keeping.

d. WFIR forms will be immediately forwarded to the CETS Public Affairs Office when four or more hectares (10 acres) have burned and/or when unusual events have occurred, including:

1. all fires escaping or starting outside the CETS boundary.
2. damage to or loss of property exceeding $1000.00.
3. damage to or loss of a threatened or endangered species habitat, or a cultural / historic site. In this event, a report must also be sent to the CETS Natural Resource Office for notification to appropriate parties such as the MA Historic Commission and the federally recognized tribe Wampanoag Tribe of Gay Head Aquinnah. The Environmental Program Manager shall decide if the report needs to be forwarded to any higher authority.
4. all personnel entrapments or fire shelter deployments.
5. major injuries or fire fatalities, or when emergency rescue operations are conducted.

c. The Otis Air National Guard Base Fire Department will submit incident reports completed (NIFRS) to the Natural Resource Office after each wildfire incident to which they respond for tracking and recording.

A.12. REVIEWS AND FORMAL INVESTIGATIONS

A.12.1. Informal Reviews

a. A debriefing will follow all wildland and prescribed fires. All debriefings will be conducted as constructive critiques aimed at improving processes and determining the facts related to a specific fire. Debriefs are intended to resolve operational issues, not impose punitive actions.

b. Informal Reviews may be conducted for the following purposes:

1. To examine the progress of an ongoing fire incident and to confirm effectiveness of decisions or to correct deficiencies.
2. To identify new or improved procedures, techniques, or tactics.
3. To determine the cost effectiveness of a fire operation.

b. Informal reviews can be conducted by the CETS Range Control or the Natural Resource Office and will serve as sufficient documentation of an informal review on fires less than four hectares (ten acres) in which no unusual events occurred.

c. After Action Reviews (AAR): Following a major wildfire incident, the CETS Range Control or the Natural Resource Office may conduct an AAR immediately after

extinguishing the fire. The AAR may be included as a portion of the WFIR and NIFRS reports.

A.12.2. Formal Investigations

a. The CETS Commander will decide at the conclusion of any major incident if a formal investigation is necessary. The commander may base this decision on advice or recommendations from the fire investigator(s), Fire Chief, the Range Officer, the Staff Judge Advocate, the Environmental Program Manager, Inspector General, and the State Safety Officer. If the CETS Commander deems a formal investigation is required, it will be conducted in accordance with all applicable Department of the Army regulations and procedures.

b. Normal post-fire investigations (similar to structural fires) may be conducted by the Otis Air National Guard Base Fire Department or the State Fire Marshals Office. A qualified fire investigating officer should head this investigation team. Multiple offices should act together to form a team to investigate and determine the cause of a fire.

A.13. POST FIRE ANALYSIS

A.13.1. Surveys and Analysis

a. In addition to reports and reviews that are completed after a wildfire, a post-fire ecological survey of the burned area will be conducted. Post-fire analysis will be made to determine the effects of the fire. This analysis can be long term and be incorporated into normal environmental monitoring surveys or studies. Although not a requirement it is strongly encouraged that data is shared with other cooperating agencies to better understand the fire ecology at the CETS.
The post-fire analysis may be combined with any of the informal or formal investigations. A post-fire analysis will need to determine either all or some of the following:

1. The effect the fire may have had on natural and cultural resources.
2. The effectiveness of the pre-suppression measures, including fuels modifications.
3. The effectiveness of the suppression measures used.
4. The effectiveness of the ICS.
5. The effectiveness of fire/fuel models used.
6. Safety review of suppression actions.
7. UXO status; the potential for UXO clean up operations when fire occurs within the CETS impact area.

b. A post-fire survey of the fire area will be conducted with or by the Natural Resource Office.

c. The effects from catastrophic fire events must be surveyed at the earliest possible time.

d. If a UXO survey is desired, then coordination with an Explosive Ordnance Disposal unit and any impact area remediation program is required.

A.13.2. Post-Fire Restoration

Large fires may require post-fire restoration and rehabilitation. Large scale restoration (i.e. revegetation) of burned areas is likely not feasible. Revegetation of selected locations for soil and wetland protection is strongly recommended. Revegetation plans must be reviewed by the MAARNG Natural Resources Office and the MA Natural Heritage and Endangered Species Program.

References:

Reference A1 – Map of Massachusetts Military Reservation

Reference A2 – Notification List

Reference A3 – Operational Decision Chart (Initial Attack Plan)

Reference A4 – Operational Decision Chart (Extended Attack Plan)

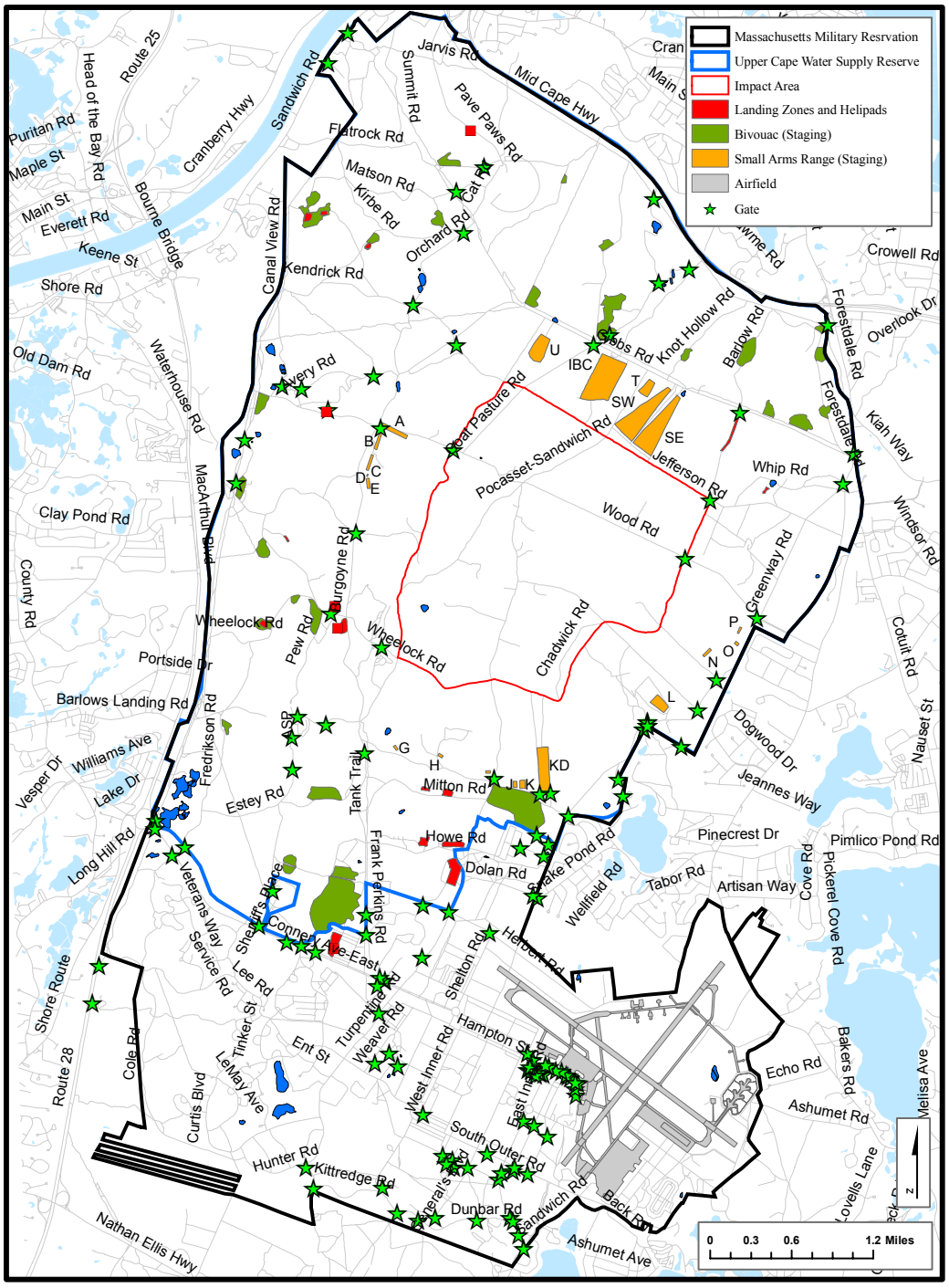
Reference A5 - Operational Decision Chart (Major Fire Situation)

Reference A6 – Operational Decision Chart (Monitoring Procedures)

Reference A7 – Radio Frequencies

Reference A8 – Wildland Fire Incident Report

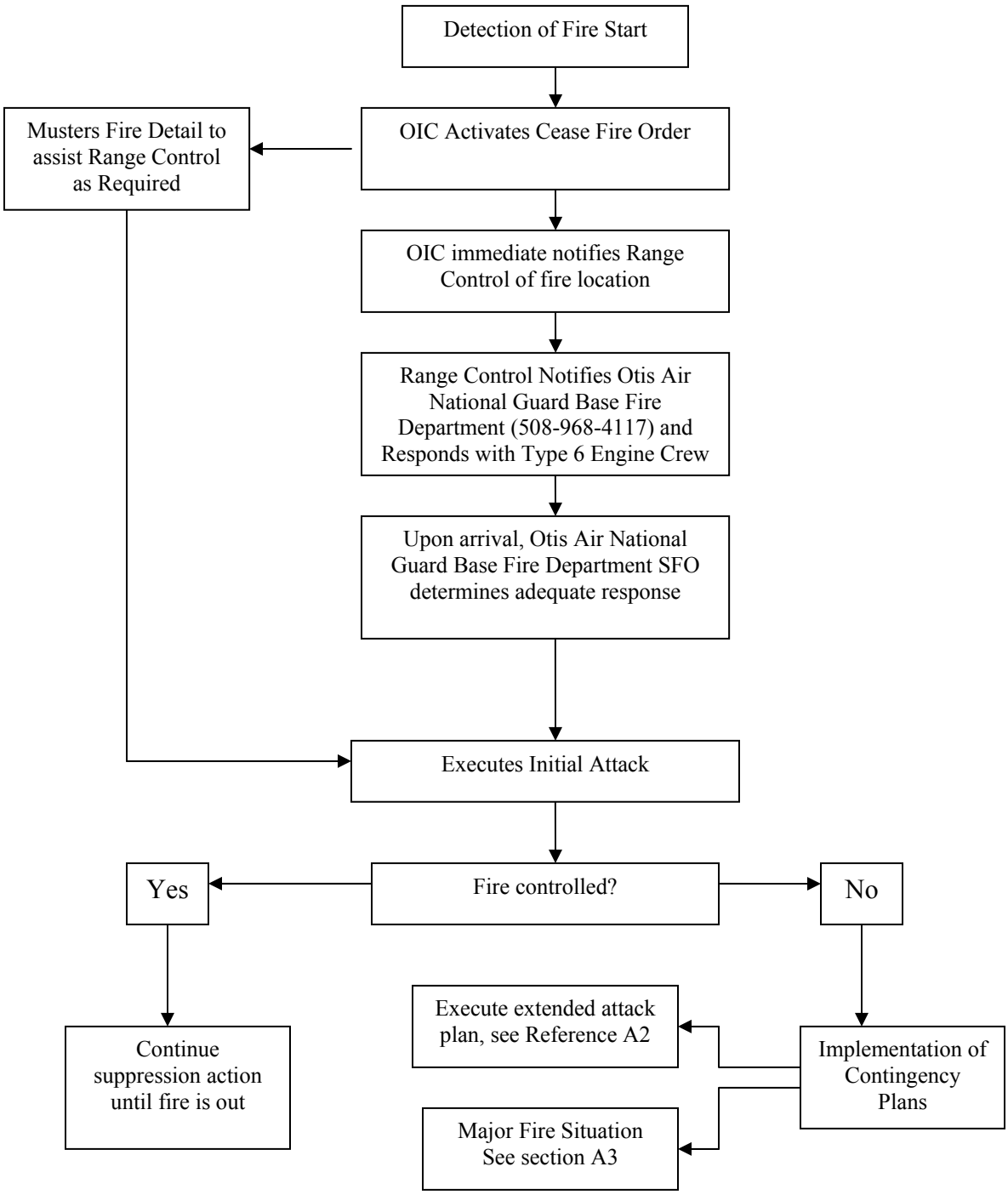
Reference A1 – Map of Massachusetts Military Reservation



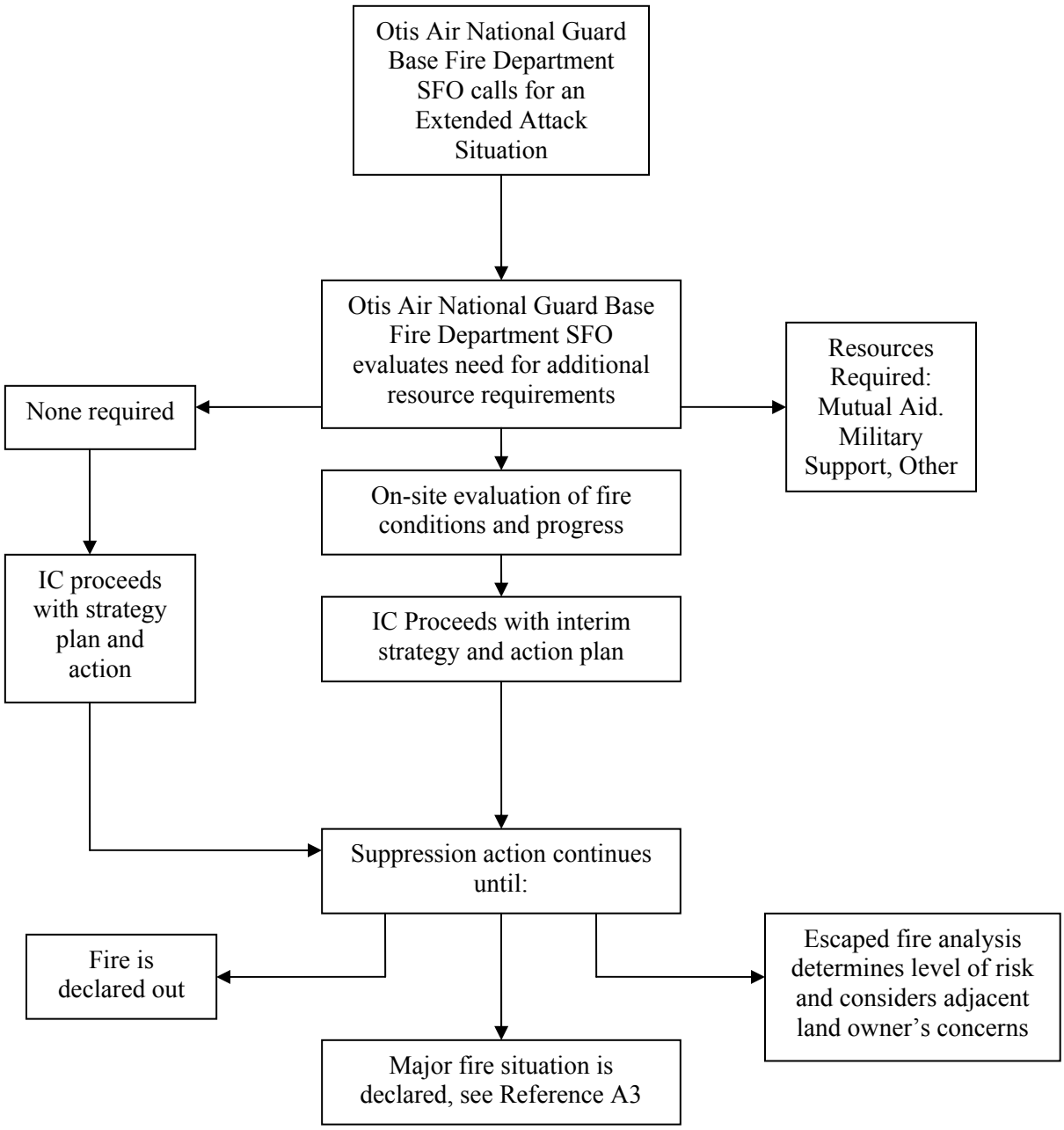
Reference A2 – Notification List

Agency	Phone Number
Emergency	911
Otis Fire Department Emergency.	508-968-4117
Otis Fire Department Dispatch.	508-968-4020
Camp Edwards Range Control	508-968-5926
MAARNG Natural Resource Office	508-968-5121 or 508-294-2244
Sandwich Fire Department	508-888-0525
Falmouth Fire Department	508-495-2500
Mashpee Fire Department	508-539-1454
Bourne Fire Department	508-759-4412
MANG Joint Operations Center (JOC)	508-233-7213
102nd FW Command Post	508-968-4386
USCG Air Station Officer of the Day (OOD/JOOD)	508-968-6330/6331
6 SWS Operations Center	508-968-3291
Barnstable County Jail	508-563-4341
Barnstable County Sheriff Dispatch	508-375-6111
Massachusetts State Police-Bourne	508-759-4488
WCIB, WXTK, WCOB	877-266-5102
WQRC	800-396-6397

