STATE OF THE RESERVATION REPORT

TRAINING YEAR 2023• CAMP EDWARDS
FINAL

Final Annual State of the Reservation Report, Camp Edwards, Training Year 2023
April 2024

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PREFACE

The Annual *State of the Reservation Report* (the Annual Report), established by the Massachusetts Environmental Policy Act process and required by state law (Chapter 47 of the Acts of 2002), is the result of many years of environmental reviews and submissions by the Massachusetts Army National Guard.

The Annual Report describes the nature and extent of military training and other activities taking place in the Camp Edwards Training Area/Upper Cape Water Supply Reserve. In addition, it describes the status of the Massachusetts Army National Guard's compliance with environmental laws, regulations and the Environmental Performance Standards, a set of 19 standards established in Chapter 47 of the Acts of 2002 guiding military and civilian usage of the Camp Edwards Training Area/Upper Cape Water Supply Reserve (Training Area/Reserve). The Annual Report illustrates that coordinated military training can occur in the Camp Edwards Training Area/Upper Cape Water Supply Reserve in a manner that is compatible with the natural resources purposes of water supply and wildlife habitat protection.

The Annual *State of the Reservation Report* covers the Massachusetts National Guard's Training Year 2023, which ran from October 1, 2022 to September 30, 2023; therefore, information provided in this report generally encompasses an individual training year rather than calendar year. The Annual Report's primary focus is the review of the Massachusetts Army National Guard's environmental programs relative to compliance with applicable local, state, and federal regulations. Each year, the Annual Report provides information on military training levels, range area usage, resource management activities, environmental indicators for training activities, and coordination among other activities and projects, such as the regional water supply and the remediation program activities.

The Annual Report also provides information on environmental reviews for proposed Massachusetts National Guard and other projects within the Upper Cape Water Supply Reserve.

The Annual Report is structured as follows:

Section 1, Introduction, discusses the structure of Joint Base Cape Cod and the environmental management structure pertaining to activities in the northern training areas of Camp Edwards.

Section 2, Small Arms Ranges and Military Training Activities, provides an update on live fire at the Small Arms Ranges at Camp Edwards and associated activities. This section also provides information on military training that occurred in the Training Area/Reserve during Training Year 2023. Data are provided on the levels of training in the various training areas in the Training Area/Reserve and range usage, as well as at the various training support area facilities in the Cantonment Area on Camp Edwards.

Section 3, Environmental Program Management, focuses on environmental management programs operated by the Massachusetts Army National Guard in the Training Area/Reserve and program compliance with the Environmental Performance Standards for the Training Area/Reserve for the training year.

Section 4, Remediation Program Activities, provides a summary of remediation activities undertaken in the Training Area/Reserve during the training year by the Installation Restoration Program and the Impact Area Groundwater Study Program.

Section 5, Miscellaneous Military and Civilian Activities and Environmental Program Priorities, provides information on major activities undertaken during Training Year 2023 that may not be directly related to a Massachusetts Army National Guard Environmental Management Program, actions in the Training Area/Reserve, or specific Environmental Performance Standards for the Training Area/Reserve.

The Annual Report is the culmination of a year-long effort by the military and civilian employees of the Massachusetts Army National Guard, Training Site Camp Edwards, the Environmental & Readiness Center, the Natural Resource Program, and the Environmental Management Commission to provide valuable information on the state of the Training Area/Reserve to interested stakeholders and the community at large. In good faith, the Annual Report is provided to the Environmental Management Commission's Environmental Officer, and the Commission's Science Advisory Council and Community Advisory Council for their input.

Annual State of the Reservation Report Key Terms

Upper Cape Water Supply Reserve

The Upper Cape Water Supply Reserve was established by Chapter 47 as public conservation land dedicated to three primary purposes: water supply and wildlife habitat protection; the development and construction of public water supply systems, and the use and training of the military forces of the commonwealth; provided that, such military use and training is compatible with the natural resource purposes of water supply and wildlife habitat protection. It comprises—and for the purposes of this report, may be synonymous with—Camp Edwards' 14,886-acre northern training area.

Camp Edwards Training Area

The Massachusetts Army National Guard Camp Edwards Training Site (Camp Edwards Training Area) is the major training area for Army National Guard soldiers in the Northeast. It is approximately 14,886 acres located on the northern portion of Joint Base Cape Cod. At Camp Edwards, soldiers practice maneuvering exercises, bivouacking, and use the small arms ranges. The Upper Cape Water Supply Reserve also is located on the 14,886 acres of Camp Edwards. It comprises—and for the purposes of this report, may be synonymous with—Camp Edwards' 14,886-acre northern training area.

Environmental Performance Standards

The Environmental Performance Standards (Appendix A) are a list of requirements, or standards for performance, that guide both military and other users in the protection of Camp Edwards' natural and cultural resources and the groundwater beneath the Training Area/Reserve. The Environmental Performance Standards were specifically created through the Massachusetts Environmental Policy Act process to protect the resources in the Training Area/Reserve and codified in Chapter 47 of the Acts of 2002. They are based in large part on existing federal, state, and Department of Defense regulations. In some cases, the protections offered by the performance standards are more stringent than those offered by other regulations. These standards apply to the Upper Cape Water Supply Reserve within the Camp Edwards Training Area.

Training Year

A training year runs from October 1 to September 30 and is based on the federal fiscal year. Information found in the annual *State of the Reservation Report* is compiled by training year. This *Annual State of the Reservation Report* is for Training Year 2023 (October 1, 2022 – September 30, 2023).

Training Support Area

There are separate facilities and equipment that can simulate live military training; these are grouped under the Training Support Area. The majority of the training activities associated with these facilities are conducted in the Cantonment Area of Camp Edwards. Training Support Areas include Kelley Tactical Training Base, the Calero Mobile Military Operations on Urban Terrain Site, the Engagement Skills Trainer, and the Virtual Convoy Operations Trainer, which are all outside of the Upper Cape Water Supply Reserve/Camp Edwards Training Area.

Small Arms Ranges

Small arms ranges allow live-fire qualification training with weapons of a small caliber, i.e., pistols, rifles and semi-automatic and automatic rifles. Small arms training is designed to train a soldier to be "qualified" in the use and maintenance of his or her assigned weapon. There are four operational active small arms ranges on Camp Edwards, which the Massachusetts Army National Guard uses for weapons familiarization, weapons zeroing (essentially customizing it to give the soldier a more accurate shot) and qualification. There are two ranges currently undergoing redesign/reconfiguration. On Camp Edwards there are 11 operationally inactive legacy ranges that have been remediated by the Impact Area Groundwater Study Program as required.

Impact Area

The 2,200-acre Impact Area is located in the center of the Upper Cape Water Supply Reserve/Camp Edwards Training Site. The small arms ranges, both active and inactive, are situated around the perimeter of the Impact Area, with range firing toward the Impact Area. The 330-acre Central Impact Area is located within the Impact Area; it was the primary target area for artillery, mortar, and other firing activities from the early 1900s until firing ceased in 1997.

Cantonment Area

The southern 7,200-acre developed area of Joint Base Cape Cod with roads, utilities, office and classroom buildings, training support areas, and housing. There are numerous federal, state and county entities located there.

Referenced Documents

The Annual *State of the Reservation* report encompasses a large amount of information and makes reference to many letters, reports and other documents that were developed over the course of Training Year 2023. Many of these are available on-line and any letter, document or report referenced in the *Annual State of the Reservation Report* is available by contacting Emily Kelly, Community Involvement Specialist, Massachusetts National Guard Environmental & Readiness Center, 339-202-9341, emily.d.kelly2.nfg@army.mil. The Massachusetts National Guard Environmental & Readiness Center's website is: https://www.massnationalguard.org/ERC/index.htm. The Environmental Management Commission's website may be found at: https://www.mass.gov/info-details/environmental-management-commission-emc.

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ACRONYMS

AFCEC	Air Force Civil Engineer Center
AgCS	Agassiz's Clam Shrimp (*Eulimnadia agassizii*)
AmCS	American Clam Shrimp (*Limnadia lenticularis*)
ANGB	Air National Guard Base
AR	Army Regulation
ATV	All Terrain Vehicle
BP	Battle Position
BMP	Best Management Practice
CAA	Clean Air Act
CAC	Community Advisory Council
CER	Camp Edwards Regulation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulation
CIA	Central Impact Area
CMP	Conservation and Management Plan
CMR	Code of Massachusetts Regulations
CPMPP	Construction Period Monitoring and Protection Plan
CRREL	Cold Regions Research and Engineering Laboratory
CS	Chemical Spill
CSCRMP	Clam Shrimp Conservation and Roadway Maintenance Plan
CSE	Comprehensive Site Evaluation
DBH	Diameter at Breast Height
DCR	Department of Conservation and Recreation
DFG	Department of Fish and Game
DFW	Division of Fisheries and Wildlife
DoD	Department of Defense
E&RC	Environmental & Readiness Center
EDB	Ethylene Dibromide
EMC	Environmental Management Commission
EPA	Environmental Protection Agency
EPR	Enhanced Performance Round
EPS	Environmental Performance Standard
FS	Fuel Spill
IAGWSP	Impact Area Groundwater Study Program
IED	Improvised Explosive Device
IMT	Individual Movement Techniques
INRMP	Integrated Natural Resources Management Plan
IWFMP	Integrated Wildland Fire Management Plan
IRP	Installation Restoration Program
ITAM	Integrated Training Area Management

Acronyms, continued

IWFMP	Integrated Wildland Fire Management Plan
JBCC	Joint Base Cape Cod
LQG	Large Quantity Generator
MAANG	Massachusetts Air National Guard
MAARNG	Massachusetts Army National Guard
MANG	Massachusetts National Guard
MassDEP	Massachusetts Department of Environmental Protection
MassDOT	Massachusetts Department of Transportation
MA SHPO	Massachusetts State Historic Preservation Office
MEC	Munitions and Explosives of Concern
MEPA	Massachusetts Environmental Policy Act
MESA	Massachusetts Endangered Species Act
MGL	Massachusetts General Law
MIPAG	Massachusetts Invasive Plants Advisory Group
mm	millimeter
MMR	Massachusetts Military Reservation
MMRP	Military Munitions Response Program
MPMG	Multipurpose Machine Gun Range
NBC	Nuclear-Biological-Chemical
NEPA	National Environmental Policy Act
NHESP	Natural Heritage and Endangered Species Program
NLEB	Northern Long-eared Bat
NWCG	National Wildfire Coordinating Group
OB/OD	open burning/open detonation
OMMP	Operation, Maintenance and Monitoring Plan
P2	Pollution Prevention
PAVE PAWS	Precision Acquisition Vehicle Entry – Phased Array Warning System
ppb	parts per billion
ppm	parts per million
PFAS	Per- and polyfluoroalkyl substances
RDX	Royal Demolition Explosive
REC	Record of Environmental Consideration
RI/FS	Remedial Investigation/Feasibility Study
ROA	Record of Action
ROD	Record of Decision
ROTC	Reserve Officers Training Corps
SAC	Science Advisory Council
SDZ	Surface Danger Zone
SGCN	Species of Greatest Conservation Need
SFS	Space Force Station

Acronyms, continued

SOP	Standard Operating Procedure
SR/ES	Source Registration/Emissions Statement
SVL	Soldier Validation Lane
TA	Training Area
TSA	Training Support Area
TTB	Tactical Training Base
TY	Training Year
UAS	Unmanned Aerial System
UMass	University of Massachusetts
URI	University of Rhode Island
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UTES	Unit Training and Equipment Site
UTM	Ultimate Training Munition
WFPC	Wildland Fire Program Coordinator
WPA	Wetlands Protection Act
WWTP	Waste Water Treatment Plant

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SECTION 1 INTRODUCTION

1.0 INTRODUCTION

This section of the Annual *State of the Reservation Report* (Annual Report) provides information on Joint Base Cape Cod (JBCC) and the environmental management structure overseeing activities in the approximately 14,886-acre Camp Edwards Training Area/Upper Cape Water Supply Reserve (Training Area/Reserve). The Upper Cape Water Supply Reserve is located on, and is contiguous with, the 14,886 acres of the Camp Edwards Training Area. (See Section 1.1 and Figure 1-1).

1.1 JOINT BASE CAPE COD STRUCTURE

Joint Base Cape Cod is a multi-service military installation and is home to the Massachusetts Army National Guard's (MAARNG) Camp Edwards, the Massachusetts Air National Guard's (MAANG) Otis Air National Guard Base (ANGB), the United States Coast Guard's (USCG) Base Cape Cod, USCG Air Station Cape Cod, the U.S. Space Force's Cape Cod Space Force Station (SFS), and the Department of Veterans Affairs Cemetery. Joint Base Cape Cod is located in the upper western portion of Cape Cod, immediately south of the Cape Cod Canal in Barnstable County, Massachusetts. It includes parts of the towns of Bourne, Mashpee and Sandwich, and abuts the Town of Falmouth. Joint Base Cape Cod covers nearly 21,000 acres – approximately 30 square miles (Figure 1-1).

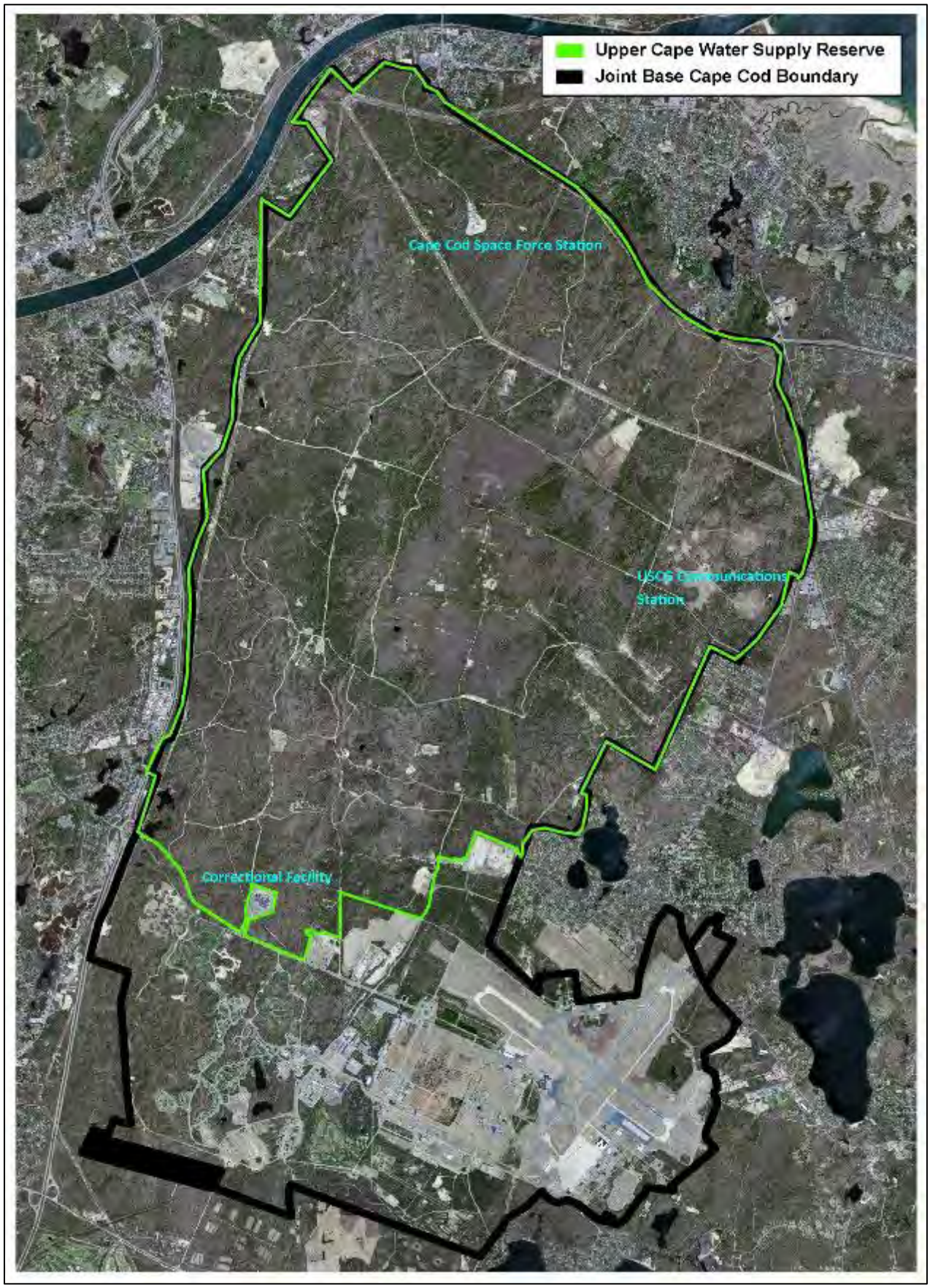
The Camp Edwards Training Area comprises 14,886 acres of the northern portion of JBCC. The remaining Camp Edwards military-controlled area of JBCC lies in the southern portion, or Cantonment Area. The Commonwealth of Massachusetts owns the land comprising Camp Edwards and leases the property to the Department of the Army, who in turn licenses the land to MAARNG for training.

The MAARNG and MAANG are part of the Commonwealth of Massachusetts Military Division. However, federal law largely dictates their activities, make-up, training, and functions. For example, most of the day-to-day activities conducted at JBCC by the National Guard, including annual and weekend training, are federal military activities funded by the federal government. In conducting federal military activities, the National Guard is required by federal law to follow Department of Defense (DoD) regulations, Army regulations, Air Force instructions, and applicable federal and state laws and regulations.

There are three major facilities in the northern portion of JBCC that are not on land under the operational control of the Massachusetts National Guard. Cape Cod SFS, which includes the PAVE PAWS ballistic missile early warning radar system, is located on an 87-acre parcel of land on the northwest corner of the Training Area/Reserve. The USCG's Communications Station is located on a 542-acre parcel along the northeastern side of the Training Area/Reserve. A Barnstable County Correctional Facility that opened in 2004 is located on a 29-acre parcel of land between Connery Avenue and the southern edge of the Training Area/Reserve. The locations of these facilities are shown in Figure 1-1. These facilities are located on land not under the control of the Massachusetts National Guard; therefor, detailed information concerning activities at these facilities is not included in the Annual Report. Questions pertaining to activities at Cape Cod SFS, the Coast Guard Communications Station, and the Barnstable County Correctional Facility should be addressed to the persons listed in Appendix A of this report.

The Commonwealth of Massachusetts has issued three utility easements on its state-owned property in the Training Area/Reserve: an electrical power line easement (Eversource), a natural gas pipeline easement (National Grid), and a natural gas pipeline easement (Algonquin - that partially overlays the National Grid easement).

Figure 1-1 Map of Joint Base Cape Cod



Additionally, there are easements issued to the Upper Cape Regional Water Supply Cooperative and to the Bourne Water District. The locations of the utilities and facilities are shown in Figure 1-2.

1.2 ENVIRONMENTAL MANAGEMENT STRUCTURE

1.2.1 Environmental Management Commission

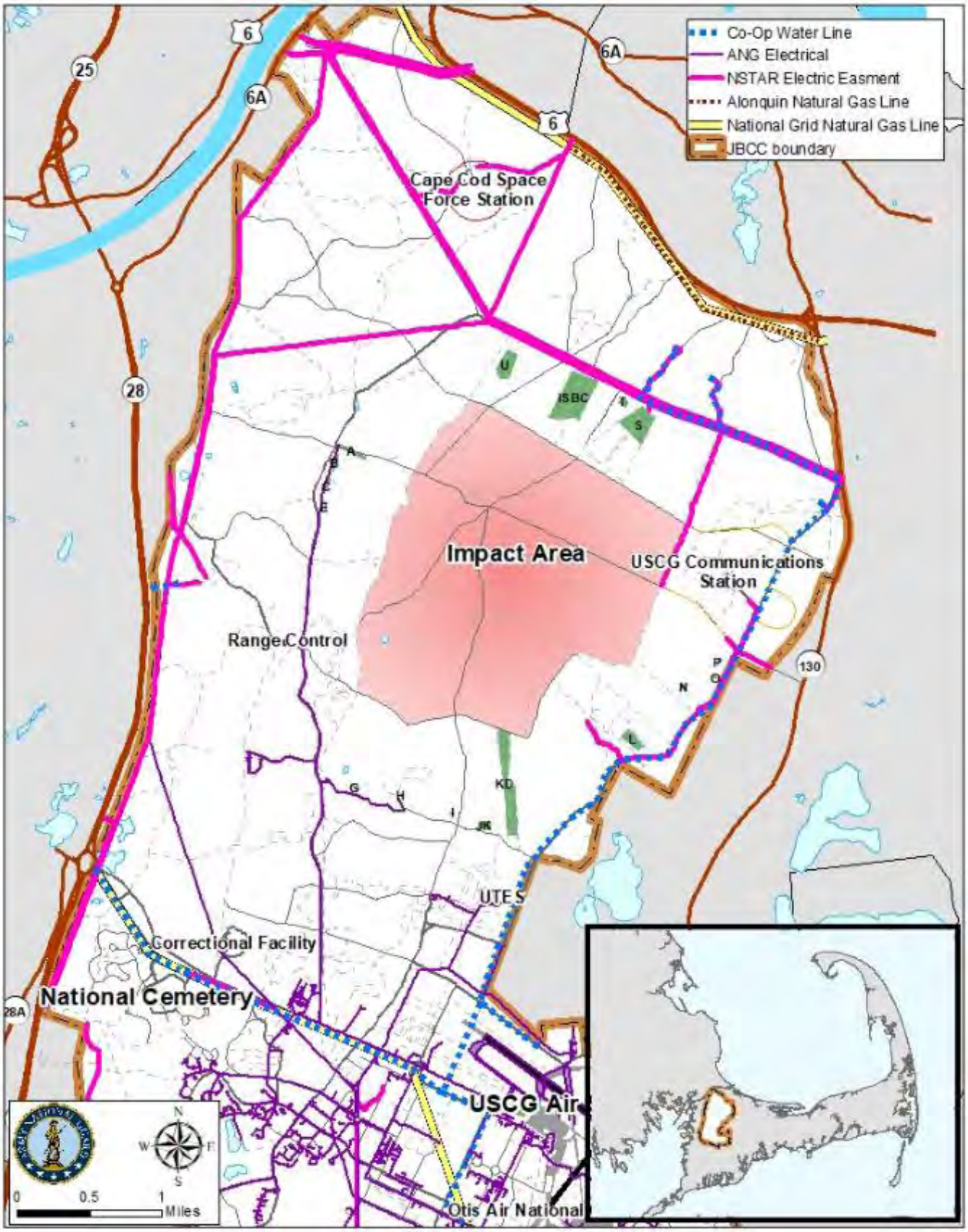
Chapter 47 of the Acts of 2002 (hereafter Chapter 47) established the Environmental Management Commission (EMC), consisting of the Commissioner of the Department of Fish and Game (DFG), the Commissioner of the Massachusetts Department of Environmental Protection (MassDEP), and the Commissioner of the Department of Environmental Management (now the Department of Conservation and Recreation [DCR]). The EMC oversees compliance with and enforcement of the Environmental Performance Standards (EPSs) (see Appendix B) in the Training Area/Reserve, coordinates the actions of environmental agencies of the Commonwealth in the enforcement of environmental laws and regulations in the Training Area/Reserve, as appropriate, and facilitates an open and public review of all activities in the Training Area/Reserve. The legislation also states that the environmental agencies on the EMC retain all their respective, independent enforcement authority.