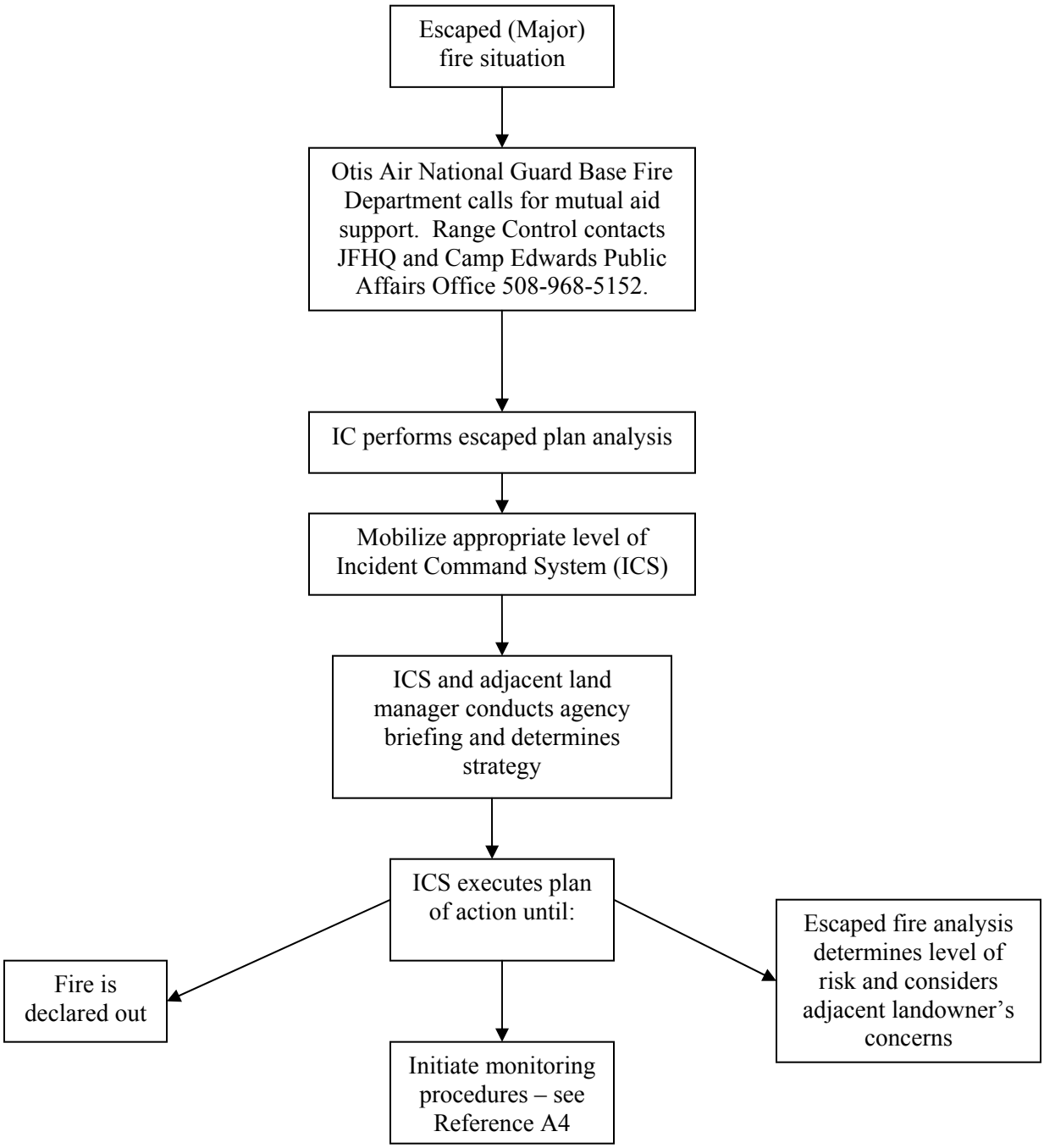
Reference A3 – Operational Decision Chart (Initial Attack Plan)



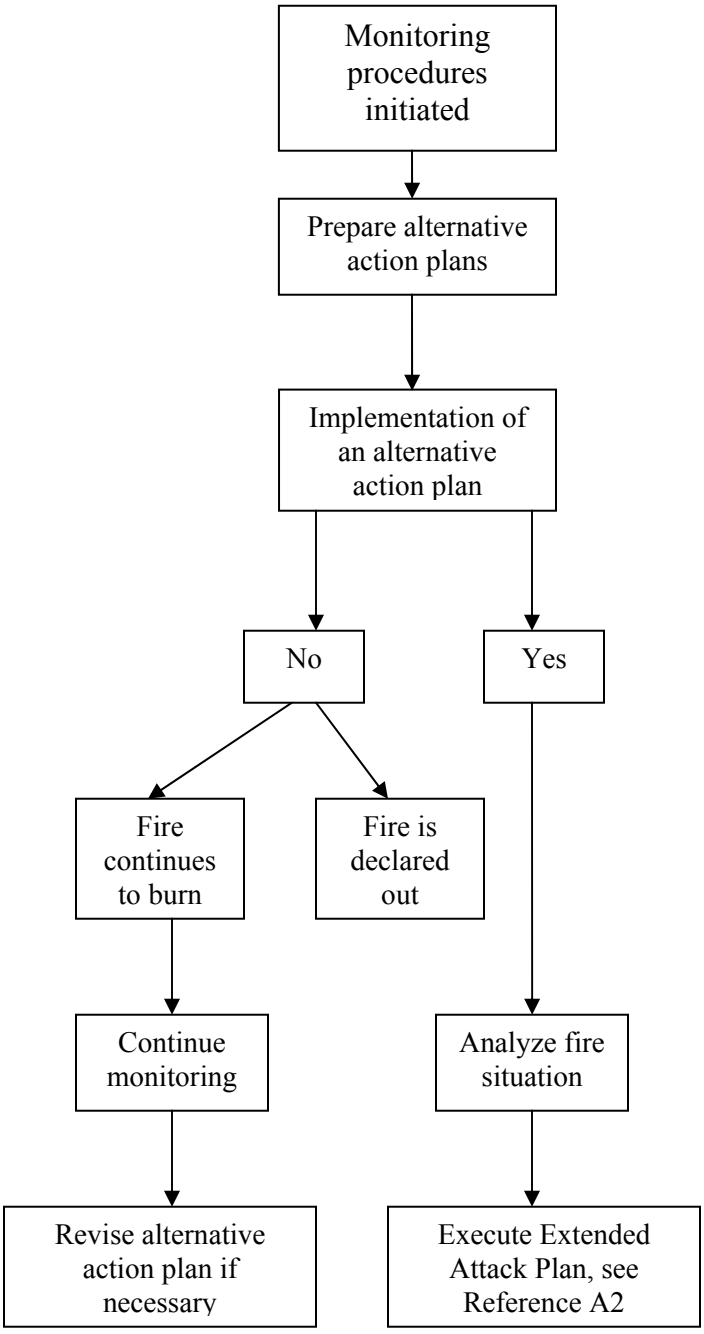
Reference A4 – Operational Decision Chart (Extended Attack Plan)



Reference A5 - Operational Decision Chart (Major Fire Situation)



Reference A6 – Operational Decision Chart (Monitoring Procedures)



Reference A7 – Radio Frequencies

ITEM	Rx FREQ	Rx TONE	Tx FREQ	Tx TONE	*REMARKS*
1	151.625	203.5	151.625	203.5	TNC
2	151.625	CSQ	151.625	CSQ	TNC; National
3	159.240	CSQ	159.240	CSQ	TNC - Shelter Island
4	159.465	CSQ	159.465	CSQ	TTOR - Martha's Vineyard
5	154.540	107.2	154.540	107.2	MA Audubon
6	151.235	71.9	151.235	71.9	MA-DCR (Ch. 13): Fire Control Districts 5, 6, 7, 8, 12, 14
7	151.310	71.9	151.310	71.9	MA-DCR (Ch. 14): Fire Control Districts 1, 2, 3, 4, 9, 10, 11
8	151.370	71.9	151.370	71.9	MA-DCR (DCR-FC Ch 15): Recreation
9	159.285	CSQ	159.285	CSQ	Northeast Compact-NFFPC (DCR-FC Ch 16)
10	151.205	CSQ	151.205	CSQ	MA-DCR: Administration
11	151.415	CSQ	151.145	CSQ	MA-DCR: Mobile Repeater Relay
12	162.450	CSQ	-	-	NWS: Egremont-MA
13	162.475	CSQ	-	-	NWS: Boston-MA
14	162.525	CSQ	-	-	NWS: Mt. Greylock-MA
15	162.550	CSQ	-	-	NWS: Camp Edwards-MA, Worcester-MA
16	153.770	CSQ	153.770	CSQ	Dukes County (Fireground) [Tone T & R possibly 114.8]
17	154.325	CSQ	-	-	Dukes County Rescue Paging [Tone R possibly 91.5]
18	155.280	CSQ	-	-	Dukes County EMS [Tone R possibly 88.5]
19	154.250	CSQ	154.250	CSQ	Aquinnah FD
20	155.355	CSQ	155.355	CSQ	Chilmark FD
21	154.415	CSQ	154.415	CSQ	Edgartown FD
22	154.445	CSQ	154.445	CSQ	Oak Bluffs FD
23	154.070	CSQ	154.070	CSQ	Tisbury FD
24	154.385	CSQ	154.385	CSQ	West Tisbury FD
25	154.295	203.5	154.295	203.5	Plymouth County (Mutual Aid)
26	154.430	173.8	154.430	173.8	Plymouth FD (Main Channel)
27	154.310	CSQ	154.310	173.8	Plymouth FD (Fireground Ch 2)
28	155.340	CSQ	-	-	Nantucket EMS & Plymouth EMS
29	154.430	CSQ	154.430	141.3	Nantucket FD & Plymouth FD [Tone possibly R-141.3 & T-CSQ]
30	153.830	CSQ	153.830	141.3	Nantucket FD & National Fireground [Tone possibly R-141.3 & T-CSQ]
31	154.145	CSQ	154.145	141.3	Nantucket FD (Secondary) [Tone

					possibly R-141.3 & T-CSQ]
32	156.800	CSQ	156.800	CSQ	USCG (Distress, Safety, Calling/Answering/Hailing)
33	156.525	CSQ	156.525	CSQ	USCG (Digital Selective Distress, Safety and Calling and Answering)
34	156.750	CSQ	-	-	USCG (Environmental info broadcast)
35	173.585	CSQ	173.585	CSQ	Otis ANGB Fire Alarm
36	139.300	110.9	143.400	110.9	Camp Edwards Range Control
37	141.800	CSQ	141.800	CSQ	MA ARNG Helicopter VHF (Primary)
38	171.725	CSQ	171.725	CSQ	NPS CACO – Direct to Simplex
Band widths as follows; Low Band 29.7-42 MHz & 35-50 MHz, VHF 136-174 MHz, UHF 403-470 MHz, and 800 806-821 MHz & 851-866 MHz					
TNC radios operate on VHF 136-174 MHz.					

Reference A8 – Wildland Fire Incident Report

WILDLAND FIRE INCIDENT REPORT
Camp Edwards Training Site – Massachusetts Army National Guard

1. INCIDENT NUMBER (YY-0000)	2. DATE (YYMMDD)	3. FIRE LOCATION (UTM COORDINATES – ZONE) NORTHING ☐☐☐☐☐☐ EASTING ☐☐☐☐☐☐

4. TIME FIRE REPORTED	5. TIME FIRE OUT	6. TIME RESPONDED	7. TIME FIRST SFO AT SCENE

8. AGENCY NOTIFICATION	PHONE	TIME CALLED	AT SCENE	REMARKS
☐ RANGE OFFICER				
☐ OTIS AIR NATIONAL GUARD BASE FIRE DEPARTMENT				
☐ NATURAL RESOURCE OFFICE				
☐OTHER				
☐				
☐				
☐				

9. EST. ACRES BURNED?	10. > 10 ACRES (AAR)	11. MAP COMPLETED?

12. FIRE CAUSE (Narrative)

13. REMARKS (Narrative)

14. FIRE REPORT COMPLETED BY:	DATE:	15. FIRE REPORT REVIEWED BY:	DATE:

WILDLAND FIRE INCIDENT REPORT FORM

GENERAL INSTRUCTIONS

PURPOSE AND USE: The purpose of this form is to document all wildfire incident(s) on lands under the jurisdiction of the Camp Edwards Army National Guard at Camp Edwards Training Site in the state of Massachusetts. This form will also be used to document when Camp Edwards Training Site assets respond to any wildland fire incident outside of the jurisdiction in support of mutual aid requests. Documentation of all wildfires is necessary to ensure accurate fire history and trend analysis to assist fire managers in future fire management planning. The form becomes part of the permanent record fire for Camp Edwards Training Site. Fire records may be kept on automated computer database as part of long term land management records.

PROPONENCY: The proponent of this form is the Natural Resource Office at the Environment and Readiness Center. Action Officer is the Natural Resource Manager.

COMPLETION INSTRUCTIONS

Item 1 Fill in incident number. Enter 2 digit calendar year followed by 3 digits in numbered sequence for the number of fires occurred during that calendar year.

Item 2 Enter date of incident. Year, month, day (YYMMDD).

Item 3 Fire location. Enter UTM coordinates that indicate approximately where the fire started. Provide as many digits as possible for the northing and easting coordinates.

Item 4 Enter the time of day the fire was first reported.

Item 5 Enter the time of day the fire was reported extinguished.

Item 6 Enter the time of day the first fire crew/unit responded to the fire location.

Item 7 Enter the time of day the first fire crew/unit arrived at the fire scene.

Item 8 Notification. Enter the time of day that each agency or individual was notified and the time that each agency or individual arrived at the fire scene.

Range Officer: Must be Notified of all fires when on duty.

Otis Fire Department: Must be notified of all fires.
Environmental Office: Must be notified of all fires.

Other local fire departments: Notified if resources are requested of them.

State Bureau of Forest Fire Control: Notified if resources are requested of them.

Remarks: Enter appropriate comments if any.

Item 9 Enter total estimated number of acres burned by fire.

Item 10 Enter YES if fire area is greater than 10 acres. An After Action Report (AAR) will be filed for all wildfires greater than 10 acres in size within 24 hours of extinguishing the fire.

Item 11 Create a map of the extent of the fire using photocopies of an accepted Camp Edwards map. To be completed within 24 hours of fire being controlled.

Item 12 Fill in narrative form any information as to the cause of the fire, ignition sources, or item known to have started the fire. DO NOT speculate. Validate with training unit OIC if the ignition is suspected of being military in origin. Conduct fire investigation if required.

Item 13 Remarks. Enter appropriate comments pertaining to subject wildfire incident, if any.

Item 14 Enter date and name of individual filling out the fire report.

Item 15 Enter date and name of the Natural Resources Manager reviewing the fire report. The Natural Resources Manager will review all fire incident reports for adequacy.

FAX INSTRUCTIONS

A COPY OF ALL FIRE REPORTS WILL BE FAXED TO THE WILDLAND FIRE PROGRAM MANAGER WITHIN 24 HOURS AFTER THE FIRE INCIDENT IS REPORTED. ALL ORIGINAL WILDLAND FIRE INCIDENT REPORTS WILL BE MAILED OR DELIVERED TO THE NATURAL RESOURCES MANAGER. A MAP MUST BE ATTACHED TO THE FIRE REPORT THAT IDENTIFIES AREAS BURNED (Item 11).

APPENDIX B: PLANT SPECIES OF MMR

Common Name	Scientific Name	Common Name	Scientific Name
Adder's-tongue fern	***Ophioglossum vulgatum***	Black willow	***Salix nigra***
Alfalfa	***Medicago sativa***	Blackberry	***Rubus alleghaniensis***
Alternnate leaved dogwood	***Cornus alternifolia***	Black-eyed Susan	***Rudbeckia hirta***
American beech	***Fagus grandifolia***	Blue flag	***Iris versicolor***
American cow wheat	***Melampyrum lineare***	Blue toadflax	***Linaria canadensis***
American hazel	***Corylus americana***	Blue vervain	***Verbena hastata***
American holly	***Ilex opaca***	Blueberry; cranberry	***Vaccinium sp.***
American starflower	***Trientalis borealis***	Bluecurls	***Trichostema dichotomum***
American willow-herb	***Epilobium ciliatum***	Bluegrass	***Poa sp.***
Apple	***Malus sylvestris***	Bluejoint	***Calamagrostis canadensis***
Arrow-leaved tearthumb	***Polygonum sagittatum***	Blue-stemmed goldenrod	***Solidago caesia***
Arrow-wood	***Viburnum recognitum***	Bluets	***Houstonia caerula***
Asparagus	***Asparagus officinalis***	Blunt spikerush	***Eleocharis obtusa***
Aster	***Aster spp.***	Blunt-leaved sandwort	***Moehringia lateriflora***
Autumn bentgrass	***Agrostis perennans***	Bluntscale-bulrush	***Scirpus smithii***
Autumn olive	***Elaeagnus umbellata***	Bracken fern	***Pteridium aquilinum***
Awl-aster	***Aster pilosus***	Bracted plantain	***Plantago aristata***
Bachelor's buttons	***Centaurea cyanus***	Bright-green spikerush	***Eleocharis olivacea***
Barnyard-grass	***Echinochloa crusgalli***	Bristly sarsaparilla	***Aralia hispida***
Bayberry	***Myrica pensylvanica***	Broad-leaf cattail	***Typha latifolia***
Bayonet rush	***Juncus militaris***	Broad-leaf meadowsweet	***Spiraea alba var. latifolia***
Beach pinweed	***Lechea maritima***	Brown knapweed	***Centaurea jacea***
Bead-grass	***Paspalum setaceum***	Brown-fruit rush	***Juncus pelocarpus***
Beaked hazel-nut	***Corylus cornuta***	Brownish beakrush	***Rhynchospora capitellata***
Bearberry	***Arctostaphylos uva-ursi***	Brownish sedge	***Carex brunnescens***
Bedstraw	***Galium pilosum***	Bulbous buttercup	***Ranunculus bulbosus***
Beggar ticks	***Bidens fondosa***	Bull thistle	***Cirsium vulgare***
Bellwort; Merrybells	***Uvularia sessilifolia***	Bur-reed	***Sparganium americanum***
Bentgrass	***Agrostris sp.***	Bushy bluestem	***Andropogon glomeratus***
Big-toothed aspen	***Populus grandidentata***	Butter-and-eggs	***Linaria vulgaris***
Bird-foot violet	***Viola pedata***	Butterflyweed	***Asclepias tuberosa***
Birdsfoot-trefoil	***Lotus corniculata***	Buttonweed; Poorjoe	***Dioda teres***
Bittersweet nightshade	***Solanum dulcamara***	Canada bluegrass	***Poa compressa***
Black bindweed	***Polygonum convolvulus***	Canada bunchberry	***Cornus canadensis***
Black cherry; Wild cherry	***Prunus serotina***	Canada goldenrod	***Solidago canadensis***
Black gum	***Nyssa sylvatica***	Canada hawkweed	***Hieracium canadense***
Black highbush blueberry	***Vaccinium atrococcum***	Canada mayflower	***Maianthemum canadense***
Black huckleberry	***Gaylussacia baccata***	Canada rush	***Juncus canadensis***
Black locust	***Robinia pseudoacacia***	Canada St. John's-wort	***Hypericum canadense***
Black medick	***Medicago lupulina***	Carey's knotweed	***Polygonum careyi***
Black Nightshade	***Solanum nigrum***	Carolina lovegrass	***Eragrostis pectinacea***
Black oak	***Quercus velutina***	Carpetweed	***Mollugo verticillata***
Black raspberry	***Rubus occidentalis***	Cat brier	***Smilax glauca***
Black snakeroot	***Sanicula marilandica***	Catnip	***Nepeta cataria***
Black swallowwort	***Cynachum nigrum***	Cat's ear	***Hypochoeris radicata***

APPENDIX B – CONTINUED

Common Name	Scientific Name	Common Name	Scientific Name
Cherries	***Prunus spp.***	Dangleberry	***Gaylussacia frondosa***
Chicory	***Cichorium intybus***	Dark green bulrush	***Scirpus atrovirens***
Choke cherry	***Prunus virginiana***	Day-lily	***Hemerocallis fulva***
Christmas fern	***Polystichum acrostichoides***	Deertongue grass	***Dichanthelium clandestinum***
Churchmouse three-awn	***Aristida dichotoma***	Dense-tuft hairsedge	***Bulbostylis capillaris***
Cinnamon fern	***Osmunda cinnamomea***	Deptford pink	***Dianthus armeria***
Clasping dogbane	***Apocynum sibiricum***	Doorweed; Common knotgrass	***Polygonum aviculare***
Cleavers	***Galium aparine***	Dooryard Violet	***Viola sororia***
Climbing false buckwheat	***Polygonum scandens***	Dotted smartweed	***Polygonum punctatum***
Coastal mannagrass	***Glyceria obtusa***	Downy chess	***Bromus tectorum***
Colt's-foot	***Tussilago farfara***	Downy goldenrod	***Solidago puberula***
Common blue-eyed grass	***Sisyrinchium montanum***	Downy Juneberry	***Amelenchier arborea***
Common boneset	***Eupatorium perfoliatum***	Dwarf Chinkapin oak	***Quercus prinoides***
Common buckthorn	***Rhamnus cathartica***	Dwarf cinquefoil	***Potentilla canadensis***
Common burdock	***Arcticum minus***	Dwarf dandelion	***Krigia virginica***
Common cinquefoil	***Potentilla simplex***	Dwarf huckleberry	***Gaylussacia dumosa***
Common dandelion	***Taraxacum officinale***	Dwarf St. John's-wort	***Hypericum boreale***
Common dodder	***Cuscuta gronovii***	Early goldenrod	***Solidago juncea***
Common elder	***Sambucus canadensis***	Early lowbush blueberry	***Vaccinium angustifolium***
Common greenbrier	***Smilax rotundifolia***	Eastern blue-eyed grass	***Sisyrinchium atlanticum***
Common ground-nut	***Apios americana***	Eastern Hemlock	***Tsuga canadensis***
Common horsetail	***Equisetum arvense***	Eaton's rosette grass	***Dichanthelium spretum***
Common milkweed	***Asclepias syriaca***	Enchanter's nightshade	***Circaea lutetiana***
Common mouse-ear chickweed	***Cerastium vulgatum***	Engelmann's arrowhead	***Sagittaria engelmanniana***
Common mugwort	***Artemisia vulgaris***	English plantain	***Plantago lanceolata***
Common mullein	***Verbascum thapsus***	European mountain-ash	***Sorbus aucuparia***
Common pinweed	***Lechea intermedia***	European silvery cinquefoil	***Potentilla inclinata***
Common plantain	***Plantago major***	Evening primrose	***Oenothera biennis***
Common quickweed	***Galinsoga quadriradiata***	Evergreen wood fern	***Dryopteris intermedia***
Common reed	***Phragmites australis***	Fall panic grass	***Panicum dichotomiflorum***
Common rush	***Juncus effusus***	Fall-dandelion	***Leontodon autumnalis***
Common snailseed-pondweed	***Potamogeton bicupulatus***	False heather	***Hudsonia ericoides***
Common velvet grass	***Holcus lanatus***	False nutsedge	***Cyperus strigosus***
Common vetch	***Vicia sativa***	False Pimpernel	***Lindernia dubia***
Common winter cress	***Barbarea vulgaris***	False Solomon's seal	***Smilacina racemosa***
Common wood rush	***Luzula multiflora***	Feverwort	***Triosteum perfoliatum***
Common yarrow	***Achillea millefolium***	Field pennycress	***Thlaspi arvense***
Common yellow flax	***Linum medium***	Field pussytoes	***Antennaria neglecta***
Common yellow wood-sorrel	***Oxalis stricta***	Field-cress	***Lepidium campestre***
Common yellow-cress	***Rorripa palustris***	Filiform fescue	***Festuca tenuifolia***
Corn speedwell	***Veronica arvensis***	Fireweed; Great willow-herb	***Epilobium angustifolium***
Corn spurry	***Spergula arvensis***	Flat topped goldenrods	***Euthamia sp.***
Crawford's sedge	***Carex crawfordii***	Floating bladderwort	***Utricularia radiata***
Crown vetch	***Coronilla varia***	Flowering dogwood	***Cornus florida***
Curled dock	***Rumex crispus***	Foam-flower	***Tiarella cordifolia***
Cypress witchgrass	***Dichanthelium dichotomum***	Forked rush	***Juncus dichotomus***

APPENDIX B – CONTINUED

Common Name	Scientific Name	Common Name	Scientific Name
Fox grape	***Vitis labrusca***	Inkberry	***Ilex glabra***
Fragrant bedstraw	***Galium triflorum***	Interrupted fern	***Osmunda claytoniana***
Fragrant cudweed	***Gnaphalium obtusifolium***	Japanese barberry	***Berberis thunbergii***
Frostweed	***Helianthemum propinquum***	Japanese honeysuckle	***Lonicera japonica***
Gall-of-the-earth	***Prenanthes trifoliolata***	Japanese wisteria	***Wisteria floribunda***
Glossy buckthorn	***Rhamnus frangula***	Jimson-weed	***Datura stramonium***
Goat's rue	***Tephrosia virginica***	Johny-jump-up	***Viola tricolor***
Goblet-aster	***Aster lateriflorus***	Juneberry; Serviceberry; Shadbush	***Amelanchier sp.***
Golden ragwort	***Senecio aureus***	Kentucky bluegrass	***Poa pratensis***
Goldenrod	***Solidago spp.***	Kentucky fescue	***Festuca arundinacea***
Grass leaved goldenrod	***Euthamia graminifolia***	Kidney Leaf Buttercup	***Ranunculus abortivus***
Gray birch	***Betula populifolia***	King-devil	***Hieracium caespitosum***
Gray goldenrod	***Solidago nemoralis***	Knawel	***Schleranthus annuus***
Gray-stemmed dogwood	***Cornus foemina***	Lady-fern	***Athyrium filix-femina***
Greater coreopsis	***Coreopsis major***	Lady's Thumb	***Polygonum persicaria***
Green foxtail-grass	***Setaria viridis***	Lance-leaved coreopsis	***Coreopsis lanceolata***
Greene's rush	***Juncus greenei***	Lance-leaved violet	***Viola lanceolata***
Ground cedar	***Lycopodium tristachyum***	Large cranberry	***Vaccinium macrocarpon***
Ground pine	***Lycopodium obscurum***	Large purple false foxglove	***Agalinis purpurea***
Groundsel tree	***Baccharis halimifolia***	Late lowbush blueberry	***Vaccinium pallidum***
Hairgrass	***Aira praecox***	Least hop clover	***Trifolium dubium***
Hairgrass	***Deschampsia flexuosa***	Least pinweed	***Lechea minor***
Hairy bush clover	***Lespedeza hirta***	Leatherleaf	***Chamaedaphne calyculata***
Hairy goldenrod	***Solidago hispida***	Leathery grape fern	***Botrychium multifidum***
Hairy pinweed	***Lechea mucronata***	Lesser daisy fleabane	***Erigeron strigosus***
Hairy small-leaved tick treefoil	***Desmodium ciliare***	Lesser stitchwort	***Stellaria graminea***
Hairy thorough-wort	***Eupatorium pilosum***	Little bluestem	***Schizachyrium scoparium***
Hairy-stem gooseberry	***Ribes hirtellum***	Locust-weed	***Chamaecrista fasciculata***
Hardhack	***Spiraea tomentosa***	Long brached frostweed	***Helianthemum canadense***
Hawkweed	***Hieracium sp.***	Long-stalked aster	***Aster dumosus***
Hawthorne	***Crataegus spp.***	Low cudweed	***Filaginella uliginosa***
Hay-scented fern	***Dennestaedtia punctilobula***	Low hop clover	***Trifolium campestre***
Hemlock witchgrass	***Dichanthelium sabulorum***	Low showy aster	***Aster spectabilis***
Highbush blueberry	***Vaccinium corymbosum***	Lupine	***Lupinus perennis***
Hispid swamp dewberry	***Rubus hispidus***	Maleberry	***Lyonia ligustrina***
Hoary bitter-cress	***Cardamine hirsuta***	Maple leaved viburnum	***Viburnum acerifolium***
Hoary mountain mint	***Pycnanthemum incanum***	Marsh fern	***Thelypteris palustris***
Hoary sedge	***Carex canescens***	Marsh skullcap	***Scutellaria galericulata***
Hog peanut	***Amphicarpaea bracteata***	Maryland tick-trefoil	***Desmodium marilandicum***
Horse Gentian	***Triosteum aurantiacum***	Meadow beauty	***Rhexia virginica***
Horse nettle	***Solanum carolinese***	Mermaid weed	***Proserpinaca palustris***
Horseweed	***Conyza canadensis***	Mild water pepper	***Polygonum hydropiperoides***
Hyssop hedge nettle	***Stachys hyssopifolia***	Mixed bladderwort	***Utricularia geminiscapa***
Indian Cucumber Root	***Medeola virginiana***	Mockernut hickory	***Carya tomentosa***
Indian pipe	***Monotropa uniflora***	Morrow's honeysuckle	***Lonicera morrowii***
Indian-hemp	***Apocynum cannabinum***	Moss pink	***Phlox subulata***

APPENDIX B – CONTINUED

Common Name	Scientific Name	Common Name	Scientific Name
Moth mullein	***Verbascum blattaria***	Perennial pea	***Lathyrus latifolius***
Mountain Laurel	***Kalmia latifolia***	Petticoat climber, Purple Lovegrass	***Eragrostis spectabilis***
Mountain-holly	***Nemopanthus mucronatus***	Pickerel weed; Tuckahoe	***Pontederia cordata***
Mouseear hawkweed	***Hieracium pilosella***	Pignut hickory	***Carya glabra***
Muhly	***Muhlenbergia frondosa***	Pilewort; Fireweed	***Erechtites hieracifolia***
Muhly	***Muhlenbergia uniflora***	Pin Cherry	***Prunus pensylvanica***
Multiflora rose	***Rosa multiflora***	Pinesap; False beechdrops	***Monotropa hypopithys***
Narrow leaved mountain mint	***Pycnanthemum tenuifolium***	Pink knotweed	***Polygonum pensylvanicum***
Narrow-leaf goldenrod	***Euthamia galetorum***	Pink ladies' slipper	***Cypripedium acaule***
Narrow-leaved bush clover	***Lespedeza angustifolia***	Pink tickseed	***Coreopsis rosea***
Narrow-leaved white-topped aster	***Aster solidagineus***	Pinweed	***Lechea spp.***
Needle grass; Black oatgrass	***Piptochaetium avenaceum***	Pitch pine	***Pinus rigida***
New York fern	***Thelypteris noveboracensis***	Plains snakecotton	***Froelichia floridana***
Nodding bur marigold	***Bidens cernua***	Pointed broom sedge	***Carex scoparia***
Nodding fescue	***Festuca obtusa***	Poison ivy	***Toxicodendron radicans***
Nodding foxtail-grass	***Setaria faberi***	Pokeweed	***Phytolacca americana***
Nodding ladies' tresses	***Spiranthes cernua***	Poor-man's pepper	***Lepidium virginicum***
Nodding smartweed	***Polygonum lapathifolium***	Poverty grass	***Danthonia spicata***
Northern bugleweed	***Lycopus uniflorus***	Poverty-grass	***Sporobolus vaginiflorus***
Northern Catalpa	***Catalpa speciosa***	Prairie cord-grass	***Spartina pectinata***
Northern crab-grass	***Digitaris sanguinalis***	Prairie three-awn	***Aristata oligantha***
Northern dewberry	***Rubus flagellaris***	Prickly bog sedge	***Carex atlantica***
Northern downy violet	***Viola sagittata***	Primrose-leaf violet	***Viola primulifolia***
Northern white cedar	***Thuja occidentalis***	Prince's pine	***Chimaphila umbellata***
Norway spruce	***Picea abies***	Purple bladderwort	***Utricularia purpurea***
Nutall's milkwort	***Polygala nuttallii***	Purple chokeberry	***Aronia x prunifolia***
Oakes' pondweed	***Potamogeton oakesianus***	Purple St. Johns-wort	***Triandenum virginicum***
Oblong-leaf Juneberry	***Amelanchier canadensis***	Purpletop	***Tridens flavus***
Orange grass	***Hypericum gentianoides***	Pussy-willow	***Salix discolor***
Orchard grass	***Dactylis glomerata***	Quaking aspen	***Populus tremula***
Oriental bittersweet	***Celastrus orbiculata***	Queen Anne's Lace	***Daucus carota***
Ovate spike-rush	***Eleocharis ovata***	Rabbit-foot clover	***Trifolium arvense***
Ox-eye daisy	***Chrysanthemum leucanthemum***	Racemed milkwort	***Polygala polygama***
Ox-eye daisy	***Leucanthemum vulgare***	Ragweed	***Ambrosia artemisiifolia***
Pale manna grass	***Puccinellia pallida***	Rattlesnake mannagrass	***Glyceria canadensis***
Panic grass	***Dichanthelium acuminatum***	Rattlesnake weed	***Hieracium venosum***
Panic-grass	***Panicum sp.***	Red baneberry	***Actaea rubra***
Partridgeberry	***Mitchella repens***	Red cedar	***Juniperus virginiana***
Pasture rose	***Rosa carolina***	Red chokeberry	***Aronia arbutifolia***
Pasture-thistle	***Cirsium pumilum***	Red clover	***Trifolium pratense***
Path rush	***Juncus tenuis***	Red fescue	***Festuca rubra***
Peach	***Prunus persica***	Red hickory	***Carya ovalis***
Pear tree	***Pyrus communis***	Red maple	***Acer rubrum***
Pearly everlasting	***Anaphalis margaritacea***	Red pine	***Pinus resinosa***
Pennsylvania blackberry	***Rubus pensilvanicus***	Red raspberry	***Rubus idaeus***
Pennsylvania sedge	***Carex pensylvanica***	Red spruce	***Picea rubens***

APPENDIX B – CONTINUED

Common Name	Scientific Name	Common Name	Scientific Name
Red-stemmed dogwood	***Cornus stolonifera***	Siver-hairgrass	***Aira carophyllea***
Red-stemmed plantain	***Plantago rugelii***	Skunk cabbage	***Symplocarpos foetidus***
Redtop; black bentgrass	***Agrostis gigantea***	Slender bush clover	***Lespedeza virginica***
Reed-grass	***Calamagrostis cinnoides***	Slender fimbry	***Fimbristylis autumnalis***
Rhode Island bent	***Agrostis capillaris***	Slender ladies' tresses	***Spiranthes lacera***
Rhodora	***Rhododendron canadense***	Slender pondweed	***Potamogeton pusillus***
Rice cut-grass	***Leersia oryzoides***	Slender wheatgrass	***Elymus trachycaulus***
Ricegrass	***Oryzopsis pungens***	Small-headed aster	***Aster vimineus***
Robbin's spikerush	***Eleocharis robbinsii***	Small-leaved Linden	***Tilia cordata***
Robin's plaintain	***Erigeron pulchellus***	Smooth brome-grass	***Bromus inermis***
Rock polypody	***Polypodium virginianum***	Smooth crab-grass	***Digitaris ischaemum***
Rough barnyard-grass	***Echinochloa muricata***	Smooth Winterberry	***Ilex laevigata***
Rough cinquefoil	***Potentilla norvegica***	Soapwort; Bouncing bet	***Saponaria officinalis***
Rough-fruited cinquefoil	***Potentilla recta***	Southern sneezeweed	***Helenium flexuosum***
Rough-stemmed goldenrod	***Solidago rugosa***	Southern three-lobed bedstraw	***Galium tinctorium***
Round leaved sundew	***Drosera rotundifolia***	Southern yellow wood-sorrel	***Oxalis dillenii***
Round-headed bush clover	***Lespedeza capitata***	Speargrass	***Poa annua***
Roundleaf Juneberry	***Amelanchier sanguinea***	Spike-rush	***Eleocharis acicularis***
Round-leafed pyrola	***Pyrola rotundifolia***	Spotted spurge; Milk-purslane	***Euphorbia maculata***
Roundseed panic grass	***Dichanthelium sphaerocarpon***	Spotted St. John's-wort	***Hypericum punctatum***
Royal fern	***Osmunda regalis***	Spotted Touch-me-not	***Impatiens capensis***
Rugosa rose	***Rosa rugosa***	Spotted wintergreen	***Chimaphila maculata***
Running pine	***Lycopodium clavatum***	Spreading dogbane	***Apocynum androsaemifolium***
Ryegrass	***Lolium perenne***	Squarrose white aster	***Aster ericoides***
Sage	***Salvia officinalis***	St. John's-wort	***Hypericum perforatum***
Sand cherry	***Prunus pumila***	St. John's-wort	***Hypericum spp.***
Sand jointweed	***Polygonella articulata***	Staghorn sumac	***Rhus typhina***
Sand spurrey	***Spergularia rubra***	Star-thistle; Knapweed	***Centaurea maculosa***
Sassafras	***Sassafras albidum***	Starved panic grass	***Dichanthelium depauperatum***
Scarlet oak	***Quercus coccinea***	Sticky hawkweed	***Hieracium scabrum***
Scotch broom	***Cytisus scoparius***	Stiff aster	***Aster linariifolius***
Scotch pine	***Pinus sylvestris***	Swamp beggar ticks	***Bidens connata***
Scrub-oak	***Quercus ilicifolia***	Swamp candles	***Lysimachia terrestris***
Sedge	***Carex spp.***	Swamp rose	***Rosa palustris***
Selfheal; Heal-all	***Prunella vulgaris***	Swamp-azalea	***Rhododendron viscosum***
Sensitive fern	***Onoclea sensibilis***	Swan's sedge	***Carex swannii***
Sessile-leaved horehound	***Lycopus amplectens***	Sweet fern	***Myrica asplenifolia***
Shallow sedge	***Carex lurida***	Sweet gale	***Myrica gale***
Sheep fescue	***Festuca ovina***	Sweet goldenrod	***Solidago odora***
Sheep sorrel	***Rumex acetosella***	Sweet pepper-bush	***Clethra alnifolia***
Sheep-laurel	***Kalmia angustifolia***	Sweet vernal grass	***Anthoxanthum odoratum***
Shining sumac; Winged sumac	***Rhus copallina***	Sweet William silene	***Silene armeria***
Shinleaf	***Pyrola elliptica***	Sweetgrass	***Hierochloe odorata***
Sickle-leaved golden aster	***Heterotheca falcata***	Sweet-scented water-lily	***Nymphaea odorata***
Silky dogwood	***Cornus amomum***	Swith-grass	***Panicum virgatum***
Silvery cinquefoil	***Potentilla argentea***	Tall beakrush	***Rhyncospora macrostachya***