Chapter 47 also directed that the EMC be assisted by two advisory councils, appointed by the Governor of Massachusetts. The Community Advisory Council (CAC), consisting of 15 members, assists the EMC by providing advice on issues related to the protection of the water supply and wildlife habitat within the Training Area/Reserve. The Science Advisory Council (SAC), consisting of up to nine members, assists the EMC by providing scientific and technical advice relating to the protection of the drinking water supply and wildlife habitat within the Training Area/Reserve. Table 1-1 lists the current CAC and SAC members.

TABLE 1-1 COMMUNITY ADVISORY COUNCIL AND SCIENCE ADVISORY COUNCIL MEMBERS

Community Advisory Council	
Member	**Area**
Andrew Campbell	Bourne Representative
Shawn Cody	Military Member
James Cummings	At-Large Member
James Dishner	At-Large Member
Viginia Gaglio	Military Member
Mark Harding	Wampanoag Representative
Mimi McConnell	At-Large Member
Heather McElroy	Cape Cod Commission
Jack Phelan	Mashpee
Robert Prophett	Upper Cape Water Supply Reserve Cooperative
Ernest Virgilio	At-Large
Ralph Vitacco	Sandwich
Science Advisory Council	
Member	**Area**
Paul Cavanagh	Subject Matter Expert, Natural Resources
Phil Gschwend	Subject Matter Expert, Chemistry
Denis LeBlanc	Subject Matter Expert, Hydrogeology
Tara Lewis	Subject Matter Expert, Natural Resources

Figure 1-2 Utility Easements and Leases



Chapter 47 also established an Environmental Officer for the Training Area/Reserve. Mr. Leonard Pinaud of MassDEP is the current Environmental Officer. In this capacity, the Environmental Officer provides monitoring of military and civilian activities on and uses of the Training Area/Reserve and the impact of those activities and uses on the water supply and wildlife habitat. Working directly for the EMC, the Environmental Officer has unrestricted access to all data and information from the various environmental and management programs in the Training Area/Reserve. The Environmental Officer has full access to all points in the Training Area/Reserve and conducts inspections at any time in order to monitor, oversee, evaluate, and report to the EMC on the environmental impact of military training and other activities. The Environmental Officer's on-site monitoring occurs prior to, during, and immediately following training and other activities. The Environmental Officer's monitoring activities include but are not limited to training sites, pollution prevention and habitat protection activities for both military and military contractors and civilians and civilian contractors in the Training Area/Reserve, as well as coordinating with and consulting with the Massachusetts National Guard Environmental & Readiness Center (E&RC) on various projects, initiatives and issues.

The Environmental Officer acts as a liaison between the EMC, SAC, CAC, military, general public, and various state agencies. The Environmental Officer identifies and monitors ongoing issues regarding training procedures and the environment in the Training Area/Reserve and keeps the EMC, SAC and CAC apprised of the progress of these issues in addition to bringing issues to the E&RC for resolution. The Environmental Officer also participates in community outreach activities with the E&RC and facilitates the EMC, SAC and CAC public meetings under the legislation.

During TY 2023, the SAC met in May 2023 and September 2023, and the CAC met in October 2022 and May 2023. The EMC met in October 2022 and June 2023. The advisory councils discussed a number of topics, all of which are covered in this report. Minutes from the meetings may be found at https://www.mass.gov/info-details/environmental-management-commission-emc.

Science Advisory Council Ad Hoc Committee

On November 2, 2017, the EMC formed an Ad Hoc Committee to the SAC to review the current small arms range environmental monitoring process and aide in developing the most appropriate monitoring processes for those ranges. Committee members are SAC member Phil Gschwend, a geochemist, SAC member Denis LeBlanc, US Geological Survey, and Jay Clausen from the US Army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL), who is a metals mobility expert. The committee had a sunset clause of two years; however, based on the effectiveness of the body and emerging issues, e.g., range monitoring and pyrotechnics, the EMC voted to allow the Ad Hoc committee to continue. The Ad Hoc Committee was most recently extended to 2024 during the EMC meeting in July 2022.

The Ad Hoc Committee did not meet during TY 2023 but met in early TY 2024 to discuss projectile removal at Camp Edwards' small arms ranges.

SECTION 2
SMALL ARMS RANGES AND MILITARY TRAINING ACTIVITIES

2.0 INTRODUCTION

Section 2 of the Annual Report provides an update on actions associated with operational active small arms ranges in the Training Area/Reserve including range maintenance, environmental sampling, and levels of military and civilian use of the ranges.

This section also provides information on the use of Training Areas, Training Support Areas (TSA) in the Cantonment Area of Camp Edwards, information on simulated munitions, and off-site training during TY 2023.

The Massachusetts National Guard (MANG) reports on some Cantonment Area training activities to provide context for why soldiers then move into the Training Area/Reserve to conduct the most realistic training possible to provide for trained and ready soldiers. In the words of the MAARNG trainers, soldiers are provided training in a "crawl, walk, run" scenario. The crawl phase is in the classroom where they learn theory and the basics of the training they are about to undertake; the walk phase is where soldiers can literally walk through the training event in a classroom setting, use simulators, or go into the field and walk through a scenario. Finally, the run phase is where the crawl and the walk phases are put into the most realistic field setting possible in the Training Area/Reserve.

2.1 CAMP EDWARDS TRAINING AREA/UPPER CAPE WATER SUPPLY RESERVE

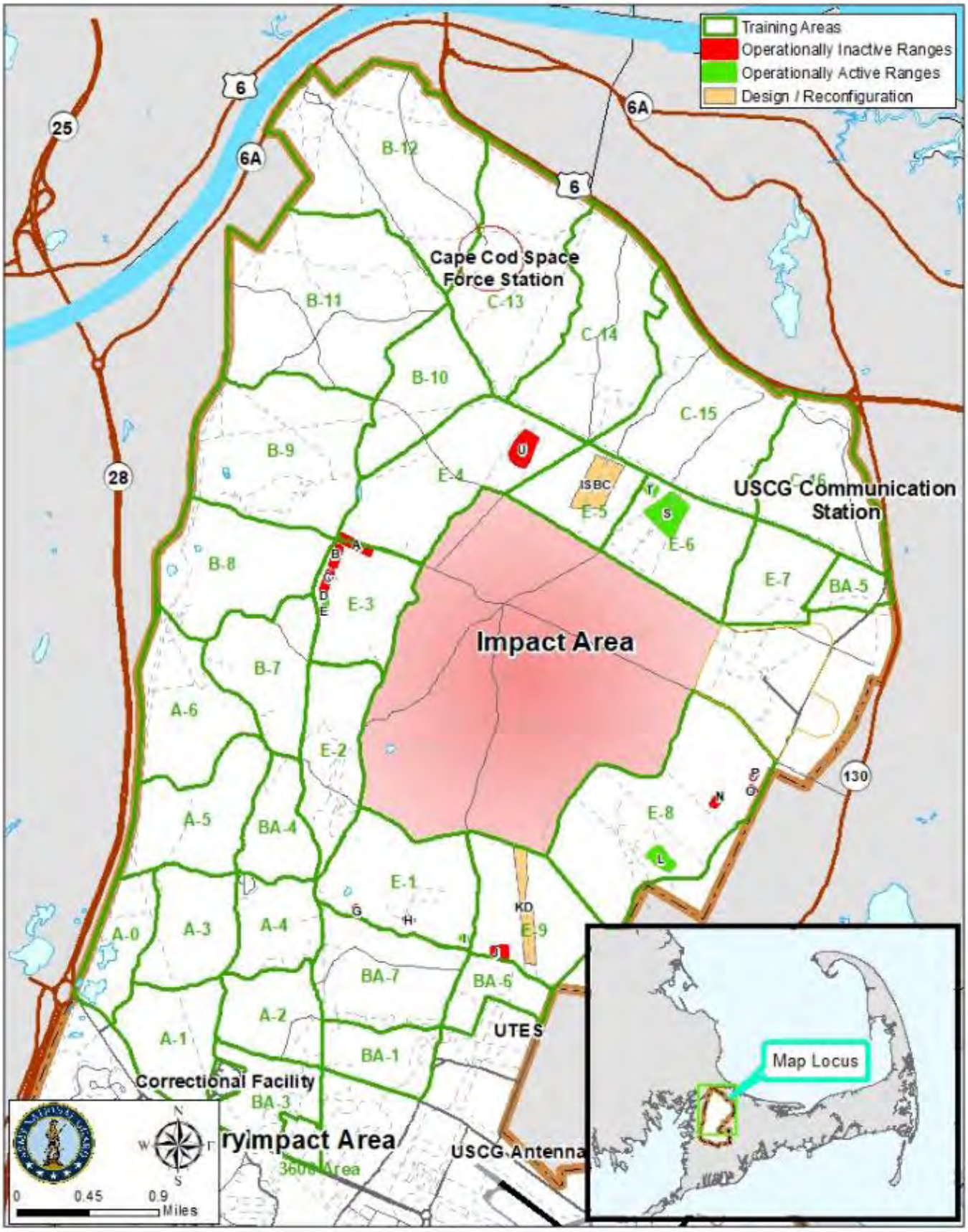
2.1.1 Military and Civilian Use

The MAARNG has approximately 5,601 soldiers who train on average one weekend per month and one two-week cycle during a training year. The Training Area/Reserve is also utilized by other DoD and law enforcement agencies (i.e.: Marines, US Coast Guard, Barnstable County Sheriff's Department, and Federal and local law enforcement). Units start planning their training several years in advance of the year in which they actually conduct their training. The unit leadership assesses the strengths and limitations of its personnel and begins to schedule training sites and resources to best support the training their units require. During the year prior (TY 2022) to the year of execution (TY 2023) units confirm geographical areas and training sites within the Training Area/Reserve. Figure 2-1 shows the locations of the major training areas and small arms ranges in the Training Area/Reserve.

Military training activities in the Training Area/Reserve are tracked by Camp Edwards Range Control based on individual training area use and the number of personnel participating in this use. This method records the number of times each training area is utilized and the number of personnel and vehicles utilizing the areas for each event. Range Control is operational 24 hours per day when units are training and, during a training day, personnel from Range Control will observe units at various locations to ensure that they are following range, safety, and environmental regulations.

Military training activities in the Training Area/Reserve are tracked by the number of times each training area is utilized per day and by the number of personnel and vehicles utilizing the areas for each use. In many cases personnel and vehicles utilize more than one training area per day.

Figure 2-1 Camp Edwards Training Areas and Ranges



As units become aware that the ranges and other training venues at Camp Edwards meet qualification standards, the use of the areas where these venues are located has increased. Fluctuations in training usage is also largely influenced by deployment cycles and changes to training doctrine and directives. Increases in usage are also related to the inaccessibility of other training bases for the MAARNG to use for their readiness training needs. In addition, over the past two decades, legacy contamination cleanup activities (managed by Air Force Civil Engineer Center (AFCEC)/Impact Area Groundwater Study Program (IAGWSP) [See Section 4.0]) in the Training Area/Reserve have resulted in small arms ranges and other training venues being unavailable for use. However, as clean-up activities have been completed these training venues are again available for compatible military use. So, with updated ranges and training venues, and investment in modernizing the Range Operations and Control Area, and the eventual completion of the cleanup program, Training Area use and numbers will fluctuate accordingly.

In Table 2-1 and Table 2-2, civilian use includes use of the ranges and training areas in the Training Area/Reserve and the Training Support Areas (TSA) in the Cantonment Area; civilian use ranges from unmanned aircraft systems ground operations and flight testing, to practicing land navigation, to training in the Calero Mobile Military Operations on Urban Terrain Site, to use of classrooms and other facilities. In addition, there were also public deer and turkey hunting seasons during TY 2023. Information on these activities is provided in Sections 3.5.4 and 3.5.5 of this report. Fluctuations in training days and event numbers from year to year is a result of inaccessibility of other training bases, differing unit training requirements, combined training needs, and deployment cycles (see above paragraph).

Table 2-1 shows the overall utilization of the ranges, training areas and training support areas during TY 2023, while Table 2-2 shows their utilization for each of the past ten training years. Graph 2-1 shows personnel use by training area for TY 2023 and the average personnel use by training area for TY 2014 to TY 2023. Graph 2-2 shows training area usage by days used for TY 2023 and the average days used by training area for TY 2014 to TY 2023.

Use of specific training areas is dependent upon its capacity to hold Soldiers, its appropriateness to support a given training exercise, and restoration of training venues through the AFCEC and IAGWSP cleanup and the Integrated Training Area Management (ITAM) programs. For specific training area use for TY 2023 see Section 2.8.1.

During TY 2023, Camp Edwards supported more standard National Guard training such as weapons qualification, land navigation and maneuvers rather than collective training exercises (training events in which Units of Soldiers using their specific unit specialty learn, practice, and demonstrate proficiency in group activities key to their overall group mission). This is reflected in the military personnel numbers in Table 2-2. While the number of training days/events was less for TY 2023, military personnel usage numbers were higher as individual Soldiers were counted as they moved in and out of various training events at Camp Edwards.

TABLE 2-1 OVERVIEW OF TRAINING USE - TY 2023

		PERSONNEL	
Area	**Training Days/Events**	**Military Personnel**	**Civilian Personnel**
Ranges	166	7,520	0
Training Areas	881	73,154	209
Training Support Areas	2,214	111,365	6,959
TOTAL	**3,261**	**192,039**	**7,168**

TABLE 2-2 TRAINING USE HISTORY

		PERSONNEL	
Training Year	**Training Days/Events**	**Military Personnel**	**Civilian Personnel**
TY 2023	3,261	192,039	7,168
TY 2022	3,894	147,303	12,139
TY 2021	3,947	168,145	6,021
TY 2020	3,041	138,474	6,828
TY 2019	2,481	94,874	12,424
TY 2018	2,118	103,864	1,673
TY 2017	2,268	144,671	3,450
TY 2016	2,065	92,083	2,271
TY 2015	2,105	122,645	2,691
TY 2014	1,845	121,740	2,050
TOTAL	**27,025**	**1,325,838**	**56,715**
MEAN	2,703	132,584	5,672

2.1.2 Training Areas

Camp Edwards has numerous areas that support military training: training areas, battle positions, observation posts, training roads, etc. The training areas also support a variety of training activities including land navigation, bivouacs, Soldier Validation Lanes, meteorological data collection, engineer/infantry/artillery skills training, driver (day and night) training, and Reserve Officer Training Corps (ROTC) training.

Other military users of the training areas during TY 2023 included the US Air Force, the US Air National Guard, US Army, the US Army Reserve, the US Coast Guard, the US Coast Guard Reserve, the US Marine Corps, and the US Navy.

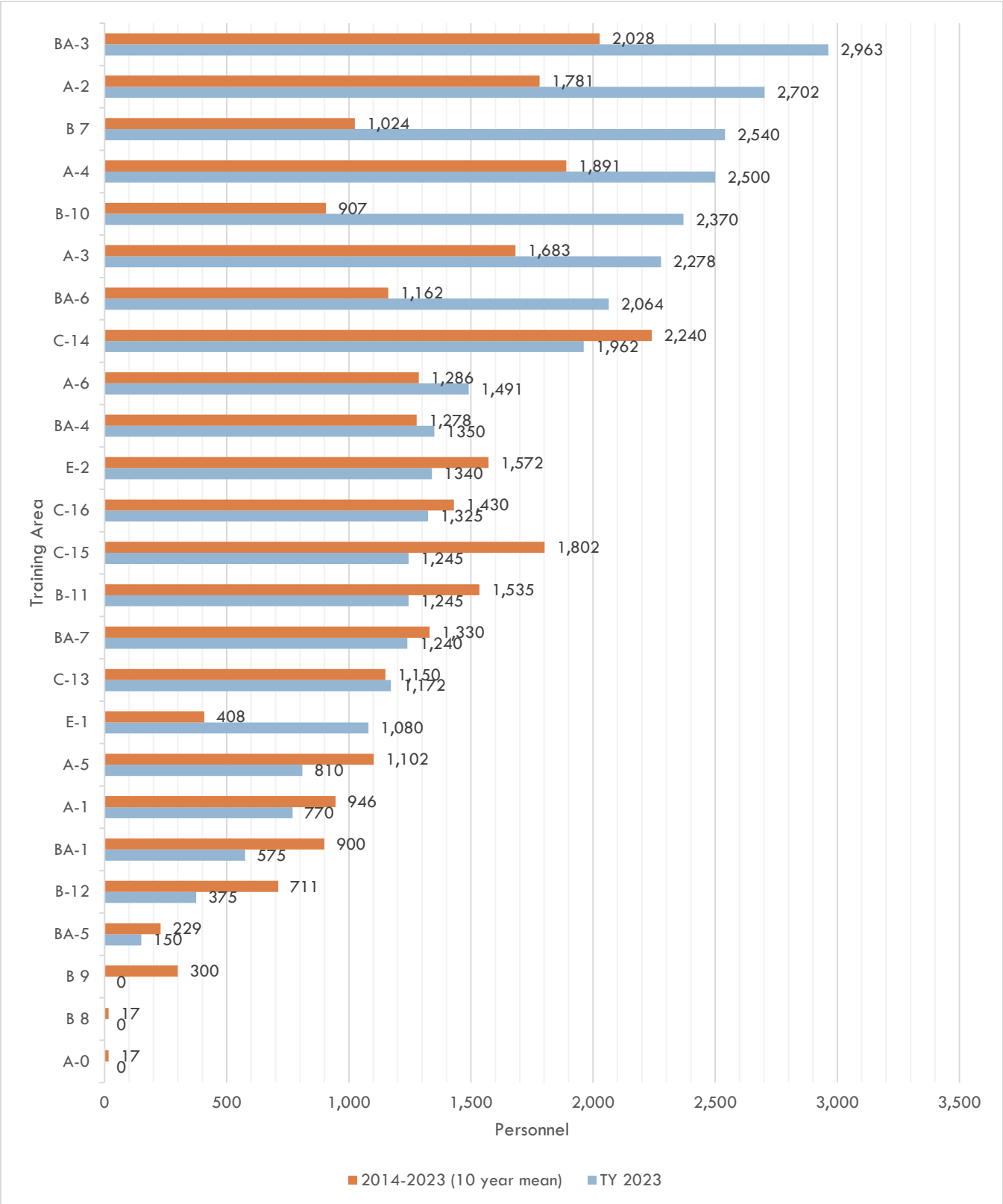
Civilian organizations using the training areas during TY 2023 included the Boy Scouts of America, the Civil Air Patrol, Martin UAV, Textron, and environmental remediation and restoration contractors.

Information on utilization of the training areas and major locations within them during TY 2023 is provided in Table 2-3 and 2-4. The total overall utilization of the training areas for the past 10 training years is included in Table 2-5. The variations over the years in training days and personnel numbers is a result of differing unit training requirements, combined training needs, and deployment cycles. During TY 2023, some type of training was conducted in at least one of the training areas and ranges on 184 calendar days.

The numbers in Tables 2-3 to 2-5 do not include employees and vehicles from the remediation programs and private contracting firms. Also, hunters using the Training Area/Reserve during the deer and turkey seasons are not tracked as they move through the various training areas. During TY 2023, hunter days in the Training Area/Reserve accounted for around 1.3 percent of the usage, and approximately 70% of the Training Area/Reserve was available to hunters during the deer hunting season. Please see Sections 3.5.4 and 3.5.5 for information about the deer and turkey hunting seasons.