APPENDIX B – CONTINUED

Common Name	Scientific Name	Common Name	Scientific Name
Tall lettuce	***Lactuca canadensis***	White colicroot, Stargrass	***Aletris farinosa***
Tansy	***Tanacetum vulgare***	White goosefoot	***Chenopodium album***
Taper-tip rush	***Juncus acuminatus***	White oak	***Quercus alba***
Tawny cotton-grass	***Eriophorum virginicum***	White pine	***Pinus strobus***
Thimble Weed	***Anemone virginiana***	White poplar	***Populus alba***
Three-toothed cinquefoil	***Potentilla tridentata***	White sweet clover	***Melilotus alba***
Three-way sedge	***Dulichium arundinaceum***	White wood aster	***Aster divaricatus***
Thyme-leaved sandwort	***Arenaria serpyllifolia***	Whitehair rosette grass	***Dichanthelium villosissimum***
Ticklegrass	***Agrostis hyemalis***	Whitlow-grass	***Draba verna***
Timothy	***Phleum pratense***	Whorled loosestrife	***Lysimachia quadrifolia***
Tiny vetch	***Vicia hirsuta***	Wild cucumber	***Echinocystis lobata***
Toothed flatsedge	***Cyperus dentatus***	Wild garlic	***Allium canadense***
Toothed white-topped aster	***Aster paternus***	Wild geranium; Purple crane's bill	***Geranuim maculatum***
Torrey's beakrush	***Rhyncospora torreyana***	Wild indigo	***Baptisia tinctoria***
Trailing arbutus; Mayflower	***Epigaea repens***	Wild oat grass	***Danthonia compressa***
Trailing Bushclover	***Lespedeza procumbens***	Wild radish	***Raphanus raphanistrum***
Tree of heaven	***Ailanthus altissima***	Wild sarsaparilla	***Aralia nudicaulis***
Tumble mustard	***Sisymbrium altissimum***	Wild strawberry	***Fragaria virginiana***
Umbellate bastard toadflax	***Comandra umbellata***	Wilow	***Salix spp.***
Umbrella-grass	***Fuirena pumila***	Winged burningbush	***Euonymus alatus***
Upland willow; Gray willow	***Salix humilis***	Winterberry	***Ilex verticillata***
Upright scorpion grass	***Myosotis micrantha***	Wintergreen; Teaberry	***Gaultheria procumbens***
Velvety sedge	***Carex vestita***	Witch grass	***Panicum capillare***
Venus' looking-glass	***Triodanis perfoliata***	Withe-rod	***Viburnum cassinoides***
Vetch	***Vicia sp.***	Wolly hudsonia	***Hudsonia tomentosa***
Viper's bugloss	***Echium vulgare***	Wood anemone	***Anemone quinquefolia***
Virginia chain fern	***Woodwardia virginica***	Wood lily	***Lilium philadelphicum***
Virginia creeper	***Parthenocissus quinquefolia***	Wool grass	***Scirpus cyperinus***
Virginia mountain mint	***Pycnanthemum virginianum***	Woolly-fruit sedge	***Carex lasiocarpa***
Virginia rose	***Rosa virginiana***	Wormseed; Mexican tea	***Chenopodium ambrosioides***
Virginia yellow flax	***Linum virginianum***	Wormseed-mustard	***Erysimum cheiranthoides***
Wand-like bush clover	***Lespedeza intermedia***	Yellow bartonia	***Bartonia virginica***
Water horehound	***Lycopus americanus***	Yellow foxtail-grass	***Setaria glauca***
Water pepper	***Polygonum hydropiper***	Yellow hedge-hyssop	***Gratiola aurea***
Water purslane	***Ludwigia palustris***	Yellow nutsedge	***Cyperus esculentus***
Water-bulrush	***Scirpus subterminalis***	Yellow stargrass	***Hypoxis hirsuta***
Water-milfoil	***Myriophyllum humile***	Yellow water-lily	***Nuphar lutea***
Watershield	***Brasenia shreberi***	Yellow-eyed grass	***Xyris difformis***
Water-willow	***Decodon verticillatus***	Yellowfruit sedge	***Carex annectens***
Wavy Leaf Aster	***Aster undulatus***		***Agropyron trachycaulum***
Waxy meadow rue	***Thalictrum revolutum***		***Carex emmonsii***
White ash	***Fraxinus americana***		***Carex longii***
White avens	***Geum canadense***		***Carex rosea***
White buttons	***Eriocaulon septangulare***		***Carex rugosperma***
White campion	***Silene pratensis***		***Cyperus filiculmis***
White clover	***Trifolium repens***		***Cyperus grayii***

APPENDIX B – CONTINUED

	Scientific Name
	Dichanthelium linearifolium
	Eupatorium hyssopifolium
	Lespedeza nuttallii
	Panicum verrucosum
	Populus nigra var. italica
	Viburnum sp.

APPENDIX C: MACROLEPIDOPTERA (MOTH AND BUTTERFLY) SPECIES OF THE MMR

Scientific Name	Scientific Name	Scientific Name
Abagrotis alternata	*Anisota stigma*	*Catocala andromedae*
Abagrotis brunneipennis	*Anisota virginiensis*	*Catocala antinympha*
Abagrotis cupida	*Anomis commoda*	*Catocala badia*
Abagrotis nefascia	*Anorthodes tarda*	*Catocala coccinata*
Achatodes zeae	*Antepione thiosaria*	*Catocala gracilis*
Acronicta afflicta	*Antheraea polyphemus*	*Catocala grynea*
Acronicta albarufa	*Anticarsia gemmatalis*	*Catocala herodias*
Acronicta americana	*Apamea amputatrix*	*Catocala ilia*
Acronicta haesitata	*Apamea burgessi*	*Catocala lineella*
Acronicta hasta	*Apamea devastator*	*Catocala micronympha*
Acronicta increta (="inclara")	*Apamea dubitans*	*Catocala paleogama*
Acronicta lithospila	*Apamea finitima*	*Catocala praeclara*
Acronicta lobeliae	*Apamea helva*	*Catocala relicta*
Acronicta longa	*Apamea inordinata*	*Catocala similis*
Acronicta modica	*Apamea lignicolora*	*Catocala sordida*
Acronicta noctivaga	*Apamea verbascoides*	*Catocala ultronia*
Acronicta oblinita	*Apantesis nais*	*Catocala unijuga*
Acronicta ovata	*Apantesis phalerata*	*Cepphis armataria*
Acronicta retardata (="caesarea")	*Apatelodes torrefacta*	*Cerma cerintha*
Acronicta sperata	*Apharetra dentata*	*Cerura multiscripta*
Acronicta superans	*Aplectoides condita*	*Chaetaglaea cerata*
Acronicta tristis	*Argyrostrotis anilis*	*Chaetaglaea sericea*
Acronicta tritona	*Autographa ampla*	*Chaetaglaea tremula*
Aethalura intertexta	*Autographa precationis*	*Charadra deridens*
Agnorisma badinodis	*Automeris io*	*Chlorochlamys chloroleucaria*
Agriopodes fallax	*Bagisara rectifascia*	*Chloroclystis rectangulata*
Agrotis gladiaria	*Baileya ophthalmica*	*Chrysanympha formosa*
Agrotis ipsilon	*Balsa labecula*	*Chytolita morbidalis*
Agrotis manifesta	*Balsa tristrigella*	*Chytonix palliatricula*
Agrotis stigmosa	*Besma endropiaria*	*Chytonix sensilis*
Agrotis venerabilis	*Besma quercivoraria*	*Cicinnus melsheimeri*
Agrotis vetusta	*Biston cognataria*	*Cingilia catenaria*
Agrotis volubilis	*Bleptina caradrinalis*	*Cisseps fulvicollis*
Allotria elonympha	*Bomolocha baltimoralis*	*Cisthene packardi*
Amolita fessa	*Bomolocha palparia*	*Clostera albosigma*
Amolita roseola	*Cabera erythemaria*	*Clostera strigosa*
Amphipoea americana	*Caenurgina crassiuscula*	*Colobochyla interpuncta*
Amphipyra pyramidoides	*Caenurgina erechtea*	*Colocasia propinquilinea*
Anacamptodes ephyraria	*Callopistria cordata*	*Cosmia calami*
Anacamptodes humara	*Callopistria mollissima*	*Crambidia pallida*
Anacamptodes vellivolata	*Callosamia promethea*	*Crocigrapha normani*
Anagoga occiduaria	*Campaea perlata*	*Cucullia convexipennis*
Anagrapha falcifera	*Caripeta sp. Nr. Piniata*	*Cyclophora packardi*
Anaplectoides prasina	*Catocala sp. Nr. Lineella*	*Cyclophora pendulinaria*
Anavitrinelia pampinaria	*Catocala amica*	*Cycnia oregonensis*

APPENDIX C – CONTINUED

Scientific Name	Scientific Name	Scientific Name
Cycnia tenera	*Eucoptocnemis fimbriaris*	*Heterocampa guttivitta*
Darapsa myron	*Eudryas unio*	*Heterocampa obliqua*
Darapsa pholus	*Eueretagrotis attenta*	*Heterocampa umbrata*
Dasychira basiflava	*Eufidonia convergaria*	*Hethemia pistasciaria*
Dasychira cinnamomea	*Eufidonia discospilata*	*Holomelina aurantiaca*
Dasylophia anguina	*Eufidonia nototaria*	*Holomelina ferruginosa*
Dasyshira obliquata	*Eugonobapta nivosaria*	*Holomelina laeta*
Dasyshira pinicola	*Eulithis diversilineata*	*Holomelina opella*
Datana drexelii	*Eulithis explanata*	*Homochlodes fritillaria*
Datana ministra	*Eumacaria latiferrugata*	*Homorthodes furfurata*
Derrima stellata	*Eumorpha pandorus*	*Hyalophora cecropia*
Diacrisia aeroides	*Euparthenos nubilis*	*Hydrelia condensata*
Dichorda iridaria	*Euphyia unangulata*	*Hydria prunivorata*
Dolba hyloeus	*Euplexia benesimilis*	*Hypagyrtis esther*
Drasteria graphica	*Eurois occulta*	*Hypagyrtis piniata*
Drasteria occulta	*Eusarca confusaria*	*Hypagyrtis unipunctata*
Drepana arcuata	*Eutrapela clemataria*	*Hyparpax aurora*
Dryocampa rubicunda	*Euxoa bostoniensis*	*Hypenodes fractilinea*
Dypterygia rozmani	*Euxoa obeliscoides*	*Hyperaeschra georgica*
Dyspyralis illocata	*Euxoa perpolita*	*Hyperstrotia flaviguttata*
Dyspyralis nigella	*Euxoa pleuritica*	*Hyperstrotia villificans*
Dyspyralis puncticosta	*Euxoa tessellata*	*Hyphantria cunea*
Ecpantheria scribonia	*Euxoa vellerpennis*	*Hypomecis umbrosaria*
Ectropis crepuscularia	*Euxoa violaris*	*Hypoprepia fucosa*
Egira alternans	*Faronta diffusa*	*Hyppa xylinoides*
Elaphria festivoides	*Feltia geniculata*	*Idia aemula*
Elaphria versicolor	*Feltia herilis*	*Idia americalis*
Ennomos magnaria	*Feltia jaculifera*	*Idia diminuendis*
Ennomos subsignaria	*Feltia subgothica*	*Idia forbesi*
Epiglaea apiata	*Furcula borealis*	*Idia julia*
Epiglaea decliva	*Furcula modesta*	*Idia lubricalis*
Epimecis hortaria	*Gabara subnivosella*	*Idia rotundalis*
Estigmene acrea	*Galgula partita*	*Idia scobalis*
Euagrotis (lubricans)	*Glena cognataria*	*Idia sp. Nr. "concisa"*
Euagrotis illapsa	*Glena cribrataria*	*Ipimorpha pleonectuosa*
Eubaphe mendica	*Gluphisia septentrionis*	*Iridopsis larvaria*
Euchaetes egle	*Grammia figurata*	*Itame argillacearia*
Euchlaena effecta	*Grammia parthenice*	*Itame pustularia*
Euchlaena irraria	*Grammia virgo*	*Itame sp. 1*
Euchlaena johnsonaria	*Gueneria similaria*	*Itame sulphurea*
Euchlaena madusaria	*Halysidota tessellaris*	*Lacanobia atlantica*
Euchlaena marginaria	*Haploa clymene*	*Lacinipolia anguina*
Euchlaena muzaria	*Harrisimemna trisignata*	*Lacinipolia meditata*
Euchlaena serrata	*Helicoverpa zea*	*Lacinipolia renigera*
Eucirroedia pampina	*Heliomata cycladata*	*Lacosoma chiridota*
Euclidea cuspidea	*Heterocampa biundata*	*Lambdina fervidaria*

APPENDIX C – CONTINUED

Scientific Name	Scientific Name	Scientific Name
Lambdina fiscellaria	*Metarranthis angularia*	*Pangrapta decoralis*
Lambdina pellucidaria	*Metarranthis broweri*	*Panopoda carneicosta*
Lapara bombycoides	*Metarranthis duaria*	*Panopoda rufimargo*
Lapara coniferarum	*Metarranthis hypocharia*	*Panthea pallescens*
Leucania commoides	*Metarranthis indeclinata*	*Paonias astylus*
Leucania extincta	*Metarranthis obfirmaria*	*Paonias excaecatus*
Leucania inermis	*Metarranthis pilosaria*	*Paonias myops*
Leucania insueta	*Metarranthis sp. Nr. Lateritiaria*	*Papaipema baptisiae*
Leucania lapidaria	*Metaxaglaea inulta*	*Papaipema pterisii*
Leucania linita	*Metaxaglaea semitaria*	*Papaipema sp. 1*
Leucania phragmatidicola	*Morrisonia confusa*	*Parallelia bistriaris*
Leucania pseudargyria	*Morrisonia evicta*	*Patalene olyzonaria*
Leucania ursula	*Morrisonia mucens*	*Peridea angulosa*
Leuconycta diphtheroides	*Nacophora quernaria*	*Peridea ferruginea*
Lithacodia albidula	*Nadata gibbosa*	*Peridroma saucia*
Lithacodia bellicula	*Nedra ramosula*	*Pero honestaria*
Lithacodia carneola	*Nematocampa resistaria*	*Pero hubneraria*
Lithacodia muscosula	*Nemoria bistriaria (=rubromarginaria)*	*Pero morrisonaria*
Lithacodia synochitis	*Nemoria mimosaria*	*Petrophora subaequaria*
Loboclea ossularia	*Nemoria rubrifrontaria*	*Phalaenophana pyramusalis*
Lobophora nivigerata	*Nephelodes minians*	*Phalaenostola larentioides*
Lochmaeus manteo	*Noctua pronuba*	*Phalaenostola metonalis*
Lomographa semiclarata	*Nola clethrae*	*Pheosia rimosa*
Lomographa vestaliata	*Nola pustulata*	*Phlogophora iris*
Lophocampa caryae	*Notodonta scitipennis*	*Phlogophora periculosa*
Lycophotia phyllophora	*Nycteola frigidana*	*Phosphila miseloides*
Lymantria dispar	*Ochropleura plecta*	*Phosphila turbulenta*
Lytrosis unitaria	*Oligia illocata*	*Phragmatobia assimilans*
Macrochilo absorptalis	*Oligia mactata*	*Phragmatobia fuliginosa*
Macrochilo litophora	*Oligia modica*	*Phragmatobia lineata*
Macrochilo orciferalis	*Oligocentra lignicolor*	*Phyllodesma americana*
Macruocampa marthesia	*Oligocentra semirufescens*	*Phyprosopus callitrichoides*
Magusa orbifera	*Oncocnemis riparia*	*Plagodis alcoolaria*
Malacosoma americanum	*Oreta rosea (="irrorata")*	*Plagodis fervidaria*
Malacosoma disstria	*Orgyia definita*	*Plagodis phlogosaria*
Marathyssa inficita	*Orgyia leucostigma*	*Plagodis serinaria*
Meganola minuscula	*Orthodes crenulata*	*Plathypena scabra*
Meganola phylla	*Orthodes cynica*	*Platyperigea meralis*
Meganola spodia	*Orthofidonia tinctaria*	*Platysenta vecors*
Melanolophia canadaria	*Orthonama centrostrigaria*	*Platysenta videns*
Melanolophia signataria	*Orthonama obstipata*	*Pleuroprucha insulsaria*
Metalectra discalis	*Orthosia revicta*	*Polia detracta*
Metalectra quadrisignata	*Oruza albocostaliata*	*Polia latex*
Metalectra richardsi	*Paectes abrostoloides*	*Polygrammate hebraeicum*
Metanema inatomaria	*Paectes pygmaea*	*Polypogon sp. 1*
Metarranthis amyrisaria	*Palthis angulalis*	*Polypogon cruralis*