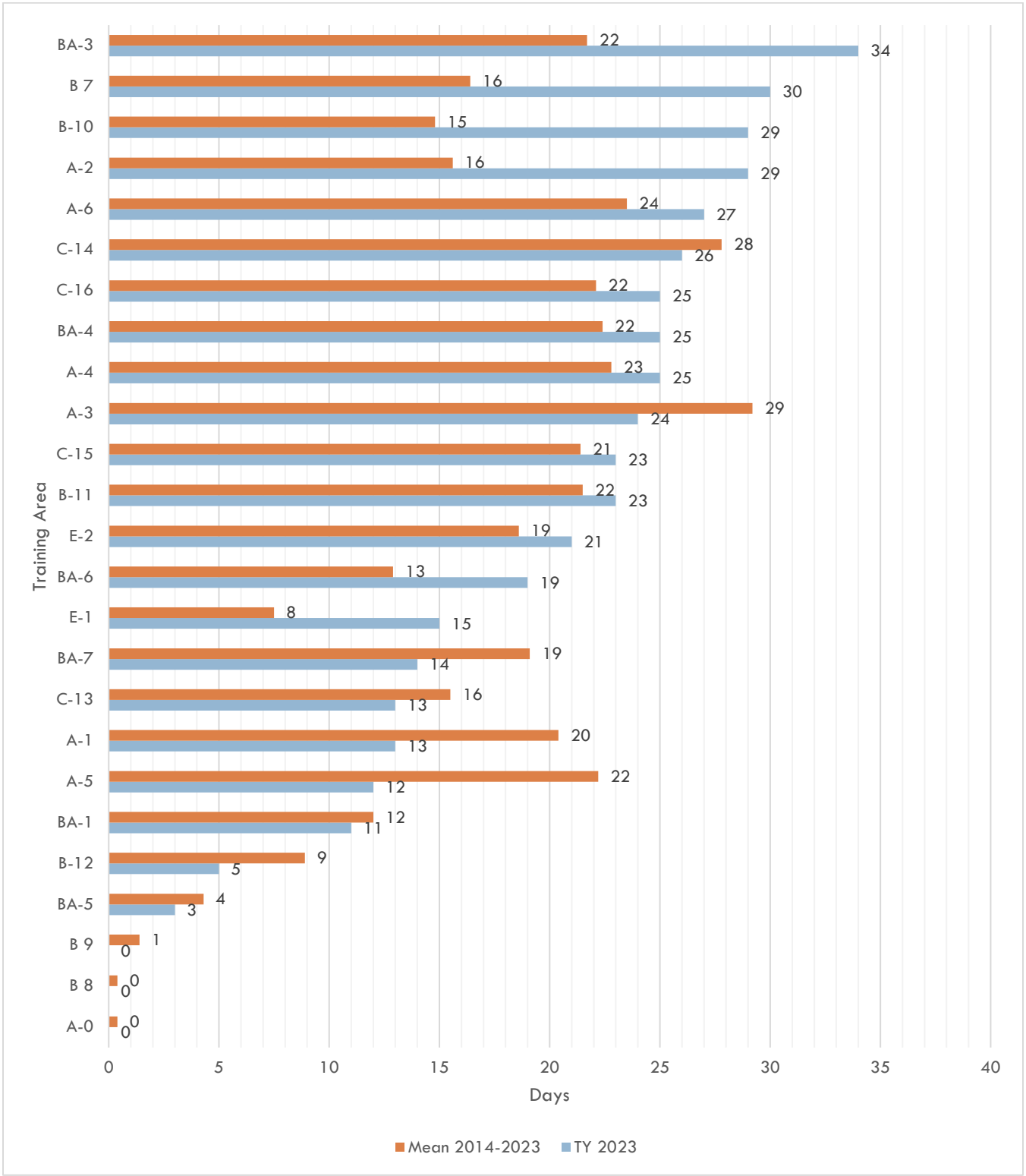
Graph 2-3 provides a visual representation of the military and civilian personnel using the individual training areas in TY 2023. While Graphs 2-4 and 2-5 show military and civilian personnel use in the training area over the past 10 training years. Note: As venues are located within a specific training area, training area venue use is also counted as a training area use.

Graph 2-1 Personnel Use by Training Area



See Figure 2-1 for Trainng Aea locations on Camp Edwards.

Graph 2-2 Training Area Usage by Days Used



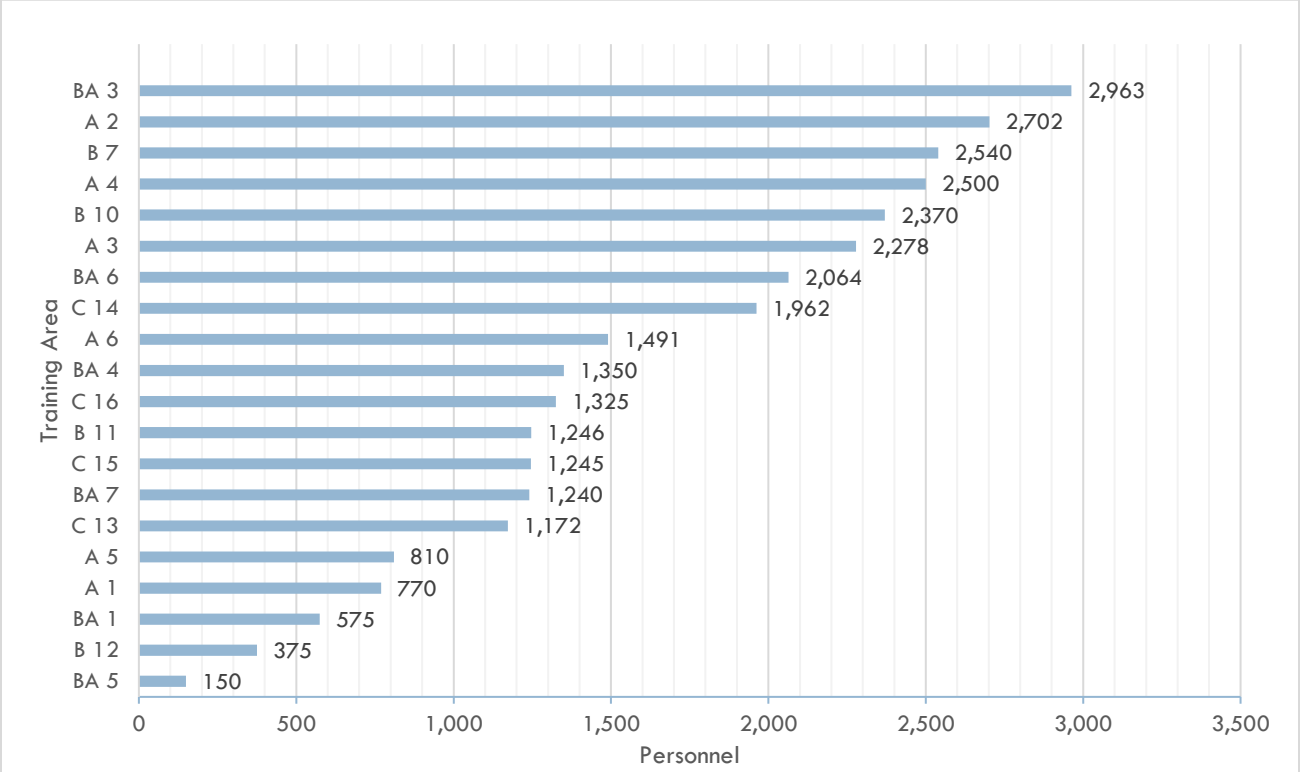
See Figure 2-1 for Trainng Aea locations on Camp Edwards.

TABLE 2-3 TRAINING AREA USE - TY 2023

Training Area	Training Days	Personnel Military	Personnel Civilian	Vehicles (Wheeled) #	Vehicles (Tracked) #
A 1	13	770	0	0	0
A 2	29	2,702	0	0	0
A 3	24	2,278	0	0	0
A 4	25	2,500	0	0	0
A 5	12	810	0	0	0
A 6	27	1,491	0	0	0
B 7	30	2,540	0	0	0
B 10	29	2,370	0	0	0
B 11	23	1,125	120	0	0
B 12	5	375	0	0	0
BA 1	11	575	0	0	0
BA 3	34	2,963	0	0	0
BA 4	25	1,350	0	0	0
BA 5	3	150	0	0	0
BA 6	19	2,064	0	0	0
BA 7	14	1,240	0	0	0
C 13	13	1,172	0	0	0
C 14	26	1,962	0	0	0
C 15	23	1,245	0	0	0
C 16	25	1,325	0	0	0
Total	**410**	**31,007**	**120**	**0**	**0**

See Figure 2-1 for Trainng Aea locations on Camp Edwards.

Graph 2-3 Training Area Use by Military and Civilian Personnel, TY 2024.



See Figure 2-1 for Trainng Aea locations on Camp Edwards.

TABLE 2-4 TRAINING VENUE USE IN THE TRAINING AREAS - TY 2023

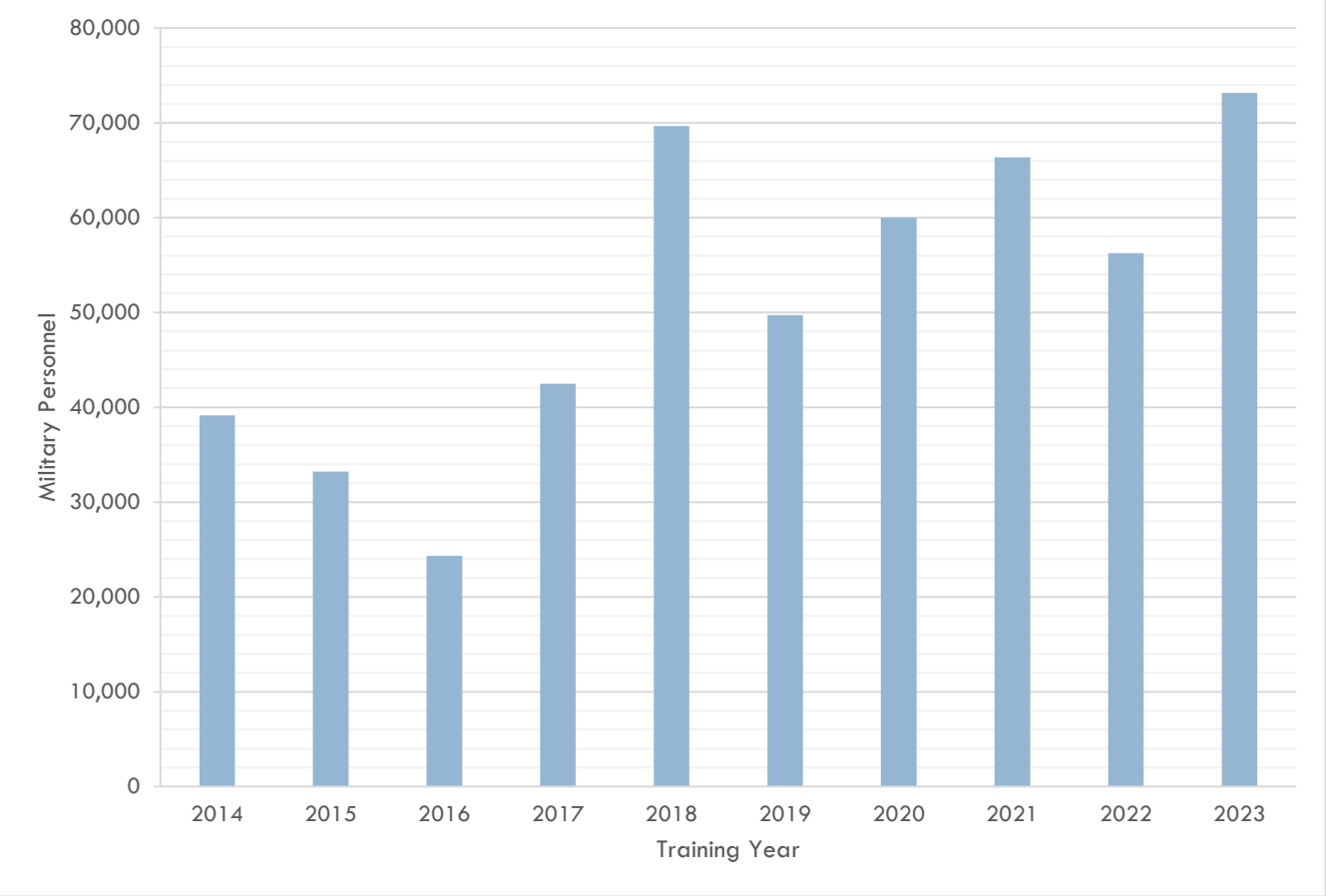
Location	Training Area	Training Days	Personnel		Vehicles (Wheeled) #	Vehicles (Tracked) #
			Military	Civilian		
SVL-OBJ 1	A 4	48	4,837	0	0	0
SVL-OBJ 2	BA 4	17	5,495	0	0	0
SVL-OBJ 4	C 14	3	180	0	0	0
OP 1	E 2	6	240	0	0	0
BP 1	BA-3	1	40	0	0	0
BP 2	BA-4	15	870	0	0	0
BP 6	BA-7	15	1,100	0	0	0
BP 7	BA-7	15	1,100	0	0	0
BP 8	BA-7	15	1,100	0	0	0
BP 9	BA-7	14	675	0	0	0
BP 12	B-11	5	550	0	0	0
BP 14	B-11	3	300	0	0	0
BP 16	B-11	5	550	0	0	0
BP 19	B-11	15	1,100	0	0	0
BP 20	B-11	2	250	0	0	0
BP 24	A-6	3	300	0	0	0
BP 27	E-1	15	1,080	0	0	0
BP 28	E-2	15	1,100	0	0	0
Training Roads	Multiple	63	8,250	0	0	0
Wheelock Hill	A-5	19	3,106	0	0	0
Land Nav 1	A-2	12	441	15	0	0
Land Nav 2	A-5	21	1,027	54	0	0
Land Nav 3	A-1	18	904	0	0	0
Land Nav 4 Alpha	C-15	8	276	0	0	0
Land Nav 4 Bravo	C-16	3	150	0	0	0
Land Nav 4 Charlie	C-15/16	15	679	0	0	0
Dig Site 1	B-9	10	491	0	0	0
Dig Site 2	C-14	11	596	0	0	0
Dig Site 3	BA-1	36	2,434	0	0	0
Landing Zones	Multiple	25	2,790	0	0	0
R4101A Airspace	N/A	17	136	15	0	0
R-4101C Airspace	N/A	1	0	5	0	0
Total		**471**	**42,147**	**89**	**0**	**0**

See Figure 2-1 for Trainng Aea locations on Camp Edwards.

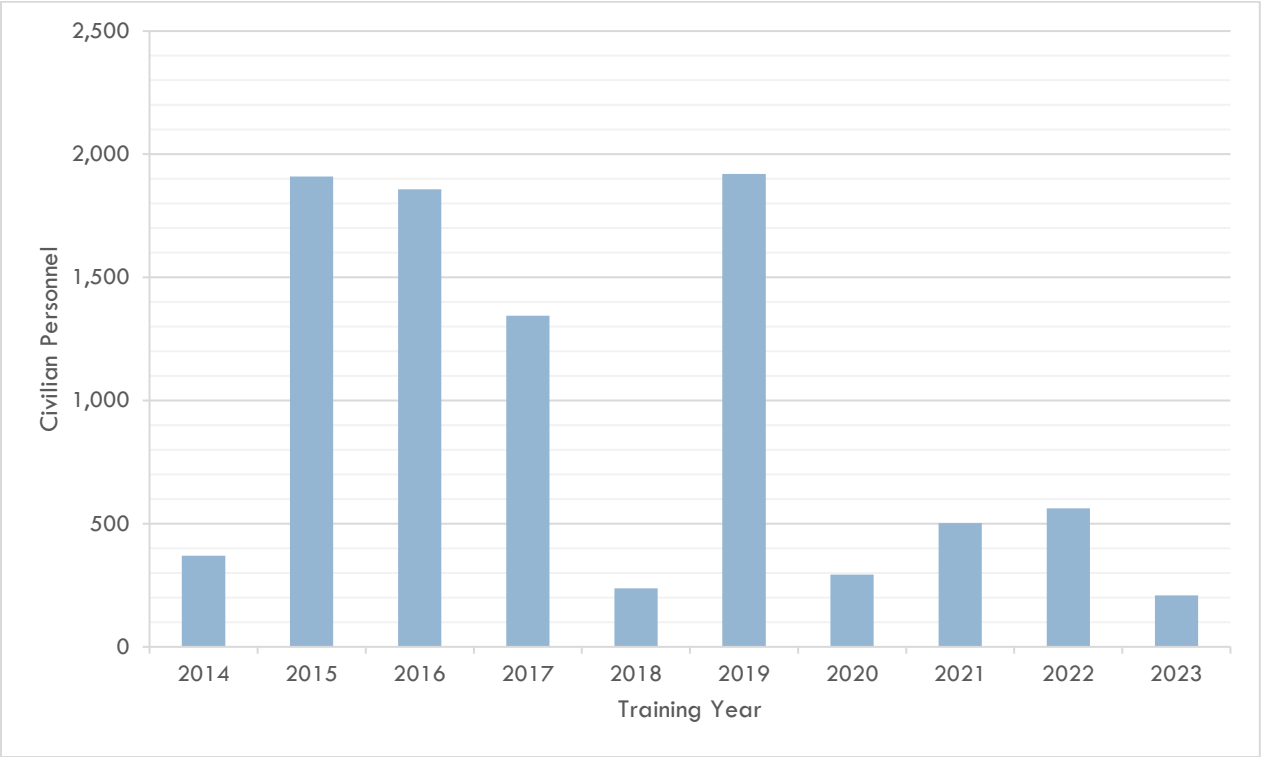
TABLE 2-5 TRAINING AREA USE HISTORY

Training Year	Training Days/Events	Personnel		Vehicles (Wheeled)	Vehicles (Tracked)
		Military	Civilian		
TY 2023	881	73,154	209	0	0
TY 2022	1,088	56,246	562	9	0
TY 2021	1,277	66,374	502	36	0
TY 2020	898	59,994	294	110	0
TY 2019	702	49,716	1,920	618	0
TY 2018	893	69,652	238	530	12
TY 2017	688	42,478	1,344	1,244	12
TY 2016	551	24,344	1,858	2,805	0
TY 2015	681	33,219	1,909	2,198	0
TY 2014	642	39,137	370	4,129	0
TOTAL	**8,301**	**514,314**	**9,206**	**11,679**	**24**
MEAN	830	51,431	921	1,168	2

Graph 2-4 Training Area Use History: Military Personnel



Graph 2-5 Training Area Use History: Civilian Personnel



2.1.3 Vehicle Use, Fueling and Maintenance

Pumping fuel in the Training Area/Reserve has been prohibited by the EPSs since 2002. Currently, the fuel point and the secondary containment pads in the Tactical Training Base (TTB) Kelley area represent the designated location for units to refuel and park and store tanker trucks at Camp Edwards. Exemptions to the EPS 15.3.3, Fuel Management, have been granted to the MAARNG by the EMC Environmental Officer to refuel in the Training Area/Reserve for critical training events, remediation and natural resource restoration work, and utility company modernization and maintenance. Refueling activities in the Training Area/Reserve during these exemptions were all completed with no adverse environmental impacts.

The military does not conduct scheduled vehicle maintenance in the training areas. Personnel in the field are authorized only to check fluid levels, add small amounts, and repair flat tires or track sections that separate during training. Major repairs and other maintenance activities and training occur at the Unit Training Equipment Site (UTES) facility located in the Cantonment Area of Camp Edwards. The UTES facility is a vehicle and motor pool area; the Massachusetts National Guard has also designated the area as a Satellite Accumulation Point to store hazardous waste. Satellite Accumulation Points are defined areas to accumulate hazardous waste (oily solids, flammable solids, etc.) Once the 55 gallon drums are full, they are transported to the 90-day central accumulation area located at the Camp Edwards warehouse. Hazardous waste is picked up on a regular schedule of approximately 70-80 days.

2.1.4 Training Support Areas (Cantonment Area)

There are separate facilities and equipment that can simulate live military training; these are grouped under the Training Support Area (TSA). The majority of the training activities associated with these facilities are conducted in the Cantonment Area of Camp Edwards.

Table 2-6 presents the total number of training days/events and personnel that used each TSA during TY 2023.

TABLE 2-6 TRAINING SUPPORT AREA USE - TY 2023

Training Support Area	Training Days/Events	Personnel	
		Military	Civilian
1100 Training Area (Drivers Training)	45	5,970	0
1300 Training Area	8	2,575	0
ACFT Running Track	44	4,167	25
Asymmetric Threat Classroom	3	153	0
Battle Simulation Ctr - Bldg 1206	102	11,125	420
Battle Simulation Ctr - Rear Offices	145	2,282	0
Battle Simulation - Bldg 1213, 1st Floor	22	660	300
Battle Simulation - Bldg 1213, 2nd Floor	34	885	300
Battle Simulation - TOC Pads	15	1,875	0
Bldg 3499 - IWQ	4	243	0
Calero Mobile MOUT	32	2,202	71
Call for Fire Trainer II 1:30	37	1,001	147
VBS3 Classroom - Bldg 3494	28	775	0
Connery Field	59	4,743	213
Counter IED Visual Indicator Lane	1	15	0
Counter IED Search House (HME)/Site Exploitation	4	43	0
Distance Learning Lab 5218	147	15,977	0
Engagement Skill Trainer 2000 - A	44	1,116	94
Engagement Skill Trainer 2000 - B	74	2,488	168
Engagement Skill Trainer 2000 - C	56	2,110	100
1243-High Risk Entry Facility-Control	14	546	115
1244-High Risk Entry Facility	14	546	115
JBCC Theater, Bldg 5219	126	20,325	2,100
Leadership Reaction Course	38	1,734	138
Lee Field	14	390	2,000
Obstacle Course	30	1,913	83
Rappel Tower 1	8	234	53
Rappel Tower 2	2	125	0
Shaw Field	14	715	50
Shoothouse LFX	3	87	0
Structural Collapse Site	16	3,614	0
TTB Kelley	89	14,356	0
Unstabilized Gunnery	3	43	0
Vault 1 - TSC	81	220	0
Vault 2 - TSC	365	730	0
Vault 3 - TSC	365	730	0
Virtual Convoy Operations Trainer #98 (VCOT - TSC)	7	107	0
Weapons Cleaning - Bldg 3498	16	457	0
Welcome Center	97	2,811	417
YD Memorial Park	8	1,277	50
TY 2023 TOTAL	**2,214**	**111,365**	**6,959**

Overall historical use of the TSA for the past 10 training years is included in Table 2-7. Figure 2-2 shows TSA locations in the Cantonment Area. Because unit commanders maximize training time by rotating personnel through several different events or exercises in a given training cycle, this again presents an inflated figure for training days compared to calendar days.

TABLE 2-7 TRAINING SUPPORT AREA USE HISTORY

Training Year	Training Days/Events	Personnel		
		Military	Civilian	Total
TY 2023	2,214	111,365	6,959	118.324
TY 2022	2,625	83,499	11,551	95,050
TY 2021	2,484	94,055	5,305	99,306
TY 2020	1,931	71,586	5,833	77,419
TY 2019	1,554	39,888	10,223	51,665
TY 2018	1,061	39,619	4,285	43,904
TY 2017	1,299	96,783	1,150	97,933
TY 2016	1,224	50,463	282	50,745
TY 2015	1,313	73,678	627	75,618
TY 2014	1,132	77,516	1,541	79,057
TOTAL	**16,837**	**738,452**	**47,756**	**789,021**
MEAN	1,684	73,845	4,776	67,082

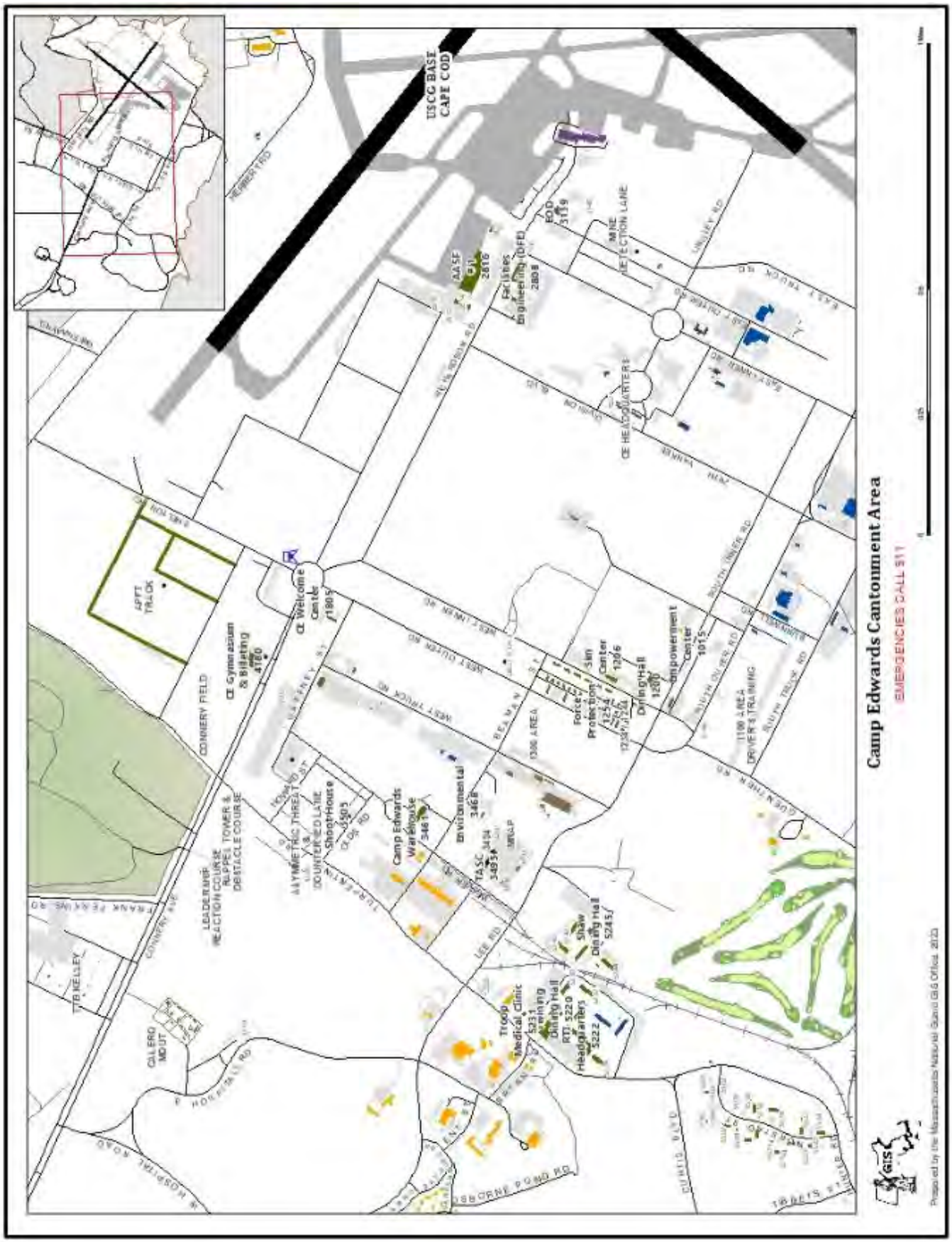
Civilian organizations using the TSA in the Cantonment Area of Camp Edwards during TY 2023 included Allied Universal Security, Brockton Fire Department, Boy Scouts of America, Cape Cod Technical Regional High School, Civil Air Patrol, Joint Base Cape Cod Fire Department, FBI Boston, Massachusetts Maritime Academy, Massachusetts State Police, Martin UAV, Massachusetts Emergency Management Agency, the Sea Cadets, Textron, US Department of Transportation, the United States Geological Survey, and the US Postal Service Inspector General, Northeast.

2.2 OFF-SITE TRAINING

During TY 2023, the MAARNG had 80 units conduct their annual two-week training cycle. Of these, 52 units trained in Massachusetts, 24 of which trained solely at Camp Edwards (approximately 1,336 Soldiers). One unit trained in Indiana; one unit trained in Iowa; one unit trained in Arizona; four units trained in New Jersey, five units trained in New York, five units trained in Virginia, six units trained in Louisiana; and five units trained in Canada. Seven units were mobilized and deployed in support of contingency operations; all seven units deployed overseas.

The total number of Massachusetts Soldiers trained during annual training for TY 2023 was 3,196 out of 5,601. Twenty units conducted year-round annual training consisting of 505 Soldiers. The number of MAARNG Soldiers that completed a two-week annual training cycle by general geographical locations is: 1,802 in Massachusetts, 1,111 in other states, and 283 in Canada.

Figure 2-2 Training Support Areas



2.3 RANGE UPDATE

The current operational active small arms ranges on Camp Edwards are Sierra, India, Echo, and Tango ranges. The ISBC and KD ranges are undergoing rehabilitation. Although not a small arms range, Lima Range, a 40 mm practice grenade range, will be discussed in this section. The locations of these ranges are shown in Figure 2-1.

2.3.1 Operations, Maintenance and Monitoring Plans

Each range is guided by an Operations, Maintenance, and Monitoring Plan (OMMP) that outlines range-specific monitoring to ensure the environment is protected to the maximum extent practicable. OMMPs are living documents that are in continuous review and updated as coordinated with the EMC Environmental Officer. Currently, the OMMPs are under review with revisions planned to include consolidating the individual, range-specific OMMPs into one document to ensure an effective and efficient document for the end user and consistent administration across all ranges. Best Management Practices (BMPs) outlined in the OMMPs are functioning as intended and are protective of the environment.

In accordance with the OMMP for each range, the MAARNG is required to capture, contain, and recover bullets/projectiles to the greatest extent practical. Recovery of projectiles is based on usage, time, and projectile density. The OMMPs define when this is required for each range. The purpose of removing projectiles is to maintain appropriate capture and containment of the projectiles, which prevents significant bullet on bullet impact, where projectiles leave the bullet pocket (an area on the capture berms where rounds are concentrated) by ricocheting, and projectile fragmentation.

During TY 2023, the MAARNG, in coordination with the EMC's Environmental Officer, excavated bullet pockets on India Range (copper Enhanced Performance Rounds) and Echo Range (9mm lead ammunition). They found that the rounds were mostly intact without severe fragmentation, do not appear to be moving with erosion, and significant projectile debris has not been found in the berms until just under the primary bullet pockets. For the Enhanced Performance Rounds, the steel penetrators oxidize and accrete, leaving the copper slug behind. The MAARNG is looking at moving to a formal projectile removal schedule, completing projectile removal on one range every two years. This formal schedule will allow MAARNG to more easily program funding to execute projectile recovery. The OMMPs will be revised to reflect any change to projectile recovery at the small arms ranges on Camp Edwards.

2.3.2 Small Arms Range Monitoring

From the monitoring of the small arms ranges, it has been shown that there are no exceedances of the OMMP standards for soil or groundwater at the ranges. OMMP standards were established in cooperation with the EMC, MassDEP and the US EPA for surface soil, porewater, and groundwater at Camp Edwards and are set to be protective of those resources and to give early indication that resources may be impacted.

Porewater is subsurface water present in soil. For porewater, collected via lysimeters, there have been exceedances of the OMMP action levels for antimony (Sb) at ranges using legacy soil for backstop berms. Those ranges include operationally active India and Tango ranges and operationally inactive Juliet and Kilo ranges. There were no porewater exceedances at the firing line or mid-range lysimeters. Antimony exceedances at the ranges that used legacy soils began to occur approximately 2 years after their use began. For further information about antimony exceedances see the paragraphs below.

In 2023 for porewater at India Range, there was an action level exceedance (6 ppb) for antimony at 8.0 ppb. This exceedance is consistent with past exceedances for this lysimeter (LY002).

Antimony is in lead alloy bullets and in bullet primers. There are two causes of increased antimony in porewater:

- legacy range soils, where lead-antimony bullets were fired, were used for berm and range construction at Juliet, Kilo, and Tango ranges.
- phosphates added to range soils (1998-1999) and lime to adjust pH and to immobilize lead in legacy soils

A finding of the Ad Hoc Committee through lab studies at CRREL, published February 2021, in New Hampshire, is that antimony is not threatening the groundwater. The work determined that the previous use of phosphates for lead immobilization and pH amendments were the cause of increased antimony in porewater and that there is not a threat to the groundwater. Soil amendments were halted several years ago at the direction of the SAC Ad Hoc committee. It has also been determined through soil sampling that antimony mobility is limited to surface soils where amendments were applied. A description of the work conducted by CRREL can be found in the TY 2022 *Annual State of the Reservation Report* on the E&RC's website: https://www.massnationalguard.org/ERC/publications.htm.

Soil, porewater and groundwater sampling conducted at each range are discussed in the sections pertaining to each range below.

2.4 ECHO RANGE

Echo Range, a dual-purpose range, is a Combat Pistol/Military Police Qualification Course, consisting of 15 firing lanes with seven pop-up targets per lane offset along the firing lanes at varying distances with one fixed Military Police target at the end of the lane. Shooters shift their pistol firing position to engage the targets at the varying distances. 9mm pistol ammunition is fired at pop-up targets, passes through, and strikes the backstop berm. The two courses of fire, on the same range, are referred to as an automated combat pistol/military police firearms qualification course. Echo Range is the only range on Camp Edwards approved for lead ammunition rather than copper EPR ammunition as a 9 mm copper round is not available in the Army inventory. Copper ammunition may be approved for use on Echo Range through non-standard training requests coordinated with and approved by the EMC's Environmental Officer.

The backstop berm is utilized as the primary projectile capture area. Single Individual Target frontal berms are the capture location for extreme low shot projectiles. The backstop berm was constructed on core material (native), landscape fabric as a demarcation line, a projectile capture medium that is 1/8th minus (road sand) and capped with topsoil that slows projectiles and allows for vegetation and slope stabilization.

Echo Range became operational in September 2019.

2.4.1 Range Maintenance and Sampling

Maintenance activities included routine berm maintenance on all lanes. A list of Range Control's maintenance and inspection activities at Echo Range in TY 2023 is included in Appendix C.

In October 2023, groundwater and surface soil samples were collected from Echo Range and analyzed for antimony, copper, lead, chloride, sulfate, calcium, magnesium, phosphate, potassium, sodium, pH, alkalinity, specific conductance, dissolved organic carbon and oxygen, where appropriate for the media being sampled. There were no anomalous, trending, or exceedance of the Action Levels specified in the OMMP for Echo Range. Groundwater could not be sampled as the well for this range has been compromised. The MAARNG will have this well repaired so that sampling can take place as required. The EMC was informed of this well issue at Echo Range. There are no lysimeters on Echo Range at this time.

A figure showing the monitoring well and soil sampling locations on Echo Range and the sampling results for TY 2023 are available in Appendix C.

2.5 INDIA RANGE

India Range is a 25-meter small arms range using copper ammunition to train soldiers on the skills necessary to align the sights on their weapons and practice basic marksmanship techniques against stationary targets. It has 20 firing positions with one target in each firing lane. The range is also used for short-range marksmanship training and qualification.

2.5.1 Range Maintenance and Sampling

A list of Range Control's inspection and maintenance activities at India Range in TY 2023 is included in Appendix C.

In October 2023, groundwater, porewater, and surface soil samples were collected from India Range. The samples were analyzed for antimony, copper, lead, chloride, sulfate, calcium, magnesium, phosphate, potassium, sodium, pH, alkalinity, specific conductance, dissolved organic carbon and oxygen where appropriate for the media being sampled. Results of the soil and groundwater analyses continue no anomalous, trending, or exceedance of the Action Levels specified in the OMMP. For porewater there was an action level exceedance (6 ppb) for antimony at 8.0 ppb. This exceedance is consistent with past exceedances for this lysimeter. Previous exceedances are discussed in Section 2.3.2.

A figure showing the monitoring wells, lysimeters and soil sampling locations on India Range and the sampling results for TY 2023 are available in Appendix C.

2.6 LIMA RANGE

Lima Range is a 40 mm practice grenade range. In 2012, the Environmental Protection Agency (EPA) Region 1 and the EMC approved returning to live firing on Lima Range using the M781 40mm Training Round.

The M781 is a practice grenade that is fired as a projectile composed of a hollow plastic "windshield" filled with Day-Glo-Orange marking powder. According to the Safety Data Sheet, the Day-Glo-Orange marking powder is considered to be non-toxic. The initial firing of the M781 40mm Training Round occurred in 2013.

Lima Range is used to train and test individual soldiers on the skills necessary to engage and defeat stationary target emplacements with the 40mm grenade launcher. The range has four self-contained stations and is 30-meters wide by 400-meters long. The stations consist of firing positions and targets of various types and distances, ranging from 100 to 350 meters. Station 1 consists of a prone fighting position with sandbags for support and two zeroing targets at 200 meters. Station 2 consists of an upright log or wall, a kneeling firing position about four feet high, and two point-type targets. The targets include a simulated window or door of a building at 100 meters and a small bunker or fighting position at 125 meters. Station 3 consists of a fighting position and two targets. The targets are a two-person bunker at 175 meters and an automatic weapon position at 200 meters. The bunker represents a point target, while the automatic weapons position represents an area target. Station 4 consists of a prone fighting position with a log or sandbag support and two area type targets at 250 meters and 350 meters.

2.6.1 Range Maintenance and Sampling

A list of Range Control's inspection and maintenance activities Lima Range in TY 2023 is included in Appendix C.

In October 2023 porewater and surface soil samples were collected from Lima Range and analyzed for antimony, copper, lead, chloride, sulfate, calcium, magnesium, phosphate, potassium, sodium, pH, alkalinity, specific conductance, dissolved organic carbon and oxygen, where appropriate for the media being sampled. There were

no action level exceedances for soil and porewater. Groundwater at Lima Range is being monitored and remediated by the IAGWSP under a USEPA Administrative Order.

A figure showing the monitoring wells, lysimeters and soil sampling locations on Lima Range and the sampling results for TY 2023 are available in Appendix C.

2.7 SIERRA RANGE

Sierra Range is an automated 300-meter pop-up modified record of fire range using copper ammunition only and is used to qualify soldiers in marksmanship proficiency. The firing line is 200 meters long with 10 firing positions. There are nine stationary, pop-up targets in each firing lane. The targets are located at 50, 100, 150, 200, 250, and 300 meters, with two targets at the 50-meter distance and one each at the other distances. The following weapons are authorized for use on Sierra and India Ranges: the M16 and M4 rifles, the M249 machine gun with 5.56mm ammunition, and the M240 machine guns (India Range only) using 7.62mm ammunition.

2.7.1 Range Maintenance and Sampling

Maintenance activities during TY 2023 at Sierra Range included routine maintenance on the 300m and 320m berms. A list of Range Control's inspection and maintenance activities at Sierra Range in TY 2023 is included in Appendix C.

In October 2023, groundwater, porewater, and surface soil samples were collected from Sierra Range. The samples were analyzed for antimony, copper, lead, chloride, sulfate, calcium, magnesium, phosphate, potassium, sodium, pH, alkalinity, specific conductance, dissolved organic carbon and oxygen where appropriate for the media being sampled. Results of the soil, porewater, and groundwater analyses continue to show no anomalous, trending, or exceedance of the Action Levels specified in the OMMP.

Figures showing the monitoring wells, lysimeters and soil sampling locations on Sierra Range and the sampling results for TY 2023 are available in Appendix C.

2.8 TANGO RANGE

Tango Range is a 25-meter EPR (copper) zeroing range with 32 firing positions with one target in each lane. Tango Range was redeveloped as an EPR range during TY 2021 in support of weapons qualification at Sierra Range. Soldiers zero their weapons at Tango Range and then move to the adjacent Sierra Range to conduct weapons qualification.

A Soldier zero's their rifle at Tango Range. *Photo by MANG Public Affairs Office*

2.8.1 Range Maintenance and Sampling

Routine berm maintenance was conducted on Tango Range during TY 2023. A list of Range Control's inspection activities at Tango Range in TY 2023 is included in Appendix C.

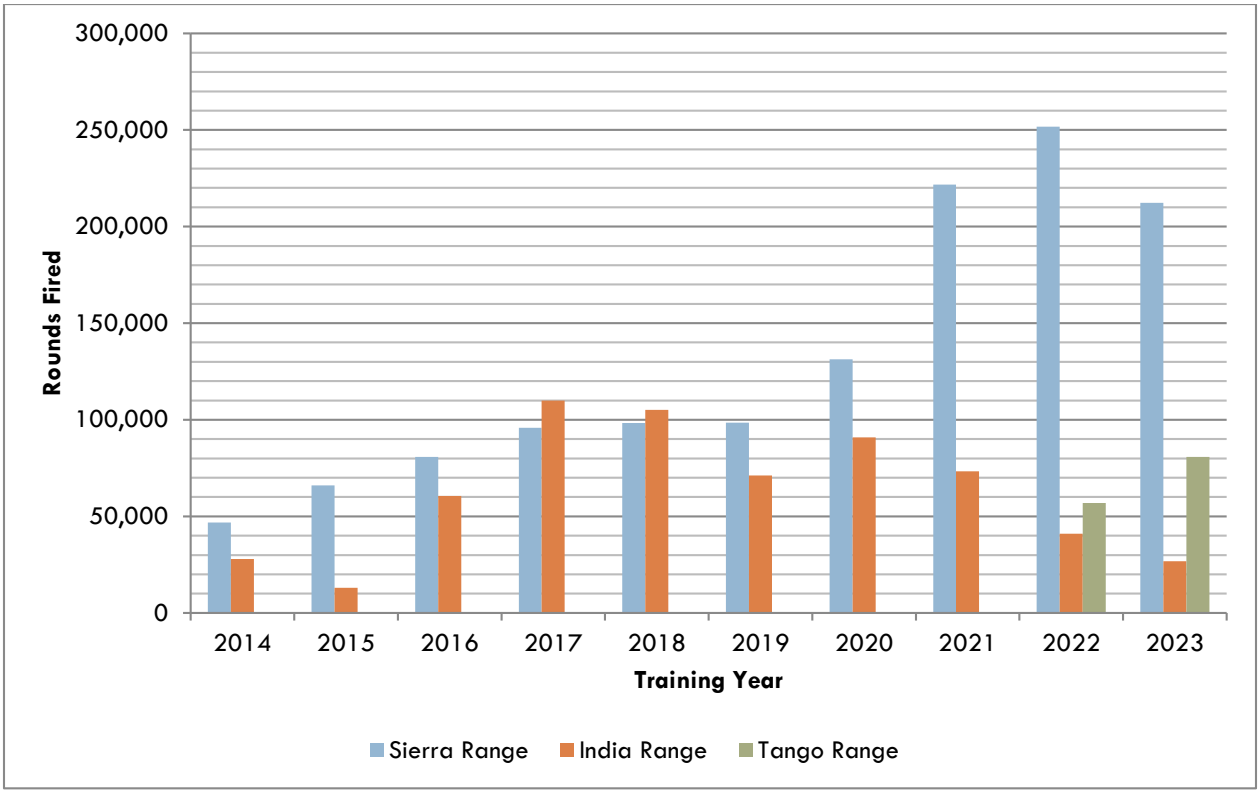
In October 2023, groundwater and surface soil samples were collected from Tango Range. The samples were analyzed for antimony, copper, lead, chloride, sulfate, calcium, magnesium, phosphate, potassium, sodium, pH, alkalinity, specific conductance, dissolved organic carbon and oxygen where appropriate for the media being sampled. Results of the soil and groundwater analyses show no anomalous, trending, or exceedance of the Action Levels specified in the OMMP.

A figure showing the monitoring wells, lysimeters, and soil sampling locations on Tango Range and the sampling results for TY 2023 are available in Appendix C. A lysimeter was installed on Tango Range in November 2023.