APPENDIX C – CONTINUED

Scientific Name	Scientific Name	Scientific Name
Polypogon jacchusalis	*Schizura ipomoeae*	*Tricholita signata*
Polypogon laevigata	*Schizura leptinoides*	*Ulolonche culea*
Polypogon lituralis	*Schizura unicornis*	*Ulolonche modesta*
Polypogon obscuripennis	*Scoliopteryx libatrix*	*Xanthia togata*
Polypogon ochreipennis	*Scopula cacuminaria*	*Xanthorhoe lacustrata*
Polypogon protumnusalis	*Scopula inductata*	*Xanthotype sospeta*
Polypogon theralis	*Scopula limboundata*	*Xanthotype urticaria*
Probole alienaria	*Semiothisa aemulitaria*	*Xestia c-nigrum*
Probole amicaria	*Semiothisa bicolorata*	*Xestia c-nigrum/dolosa*
Polypogon jacchusalis	*Semiothisa bisignata*	*Xestia dilucida*
Polypogon laevigata	*Semiothisa continuata*	*Xestia dolosa*
Polypogon lituralis	*Semiothisa granitata*	*Xestia elimata/praevia*
Polypogon obscuripennis	*Semiothisa minorata*	*Xestia normaniana*
Polypogon ochreipennis	*Semiothisa multilineata*	*Xestia smithii*
Polypogon protumnusalis	*Semiothisa pinistrobata*	*Xylomoia chagnoni*
Polypogon theralis	*Semiothisa sexmaculata*	*Xylotype capax*
Probole alienaria	*Semiothisa transitaria*	*Xystopeplus rufago*
Probole amicaria	*Semiothisa ulsterata*	*Zale aeruginosa*
Probole nepiasaria	*Sideridis congermana*	*Zale curema*
Prochoerodes transversata	*Sideridis maryx*	*Zale helata*
Proitame virginalis	*Sideridis rosea*	
Protoboarmia porcelaria	*Smerinthus jamaicensis*	
Protolampra brunneicollis	*Spaelotis clandestina*	
Protorthodes oviduca	*Spargaloma sexpunctata*	
Proxenus miranda	*Sphinx drupiferarum*	
Psectraglaea carnosa	*Sphinx gordius*	
Pseudaletia unipuncta	*Sphinx poecilla*	
Pseudohermonassa bicarnea	*Spilosoma congrua*	
Pseudothyatira cymatophoroides	*Spilosoma dubia*	
Pyrrharctia isabella	*Spilosoma latipennis*	
Raphia frater	*Spilosoma virginica*	
Redectis vitrea	*Spiramater grandis*	
Renia "adspergillus"	*Spiramater lutra*	
Renia discoloralis	*Spodoptera frugiperda*	
Renia factiosalis	*Spodoptera ornithogalli*	
Renia flavipunctalis	*Sunira bicolorago*	
Renia nemoralis	*Sutnya privata*	
Renia salusalis	*Symmerista albifrons*	
Renia sobrialis	*Syngrapha octoscripta*	
Rheumaptera hastata	*Tacparia atropunctata*	
Rhizedra lutosa	*Tacparia detersata*	
Schinia arcigera	*Tarachidia candefacta*	
Schinia septentrionalis	*Tetracis cachexiata*	
Schinia spinosae	*Tetracis crocallata*	
Schizura apicalis	*Tolype laricis*	
Schizura badia	*Tolype velleda*	

APPENDIX D: ODONATE (DRAGONFLY AND DAMSELFLY) SPECIES OF CAMP EDWARDS

Common Name	Scientific name
Amber-winged Spreadwing	*Lestes eurinus*
Atlantic Bluet	*Enallagma doubledayi*
Azure Bluet	*Enallagma aspersum*
Black Saddlebags	*Tramea lacerata*
Black-tipped Darner	*Aeshna tuberculifera*
Blue Corporal	*Libellula deplanata*
Blue Dasher	*Pachydiplax longipennis*
Calico Pennant	*Celithemis elisa*
Carolina Saddlebags	*Tramea carolina*
Citrine Forktail	*Ischnura hastata*
Comet Darner	*Anax longipes*
Common Baskettail	*Epitheca cynosura*
Common Green Darner	*Anax junius*
Common or Sweetflag Spreadwing	*Lestes disjunctus/forcipatus*
Common Sanddragon	*Progomphus obscurus*
Common Spreadwing	*Lestes disjunctus*
Common Whitetail	*Libellula lydia*
Dot-tailed Whiteface	*Leucorrhinia intacta*
Eastern Amberwing	*Perithemis tenera*
Eastern Forktail	*Ischnura verticalis*
Eastern Pondhawk	*Erythemis simplicicollis*
Elegant Spreadwing	*Lestes inaequalis*
Four-spotted Skimmer	*Libellula quadrimaculata*
Fragile Forktail	*Ischnura posita*
Fragile Forktail	*Ishnura posita*
Frosted Whiteface	*Leucorrhinia frigida*
Golden-winged Skimmer	*Libellula auripennis*
Goldenwings	*Libellula auripennis/needhami*
Great Blue Skimmer	*Libellula vibrans*
Green-striped Darner	*Aeshna verticalis*
Halloween Pennant	*Celithemis eponina*
Lancet Clubtail	*Gomphis exilis*
Lilypad Forktail	*Ischnura kellicotti*
Lyre-tipped Spreadwing	*Lestes unguiculatus*
Martha's Pennant	*Celithemis martha*
Mottled Darner	*Aeshna clepsydra*
New England Bluet	*Enallagma laterale*
Northern Bluet	*Enallagma cyathigerum*
Painted Skimmer	*Libellula semifasciata*
Painted Skimmer	*Libellula semifasciata*
Petite Emerald	*Dorocordulia lepida*
Pond Damsel	*Coenagrionidae species*
Prince Baskettail	*Epitheca princeps*

APPENDIX D – CONTINUED

Common Name	Scientific name
Ruby Meadowhawk	*Sympetrum rubicundulum*
Scarlet Bluet	*Enallagma pictum*
Seaside Dragonlet	*Erythrodiplax berenice*
Sedge Sprite	*Nehalennia irene*
Shadow Darner	*Aeshna umbrosa*
Skimming Bluet	*Enallagma geminatum*
Skimming Bluet	*Enallagma signatum*
Slaty Skimmer	*Libellula incesta*
Slender Spreadwing	*Lestes rectangularis*
Spangled Skimmer	*Libellula cyanea*
Spatterdock Darner	*Aeshna mutata*
Sphagnum sprite	*Nehalennia gracilis*
Spotted Spreadwing	*Lestes congener*
Spot-winged Glider	*Pantala hymenaea*
Stream Cruiser	*Didymops transversa*
Swamp Spreadwing	*Lestes vigilax*
Sweetflag Spreadwing	*Lestes forcipatus*
Twelve-spotted Skimmer	*Lebellula pulchella*
Twelve-spotted Skimmer	*Libellula pulchella*
Variable Dancer	*Argia fumipennis*
Vesper Bluet	*Enallagma vesperum*
Wandering Glider	*Pantala flavexcens*
White Corporal	*Libelula exusta*
Widow Skimmer	*Libellula luctuosa*
Yellow-legged Meadowhawk	*Sympetrum vicinum*

APPENDIX E: BIRD SPECIES OF CAMP EDWARDS

Common Name	Scientific	name
Acadian Flycatcher	*Empidonax*	*virescens*
American Crow	*Corvus*	*brachyrhynchos*
American Goldfinch	*Carduelis*	*tristis*
American Kestrel	*Falco*	*sparverius*
American Robin	*Turdus*	*migratorius*
American Woodcock	*Scolopax*	*minor*
Bank Swallow	*Riparia*	*riparia*
Barn Swallow	*Hirundo*	*rustica*
Belted Kingfisher	*Ceryle*	*alcyon*
Black-and-white Warbler	*Mniotilta*	*varia*
Black-billed Cuckoo	*Coccyzus*	*erythropthalmus*
Black-capped Chickadee	*Parus*	*atricapillus*
Blackpoll Warbler	*Dendroica*	*striata*
Blue Jay	*Cyanocitta*	*cristata*
Broad-winged Hawk	*Buteo*	*platypterus*
Brown Creeper	*Certhia*	*americana*
Brown Thrasher	*Toxostoma*	*rufum*
Brown-headed Cowbird	*Molothrus*	*ater*
Canada Goose	*Branta*	*canadensis*
Carolina Wren	*Thryothorus*	*ludovicianus*
Cedar Waxwing	*Bombycilla*	*cedrorum*
Chestnut-sided Warbler	*Dendroica*	*pensylvanica*
Chimney Swift	*Chaetura*	*pelagica*
Chipping Sparrow	*Spizella*	*passerina*
Clay-colored Sparrow	*Spizella*	*pallida*
Common Grackle	*Quiscalus*	*quiscula*
Common Loon	*Gavia*	*immer*
Common Tern	*Sterna*	*hirundo*
Common Yellowthroat	*Geothlypis*	*trichas*
Cooper's Hawk	*Accipiter*	*cooperii*
Double-crested Cormorant	*Phalacrocorax*	*auritus*
Downy Woodpecker	*Picoides*	*pubescens*
Eastern Bluebird	*Sialia*	*sialis*
Eastern Kingbird	*Tyrannus*	*tyrannus*
Eastern Meadowlark	*Sturnella*	*magna*
Eastern Phoebe	*Sayornis*	*phoebe*
Eastern Wood-pewee	*Contopus*	*virens*
Empidonax Flycatchers	*Empidonax*	
European Starling	*Sturnus*	*vulgaris*
Field Sparrow	*Spizella*	*pusilla*
Fish Crow	*Corvus*	*ossifragus*
Grasshopper Sparrow	*Ammodramus*	*savannarum*
Gray Catbird	*Dumetella*	*carolinensis*

APPENDIX E – CONTINUED

Common Name	Scientific	name
Great Black-backed Gull	*Larus*	*marinus*
Great Blue Heron	*Ardea*	*herodias*
Great Crested Flycatcher	*Myiarchus*	*crinitus*
Great Horned Owl	*Bubo*	*virginianus*
Green-backed Heron	*Butorides*	*striatus*
Hairy Woodpecker	*Picoides*	*villosus*
Hermit Thrush	*Catharus*	*guttatus*
Herring Gull	*Larus*	*argentatus*
Horned Lark	*Eremophila*	*alpestris*
House Finch	*Carpodacus*	*mexicanus*
House Sparrow	*Passer*	*domesticus*
House Wren	*Troglodytes*	*aedon*
Indigo Bunting	*Passerina*	*cyanea*
Killdeer	*Charadrius*	*vociferus*
Mallard	*Anas*	*platyrhynchos*
Mourning Dove	*Zenaida*	*macroura*
Mourning Warbler	*Oporornis*	*philadelphia*
Mute Swan	*Cygnus*	*olor*
Northern Bobwhite	*Colinus*	*virginianus*
Northern Cardinal	*Cardinalis*	*cardinalis*
Northern Flicker	*Colaptes*	*auratus*
Northern Harrier	*Circus*	*cyaneus*
Northern Mockingbird	*Mimus*	*polyglottos*
Northern Oriole	*Icterus*	*galbula*
Northern Rough-winged Swallow	*Stelgidopteryx*	*serripennis*
Orchard Oriole	*Icterus*	*spurius*
Osprey	*Pandion*	*haliaetus*
Ovenbird	*Seiurus*	*aurocapillus*
Peregrine falcon	*Falco*	*peregrinus*
Pine Warbler	*Dendroica*	*pinus*
Prairie Warbler	*Dendroica*	*discolor*
Purple Finch	*Carpodacus*	*purpureus*
Red Knot	*Calidris*	*canutus*
Red-bellied Woodpecker	*Melanerpes*	*carolinus*
Red-breasted Nuthatch	*Sitta*	*canadensis*
Red-eyed Vireo	*Vireo*	*olivaceus*
Red-necked Grebe	*Podiceps*	*grisegena*
Red-tailed Hawk	*Buteo*	*jamaicensis*
Red-winged Blackbird	*Agelaius*	*phoeniceus*
Rock Dove	*Columba*	*livia*
Ruby-throated Hummingbird	*Archilochus*	*colubris*
Ruffed Grouse	*Bonasa*	*umbellus*
Rufous-sided Towhee	*Pipilo*	*erythrophthalmus*
Savannah Sparrow	*Passerculus*	*sandwichensis*

APPENDIX E – CONTINUED

Common Name	Scientific	name
Scarlet Tanager	*Piranga*	*olivacea*
Semipalmated Sandpiper	*Calidris*	*pusilla*
Sharp-shinned Hawk	*Accipiter*	*striatus*
Song Sparrow	*Melospiza*	*melodia*
Swamp Sparrow	*Melospiza*	*georgiana*
Tree Swallow	*Tachycineta*	*bicolor*
Tufted Titmouse	*Parus*	*bicolor*
Turkey Vulture	*Cathartes*	*aura*
Upland Sandpiper	*Bartramia*	*longicauda*
Veery	*Catharus*	*fuscescens*
Vesper Sparrow	*Pooecetes*	*gramineus*
Whip-poor-will	*Caprimulgus*	*vociferus*
White-breasted Nuthatch	*Sitta*	*carolinensis*
White-eyed Vireo	*Vireo*	*griseus*
Wild Turkey	*Meleagris*	*gallopavo*
Wood Thrush	*Hylocichla*	*mustelina*
Yellow Warbler	*Dendroica*	*petechia*
Yellow-billed Cuckoo	*Coccyzus*	*americanus*

APPENDIX F: MAMMAL SPECIES OF THE MMR

Scientific Name	Common Name
Blarina brevicauda	Short-tailed shrew
Canis familiaris	Domestic dog
Canis latrans	Coyote
Cleithrionomys gapperi	Southern red-backed vole
Didelphis virginiana	Opossum
Eptesicus fuscus	Big brown bat
Felis domesticus	Domestic cat
Glaucomys volans	Southern flying squirrel
Lasiurus borealis	Red bat
Marmota monax	Woodchuck
Mephitis mephitis	Striped skunk
Microtus pennsylvanicus	Meadow vole
Mustela frenata	Long-tailed weasel
Myotis septentrionalis	Northern myotis
Odocoileus virginianus	White-tailed deer
Ondatra zibethicus	Muskrat
Peromyscus leucopus	White-footed mouse
Pipistrellus subflavus	Eastern pipistrelle
Procyon lotor	Raccoon
Scalopus aquaticus	Eastern mole
Sciurus carolinensis	Gray squirrel
Sorex cinereus	Masked shrew
Sylvilagus floridanus	Eastern cottontail
Tamias striatus	Eastern chipmunk
Tamias striatus	Eastern chipmunk
Tamiasciurus hudsonicus	Red squirrel
Urocyon cinereoargenteus	Gray fox
Vulpes vulpes	Red fox
Zapus hudsonius	Meadow jumping mouse

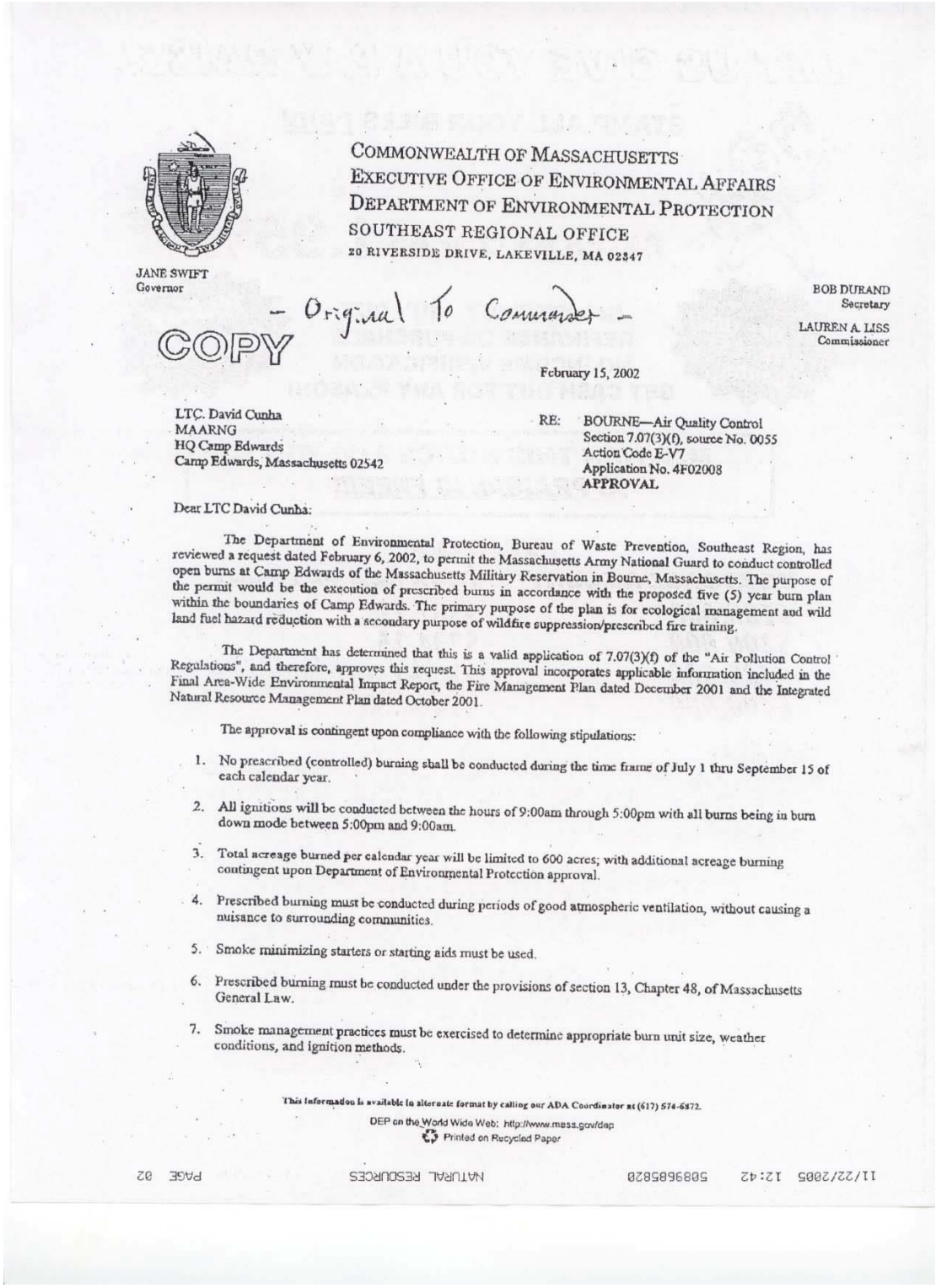
APPENDIX G: REPTILE AND AMPHIBIAN SPECIES OF THE MMR

Scientific Name	Common Name
Reptiles	
Terrapene carolina carolina	Eastern box turtle
Clemmys guttata	Spotted turtle
Chelydra serpentina	Snapping turtle
Sternotherus odoratus	Musk turtle
Chrysemys picta. picta	Eastern painted turtle
Coluber constrictor	Black racer
Opheodrys vernalis	Smooth green snake
Thamnophis sirtalis sirtalis	Garter snake
Thamnophis sauritus sauritus	Eastern ribbon snake
Diadophis punctatus edwardsii	Northern ring-necked snake
Lampropeltis triangulum	Milk snake
Heterodon platirhinos	Eastern hog-nosed snake
Amphibians	
Rana catesbeiana	Bullfrog
Rana clamitans	Green frog
Hyla versicolor	Grey treefrog
Rana sylvatica	Wood frog
Pseudacris crucifer	Spring peeper
Bufo americanus	American toad
Ambystoma maculatum	Spotted salamander
Notophthalmus viridescens	Eastern newt
Plethodon cinereus	Redback salamander
Rana palustris	Pickerel frog
Bufo americanus	American toad