2.9 RANGE USAGE DATA

A total of 2,199,760 rounds of copper ammunition has been fired at Camp Edwards since its use was approved: 1,372,213 at Sierra Range, 637,032 at India Range, and 137,672 at Tango Range. The total number of copper ammunition rounds fired includes 16,718 at the inactive operational ISBC Range, which was used for two approved, non-standard training events in June and July 2022 and an approved, non-standard training event in April 2023; and 36,125 rounds fired on Echo range during two non-standard training events in TY 2021 and two approved, non-standard training events in TY 2022. Graph 2-6 provides a summary of copper ammunition fired at Sierra, India and Tango ranges since use of copper ammunition was approved at them. During TY 2020, the MAARNG transitioned to all copper-based rifle ammunition. The graph shows an upward trend in copper ammunition use overall. On India Range, copper ammunition use has declined since India Range ceased to be the primary zeroing range for Sierra Range. When Tango Range was redeveloped into a copper ammunition range in TY 2021, it became the primary zeroing range, and it is easy for Soldiers to walk to Sierra Range to qualify. Information on the number of copper ammunition fired on Sierra, India, and Tango ranges each training year is provided in Appendix C.

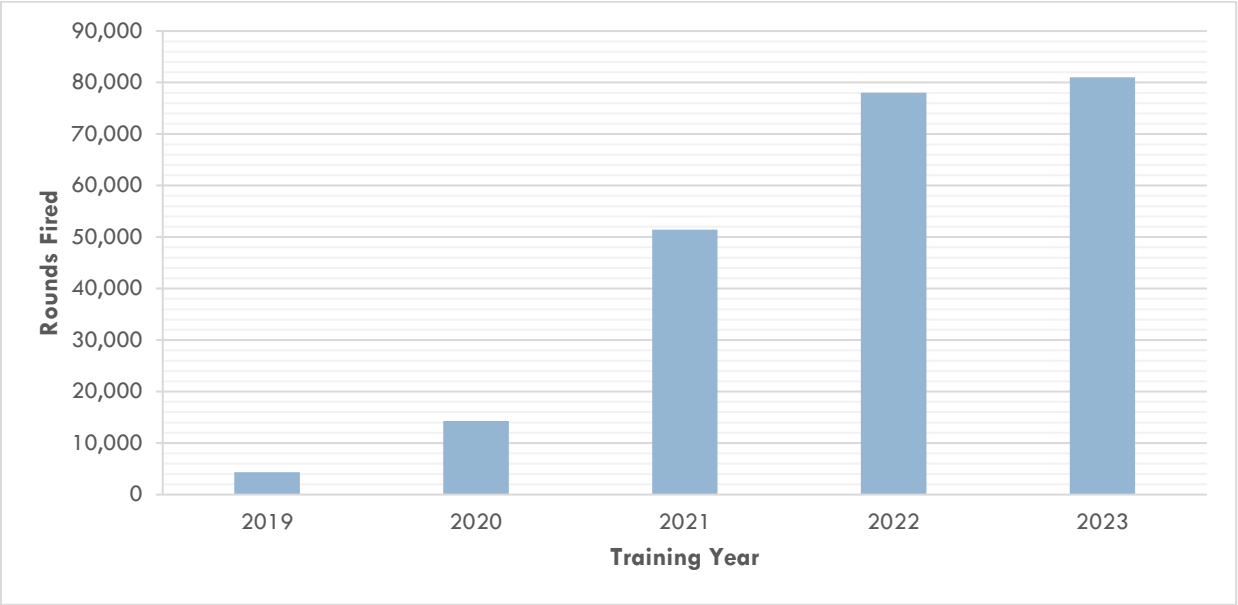
Graph 2-6 Copper Ammunition Use – Sierra, India, and Tango Ranges



Note: Tango Range became operational utilizing copper ammunition during TY 2022.

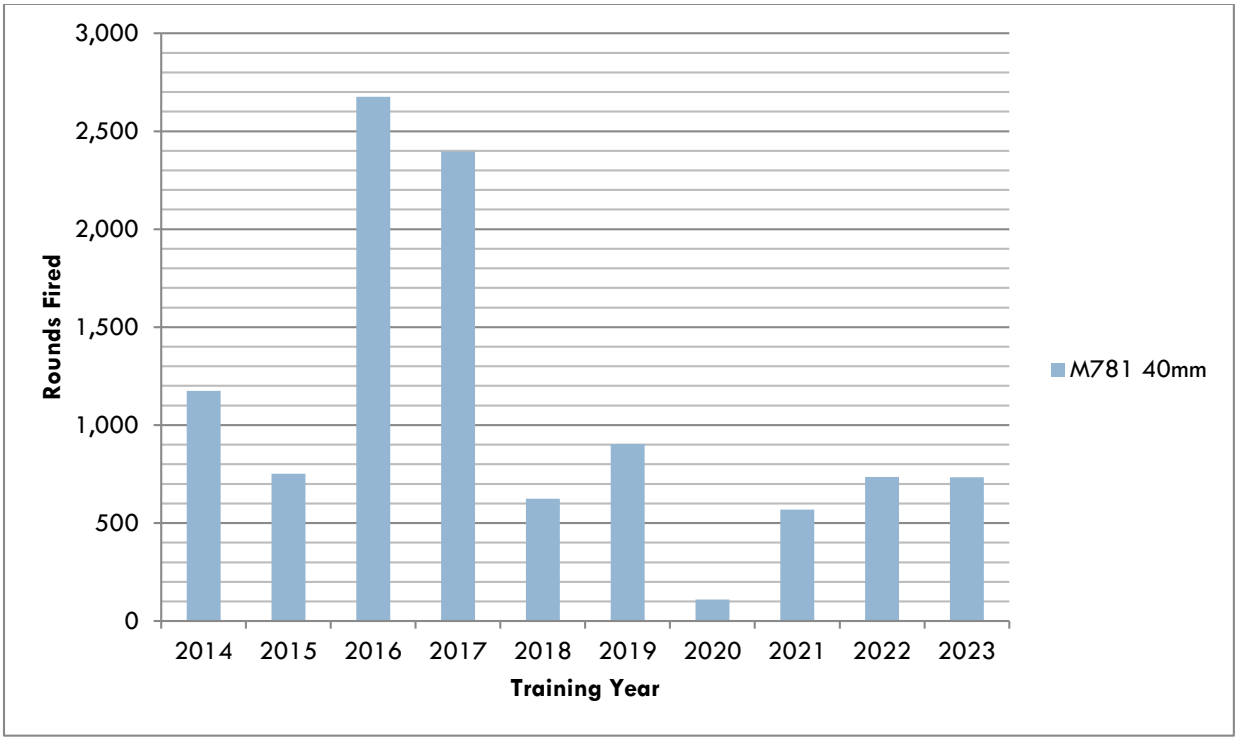
Since TY 2019, a total of 229,560 rounds of 9mm lead ammunition has been fired at Echo Range. Graph 2-7 shows the number of 9mm rounds of lead ammunition fired on Echo Range. During TY 2023, 30 rounds of 12 Gauge ammunition (lead) were fired on Echo Range as part of an approved, non-standard training event in March 2023. Information on lead ammunition fired from TY 2007 through TY 2023, including amounts and types, is provided in Appendix C.

Graph 2-7 9mm Lead Ammunition Round Use – Echo Range



A total of 12,375 M781 40mm Training Rounds have been fired at Lima Range since its use was approved. Graph 2-8 provides information on the number of M781 40mm Training Rounds fired at Lima Range. The graph reflects the cyclic requirement for qualification for grenadiers. Units that have grenadiers only have one to two soldiers with that requirement in the unit; not every soldier uses this weapon.

Graph 2-8 M781 40MM Training Round Use – Lima Range



The was no civilian use of the small arms ranges during TY 2023. During TY 2023, some type of weapons firing was conducted on at least one of the ranges on 82 calendar days.

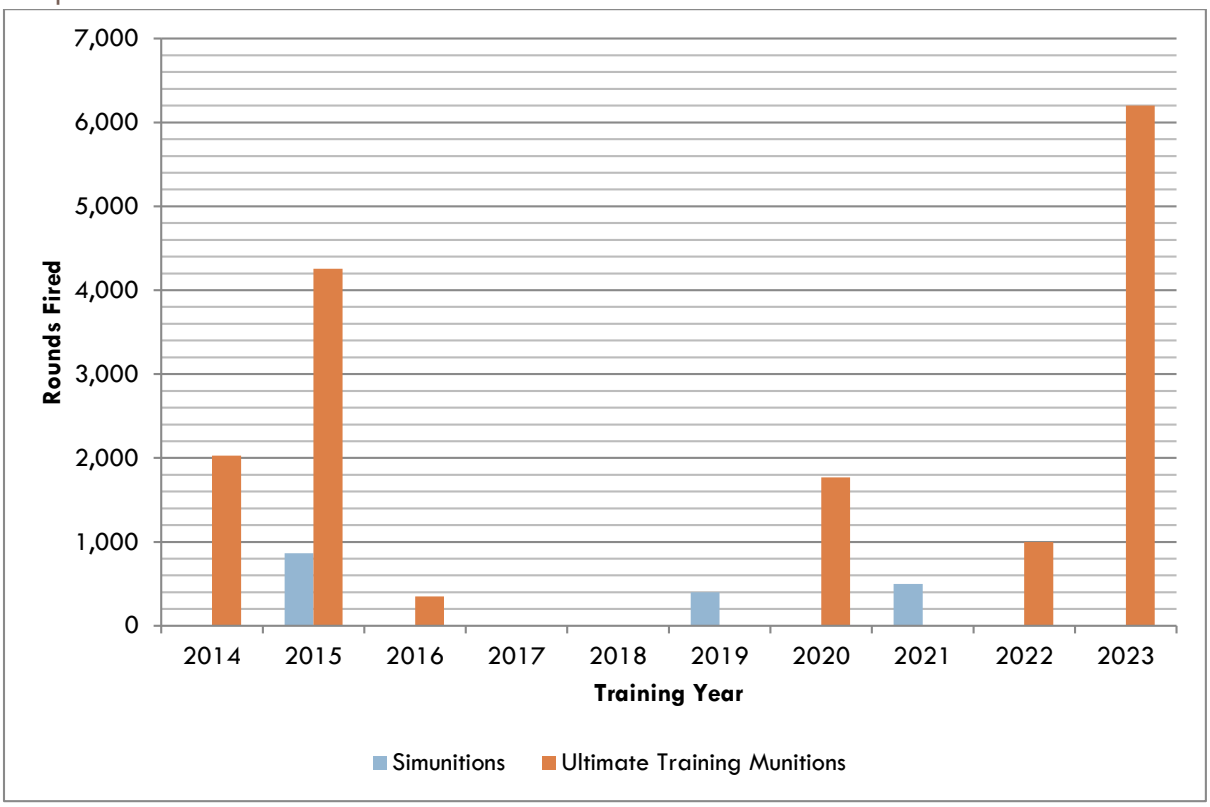
2.10 SIMULATED MUNITIONS

The MAARNG uses two types of simulated munitions at Camp Edwards: an Ultimate Training Munitions (UTM) Man Marker Round and a Simunitions FX Marking Round. Simulated munitions are wax marking tipped ammunition that can be used in a standard weapon. They can be shot at a Soldier wearing proper personal protective equipment with the wax projectile leaving a colored mark on their clothing letting them know they are hit. Simulated munitions are best used in concert with other simulators to be effective for most units. The UTM Man Marker Round and the Simunitions FX Marking Round are on the Camp Edwards Approved Munitions List. These munitions are primarily used at Training Area venues such as the Soldier Validation Lanes.

The EMC required that the Annual Report include steps taken by the National Guard and progress associated with converting to the use of lead-free primer in simulated munitions. The Massachusetts National Guard monitors the availability of alternate munitions; currently, no new information has been provided.

Graph 2-9 provides the number of UTM and Simunitions FX Marking Rounds fired in the Training Area/Reserve since 2014. As units become aware that the ranges and other training venues at Camp Edwards meet qualification standards, the use of the areas where these venues are located has increased. Fluctuations in training usage is also largely influenced by deployment cycles and changes to training doctrine and directives. Increases in usage are also related to the inaccessibility of other training bases for the MAARNG to use for their readiness training needs.

Graph 2-9 Simulated Munitions Use



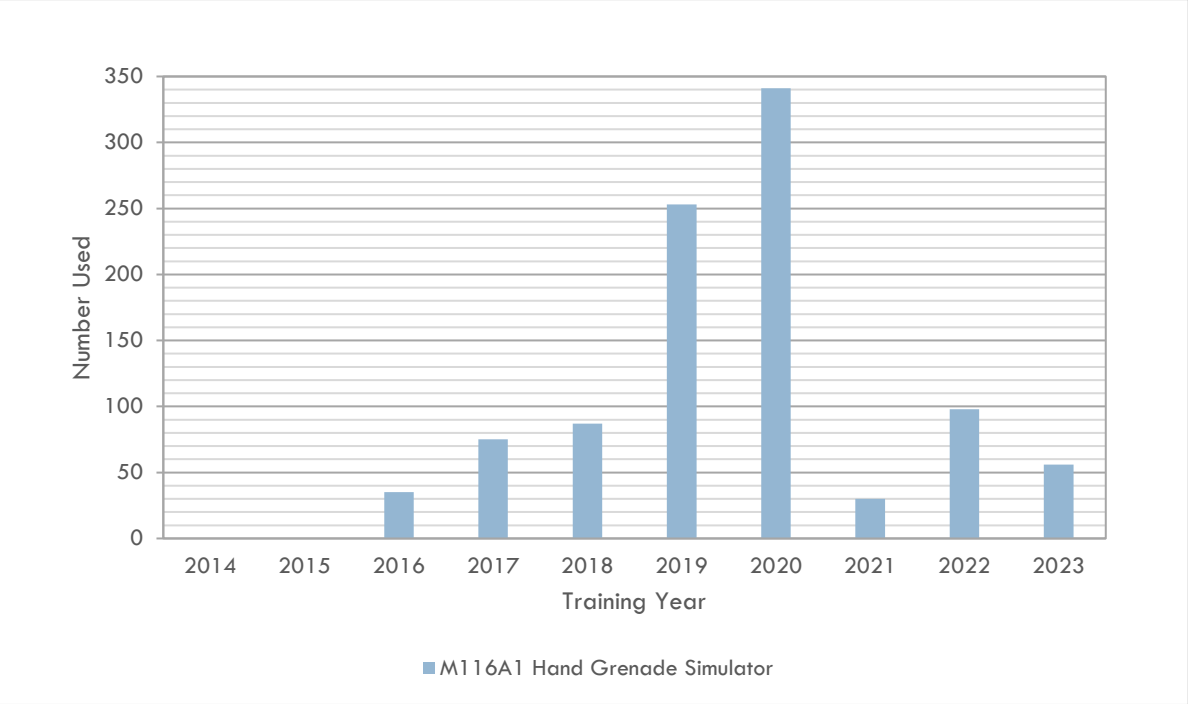
2.11 PYROTECHNICS

Military pyrotechnics are used to simulate battlefield noises and effects during troop maneuvers and training. Use of these devices is to prepare soldiers for the rigors of combat by simulating the stress and confusion of war. Currently the M116A1 and M69 Hand Grenade Simulators are approved for training use at Camp Edwards and are on the Camp Edwards Approved Munitions List.

2.11.1 M116A1 HAND GRENADE SIMULATOR

The M116A1 Hand Grenade Simulator was approved for use at Camp Edwards in March 2010. Fifty-six were used in the Training Area/Reserve during TY 2023. Graph 2-10 shows the number used each training year since TY 2014. M116A1 hand grenade simulator use increased because the MAARNG has been conducting more collective training versus individual unit training. The M116A1 is used primarily during collective unit training and is used to simulate battlefield conditions during training events.

Graph 2-10 M116A1 Hand Grenade Simulator Use



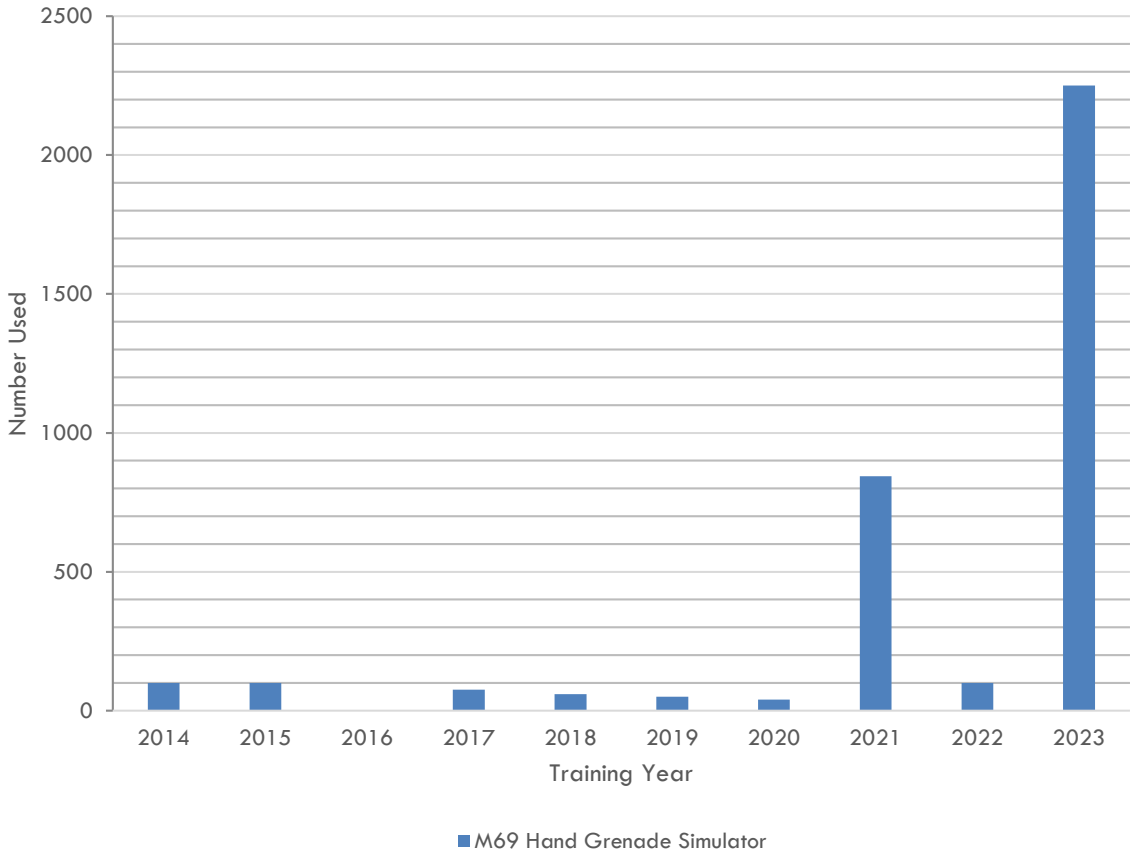
2.11.2 M69 HAND GRENADE SIMULATOR

In 2013, EPA Region 1 and the EMC approved the use of the M69 Hand Grenade Simulator on Camp Edwards.

The M69 provides realistic training and familiarizes soldiers with the functioning of a fragmentation hand grenade. After a delay of four to five seconds, the M69 emits a small puff of white smoke and makes a popping noise. The grenade bodies are reused repeatedly by replacing the fuse assembly.

Camp Edwards developed a Standard Operating Procedure and Course Management Plan for the M69 Hand Grenade Simulator, approved by the EMC in 2014. The plan allows for maximum effective use of the M69 Hand Grenade Simulator with the M288 Fuse in the Camp Edwards training areas and on the Hand Grenade Qualification Course while abiding by training and environmental guidelines. Use of the M69 Hand Grenade Simulator began in September 2014. During TY 2023, 2,250 were used in the Training Area/Reserve. Graph 2-11 shows the number of M69 Hand Grenade Simulators used since TY 2014. M69 Hand Grenade Simulator use showed an increase during TY 2023. The nature of required M69 grenade training is cyclical; also, during TY 2023, some units that may have trained at Fort Devens trained at Camp Edwards as Fort Devens was unavailable.

Graph 2-11 M69 Hand Grenade Simulator Use



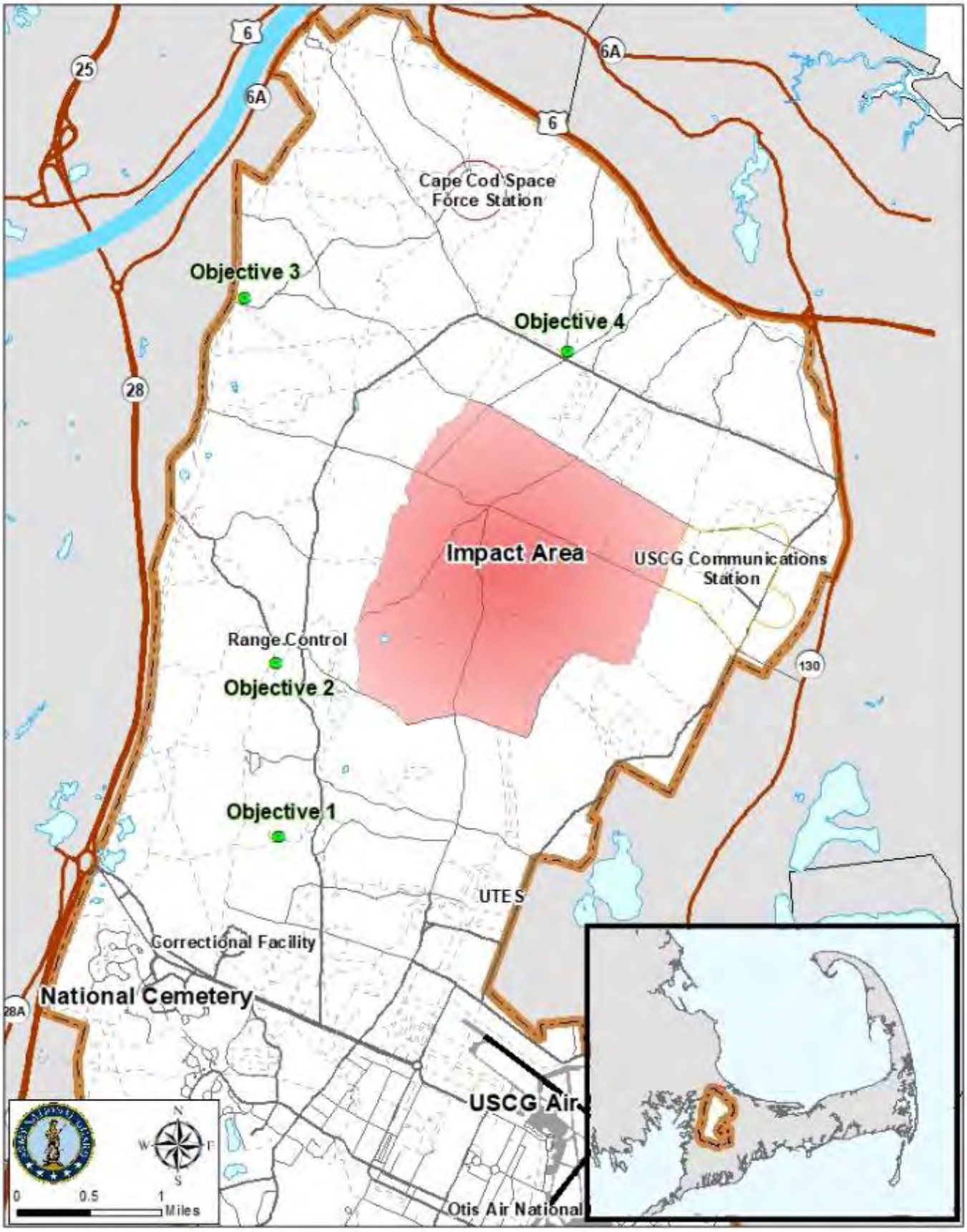
2.12 SOLDIER VALIDATION LANE

The SVL uses conex-like shipping containers as training aids, which can be reconfigured to mimic small villages and used for Improvised Explosive Device (IED) training. The containers are located in open or previously cleared, historically-used locations including training and bivouac sites within the Training Area. The ability to periodically reconfigure the portable training aides within the Training Area will critically enhance the ability to adapt scenarios to the most current combat situations, ultimately helping to save the lives of soldiers on the battlefield.

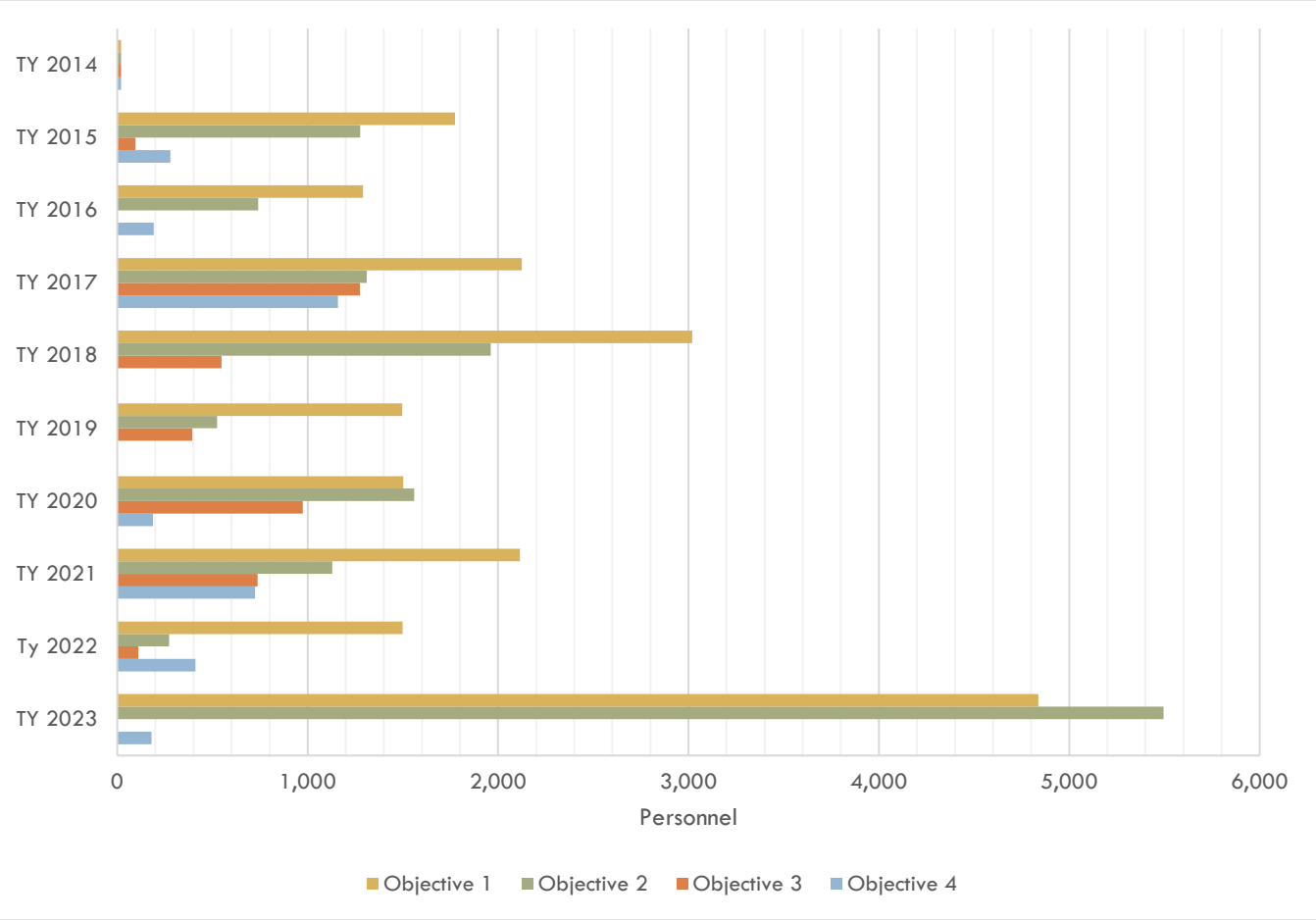
Three SVL locations (called objectives) were used during TY 2023 to meet military training needs: Objective 1 in Training Area A-4; Objective 2 in Training Area BA 4; and Objective 4 in Training Area C-14. Graph 2-12 shows the use of all four SVL Objectives since TY 2014. SVL use also showed an increase in TY 2023 due to cyclical training requirements and units that may have trained at Fort Devens trained at Camp Edwards instead due to Fort Devens being unavailable. The locations of the SVL Objectives are shown in Figure 2-3.

The Natural Heritage and Endangered Species Program (NHESP) requires a yearly monitoring report be submitted documenting the locations and numbers of containers and the approximate dates of placement within these locations, as well as documenting any cutting of trees or leveling of sites that were required for container placement. The Soldier Validation Lane Annual Monitoring Report for TY 2023 is available in Appendix C.

Figure 2-3 Soldier Validation Lane Objective Locations



Graph 2-12 Soldier Validation Lane Use



2.13 MULTI-PURPOSE MACHINE GUN RANGE

During TY 2015, the MAARNG's MILCON (Military Construction) project submission to construct a Multi-Purpose Machine Gun Range (MPMG) in 2020 on Camp Edwards at KD Range was funded by Congress. An MPMG is where soldiers train and qualify with automatic weapons. KD Range is an operational inactive range currently used for unmanned aerial vehicle training.

The approximately $11.5 million project consists of $9.7 for range construction and $1.8 million for targetry. Environmental contracting and review of the project began in May 2018 and includes review under both the National Environmental Policy Act (NEPA) and the Massachusetts Environmental Policy Act (MEPA).

As part of the preliminary planning process, Camp Edwards conducted a test fire at KD Range on August 14, 2015, to simulate noise from the proposed MPMG range. The results of the test fire showed noise levels did not exceed MassDEP levels for nuisance noise and met the Army's criteria for considering a range in this area. Other surveys included an Archeological Survey in 2016 (no "finds" reported); Flora/Fauna Planning/Impact Assessment Surveys; Federal species: Bats surveyed in 2015 and 2016 (project area); Frosted elfin surveyed in 2017, and the Rusty-patched bumble bee, which was surveyed in 2017; State species: Eastern Whip-poor-will surveyed annually, including adjacent to project area; updated base-wide moth survey, and then under the Migratory Bird Treaty Act, base-wide annual bird monitoring including in and near the project area.

Over the past eight years, the MAARNG has coordinated with multiple state and Federal agencies including NHESP to ensure that adverse impacts to natural resources (including state-listed rare species) were avoided or mitigated.

For the MEPA process, a Notice of Project Change was filed in February 2020 with a 30-day public comment period. The Secretary of the Executive Office of Energy and Environmental Affairs determined that a Supplemental Environmental Impact Report (SEIR) should be completed. The MAARNG submitted the SEIR on June 11, 2020, with a 30-day comment period. The MAARNG received a certificate signed by the Secretary on July 17, 2020, which determined the SEIR submitted for the project adequately and properly complies with MEPA and its implementing regulations.

For the NEPA process, the Environmental Assessment was completed in August 2020 and a 30-day public comment period was held from August 8, 2020 to September 7, 2020. Approximately 367 comment letters, with approximately 917 comments and questions, were received from state and local agencies, environmental groups, and members of the public. The primary concerns from these comment letters were: why is the range needed; will the range cause increased traffic; will the range cause noise issues; was habitat, rare species and carbon sequestration considered; and will the range impact groundwater. In April 2021, the MAARNG provided responses to those comments in the "*Public Comment Summary Report for the Multi-Purpose Machine Gun Range at the Known Distance Range Environmental Assessment*." After comprehensive review of the project, on April 30, 2021, National Guard Bureau determined the Environmental Assessment met the "Finding of No Significant Impact." The Public Comment Summary Report and the "Finding of No Significant Impact" are both available on the publications page of the E&RC's website: https://www.massnationalguard.org/ERC/publications.htm.

In August 2021, the EPA elected to conduct a Sole Source Aquifer review of the proposed MPMG range. In April 2023, EPA released its draft determination that the MPMG has "the potential to contaminate the aquifer and create a significant public health hazard." The EPA subsequently held a 30-day public comment period and a public hearing was held on May 24, 2023. The MAARNG provided comment on the draft determination during the public hearing. The MAARNG continues to engage with the EPA at both the regional and national level. EPA's final determination is forthcoming.

In addition to environmental review under MEPA and NEPA, the MAARNG must receive the EMC's approval for both the MPMG range design and its OMMP.

SECTION 3
ENVIRONMENTAL PROGRAM MANAGEMENT

3.0 INTRODUCTION

Chapter 47 requires the Annual Report to contain information describing the range of resource management activities conducted by the MAARNG in the Training Area/Reserve and to report on activities associated with the EPSs for the Training Area/Reserve. Sections 3.1 through 3.15 include information for each EPS where there were associated activities. Section 3.16 provides similar information for the generic Cultural Resources EPS that also applies to MAARNG activities in the Training Area/Reserve. In addition to meeting this requirement, Section 3 provides information on required mitigation measures undertaken by the MAARNG and information on any noncompliance with the EPSs or other laws and/or regulations.

Chapter 47 also requires the Annual Report to describe long-term trends in the major areas of resource management and activities. Data are provided in this report back through TY 2014, when available, or longer when appropriate to illustrate long-term trends. Additional information on environmental management activities performed in the Training Area/Reserve can be found on the Publications page of the E&RC web site at: https://www.massnationalguard.org/ERC/publications.htm.

During TY 2023, Records of Environmental consideration (RECs) were prepared to assess the potential impacts of eight proposed actions on natural and cultural resources in the Training Area/Reserve. RECs are an internal environmental review document based on NEPA. The RECs reviewed were for general maintenance of roads, trails, and firebreaks, as well as a project to construct range support facilities at three separate range complexes.

Appendix D identifies the relevant federal, state, DoD, and U.S. Army environmental regulations governing MAARNG activities in the Training Area/Reserve.

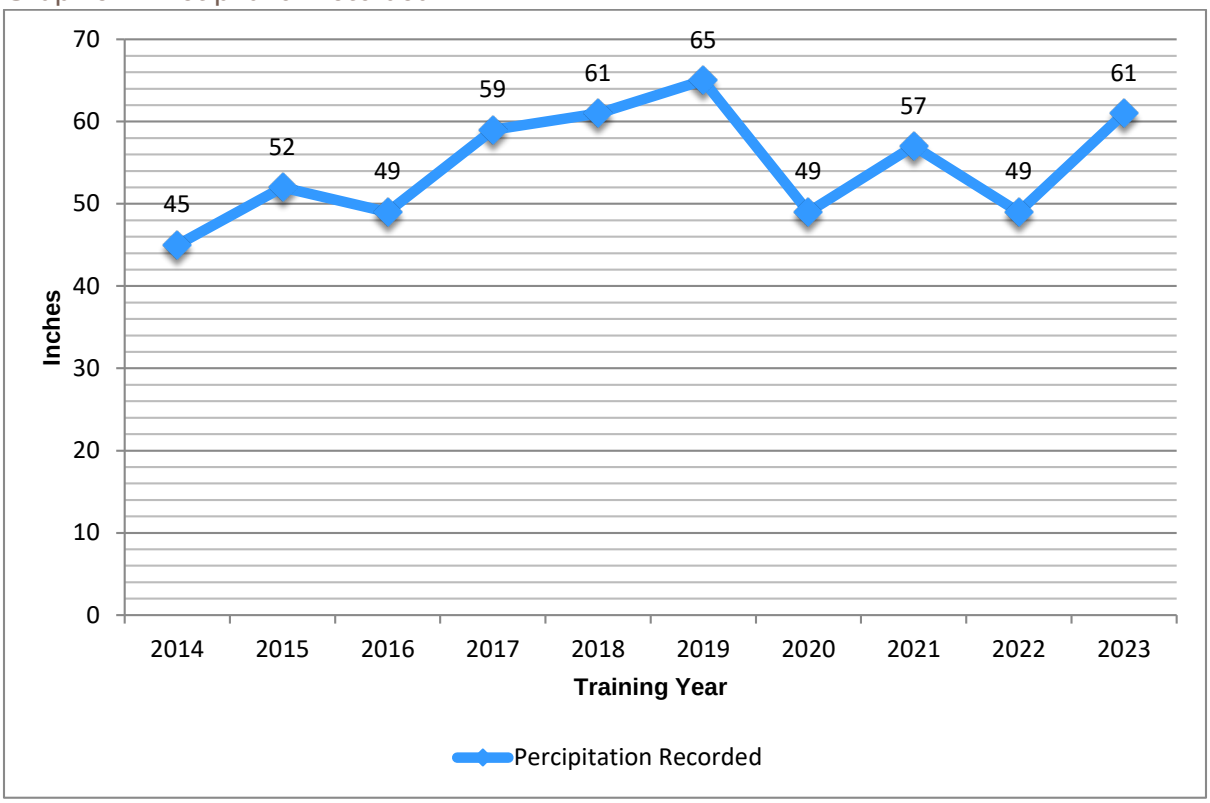
3.1 GROUNDWATER RESOURCES MANAGEMENT

The MAARNG complied with the Groundwater Environmental Performance Standard during TY 2023. Travel in Zone 1 Wellhead Protection Areas was limited to foot travel or to vehicles required for construction, operation, or maintenance of wells. The Upper Cape Regional Water Supply Cooperative continues to have fencing around its three water supply wells and appropriate signage around the each of the well's 400-foot radius in the Training Area/Reserve. Both the Upper Cape Regional Water Supply Cooperative and the 102nd Intelligence Wing operated within the water withdrawal limits of their respective MassDEP issued permit or registration. The Bourne Water District has a well in the Training Area/Reserve that is part of its overall water supply system. Groundwater quality reports for the 102nd Intelligence Wing and the Bourne Water District and the Upper Cape Regional Water Supply Cooperative's Long-Range Monitoring Report are available by contacting Mr. Dan Mahoney, Sandwich Water District, at 508-888-2775. The JBCC Groundwater Protection Policy is available on the Publications page of the E&RC website at https://www.massnationalguard.org/ERC/publications.htm.

3.1.1 Precipitation

Precipitation information included in the Annual Report is obtained from the Northeast Regional Climate Center at Cornell University in Ithaca, New York, based on recordings from a station in East Sandwich, Massachusetts. That station reported a total of 60.64 inches of precipitation for TY 2023 (Graph 3-1).

Graph 3-1 Precipitation Recorded



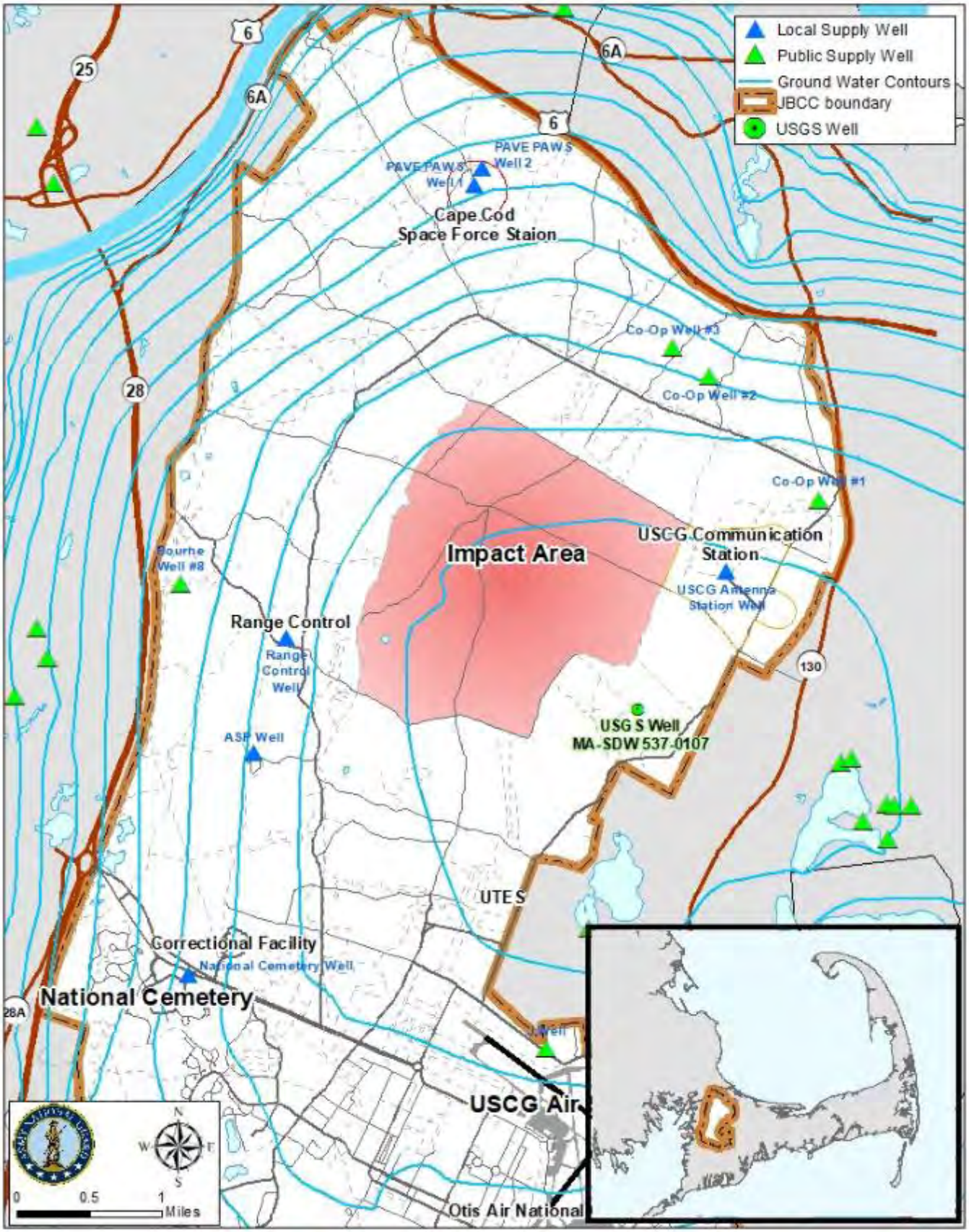
3.1.2 Groundwater Level

During the early part of TY 2005, the U.S. Geological Survey (USGS) installed a monitoring well (USGS number MA-SDW 537-0107) on Camp Edwards to record the altitude of the water table in the Cape Cod aquifer. The well is located west of Greenway Road on the J-1 Range of the Reserve and is about 107 feet deep. A recording device in the well electronically transmits a continuous record of the water level near the top of the water-table mound that forms the Sagamore groundwater-flow system on western Cape Cod. The well's location is shown in Figure 3-1.