Appendix H: State Listed Rare Species at the MMR

Scientific Name	Common Name	Status in MA	Heritage Status
PLANTS (11)			
Rhynchospora torreyana	Torrey's Beak Rush	*E	G5
Thuja occidentalis	Northern White Cedar	E	G5
Triosteum perfoliatum	Broad Tinker's Weed	E	G5
Ophioglossum pusillum	Adder's Tongue Fern	T	G5
Asclepias tuberosa	Butterflyweed	WL	G5
Fuirena pumila	Umbrella Grass	WL	G5
Lechea minor	Least Pinweed	WL	G5
Lupinis perennis	Lupine	WL	G5
Polygala nuttallii	Nutall's Milkwort	WL	G5
Stachys hyssopifolia	Hyssop Hedge Nettle	WL	G5
Eleocharis ovata	Ovate Spike-sedge	E	G5
BIRDS (6)			
Bartramia longicauda	Upland Sandpiper	E	G5
Ammodramus savannarum	Grasshopper Sparrow	T	G5
Circus cyaneus	Northern Harrier	T	G5
Parula americana	Northern Parula	T	G5
Pooecetes gramineus	Vesper Sparrow	T	G5
Accipiter striatus	Sharp-shinned Hawk	SC	G5
REPTILES and AMPHIBIANS (2)			
Scaphiopus holbrooki	Eastern Spadefoot	T	G5T5
Terrapene carolina carolina	Eastern Box Turtle	SC	G5T5
ODONATES (5)			
Anax longipes	Comet Darner	SC	G5
Aeshna mutata	Spatterdock Darner	E	G3G4
Enallagma carunculatum	Tule Bluet	SC	G5
Enallagma recurvatum	Pine Barrens Bluet	T	G3
Enallagma laterale	New England Bluet	SC	G3
MOTHS (16)			
Acronicta albarufa	Barrens Daggermoth	T	G3G4
Hemileuca maia	Coastal Barren's Buckmoth	SC	G5T3T4
Catocala herodias gerhardi	Gerhard's Underwing	SC	G3T3
Cicinnius melsheimeri	Melsheimer's Sack Bearer	T	G4
Faronta rubripennis	Pink Streak	T	G3G4
Papaipema sulphurata	Water-Willow Stem Borer	T	G2
Cingilia catenaria	Chain-dotted Geometer	SC	G4
Abagrotis nefascia benjamini	Coastal Heathland Cutworm	SC	G4T3
Metarrhanthis pilosaria	Coastal Swamp Metarranthis	SC	G3G4
Papaipema sp.	Ostrich Fern Borer	SC	G3G4
Itame sp.	Pine Barrens Itame	SC	G3
Zale sp.	Pine Barrens Zale	SC	G3Q
Psectraglaea carnosa	Pink Swalow Moth	SC	G3
Oncocnemis riparia	*noctuid moth*	SC	G4
Bagisara rectifascia	Straight Lined Mallow Moth	SC	G4
Euchlaena madusaria	Sandplain Euchlaena	SC	G5S1
BUTTERFLYS (1)			
Callophrys irus	Frosted elfin	SC	G3
*E=Endangered, T=Threatened	SC=Special Concern	WL=Watch-listed	

APPENDIX I. CAMP EDWARDS AIR QUALITY (PRESCRIBED FIRE) PERMIT



COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
SOUTHEAST REGIONAL OFFICE
20 RIVERSIDE DRIVE, LAKEVILLE, MA 02347

JANE SWIFT
Governor

BOB DURAND
Secretary

LAUREN A. LISS
Commissioner

- Original To Commander -

COPY

February 15, 2002

LTC. David Cunha
MAARNG
HQ Camp Edwards
Camp Edwards, Massachusetts 02542

RE: BOURNE—Air Quality Control
Section 7.07(3)(f), source No. 0055
Action Code E-V7
Application No. 4F02008
APPROVAL

Dear LTC David Cunha:

The Department of Environmental Protection, Bureau of Waste Prevention, Southeast Region, has reviewed a request dated February 6, 2002, to permit the Massachusetts Army National Guard to conduct controlled open burns at Camp Edwards of the Massachusetts Military Reservation in Bourne, Massachusetts. The purpose of the permit would be the execution of prescribed burns in accordance with the proposed five (5) year burn plan within the boundaries of Camp Edwards. The primary purpose of the plan is for ecological management and wild land fuel hazard reduction with a secondary purpose of wildfire suppression/prescribed fire training.

The Department has determined that this is a valid application of 7.07(3)(f) of the "Air Pollution Control Regulations", and therefore, approves this request. This approval incorporates applicable information included in the Final Area-Wide Environmental Impact Report, the Fire Management Plan dated December 2001 and the Integrated Natural Resource Management Plan dated October 2001.

The approval is contingent upon compliance with the following stipulations:

1. No prescribed (controlled) burning shall be conducted during the time frame of July 1 thru September 15 of each calendar year.
2. All ignitions will be conducted between the hours of 9:00am through 5:00pm with all burns being in burn down mode between 5:00pm and 9:00am.
3. Total acreage burned per calendar year will be limited to 600 acres; with additional acreage burning contingent upon Department of Environmental Protection approval.
4. Prescribed burning must be conducted during periods of good atmospheric ventilation, without causing a nuisance to surrounding communities.
5. Smoke minimizing starters or starting aids must be used.
6. Prescribed burning must be conducted under the provisions of section 13, Chapter 48, of Massachusetts General Law.
7. Smoke management practices must be exercised to determine appropriate burn unit size, weather conditions, and ignition methods.

This information is available in alternate format by calling our ADA Coordinator at (617) 574-6872.
DEP on the World Wide Web: http://www.mass.gov/dep
Printed on Recycled Paper

11/22/2005 12:42 5089685820 NATURAL RESOURCES PAGE 02

8. The prescribed burn plan (to include smoke screening and management conditions) be reviewed and approved by an appropriately experienced Prescribe Burn Boss or Fire Manager, prior to the ignition of any burn unit.

9. The Department of Environmental Protection, Bureau of Waste Prevention, Southeastern Region must be provided with a cover letter summarizing the intent to conduct a prescribed burn at a minimum of ten (10) days but not greater than twenty (21) days prior to any proposed prescribed burn. The letter must identify the prescribed Fire Management Zone and associated Burn units (figure #3), each proposed prescribed burns objectives, and the window or windows (dates) that each burn is to be conducted. Additionally, the Bureau of Waste Prevention, Compliance and Enforcement Section, Southeast Regional Office shall be notified by fax (FAX #508-947-6557 or 508-946-2835) of the intent to conduct any prescribed burn prior, but not in excess of 48 hours to any ignition.

10. The fire department and board of health in the towns of Sandwich, Bourne, Mashpee, and Falmouth must be notified in writing of the intent to conduct a prescribed fire at a minimum of one month but not to exceed 6 months prior to any prescribed burn. Additionally they must be notified before ignition takes place but not in excess of 48 hours to any ignition.

11. The public must be notified by mass media (newspaper and/or radio) at a minimum of one month but not to exceed 6 months prior to any prescribed burn. Additionally the public must be notified by mass media (newspaper and/or radio) before ignition takes place but not in excess of 48 hours to any ignition.

12. Upon exhausting all efforts of coordination between the Impact Area Groundwater Study Project, the Installation Restoration Program and the Remedial Project Managers, per the Final Environmental Impact Report for the Massachusetts National Guard (2001) remedial activities will be the priority activity.

13. By January 15th of each year, the Massachusetts Army National Guard shall provide the Department of Environmental Protection with a summary of the fire management activities that have been conducted during the previous calendar year.

Failure to comply with these conditions may result in the revocation of this authorization.

Should you have any questions relative to this matter, please contact Steven Risi at the Regional Office at (508) 946-2774.

Very truly yours,

Gerald A. Monte, Chief
Compliance & Enforcement Section

M/SR/re

cc: Board of Health
Town Hall
24 Perry Avenue
Buzzards Bay, MA 02532

Bourne Fire Department
130 Main Street
Buzzards Bay, MA 02532
ATTN: Fire Chief

Board of Health
Town Hall
59 Town Hall Square
Falmouth, MA 02540

cc: Falmouth Fire Department
399 Main St.
Falmouth, MA 02540
ATTN: Fire Chief

Board of Health
270 Quaker Meetinghouse Road
East Sandwich, MA 02537

Sandwich Fire Department
P.O. Box 1340, RTE 6A
East Sandwich, MA 0256337
ATTN: Fire Chief

Board of Health
16 Great Neck Rd North
Mashpee, MA 02649

Mashpee Fire Department
Route 151
Mashpee, MA 02649
ATTN: Fire Chief

MAARNG
HQ Camp Edwards
Camp Edwards, MA 02542
ATTN: Michael A. Ciaranca, Ph. D
Natural Resource Manager

DEP-SERO
ATTN: Paul A. Taurasi, P.E., Regional Director
Millie Garacia-Surette, DRD, BWSC
Leonard Pinauld Chief, Federal Facilities Remediation Section
David Johnston, DRD/BWP
Carl Natho, BWP

APPENDIX J. CAMP EDWARDS PRESCRIBED FIRE NOTIFICATION PROTOCOL

Prescribed Fire Notification Protocol

A minimum of 30 days (but no more than six months) prior to an anticipated prescribed burn:

- Develop and send a letter of intent **(Attachment 1)** to the Department of Environmental Protection, Bureau of Waste Prevention, Southeast Region **(List A)**. The letter of intent should:
  - Summarize the intent to conduct a prescribed burn
  - Identify the prescribed Fire Management zone and associated burn units
  - Include objectives for each proposed prescribed burn
  - Identify the window or windows (dates) that each burn is to be conducted

- Notify the following, in writing, of the intent to conduct a prescribed fire:
  - Fire departments in the Upper Cape towns of Falmouth, Mashpee, Sandwich, and Bourne **(List B)**
  - Boards of health in the towns of Falmouth, Mashpee, Sandwich, and Bourne **(List C)**
  - Town Administrators in the towns of Falmouth, Mashpee, Sandwich, and Bourne **(List D)**
  - Selectmen representatives to the Senior Management Board **(List E)**
  - The Environmental Management Commission and its staff, and the chairs of the Community Advisory Council and the Scientific Advisory Council **(List F and List J)**
  - Massachusetts State Police at the police barracks located in Bourne **(List G)**

- Alert the following, by email, of the intent to conduct a prescribed fire:
  - On-base commands **(List H)**
  - Environmental cleanup program managers **(List I)**
  - Community Advisory Council and Scientific Advisory Council members **(List J)**
  - Members of the Upper Cape Water Cooperative **(List K)**
  - CPT Winfield Danielson, state public affairs: winfield.danielson@ma.ngb.army.mil; and COL Manny Constantine, chief of staff: manuel.constantine@ma.ngb.army.mil

- Inform the public of the intent to burn
  - Draft and send a press release to local and regional newspaper and radio outlets **(List L)**. Press release information should include who is conducting the burn, the date(s) of the anticipated burn, location, contact information for questions or concerns **(Attachment 2)**
  - Develop and submit a paid advertisement to local newspapers **(Attachment 3)**

Two weeks prior to anticipated burn window:

- Mail a reminder letter to DEP and the Bureau of Waste Prevention **(List A)**

One week prior to the burn window:

- Rerun paid advertisement or media notice in local newspapers and radio outlets **(List L)**
- Include information on up-coming prescribed burn in weekly e-mail update to Selectmen

48 hours prior to anticipated ignition (or less)

- Fax a notification to boards of health in Falmouth, Mashpee, Sandwich, and Bourne **(List C)**
- Fax a notification to fire departments in Falmouth, Mashpee, Sandwich, and Bourne **(List B)**
- Alert the public to the up-coming burn via local newspaper and radio outlets **(List L)**
- Notify the Bureau of Waste Prevention, Compliance and Enforcement Section, Southeast Regional Office, by fax (fax: 508-947-6557 or 508-946-2835)
- Fax or email reminder to DEP **(List A)**

24 hours prior to anticipated ignition

- Notify the following by telephone:
  - Fire department chiefs in Falmouth, Mashpee, Sandwich, and Bourne **(List B)**
  - Town administrators in Falmouth, Mashpee, Sandwich, and Bourne **(List D)**
  - SMB selectmen **(List E)**
  - The Department of Environmental Protection **(List A)**
  - The Environmental Management Commission and its staff **(List F)**
  - On-base commands **(List H)**
  - Environmental clean-up program managers **(List I)**
  - The Upper Cape Water Cooperative **(List K)**
  - Laurie Perry, Tribal Administrator, Wampanoag Tribe of Gay Head-Aquinnah, 508-645-9265
- Email or call: CPT Winfield Danielson, state public affairs: winfield.danielson@ma.ngb.army.mil, (508) 233-6560; and COL Manny Constantine, chief of staff: manuel.constantine@ma.ngb.army.mil, (508) 233-6800
- Notify the Scientific Advisory Council and Community Advisory Council chairs and council members **(List J)**

Post-burn

- Issue a follow-up news release (if desired)

Address List A

Gerald A. Monte, Chief
Compliance and Enforcement Section
Southeast Regional Office
Department of Environmental Protection
20 Riverside Drive, Lakeville, MA 02347

fax: 508-947-6557 or 508-946-2835

Address List B—Upper Cape Fire Departments

Sandwich Fire Chief
Dennis Newman
Sandwich Fire Department
115 Route 6A
Sandwich, MA 02563
Phone: 508-888-0525
Fax: 508-833-8010

Falmouth Fire Chief
Paul Brodeur
Falmouth Fire Department
399 Main Street
Falmouth, MA 02540
Phone: 508-495-2500
Fax: 508-495-2519

Mashpee Fire Chief
George Baker
Mashpee Fire Department
20 Frank Hicks Drive
Mashpee, MA 02649
Phone: 508-539-1454
Fax: 508-539-1453

Bourne Fire Chief
Charles Klueber
Bourne Fire Department
130 Main Street
Buzzards Bay, MA 02532
Phone: 508-759-4412
Fax: 508-759-9585

Address List C—Upper Cape Cod Boards of Health

Cynthia Coffin
Health Agent
Bourne Town Hall
24 Perry Avenue
Buzzards Bay, MA 02532

Phone: 508-759-0615
Fax: 508-759-8026
ccoffin@townofbourne.com

David Carignan
Health Agent
Falmouth Town Hall
59 Town Hall Square
Falmouth, MA 02540
Phone: 508-548-7611, x254
Fax: 508-457-2511

Steven R. Ball
Chair, Mashpee Board of Health
16 Great Neck Road North
Mashpee, MA 02649
Phone: 508-539-1400 x555
Fax: 508-539-1403

Richard Loring
Chair, Sandwich Board of Health
16 Jan Sebastian Drive
Sandwich, MA 02563
Board of health phone: 508-888-4200
Board of health fax: 508-833-0018
health@townofsandwich.net

Address List D—Town Administrators

William Griffin, Administrator, Town of Bourne
Bourne Town Hall
24 Perry Avenue
Buzzards Bay, MA 02532
Phone: 508-759-0600
Fax: 508-759-0620
WGriffin@townofbourne.com

Robert L. Whritenhour, Administrator, Town of Falmouth
Falmouth Town Hall
59 Town Hall Square
Falmouth, MA 02540
Phone: 508-495-7320
Fax: 508-457-2573

Joyce M. Mason, Administrator, Town of Mashpee,
Mashpee Town Hall
16 Great Neck Road North
Mashpee, MA 02649
Phone: 508-539-1400 x510
Fax: 508-539-1403
jmmason@ci.mashpee.ma.us

George Dunham, Administrator, Town of Sandwich
130 Main Street
Sandwich, MA 02563
Phone: 508-888-4910
Fax: 508-888-8655
townhall@townofsandwich.net

Address List E—SMB Selectmen

Linda Zuern, Bourne
24 Perry Ave
Bourne, MA 02532
Work phone: 508-759-1101
Fax: 508-759-0620
Home phone: 508-564-4875
Lzuern@townofbourne.com

Chuckie Green, Bourne
16 Great Neck Road North
Mashpee, MA 02649
Work phone: 508-539-1400, x510
Fax: 508-539-1403
bos@ci.mashpee.ma.us

Virginia Valeila, Falmouth
59 Town Hall Square
Falmouth, MA 02540
Work phone: 508-548-7611 (do not call work unless emergency)
Home phone: 508-563-9028
Fax: 508-763-8624
valiela@meganet.net

Frank Pannorfi, Sandwich
130 Main Street
Sandwich, MA 02563
Work phone: 508-888-4910
Home phone: 508-888-8517
Fax: 508-833-8045
frank.pannorfi@aol.com

Address List F—Environmental Management Commission and Staff

Robert W. Golledge Jr.
Commissioner, DEP
One Winter Street, 2nd FL
Boston, MA 02108
Phone: 617-295-5856
Fax: 617-574-6880
edward.kunce@state.ma.us

David Peters, Chair
Commissioner, DFWELE
251 Causeway Street, Suite 400
Boston, MA 02114
Phone: 617-626-1550
Fax: 617-626-1505
david.peters@state.ma.us

Peter Webber
Acting Director, DCR
251 Causeway Street, Suite 600
Boston, MA 02114
Phone: 617-626-1300
Fax: 617-626-1349
peter.webber@state.ma.us