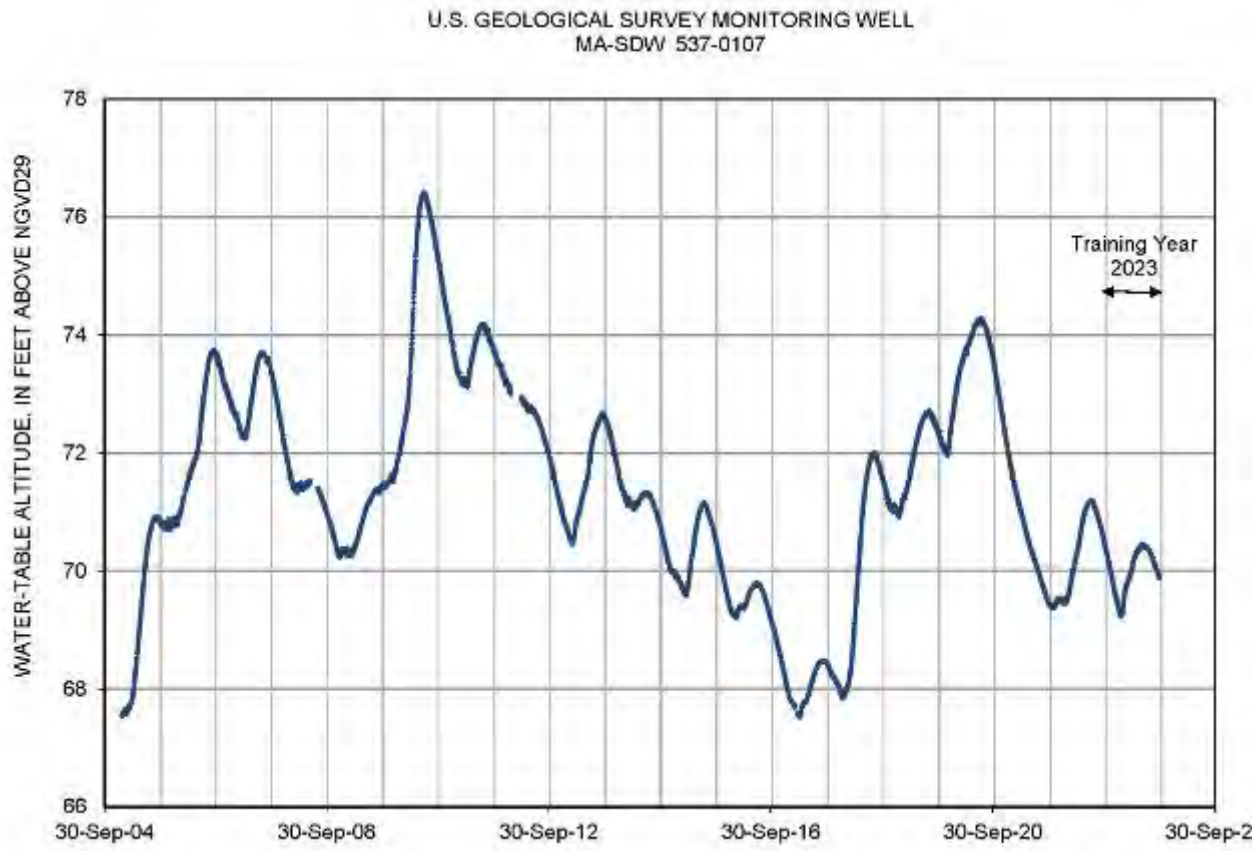
The pattern of water-level changes observed at the monitoring well is caused by natural seasonal and year-to-year variations in recharge from precipitation. Graph 3-2 shows the trend in the water-table altitude at the USGS monitoring well for the 2005-2023 training years. The water-table altitude declined about 1.3 feet between October 2022 and January 2023, rose about 1.2 feet between January and June 2023, then declined about 0.6 feet between June and October 2023. Similar trends in groundwater levels were observed this year elsewhere on Cape Cod and in southeastern Massachusetts (https://www.usgs.gov/centers/new-england-water/data-tools).

The IAGWSP provides part of the funding for the operation of the monitoring well because the water-level data are used in that program. The well became operational in January 2005. Information about the well and the observed groundwater levels are publicly available on the following USGS website: https://waterdata.usgs.gov/monitoring-location/414159070310501/

Figure 3-1 Well Locations



Graph 3-2 U.S. Geological Survey Monitoring Well



3.1.3 Water Supply Systems

Upper Cape Regional Water Supply Cooperative

The Upper Cape Regional Water Supply Cooperative provided 376,255,000 gallons of water (a daily average of 1,030,836) from its three wells to the six public water supply systems it services during TY 2023: Bourne Water District, Mashpee Water District, Sandwich Water District, the Town of Falmouth water system, the Barnstable County Correctional Facility, and the Otis ANGB water supply system. The Cooperative is authorized to withdraw up to 3.0 million gallons per day. Graph 3-3 shows the daily average pumping rate of the Cooperative since TY 2014. The locations of the Cooperative's three water supply wells (WS-1, WS-2, WS-3) and its seven sentry monitoring wells (C-1 through C-7) are shown in Figure 1 in Appendix E. The Cooperative's 2023 Long Term Monitoring Sentry Well Sampling Results will be available in the *Final Annual State of the Reservation Report.*

Otis ANGB Public Water Supply System

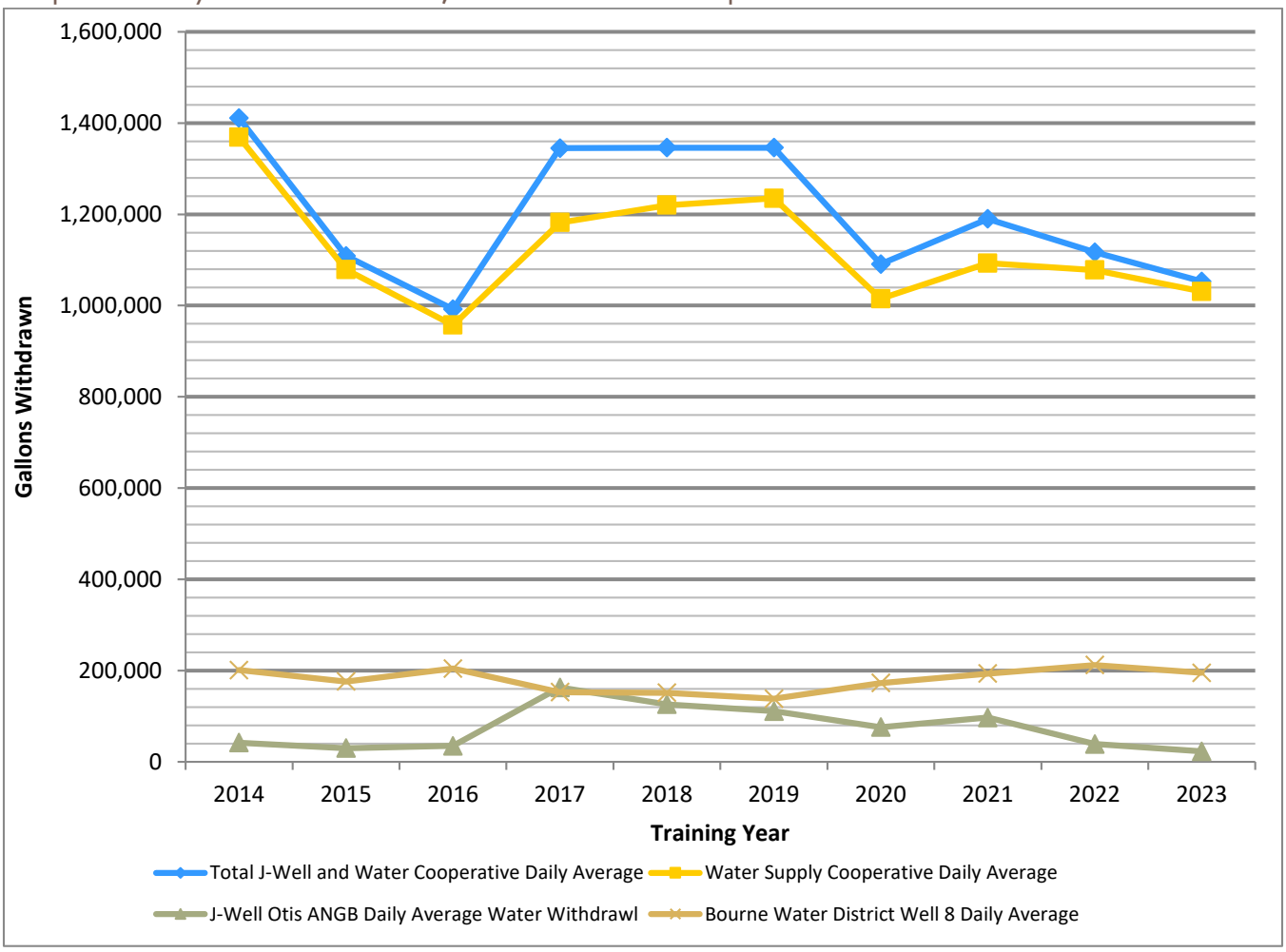
The Otis ANGB system pumped an average of 22,099 gallons of water per day and a total of 8,066,000 gallons of water from its well, known as J-Well (located in the Cantonment Area), during TY 2023. It also received 39,359,000 gallons from the Cooperative during TY 2023; a daily average of 107,833 gallons. Graph 3-3 shows the daily average pumping rate of the Otis system since TY 2014.

A copy of the calendar year 2022 Consumer Confidence Report for Otis ANGB is provided in Appendix E.

Bourne Water District Water Supply Well

During TY 2023, Bourne Water District Well 8 pumped a total of 71,016,800 gallons, with a daily average of 194,567 gallons pumped. Graph 3-3 shows the daily average pumping rate of Well 8 for TY 2014 through TY 2023. The well's location is shown in Figure 3-1. A copy of the calendar year 2022 Bourne Water District's Consumer Confidence Report is provided in Appendix E.

Graph 3-3 Daily Water Withdrawal, J-Well and Water Cooperative



Note: Bourne Water District Well 8 began production on May 30, 2014.

Other Water Wells

There are two water supply wells located within the boundary of the Training Area/Reserve. These are located at Cape Cod SFS (PWS# 4036008) and the USCG Communications Station. Further information on water supply wells is available on MassDEP's website: https://www.mass.gov/service-details/well-database.

3.2 WETLANDS AND SURFACE WATER MANAGEMENT

The MAARNG did not take any actions during TY 2023 that resulted in the loss of any wetland resources or their 100-foot buffer areas. No new bivouac areas were created in the Training Area/Reserve during the year within 500 feet of any wetland and no land alteration activities were conducted by the MAARNG within 100 feet of a certified vernal pool during the year. Consistent with EPS 2.7, in TY 2023 trails and roads listed within 500 feet of wetlands were closed to vehicle access from February 15 to May 15 to protect migrating and breeding amphibians. Environmental Program representatives routinely attended coordination meetings held by various

parties (e.g., Camp Edwards, IAGWSP) to stay abreast of the activities in the Training Area/Reserve and to ensure appropriate coordination occurred and wetland impacts were avoided or permitted. No official permitting was required for projects during TY 2023.

3.2.1 Vernal Pools

There is an ongoing planning effort, initiated in TY 2021, to create new vernal pool habitat at Camp Edwards to provide small habitat features for a variety of plants and animals. The next planning phase towards implementation was initiated in TY 2023 when MAARNG contracted the Public Archeological Library to conduct an archaeological survey and evaluation of sites proposed for vernal pool creation. The three sites are in training area C-14 providing connectivity between a cluster of vernal pools to the south (Raccoon Swamps) and Spruce Swamp to the north. Roads within 500 feet of the existing wetlands are closed to vehicle traffic thus the creation of vernal pools in the proposed location would not create additional restricted areas. Vernal pool creation sites were determined through a siting analysis performed in TY 2021 by SWCA Environmental Consultants, using GIS and field verification, to locate appropriate sites that do not interfere with the military mission but that will provide ecological benefit. For background, budgeting for this project came from the funds set aside in the event MAARNG was required to mitigate for the filling of three problematic road puddles that were attracting vernal pool breeding amphibians. The Bourne Conservation Office did not apply wetland jurisdiction to the road puddles and therefore mitigation was not needed, thus this project, in good faith, seeks to create habitat that is overall in short supply on the base.

3.3 RARE SPECIES MANAGEMENT

Rare species monitoring and management is an integral part of adaptive management for a healthy ecosystem. Rare species are often important indicators of regional or local ecological threats and trends. Collaborative planning and prioritization of rare species efforts is a priority for MAARNG within and outside the Training Area/Reserve and are key to DoD conservation. The Natural Resources Office in TY 2023, as usual, undertook extensive rare species monitoring and management efforts through contracted and in-house projects. This includes numerous efforts documenting and reporting wildlife and plant species listed under the Massachusetts Endangered Species Act (MESA) on Camp Edwards. The office and its contractors observed 17 state-listed species and is reporting the sightings to NHESP in early TY 2024. These species and simple count totals are reported in the various tables below, divided across species groups.

The tables below only include state-listed (MESA) and federally-listed species. The Natural Resources Office also reports observations of "Tracking List" species to NHESP as a standard condition of scientific collection permits for reptiles and amphibians. Additionally, observations of species on the MassWildlife Plant Watch List are reported annually.

TY 2023 was a notable year for rare species documentation, particularly in that multiple state-listed species were newly documented at Camp Edwards, including within the Training Area/Reserve. Further details on these observations are below, but one insect (Purple Tiger Bettle, *Cicindela purpurea*) and two plants (Papillose Nut-sedge, *Scleria pauciflora*; Stiff Yellow Flax, *Linum texanum var. medium*) were all new discoveries. All were also found with relatively numerous counts suggesting that each had been present, but undocumented, despite targeted efforts including plant and tiger beetle surveys. All species showed a strong affiliation with soldier training and managed areas including dig sites, ranges, and training roads.

The Natural Resources Office formally and informally reviewed proposed military and civilian activities and project designs in the Training Area/Reserve to ensure that adverse impacts to natural resources (including listed species) were avoided or mitigated. Multiple projects included external coordination and permitting in TY 2023 for rare species. The dominant effort amongst these was formal consultation with the US Fish and Wildlife Service (USFWS) for potential impacts to bats from ongoing mission activities (training, natural resources

management, etc.). The USFWS developed an interim consultation process for the Northern Long-eared Bat to facilitate effective and protective conservation and consultation under the federal Endangered Species Act, as discussed below in Section 3.3.2. Project reviews and consultations with MassWildlife included the annual road maintenance work plan and the construction of a physical fitness track, which is outside the Training Area/Reserve.

The following subsections outline efforts for species or species groups during TY 2023. The tables below present raw number counts that are reported to NHESP based on sightings, including formal surveys and casual encounters. Some of the totals reported include results of formalized surveys that are used to evaluate populations, however, the raw count totals in the following tables should not be used to infer population trends or similar. Counts are highly dependent on within-year project priorities and efforts, as well as external influences (location availability during survey windows, etc.). Zeros most often represent a lack of effort relative to a particular species, rather than absence.

Each year more effort is made to incorporate long-term monitoring of focal resources and such efforts are reported in more detail below, including analyzed results when available. For example, population trends for bird Species of Greatest Conservation Need are reported in Section 3.5.3. The Lepidoptera Monitoring Plan, completed in TY 2022, provides a robust statistical framework for monitoring trends in state listed Lepidoptera in response to habitat management by combining vegetation and moth surveys. State-listed species such as the Whip-poor-will lend themselves to data collection for trends analysis (annual point-count transects) and cooperation with statewide or national efforts (Section 3.3.7). Likewise, bird monitoring standardization allows for long-term trends analysis (Section 3.5.3) and better integration with broader conservation initiatives. Trends analysis requires years of data collection to account for inter-annual variability (i.e. drought versus wet years) and sampling occasion covariates (i.e. low temperatures, wind, noise, etc.) to prevent normal variability for being mistaken for true trends. At regular intervals, the Natural Resources Office plans to interpret trend data with different species or groups being examined each year. The Natural Resources Program staff are also working with statewide and regional efforts to coordinate monitoring, including participating in the annual Northeastern Nightjar Survey, the Monarch Larva Monitoring Project, the Frosted Elfin Habitat and Butterfly Survey Protocol, and regional monitoring plots for New England cottontail.

A note on naming conventions: common names for species are used for those species having them. While many taxonomic groups do not have broad use of common names (e.g., insects and other invertebrates) defaulting to common names is intended to increase the approachability of this report. All species are first referenced with both the common name and the scientific name with the latter in parentheses. The species tables also include both. Where common names are inconsistent across primary resources the default name used in this report and other MAARNG documents for rare or listed species is that used by regulatory agencies (USFWS, MassWildlife). Secondarily, common names follow standard local or national references such as the American Ornithologists Union, Moth Photographers Group, and Native Plant Trust's GoBotany website.

3.3.1 Rare Plants

Planning level surveys for rare plants were carried out in TY 2023 under two separate contracts. One, initiated in TY 2022, concentrated on the managed grasslands in the Cantonment area, south of the northern training area, and the other on early successional open habitat along some of the roads and utility rights of way in the Training Area/Reserve. As part of the grassland contract, the Natural Resources Office coordinated with the IAGWSP to schedule and provide escort for two survey days within the Central Impact Area (CIA). Both contracts targeted federally and state listed rare plant species occurring in Massachusetts in similar habitat conditions.

Federally-listed species, (American Chaffseed, *Schwalbea americana*, and Sandplain Gerardia, *Agalinis acuta*) were not encountered during surveys. Three Massachusetts state-listed species were observed, Grass-leaved

Ladies'-tresses (*Spiranthes vernalis*, Threatened), Stiff Yellow Flax (*Linum medium var. texanum*, Threatened) and Papillose Nut-sedge (*Scleria pauciflora*, Endangered). Papillose Nut-sedge and Stiff Yellow Flax had not been recorded on Camp Edwards previously and were discovered in five and three locations, respectively. The three Stiff Yellow Flax populations are in the Cantonment grasslands whereas the five Papillose Nut-sedge locations are in the Training Area/Reserve. One of the five Papillose Nut-sedge populations was found by Natural Resources' field technicians after becoming familiar with it the previous day at a location discovered by the contractor. Two of the locations are associated with firing ranges, benefiting from regular mechanical disturbance and the other three locations are associated with ordnance investigations in the impact area. Grass-leaved Ladies'-tresses was first observed in 2021 by Natural Resources staff. Overall, 2023 proved to be a productive year for this rare orchid. Three other non-listed species of *Spiranthes* orchids were also observed to be much more prevalent than in other years.

Field technicians and the Conservation Field Specialist conduct rare plant surveys during Summer 2023 in the Training Area/Reserve. *Photo by Erin Hilley, NR/ITAM*

Overall, the regular precipitation throughout the summer likely contributed to a productive year for the above listed plants as well as other special status species (e.g., NHESP Watch List) some of which had been observed in previous years (e.g., Nutall's Milkwort, *Polygala nuttallii*, and Narrow-leaved Bush-clover, *Lespedeza angustifolia*) and others that had not or that were historic records (e.g., Whorled Milkwort, *Polygala verticillata*, and Sandplain Flax, *Linum intercursum*). The contractor will report rare species observations to NHESP and the Natural Resources Office is reviewing final reports for the two contracts.

The Natural Resources Office conducts annual surveys of a subset of known rare plant sights for Adder's Tongue Fern (*Ophioglossum pusillum*) and Broad Tinker's-weed (*T. perfoliatum*). As in TY 2022, Broad Tinker's-weed counts included all *Triosteum* individuals based on the genetics study described in greater detail in last year's report. In TY 2023 six rare plant sites were surveyed for Broad Tinker's-weed. Broad Tinker's-weed was observed in three of the six sites and not observed in the other three. These were fairly expected results based on past and historic observations. In TY 2023, a new incidental sighting of Broad Tinker's-weed was found by field technicians growing at the edge of one of the inactive firing ranges. This is the first new location of Broad Tinker's-weed in many years and the first outside of a frost bottom at Camp Edwards. This is an intriguing new occurrence from considerations of both dispersal and site condition.

Triosteum Perfoliatum, Broad Tinkers-Weed, Camp Edwards, MA. *Photo by Jake McCumber, NR/ITAM*

Five rare plant sites were surveyed for Adder's Tongue Fern. Field technicians conducting the surveys counted a total of 215 plants with the largest contribution (189 plants) from a single site. Two sites contributed 19 and 7 plants respectively. Adder's Tongue Fern was absent at two sites, which was not surprising based on past survey results. Natural Resources biologists will continue communication with MassWildlife regarding the

population status and management of this small-statured and easily overlooked plant. In TY 2023, MAARNG staff installed a game camera at two rare plant sites to observe use of the sites by deer and other wildlife including browse pressure on the rare plants. Natural Resources Staff have yet to quantify these results, but browsing by deer has been observed as an impact on both Adder's Tongue Fern and Broad Tinker's-weed. Previously reported installation of a wooden "corral" style fence at one frost bottom has proven effective at excluding deer. Table 3-1 lists the rare plants reported to NHESP.

TABLE 3-1 LIST OF RARE PLANTS REPORTED TO NHESP

Quantities shown are not resulting of standardized surveys, and should not be interpreted as population trends.

			Individuals Reported						
Common/Scientific Names	**Fed Status**	**State Status**	**TY 2017**	**TY 2018**	**TY 2019**	**TY 2020**	**TY 2021**	**TY 2022**	**TY 2023**
			PLANTS						
Adder's Tongue Fern[1] *(Ophioglossum pusillum)*	-	T	247	0	25	646	N/A	225	215
Grass-leaved Ladies'-tresses *(Spiranthes vernalis)*	-	T	0	0	0	0	6	0	88
Broad Tinker's-weed[2] *(Triosteum perfoliatum)*	-	E	127	0	200	6	N/A	1883	3,161
Stiff Yellow Flax *(Linum texanum var. medium)*	-	T	0	0	0	0	0	0	92
Papillose Nut-sedge *(Scleria pauciflora)*	-	E	0	0	0	0	0	0	41,124

[1] In most years a subset of *O. pusillum* sites are surveyed. In 2023, the five known extant sites were surveyed. This needs to be considered if comparing total numbers across years. In 2018, only sites with historic records and no recent records were surveyed, and this should not be interpreted as a loss of rare plants between 2017 and 2018. The total number of 2019 numbers are likely under representative, as surveys occurred late in the season.

[2] *Triosteum perfoliatum* surveys, starting in 2022, are carried out using recent findings from a genetics study that suggest that the two species of *Triosteum* on the base, the other non-rare T. aurantiacum, are the same genetically and should be treated as the rare *T. perfoliatum*. Totals for years previous to 2022 consist only of *Triosteum* individuals that showed certain identification features now not relied on.