Mark Begley
Director/Senior Environmental Officer
Bldg 1204 West Inner Road
Camp Edwards, MA 02532
Phone: 508-968-5127
Fax: 508-968-5128
mark.begley@state.ma.us

Address List G—State Police Barracks

Massachusetts State Police Barracks
Bourne Rotary, Route 28
Bourne, MA 02352
Phone: 508-759-4488
Fax: 508-759-2221

Address List H—On-Base Commands

102nd Fighter Wing
Col. Paul Worcester
158 Reilly Street
Otis ANGB, MA 02542
508-968-4090

Headquarters Camp Edwards
COL Bernard A. Flynn
Building 3468, Camp Edwards
Camp Edwards, MA 02542
Phone: 508-968-5885
Fax: 508-968-5906
bernard.a.flynn@us.army.mil

Coast Guard Air Station
Bob Cannon, Environmental Health and Safety
USCG Air Station, Cape Cod
Air Station Cape Cod, MA 02542-5005
Phone: 508-968-6487
Fax: 508-968-6693
RFCannon@d1.uscg.mil

Cape Cod Air Station—6th Space Warning Squadron
Lt. Col. Nina Armagno
1 Flatrock Road
Sagamore, MA 02561-0428
Phone: 508-968-2277
nina.armagno@capecod.af.mil

Address List I—Environmental Remediation Program Managers

Impact Area Groundwater Study Program
Hap Gonser, Interim Program Manager
565/567 West Outer Road
Camp Edwards, MA 02542
Phone: 508-968-5107
Fax: 508-968-5286
kent.gonser@ma.ngb.army.mil

Installation Restoration Program
Jon Davis, Interim Program Manager
322 East Inner Road
Otis ANGB, MA 02542
Phone: 508-968-4670
Fax: 508-968-4673
robert.gill@brooks.af.mil

CH2M Hill
Marc Slechta
318C East Inner Road
Otis ANGB, MA 02542
Phone: 508-968-4670 x5988
Fax: 508-968-4916
mslechta@ch2m.com

Jacobs Engineering
Carl Wilson - Safety Manager
Jacobs/Bourne Field Service Office
phone: 508-743-0214
fax: 508-743-9177
e-mail: carl.wilson@jacobs.com

Address List J—Community Advisory Council and Scientific Advisory Council

Virginia Valeila, CAC Chair
PO Box 237
North Falmouth, MA 02556
Work: 508-763-5924
Home: 508-563-9028
Fax: 508-763-8624
valeila@meganet.net

Mark Harding, CAC Vice Chair
PO Box 28
Mashpee, MA 02649
Phone: 508-645-3463
wamp@cape.com

Chuckie Green, CAC
137 Meetinghouse Road
Mashpee, MA 02649
Work: 508-539-1400, ext 510
Home: 508-539-3001
Fax: 508-539-1403
bos@ci.mashpee.ma.us

Haydon Coggeshall, CAC
PO Box 166,
Sagamore Beach, MA 02562
Home: 508-888-2022
hscoggeshall@aol.com

Joseph Materia
Bldg 1204, West Inner Road
Camp Edwards, MA 02542
Work: 508-968-5106
Fax: 508-968-5144
joseph.materia@ma.ngb.army.mil

Donald Quenneville, CAC
Donald.quenneville@mabarn.ang.af.mil

Thomas Hobiaca, CAC
US Coast Guard, Bldg 5215
Air Station Cape Cod, MA 02542
Work: 508-968-6480
Home: 508-564-6454
Fax: 508-968-6491
thobaica@ascapecod.uscg.mil

Daniel Mahoney, CAC
P.O. Box 600
Sandwich, MA 02563
Work: 508-888-2775
Fax: 508-888-9675
dhcm@netzero.net

Jean Crocker, CAC
40 Tracey Road
Cotuit, MA 02635
Home: 508-428-4283
Fax: 508-428-4283
buzzcrocker@attbi.com

James Cummings, CAC
P.O. Box 397
Barnstable, MA 02630
Work: 508-375-6012
Fax: 508-362-5023
jcummings@bsheriff.net

Robert Deane, CAC
8 Dogwood Road
Bourne, MA 02532
Home: 508-833-0080
Fax: 508-833-9143
rdd0008@aol.com

Larry Cole, CAC
18 Wychmere Harbor Drive
Harwich Port, MA 02646
Home: 508-432-2464
larrcole@cape.com

Mimi McConnell, CAC
P.O. Box 832
Cotuit, MA 02635
Home: 508-428-9573
Fax: 508-420-4544

Margo Fenn, CAC
3225 Main Street
Barnstable, MA 02630
Work: 508-362-3828
Fax: 508-362-3136
mfenn@capecodcommission.org

Russell Cookingham, SAC Chair
PO Box 1037, 95 Eel Pond Road
Monument Beach, MA 02553
Home: 508-759-6786
russc@cape.com

Paul Cavanaugh, SAC Vice Chair
225 Thomas Landers Road
East Falmouth, MA 02536
Work: 508-224-6521
Fax: 508-224-9220
kwcavanaugh@prodigy.net

Andrew Finton
The Nature Conservancy
47 Union Street
Watertown, MA 02472
Work: 601-227-7017 x303
andyfinton@pobox.com

Phil Gschwend
Department of Civil and Environmental
Engineering, 48-415
Massachusetts Institute of Technology
Cambridge, MA 02139
Work: 617-253-1638
Fax: 617-253-7395
pmgsche@mit.edu

Denis LeBlanc
US Geological Survey
10 Bearfoot Road
Northborough, MA 01532
Work: 508-490-5030
Fax: 508-490-5068
dleblanc@usgs.gov

Anne Mulligan
Marine Policy Center, MS #41
Woods Hole Oceanographic Institution
Woods Hole, MA 02543
Work: 508-289-2609
mulligan@whoi.edu

Donald Schall
ENSR Consulting & Engineering, Inc
95 State Road
Sagamore Beach, MA 02562
Work: 508-888-3900
Fax: 508-888-6689
dschall@ensr.com

Ralph Vacarro
PO Box 245
West Falmouth, MA 02574
Home: 508-548-2747
rvac@aol.com

J. Warren Webb
Oak Ridge National Laboratory
PO Box 2008, Bldg. 1505
Oak Ridge, TN 37931-6036
Work: 865-574-7395
Fax: 865-576-8543
webbjw@ornl.gov

Address List K—Upper Cape Water Cooperative

Dan Mahoney
P.O. Box 600
Sandwich, MA 02563
Work: 508-888-2775
Fax: 508-888-9675
dhcm@netzero.net

additional info forthcoming

Address List L—Local and Regional Media

Newspapers—Regional

Barnstable Patriot
Published weekly on Thursdays
P.O. Box 1208
Hyannis, MA 02601
Phone: 508-771-1427
Fax: 508-790-3997
Deadline: Monday, 5 p.m.

Boston Globe
Published daily
135 Morrissey Blvd.
P.O. Box 2378Boston, MA 02107
Phone: 617-929-3000
Fax: 617-929-3192

Boston Herald
Published daily
P.O. Box 2096
Boston, MA 02106
Phone: 617-426-3000
Fax: 617-542-1315

The Cape Codder (lower Cape)
Published weekly, Thursdays
5 Namskaket Road
P.O. Box 39
Orleans, MA 02653-6776
Phone: 508-247-3200
Fax: 508-247-3201
Deadline: Monday, 5 p.m.

Cape Cod Times
71 Route 6A, Merchants Square
Sandwich, MA 02563
Phone: 508-888-5454
Fax: 508-888-5443
Deadlines: ads- 3 business days prior
editorials, at least one week prior

Newspapers—Local

The Upper Cape Codder and The Register (mid Cape)
Weekly, Thursdays
Sunflower Marketplace
923G, Route 6A
Yarmouthport, MA 02675
Phone: 508-247-3200
Fax: 508-247-3201
Deadline: Monday, 5 p.m.

The Enterprises (Falmouth, Mashpee, Sandwich and Bourne editions)
Falmouth—bi weekly, Tuesday and Friday
All others—weekly, Fridays
50 Depot Avenue
Falmouth, MA 02540
Phone: 508-548-4700
Fax: 508-540-8407
Deadlines: press releases-one week prior
Ads (Tuesday paper) Monday at 11 a.m.
(all others) Wednesday at 11 a.m.

Radio

Boch Broadcasting
News Director Judith Goetz
WCOD (Adult-Contemporary) 106.1 FM
WTWV (Adult Alternative) 101.1 FM
WXTK (Talk Radio) 95.1 FM
WDVT (Star Hit Music) 93.5 FM
Phone: 508-775-5678
Fax: 508-862-6329

Makkay Group Broadcasting:
News Director Bill Lowell
WCIB (Adult Contemporary) 101.9 FM
WPXE (Album-Rock) 102.9 FM
WRZE (Dance Music) 96.3 FM
Phone: 508-548-3102 or 508-428-7103
Fax: 508-778-9651

WATD (Adult Contemporary) 95.9 FM
News Director: Christine James
130 Enterprise Drive
Marshfield, MA 02050
Phone: 781-837-1169
Fax: 781-837-1825

WKKL (Alternative) 90.7 FM
Program Director Meg McManus
West Barnstable, MA
Phone: 508-375-4030
Fax: 508-375-4020

WKPE (Rock) 104.7 FM
Program Director Dan Towers
Radio Center
25 Bog Hollow Road
Orleans, MA 02653
Phone: 508-771-2998
Fax: 508-255-9787

WPLM (Adult Contemporary) 99.1 FM
Public Service Director Tony Arden
P.O. Box 1390
Plymouth, MA 02362-1390
Phone: 508-746-1390
Fax: 508-830-1128

WMVY (Adult Alternative) 92.7 FM
News Director Deborah Medwin
P.O. Box 1148
Vineyard Haven, MA 02568
Phone: 508-693-5000
Studio: 508-693-5118
Fax: 508-693-8211

WOMR 92.1 FM
14 Center Street
P.O. Box 975
Provincetown, MA 02657
Phone: 800-921-9667 or 508/487-2106
Fax: 508-487-5524
info@womr.org

WQRC (Contemporary) 99.9 FM
WOCN 103.9 FM
News Director Matt Pitta ext. 104
737 West Main Street
Hyannis, MA 02601
Phone: 508-771-1224
Fax: 508-775-2605
News Hotline: 800-396-NEWS

WCAI/WNAN (public radio) 90.1 FM
Executive Producer Jay Allison
P.O. Box 82
Woods Hole, MA 02543
Phone: 508-548-9600
Fax: 508-548-5517
cainan@wgbh.org

Associated Press
News Editor Karen Testa
184 High Street
Boston, MA 02110
Phone: 617-357-8100
Fax: 617-338-8125

Attachment 1—Sample Letter of Intent

Gerald A. Monte, Chief
Compliance and Enforcement Section
Southeast Regional Office
Department of Environmental Protection
20 Riverside Drive, Lakeville, MA 02347

Gerald,

This letter is to inform you of the intent to conduct prescribed burns on Camp Edwards during the window of 25-28 February as conditions permit.

The primary intent of these burns is for training; we are conducting a workshop for local fire companies, state and federal agencies.

With the changing of personnel many of these agencies have no personnel with wildfire or prescribed fire experience or training.

This training will provide a crucial public safety service and for free, which is critical at this time.

Enclosed is a figure identifying the fire management zone and burn units that will be utilized for this training.

As it is training, only small burns will be conducted, two to three, 5 to 25 acre burns per unit.

If there are any questions please contact me.

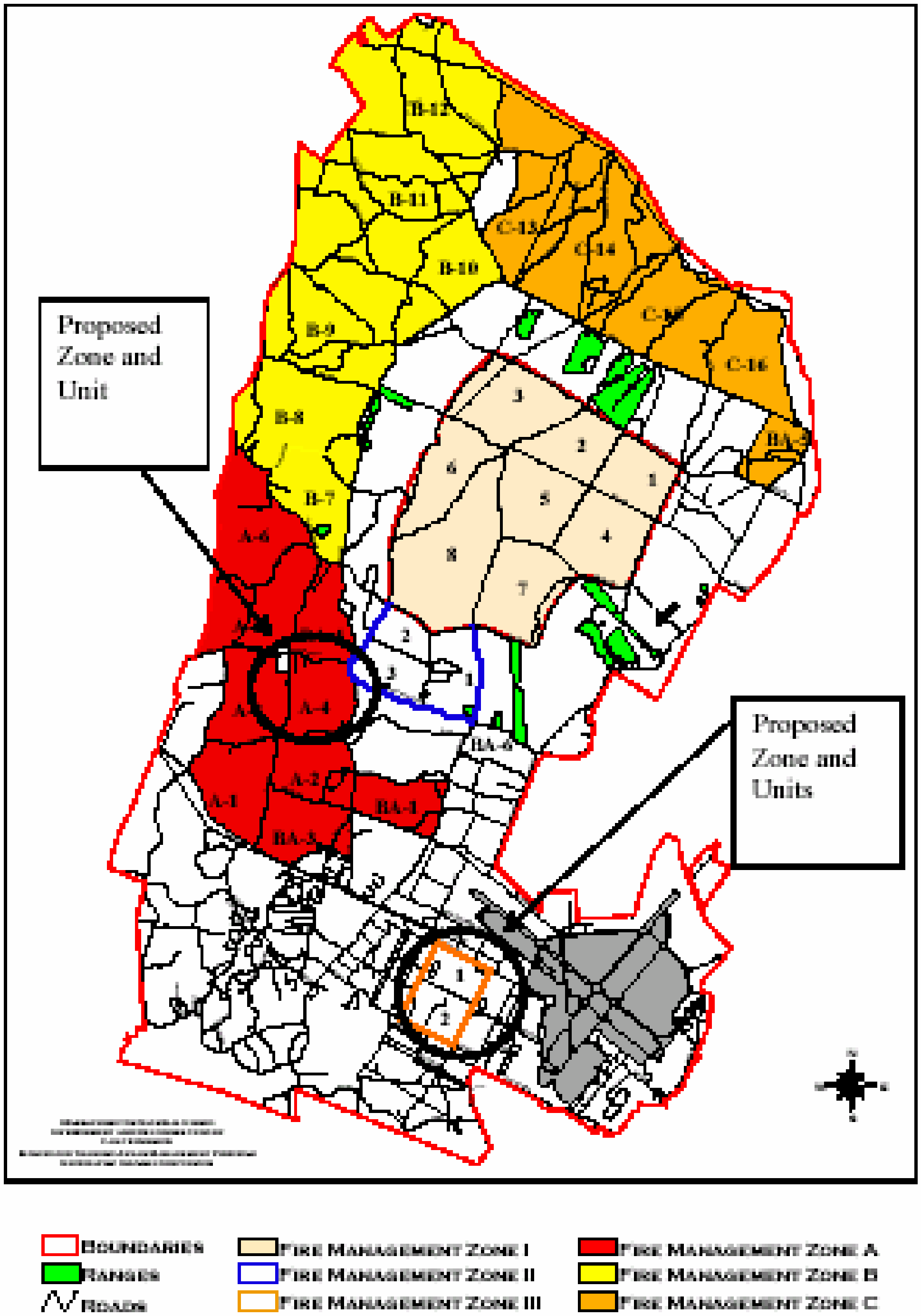
Sincerely,

//S//
Michael A. Ciaranca, Ph.D.
Natural Resoucre Manager
MAARNG
Bldg 2808
HQ Camp Edwards
Camp Edwards, MA 02542
Phone: 508-968-5121
Fax: 508-968-5820
Michael.Ciaranca@ma.ngb.army.mil

Enc.

Cc: LTC Cunha, Camp Edwards
COL Materia, Environmental and Readiness Center

Camp Edwards
Fire Management Zones



Attachment 2—Sample Press Release

Environmental & Readiness Center

Massachusetts Military Reservation
Building 1204, Camp Edwards, MA 02542
508-968-5143 DSN: 557-5143
Fax: 508-968-5144

Media Notice

Contact: Lynda Wadsworth

March 27, 2003

508-968-5152/ 508-958-6691

For Immediate Release

PRESCRIBED BURN SCHEDULED AT CAMP EDWARDS

Camp Edwards, Massachusetts Military Reservation - The Massachusetts Army National Guard's Natural Resource Program will conduct a prescribed burn at Camp Edwards. The burn will be conducted Friday, March 28, 2003, weather conditions permitting.

In addition, the Massachusetts Army National Guard will conduct prescribed burns during the period of April 1 to June 31, 2003, in the training area of Camp Edwards. Any prescribed burns planned for this period are contingent on weather conditions.

Prior to burning at Camp Edwards, local fire departments, local boards of health, town administrators, and the Department of Environmental Protection will be notified.

-End-

Attachment 3—Sample Paid Advertisement

On April 22, 2003, the Natural Resources Office at Camp Edwards on the Massachusetts Military Reservation (MMR) will conduct a prescribed burn on approximately 100 acres of the northern training area of MMR. The burn will be conducted weather permitting.

Prior to burning, local fire departments, local boards of health, town administrators, and the Department of Environmental Protection will be notified.

Questions may be directed to Lynda Wadsworth, Public Outreach Manager, at 508-968-5152, or to Dr. Michael Ciaranca, Natural Resources Manager, at 508-968-5143.

APPENDIX K. PRESCRIBED FIRE BURN PLAN TEMPLATE

PRESCRIBED FIRE BURN PLAN

State:
Preserve/Site:
Burn Unit:

Fire Planner(s):

Name:
Title: _____ *Signature* _____ *Date*

Name:
Title: _____ *Signature* _____ *Date*

Fire Leader:

Name:
Title: _____ *Signature* _____ *Date*

Fire Manager:

Name:
Title: _____ *Signature* _____ *Date*

1. **LOCATION:**
   Preserve/Site:
   Burn Unit:
   Map Location (e.g. T/R/Sec.):
   Unit Area:
   County/State:
   Ownership:

2. **SOURCES OF EMERGENCY ASSISTANCE (location & phone #):**
   Fire:
   Law Enforcement:
   Medical:
   Attorney:
   Nearest Phone to Unit:

3. **PERMITS AND OFFICIAL NOTIFICATIONS:**
   Burn Permit/Notification Required? Yes / No
   Source(s):

   Air Quality Permit/Notification Required? Yes / No
   Source(s):

   Other Notifications Required? Yes / No
   Source(s):

4. **NEIGHBOR NOTIFICATIONS:**

Name	Address	Phone

5. UNIT DESCRIPTION:

Vegetation Types	Fuel Models	% of Unit Area	% Slope	Aspect

Fire Unit Narrative Description (include description of surrounding fuels):

Maps Attached:

Preserve location map: Yes / No
Preserve burn unit map: Yes / No
Preserve fuels map: Yes / No
Burn unit map with ignition pattern, hazards, etc: Yes / No
Aerial photograph: Yes / No
Smoke Screening Map Yes / No
Map to Hospital Yes / No
Other:

6. PRESCRIBED BURN JUSTIFICATION:

Type of Burn (ecological management, hazard reduction, training, or research):

Burn Unit Management Goal(s):

Specific Burn Objectives:

7. FUEL AND WEATHER PRESCRIPTION (give acceptable ranges)

Required Parameters:	**MAX**	**MIN**	**PREFERRED (if applicable)**
Wind Direction(s)			
Effective Windspeed (mph)			
1-Hour Fuel Moisture (%)			
10-Hour Fuel Moisture (%)			
100-Hour Fuel Moisture (%)			
Live Fuel Moisture (%)			
Atmospheric Mixing Height (ft)			
Other (e.g. KBDI, Live/dead ratio):			

Guidance Parameters:	**MAX**	**MIN**	**PREFERRED (if applicable)**
Air Temperature (ºF)			
Relative Humidity (%)			
Days Since Rain			
20 ft wind speed (mph)			

List any combinations of parameters that you will exclude from your burn window (e.g. high windspeeds with low 1-hour fuel moisture).

Other Comments:

8. PREDICTED FIRE BEHAVIOR (From BEHAVE or attach BEHAVE outputs: use inputs from #7; include predictions for fuels surrounding burn unit) Use this information as a guide to the potential range of behavior from a free-burning fire, and for contingency planning.

	Fuel Model		
	#	#	#
Max. Headfire Flame Length			
Min. Headfire Flame Length			
Max. HF Rate of Spread			
Min. HF Rate of Spread			
Max. Backfire Flame Length			
Min. Backfire Flame Length			
Max BF Rate of Spread			
Min. BF Rate of Spread			
Max. Scorch Height			

9. FIRE BEHAVIOR NARRATIVE (Describe *desired* fire behavior. How will you manipulate fire behavior to meet management and control objectives?):

10. SMOKE MANAGEMENT PLAN

Smoke screening procedures completed? Yes / No

List <u>downwind/downdrainage</u> smoke sensitive areas (give distance):

List other smoke sensitive areas:

Map of smoke sensitive areas attached? Yes / No

Describe desirable smoke behavior and smoke management actions:

11. CREW ORGANIZATION

Qualified fire leader(s):
Crew Number to
Organization chart attached? Yes / No
Fitness & experience requirements if different from agency guidelines:

12. EQUIPMENT

Required items:	**Available**
Pumper on site	Yes / No
Three radios	Yes / No
Protective clothing	Yes / No
First aid kit	Yes / No
Weather kit	Yes / No
Fire shelters	Yes / No

Justification(s) for exemptions:

Equipment Item	Number	Source

13. BURN DURATION

Time (indicate minutes or hours) for:
Baseline Preparation:
Spreading Fire:
Mop-up:
Total Duration:

14. MANAGING THE BURN (Describe each of the following):

Firebreak preparations:

Firing techniques and ignition pattern:

Crew communication:

Fire behavior and weather monitoring:

Holding:

Fire sensitive areas:

Contingencies (include safety zones, escape routes, secondary control lines, escape response procedures):

Potential hazards to crew:

Mop-up:

Public relations:

Follow-up assignments:

15. DOCUMENTATION

Does the site have a Site Conservation Plan? Yes / No
Review of Laws and Regulations complete? Yes / No
Site Fire Management Plan complete? Yes / No
Site Wildfire Response Plan complete? Yes / No

Exemptions or modifications of agency burn requirements and guidelines:

Justification(s) for exemptions or modifications:

16. LEGAL CONSIDERATIONS

Describe the ownership/management responsibility of this site:

Releases/waivers required? Yes / No
Releases/waivers attached? Yes / No

PRE-BURN CHECKLIST AND CREW BRIEFING

Preserve: **Fire Unit:** **Date:**

A. PRIOR TO CREW BRIEFING

- ☐ Fire Unit is as described in plan.
- ☐ Required firebreaks complete.
- ☐ Permits obtained. Give permit #'s:
- ☐ Official and neighbor notifications complete.
- ☐ Required equipment is on-site and functioning.
- ☐ Planned ignition and containment methods are appropriate.
- ☐ List of emergency phone numbers are in each vehicle.
- ☐ Planned contingencies and mop-up are appropriate.

B CREW BRIEFING

- ☐ Each crew member has a burn unit map.
- ☐ Fire Unit size and boundaries discussed.
- ☐ Fire Unit hazards discussed.
- ☐ Purpose of burn.
- ☐ Anticipated fire and smoke behavior.
- ☐ Review of equipment and troubleshooting.
- ☐ Check crew qualifications.
- ☐ Review organization of crew and assignments.
- ☐ Review methods of ignition, holding, mop-up, communications.
- ☐ Review contact with the public; traffic concerns.
- ☐ Location of vehicles, keys, and nearest phone.
- ☐ Location of back-up equipment, supplies, and water.
- ☐ Review all contingencies including escape routes.
- ☐ Review mop-up procedures.
- ☐ Answer questions from crew.
- ☐ Give crew members the opportunity to decline participation.

C. PRIOR TO IGNITION

- ☐ Weather and fuel conditions are within prescriptions.
- ☐ Weather forecast, obtained within two hours of ignition, says prescribed weather will hold for two hours past expected duration of burn.
- ☐ Crew members have required protective clothing.
- ☐ Crew members have matches.
- ☐ Conduct test burn.

D. BEFORE LEAVING BURN UNIT

- ☐ Mop-up completed as described in prescription.
- ☐ Next morning inspection arranged.
- ☐ Notifications of completed burn (if required).

E. NOTE ANY MODIFICATIONS TO RX

APPENDIX L PRESCRIBED FIRE COMPLEXITY RATING WORKSHEET

Site:	Unit:	State:	Date:
Complexity Score (circle)			
Low (44-80 pts)	***Moderate (81-150 pts)***	*High (151-220 pts)*	

Weighting Factor x Complexity Value = Total points. Sum of Total points = Complexity Score

Complexity Element	Weighting Factor	Complexity Value (1-	Total Points	*Rationale and/or Mitigation Procedures* (Use for clarification of rationale and/or actions.)
1. Safety	5			
2. Difficulty of Containment	5			
3. Fuels and Fire Behavior	5			
4. Wildland / Urban Interface	5			
5. Objectives	4			

Sub Total (Page 1)				
Complexity Element	**Weighting Factor**	**Complexity Value**	**Total Points**	***Rationale and/or Mitigation Procedures***
6. Management Organization	**4**			
7. Contingency Planning and Resources	**4**			
8. Natural, Cultural, Social Values	**3**			
9. Air Quality Values	**3**			
10. Logistics	**3**			
11. Tactical Operations	**2**			
12. Cooperator Coordination	**1**			
Sub Total		**Page 2**		**Additional Comments:**
		Page 1		

Complexity Element	Complexity Value Evaluation Examples		
	1	3	5
1. Safety Weighting Factor - 5	▪ All safety issues have been identified and mitigated.	• A number of significant issues have been identified and some of them are difficult to address through mitigation.	• Complex safety issues exist.
2. Difficulty of Containment Weighting Factor - 5	• Low threat of escape past unit boundaries. • Probability of Ignition<50%. • Boundaries naturally defensible or firebreaks easily installed and defended. • Secondary control lines strong and easily accessed by vehicles and/or crew.	• Moderate threat of escape from unit boundaries. • 50<Probability of Ignition<70% • Moderate risk of slopover or spot fires. • Fuel type produces numerous firebrands. • Secondary control lines difficult to access or not secure.	• High threat of escape from unit boundaries. • Probability of Ignition>70%. • High risk of slopover or spot fires. • Secondary control lines non-existent or inadequate without significant resource commitment.
3. Fuels and Fire Behavior Weighting Factor - 5	• Low variability in slope & aspect. • Weather uniform and predictable. • Surface fuels (grass and/or needles) only. • No drought present or predicted within burn period. • Duff or organic soils will not ignite.	• Moderate variability in slope & aspect. • Weather variable but predictable. • Ladder fuels present and torching expected. • Fuel types/loads variable. • Dense, tall shrub or mid-seral forest communities. • Drought index indicates normal to moderate drought conditions; present expected within burn period. • Upper level of duff or organic soil will burn.	• High variability in slope & aspect. • Weather variable and difficult to predict. • Extreme fire behavior and/or stand replacement fire. • Fuel types/loads highly variable. • Altered fire regime, hazardous fuel /stand density conditions. • Drought index indicates severe drought conditions; present or expected within burn period. • Significant portions duff or organic soils will burn.
4. Wildland / Urban Interface Weighting Factor - 5	• No risk to people or property within or adjacent to fire, or values to be protected are easily mitigated. • Potential damage from escape low.	• Several values to be protected. • Mitigation through planning and/or preparations is complex. • May require some commitment of specialized resources. • Potential damage from escape moderate.	• Numerous values and/or high values to be protected. • Severe damage likely without significant commitment of specialized resources with appropriate skill levels. • Potential damage from escape high.
Complexity Score			**Rated by:**

Complexity Element	Complexity Value Evaluation Examples		
	1	3	5
5. Objectives **Weighting Factor - 4**	• Maintenance objectives. • Prescriptions broad. • Easily achieved objectives.	• Restoration objectives. • Reduction of both live and dead fuels. • Moderate to substantial changes in two or more strata of vegetation. • Objectives judged to be moderately hard to achieve. • Objectives may require moderately intense fire behavior.	• Restoration objectives in altered fuel situations. • Precise treatment of fuels and multiple ecological objectives. • Major change in the structure of 2 or more vegetative strata. • Conflicts between objectives and constraints. • Requires a high intensity fire or a combination of fire intensities that are difficult to achieve.
6. Management Organization **Weighting Factor - 4**	• Span of control held to 2 - 3. • 6 - 12 person crew and 1 - 2 engines.	• Span of control held to 4 – 5. • Multiple resources required (engines, dozers, aerial ignition, terra torch, etc.). • 8 - 20 person crew and 1 - 3 engines.	• Span of control greater than 5 – 7. • Multiple branch, divisions or groups. • Specialized resources needed to accomplish objectives. • Organized management team required (Fire Use or Incident Management).
7. Contingency Planning and Resources **Weighting Factor - 4**	• Adequate contingency resources on site.	• Contingency resources limited or have more than a 15 - 30 minutes response time.	• Contingency resources limited or have more than a 30+ minutes response time.
8. Natural, Cultural, and Social Values **Weighting Factor - 3**	• No risk to natural, cultural, and/or social resources within or adjacent to fire, or mitigation through planning and preparations is adequate.	• Several values to be protected. • Mitigation through planning and/or preparations is complex. • May require some commitment of specialized resources.	• Numerous values and/or high values to be protected. • Severe damage likely without significant commitment of specialized resources with appropriate skill levels.
9. Air Quality Values	• Few smoke sensitive areas near fire. • Smoke produced for less than 1 burning period. • Air quality agencies generally require only initial notification and/or permitting. • No potential for scheduling conflicts with cooperators.	• Multiple smoke sensitive areas, but smoke impact mitigated in plan. • Smoke produced for 2-3 burning periods. • Daily burning bans are sometimes enacted during the burn season. • Infrequent consultation with air quality agencies is needed.	• Multiple smoke sensitive areas with complex mitigation actions required. • Health or visibility complaints likely. • Smoke produced for greater than 3 burning periods. • Multi-day burning bans are often enacted during the burn season. • Smoke sensitive Class I air-sheds.

Weighting Factor - 3		• Low potential for scheduling conflicts with cooperators.	• Frequent consultation with air quality agencies is needed. • High potential for scheduling conflicts with cooperators.

Complexity Element	Complexity Value Evaluation Examples		
	1	3	5
10. Logistics Weighting Factor - 3	• Easy access. • Duration of fire is 1 day (holding or monitoring).	• Difficult access. • Duration of fire support between 2 and 3 days. • Logistical position assigned. • Anticipated difficulty in obtaining resources.	• No vehicle access. • Duration of support is greater than 3 days. • Multiple logistical positions assigned. • Remote camps and support necessary.
11. Tactical Operations Weighting Factor - 2	• Simple ignition patterns with only one igniter inside the unit. • Ignition complete within one burning period. • Single ignition method used. • Resources required for 1 day. • Holding requirements minimal.	• Multiple firing methods and/or sequences with two igniters inside the unit at once. • Use of specialized ignition methods (i.e. terra-torch or Premo-Mark III). • Ignition continues for two burning periods. • Resources required for 2 to 3 days. • Holding actions to direct or delay fire spread.	• Complex firing patterns highly dependent upon local conditions. • Simultaneous use of multiple firing methods and/or sequences, greater than 2 igniters inside unit. • Simultaneous ground and aerial ignition. • Use of heli-torch. • Resources required for over 3 days. • Multiple mitigation actions at variable temporal and spatial points identified. • Aerial support for mitigation actions desirable or necessary.
12. Cooperator Coordination Weighting Factor - 1	• Cooperators not involved in operations. • No concerns.	• Simple joint-jurisdiction fires. • Some competition for resources. • Some concerns.	• Complex multi-jurisdictional fires. • High competition for resources. • High concerns.

APPENDIX M. CAMP EDWARDS POST-BURN SUMMARY TEMPLATE

Prescribed Fire Summary Report

Date:
Burn Units:
Location:
Landowners:

Prepared by:
Date Prepared:

Review by:
Date Reviewed:

Appendices:

Overview:
An abstract of document including overall burn operations describing location, ownership, primary legal considerations, ecological objectives, ect…

Event Summary:
This section includes a description of burn unit(s), burn objectives, and prescription treatments. A table from the FEMO Event Log should be included. Any outstanding happenings should also be mentioned here.

Table 1. Event log for *month, day, year*.

Time	Event

Table 2. Hourly totals for events of *month, day, year*.

Time	Event

Weather:
Describe the weather parameters required to meet prescription (see site specific burn plan), also include weather predictions leading up to the burn day. Recount weather data, through written description, collected by the FEMO during burn operations including tables highlighting burn day running events and monitored weather data. Also describe in writing and via tables fuel moistures collected by the FEMO for various fuel classes.

Table 3. Monitored fire weather on *month, day, year*.

	1	2	3	4	5	6	7	8
Time								
Wind (min)								
Wind (avg)								
Wind (max)								
Wind Dir.								
Dry Bulb (F)								
Wet Bulb (F)								
RH (%)								
Cloud Cov (%)								

Table 4. Fuel moisture reading taken on *month, day, year*.

Time	Fuel Model	Sun (D) Shade (S)	1-H (%)	10-H (%)	100-H (%)

Fire Behavior:
Description of fire behavior as recorded by the FEMO. Include and graphics of tables as needed.

Smoke Behavior:
Include a description of smoke behavior and any specific management notes as needed.

Fire Effects:
Include a description of any first order fire effects (i.e., biomass consumption, crown scorch, bole damage, and smoke production) observed during burn day. Attach any necessary figures, tables, or appendices as necessary.

Resources:
Describe all resources used for the prescribed burn from all agencies involved including equipment, personnel, and vehicles. Tables, figures, and appendices are to be included when necessary. Also include a brief description of resource utilization and assignment (i.e., holding lines, positions, ect…)

Table 5. Expended resourced during burn activities on *month, day, year*.

Resources	Quantity
Acreage	
Torch Fuel (ga.)	
Flares	
Pump Fuel (ga.)	
Vehicle Fuel (ga.)	
Water (ga.)	
Drinking Water (ga.)	
Person Hours	

Table 6. Personnel resourced involved with burn activities on *month, day, year*.

Organization	Personnel
Total	

Table 7. Vehicle resources used on *month, day, year*.

Organization	Vehicle	Type	Capacity (ga.)

Table 8. Assignment list for personel during burn on *month, day, year*.

Assignment	Name	Organization	Qualifications
Burn Boss			
FEMO			
Holding line			
Holding Boss			
Holding Boss Apprentice			
Holding line			
Holding Boss			
Interior Ignition			
Ignition Boss			

After Action Review:
Final comments and suggestions…

Appendices:
Include any additional data in this section that appends the above text.

APPENDIX N. TYPE 6 ENGINE, SPECIFICATIONS

- Four wheel drive with greater than adequate load suspension.
- Pump Rating – minimum flow 30gpm at 100psi
- Tank Capacity – range 150-400 gal
- Standard Plumbing
    - suction inlet, 2" (or 1½")
    - pressure relief valve with bypass
    - proportioner, foam injection
    - three discharge outlets, ¾", 1" (to reel), 1½"
    - booster hose, 100' x 1"
- Hose
    - 2 ea., hard suction, 10'x2" (or 1½" if pump so plumbed)
    - 1 ea., high pressure, abrasion resistant, fill, 25'x1½"
    - 3 ea., lightweight forestry, 100'x1½"
    - 3 ea., lightweight forestry, 100'x1"
    - 2 ea., high pressure, garden, 50'x¾"
- Nozzles
    - 2 ea., forester twin tip, 1"
    - 2 ea., adjustable barrel, ¾"
    - 2 ea., combination, 1"
    - 1 ea., foam, air aspirated, 1"
- Reducers
    - 1 ea., 2½"x1½"
    - 2 ea., 1½"x1"
    - 2 ea., 1"x¾"
- Adapters
    - 2 ea., 1½"NH x 1½"NPSH
    - 2 ea., 1"NPSH x 1"NH
    - 2 ea., 1" NH x 1"NPSH
- Accessories
    - 2 ea., gated wye, 1½"
    - 1 ea., foot valve strainer, 2" (or 1½")
    - 2 ea., spanner wrench
    - 1 ea., hydrant wrench
- gaskets, assorted
- handtools (rake, pulaski, shovel, torch, collapsible back pack pump)
- mechanic tools, files, spark plug
- Optional items
    - Tees, shut-offs, double male/female, hose clamp, wand, tips

APPENDIX O. MASSACHUSETTS ARMY NATIONAL GUARD HELICOPTER SUPPORT PROCEDURES