3.3.2 State and Federally Listed Bats

The Northern Long-eared Bat (NLEB) was federally listed as threatened in May 2015 and proposed for listing as endangered in March 2022. The change to endangered status became effective in March 2023. The Tricolored Bat (*Perimyotis subflavus*) was proposed for listing as endangered in September 2022, but the final rule for listing was not yet published in TY 2023. These listings are primarily due to the severe population crashes (estimated greater than 95 percent for NLEB and greater than 90 percent for Tricolored bats in the areas where a fungus has impacted hibernating bat colonies) caused by white-nose syndrome. The extent of population loss drives concerns for impacts on individuals and maternal roost sites throughout the eastern United States. The change from threatened to endangered for the NLEB took away the 4 (d) rule, which allowed for many of the current habitat management and some training activities on Camp Edwards. With a change to endangered status, the USFWS created the Interim Consultation Framework for Northern Long-eared Bats to cover activities until 1

April 2024. For actions continuing past this date, the MAARNG will need to reinitiate consultation. On April 7, 2023, the Natural Resources Office submitted the Biological Assessment Form for the Interim Consultation Framework to cover regular training activities, planned habitat management, prescribed fire activities, and groundwater remediation activities planned before April 1, 2024.

The MAARNG is working on consultations for all regular training, habitat management, and groundwater remediation activities and for individual projects. The eight years of acoustic data collection, multiple mist netting and telemetry projects, and the current contract to summarize bat activity (more details below) on base will aid in forming a Biological Assessment that is both protective of the species while providing ample training opportunities and beneficial habitat management.

In 2014, the Natural Resources Office began acoustic monitoring on base and continued into 2021. Additional acoustic surveys were conducted around KD Range in summer 2023. All acoustic data were vetted for any Myotid (includes NLEB, Little brown bats, and Eastern small-footed bats) or Perimyotid (Tricolored bats) calls. In 2021, five acoustic sites were monitored, and NLEB were detected only at site 15_35, along the edge of the base. Tricolored bats and Little brown bats were detected at four locations, but not at the site near the Trench lines on Knot Hollow Road. Tricolored bats occurred in low numbers with activity rates (bat passes per detector night) all less than 0.04. Little brown bats varied more in their activity levels ranging from 0.01-0.44, with the highest activity detected at site 15_35 and comparable activity (0.32) at site 15_36 on Flatrock Road. In TY 2023, six acoustic stations were monitored within the MPMG project footprint. Results indicate no NLEB detections and 5 Tricolored bat calls.

In TY 2023, the MAARNG contracted Tetra Tech and Moonrise Ecological Services to complete mist netting surveys on base. The contractor performed mist netting during July at seven locations spread across the site over 16 nights. Twenty–four Big brown bats and four Eastern red bats were captured in the mist nets. None of the target *Myotis* or *Perimyotis* species were captured despite the level of effort and targeted site selection.

To better understand the full context of survey results and satisfy Section 7 requirements for consultation on federally funded activities carried out by the MAARNG, the Natural Resources Office has contracted Tetra Tech to assist with the development of portions of consultation documents. Tetra Tech has been compiling all the past acoustic monitoring data. This data will be used to look at bat activity across the site to determine the best management practices to minimize possible impacts to bats and determine the likelihood of bat occurrences across the training area. Additionally, Tetra Tech is assisting in reviewing the best scientific and commercially available data to determine the level of possible impact from the activities occurring on base. This information is vital for creating conservation measures that avoid or minimize impacts on the Northern long-eared bat (federally endangered), the Tricolored bat (proposed), and the Little brown bat (under review).

Lastly, the Natural Resources Office continues to work with BRI on a manuscript about Silver haired bat winter occurrences on base.

AFCEC and Cape Cod SFS manage two 1.5 megawatt (MW) and two 1.68 MW wind turbines in the Training Area/Reserve. Turbine operation is curtailed for the NLEB from July 15 to October 15, 30 minutes before sunset to 30 minutes after sunrise for wind speeds less than 4.5 meters per second. There were no observed bat or bird strikes during TY 2023. Equipment maintenance personnel are the primary observers and perform weekly operations and maintenance checks. Acoustic surveys conducted at Cape Cod SFS, including turbine sites, found relatively low levels of activity, which was dominated by Big Brown Bat and consistent with results in surrounding areas.

TABLE 3-2 LIST OF RARE MAMMALS REPORTED TO NHESP

Quantities shown are not resulting of standardized surveys and should not be interpreted as population trends.

			Individuals Reported						
Common/Scientific Names	**Fed Status[1]**	**State Status**	**TY 2017**	**TY 2018**	**TY 2019**	**TY 2020**	**TY 2021**	**TY 2022**	**TY 2023**
			MAMMALS						
Northern Long-Eared Bat[2] *(Myotis septentionalis)*	T	E	2	1	3	1	1	N/A[3]	0
Little Brown Bat[2] *(Myotis lucifugus)*	UR	E	4	2	6	2	4	N/A	5
Tricolored Bat[2] (Perimyotis subflavus)	UR	E	3	2	3	1	4	N/A	3
Eastern Small-Footed Bat[2] *(Myotis leibii)*	UR	E	0	0	1	1	1	N/A	0

[1] "UR" indicates a species is currently under review for listing on the federal Endangered Species Act.

[2] Acoustic monitoring collects "call sequence" data and the true number of individuals is unknown. Numbers in the table reflect the number of survey sites with acoustic detections confirmed through manual call vetting. Numbers are reported to NHESP, but not tracked by them due to current uncertainty in using acoustic identifications.

[3] No bat monitoring was conducted during TY 2022.

3.3.3 New England Cottontail Rabbit Study

The Natural Resources Office began a study in TY 2010 on the New England cottontail rabbit (*Sylvilagus transitionalis*), at the time a candidate species for federal listing. Original study objectives were to determine the home range and habitat preferences of the species. This information can be used regionally to influence effective management efforts for this species. Current and future efforts are transitioning more from research into population monitoring, though with a strong emphasis on evaluating the effects of habitat management on cottontails. New England cottontails occur in suitable scrub oak or dense shrub habitat along powerlines or in the Impact Area on Camp Edwards.

In 2015, the USFWS removed New England cottontail from the federal candidate list. The finding was based upon the conservation implementation enacted and future commitments by the large regional partnership, including MAARNG and Camp Edwards. Continued habitat management and monitoring are critical to New England cottontail success and keeping the species from being federally listed.

In TY 2021, the Natural Resources Office contracted the USFWS working with the University of Rhode Island to perform statistical analysis and reporting for the New England cottontail data compiled thus far. The USFWS has contributed additional funding to analyze their data from Mashpee National Wildlife Refuge as a larger data set to have more applicability for all of Cape Cod. The DFW also added their data on Cape Cod to provide a more robust data set. The University of Rhode Island completed their report in late TY 2023 and a manuscript is still in development, the results of which will be shared with next year's report. Research into possible ways to limit the impact of Eastern cottontails on New England cottontails may also be necessary to conserve the species.

The Natural Resources Office continued active participation on the New England Cottontail Technical Committee, working with partners to prioritize and develop actions and efforts to implement the conservation

strategy for the species. The Natural Resources Office performed pellet searches in TY 2023 in regional plots and in areas with previous management history. In TY 2023, the Natural Resources Office also continued collaborating with the State University of New York College of Environmental Science and Forestry and USFWS to create experimental management plots and complete monitoring for New England cottontail and bat utilization of the plots.

3.3.4 Agassiz's Clam Shrimp

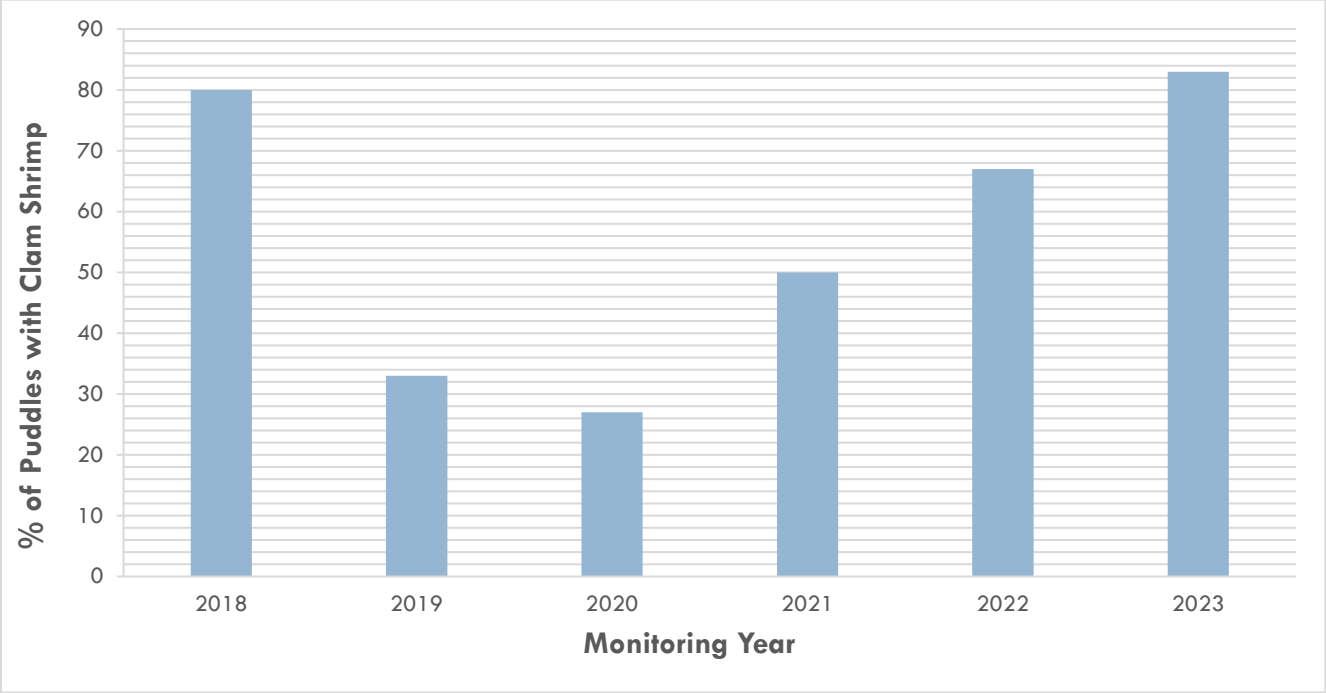
Roadway puddles in the Training Area/Reserve provide habitat for two state-listed clam shrimp species. Agassiz's Clam Shrimp (*Eulimnadia agassizii*, [AgCS]) were discovered in roadway puddles on base in TY 2015 during an effort to resurvey rare species records older than 15 years. In this case, an observation and collection made on Camp Edwards in 1999. American Clam Shrimp (*Limnadia lenticularis*, [AmCS]) were identified by Natural Resources staff in TY 2021. A non-listed species, the Mattox Clam Shrimp (*Cyzicus gynecea*) also inhabits roadway puddles on the base. The species most ubiquitous in dirt road puddles at Camp Edwards is the Agassiz's Clam Shrimp.

Puddles in dirt/gravel roads are most often created by uneven roadway compaction and are unvegetated. In TY 2018 when several puddles containing AgCS along Herbert and Cat roads had become large enough to impede use for training, the Natural Resources Office worked with NHESP and Oxbow Associates to create a Conservation and Management Plan (CMP) to address the necessary road repairs and provide net benefit for the species. The CMP included several components: new puddle creation, *in-situ* modification to improve puddles, relocation of egg-bearing sediment, and three years of monitoring. The CMP requirements were completed in TY 2020. A fourth year of monitoring, not required, was completed in TY 2021 to compensate for 2020 drought conditions that resulted in often dry puddles with fewer opportunities to observe clam shrimp and because clam shrimp are of strong focal conservation interest for MAARNG. Despite the drought and lack of favorable conditions in 2020, AgCS were still found in three of the 11 puddles monitored and, for the first time AgCS and Mattox Clam Shrimp were documented existing in the same pool at the same time.

In TY 2021, Natural Resources staff coordinated with MassWildlife to amend the CMP permit to allow for long term road repairs. The CMP amendment, called Clam Shrimp Conservation and Roadway Maintenance Plan, borrows on elements from the original CMP, such as habitat improvement and annual monitoring, brings in new elements, such as road category designations and their associated treatments and annual Road Work Plans, and provides for a net conservation benefit to the species. The original CMP allowed for location specific improvements to training roads and clam shrimp puddles. The amended permit establishes a long-term protocol that allows for regular road maintenance and repair of road puddles in the Camp Edwards training area while preserving a network of suitable and available puddle habitat for clam shrimp populations.

TY 2023 was the sixth consecutive year of formal clam shrimp monitoring. A subset of twelve puddles situated throughout the northern training area were monitored by MAARNG staff and seasonal field technicians from May through October. Ten of the 12 puddles, or 83 percent, contained Agassiz's clam shrimp. All clam shrimp collected were identified in the lab by Natural Resources staff and field technicians and keyed out to AgCS. Clam shrimp are collected under an annually renewed NHESP issued Scientific Collection Permit. Collections are donated to NHESP. This was a productive year for AgCS, up from 67 percent in 2022, and up from all three years previous to 2022 which were at 50 percent and lower. Precipitation was consistent throughout the monitoring season, keeping puddles refreshed with water conducive for multiple generations of clam shrimp and for detection when monitoring. In some years, puddles go dry for much of the summer or don't contain water long enough for clam shrimp eggs to hatch and develop which reduces detection rates even if clam shrimp are present in the form of eggs.

Graph 3-4 Agassiz's & American Clam Shrimp Monitoring Results



Graph 3-4: Annual results showing the percentage of puddles with confirmed presence of Agassiz's Clam Shrimp (and limited American Clam Shrimp) during standardized annual monitoring. Number of formal survey sites ranged between 10 and 12 with a standard of 12 from 2021 forward.

In addition to the highly successful rate of puddles containing AgCS, below are a few highlights from TY 2023 that really underscore the resiliency of AgCS in a dynamic and seemingly inhospitable habitat (i.e., roadway puddles) and shows that soldier training and protection of rare species can work in tandem.

1) Agassiz's Clam Shrimp were documented in a monitoring puddle called FRED (Fredrikson Road) six months after the puddle had been drained, filled, and reformed in a smaller footprint at the side of the road to allow vehicle passage. The puddle was very large and prohibitively deep, thus prioritized on maintenance work plans. It was modified by Natural Resources-ITAM staff in January 2023 under the Road Work Plan 2-Dec2021. Prior to modifying FRED puddle, two five-gallon buckets were filled with sediment from the puddle. The sediment was added back to the reformed puddle once the work was complete. The sediment contains the durable eggs from the clam shrimp therefore helping to repopulate the puddle.

2) Agassiz's Clam Shrimp were documented in a monitoring puddle called PEW (Pew Road) that was known to contain clam shrimp but that graded over during road work in January 2023 without prior approval. Corrective measures were implemented immediately, including disciplinary action and site restoration. PEW puddle was quickly restored, but in a smaller footprint and to one side of the road rather than the entire width of the road as it had existed previously. The original error primarily came down to communication, as did the recovery, and the incident has ultimately been constructive in communicating processes and repairing road access while ensuring clam shrimp habitat and presence persist.

3) Agassiz's Clam Shrimp were documented by Natural Resources seasonal field technicians, in a mitigation puddle named WHEE3 two years after the puddle was filled during road grading in November 2021. WHEE3 was a particularly small, nondescript, and ephemeral puddle on Wheelock Road that had contained AgCS in the summer of 2021, but only briefly and only after MAARNG introduced the clam shrimp to the puddle to mitigate for approved roadwork that resulted in the loss of clam shrimp puddles

along the impact area boundary road. After AgCS were introduced to WHEE3, they were observed persisting in the puddle including after a drying period, meaning that the eggs had persisted through the drying cycle to hatch after precipitation. The rediscovery of AgCS, in a naturally reformed puddle two years after AgCS introduction and puddle filling shows how well suited they are to this dynamic environment and shows that soldier training and base activities can work in tandem with conservation and protection of rare species.

In April 2023, the Natural Resources Office submitted Road Work Plan 3-Apr2023. A significant component of the Clam Shrimp Conservation and Roadway Maintenance Plan is the submission of annual road work plans developed by MAARNG for MassWildlife review and approval. This involves planning meetings and coordination with participants from Natural Resources, IAGWSP, Camp Edwards troop labor projects, and Facilities and Engineering. Potential impacts to clam shrimp and clam shrimp habitat, as well as other wildlife and natural resources concerns, are evaluated by Natural Resources staff. Required and voluntary mitigation, based on evaluated impacts and a Net Benefit standard, is proposed and included in the road work plan.

Road Work Plan 3 includes two puddle improvement projects which are planned for the fall and winter 2023/24. Both puddles, BP1-1 and BP1-4, have supported AgCS in the past. Their current size has made them nearly impassable at certain times of the year due to water depth, overall size, and permanent to near-permanent inundation. Size, depth, and duration are the three threshold criteria used to determine when a puddle can or should be repaired. The CMP Clam Shrimp Conservation and Roadway Maintenance Plan provides a guide for the type of mitigation required, if any, when repairing puddles with weight given to known clam shrimp sites. BP1-1 and BP1-4 are an obstacle to vehicles but they also attract breeding amphibians including spotted salamanders, resulting in a potential sink when the roads receive increased traffic. MAARNG Natural Resources Program staff will modify BP1-1 and BP1-4 using methods successfully applied in previous projects. A Final Conditions Report is submitted to MassWildlife when work is complete. Lastly, the Natural Resources Office will coordinate with the IAGWSP, Camp Edwards troop labor officials, and Facilities and Engineering in November/December to develop a Road Work Plan for the coming year.

TABLE 3-3 LIST OF RARE CRUSTACEANS REPORTED TO NHESP

Quantities shown are not resulting of standardized surveys and should not be interpreted as population trends.

Common/Scientific Names	Fed Status	State Status	Individuals Reported TY 2017	TY 2018	TY 2019	TY 2020	TY 2021	TY 2022	TY 2023
CRUSTACEANS[1]									
Agassiz's Clam Shrimp *(Eulimnadia agassizii)*	-	E	6	38	9	3	5	13	12
American Clam Shrimp *(Limnadia lenticularis)*	-	SC	0	0	0	0	3	0	0

[1] Counts represent the number of sites (i.e., puddles or pools) where clam shrimp were observed during annual surveys. Annual surveys include a subset of sites that have contained clam shrimp in the psat, have not contained clam shrimp in the past, and that have not been surveyed previously.

3.3.5 Eastern Box Turtle

3.3.5.1 Turtle Protection

Extensive Eastern Box Turtle Protection planning and effort exists in support of the MPMG Range Project, which has been described in detail in previous reports. In TY 2023 MPMG turtle protection efforts were focused on basic monitoring of area turtles, including opportunistically tagging new turtles found in the area. AECOM (contracted support) tracked turtles outfitted with radio-transmitter tags at the proposed range location to change out transmitters and to get fall hibernacula locations. A summary of their activities will be submitted to NHESP in the winter of 2023-2024.

LEC Environmental Consultants, Inc. provided turtle protection oversight in coordination with MassWildlife and MAARNG Natural Resources Office for the physical fitness track and field construction (outside the Training Area/Reserve).

Oxbow Associates, contracted by Eversource, coordinated with the Natural Resources Office on their activities on base including turtle protection for the Bourne Switching Station and along the powerline paralleling Gibbs Road. The Natural Resources Office shared transmitter frequencies for turtles along the powerlines to facilitate turtle protection during powerline installation this year. Oxbow Associates has also provided information on the health of turtles they find on base and coordinated on nesting site creation to be completed on the powerline for their mitigation efforts.

3.3.5.2 Monitoring and Research

In TY 2021, the Natural Resources Office contracted AECOM to perform detection dog-assisted surveys to find box turtles and place radio transmitters on them in a variety of habitats on base. This broad landscape level approach will allow monitoring of turtles in management areas receiving a variety of treatments. Periodic monitoring of these turtles over time will provide a broad-scale look at impacts from both the range development activities and mitigation activities on base. This contract will contribute towards the long-term box turtle monitoring requirement in the CMP for the range development projects. Turtle searches were completed in October 2022. The surveys resulted in 15 turtles found of which 13 were large enough to place radio-transmitters on. These turtles will continue to be monitored periodically for the Conservation and Management Permit.

In-house 2023 turtle telemetry efforts focused on tracking tagged turtles during spring emergence and changing out transmitters. AECOM assisted in changing turtle transmitters this year as well. Turtles were assessed for the presence of fly larvae when found above ground. Tagged turtles are mostly in Training Areas C-14, E-5 (Sierra and Tango Ranges) and E-9, which are areas with future construction projects or areas with previously tagged turtles. Other turtles from the canine-assisted surveys are also tracked in mitigation areas and forest retention areas. Sixty-four turtles were being tracked by the end of the fiscal year.

In TY 2021, the Natural Resources Office contracted the University of Illinois' Wildlife Epidemiology Lab to conduct health assessments, take blood samples and swabs to explore the impacts from the larval infestations that had been observed in previous years and potential causes. A veterinary student spent 12 weeks on base taking 109 samples from Eastern box turtles. She also took samples from Spotted turtles and painted turtles that were captured during a Legacy funded effort. Blood samples for lead were taken from painted turtles in the Rod and Gun wetlands and other wetlands for comparison given the history of skeet shooting and planned clean up by AFCEC at that site. The veterinarian from the Wildlife Epidemiology Lab also spent a day on base examining the Dipteran larval infestations. In TY 2022, the Wildlife Epidemiology Lab provided results and a report on the findings. The findings were also presented at the American Association of Zoo Veterinarians (AAZV) conference in September 2022 (presentation on box turtle findings and a poster on spotted and painted turtle findings). In TY 2023, the Wildlife Epidemiology Lab continued to work on two manuscripts for publication in the Journal of

Zoo and Wildlife Medicine entitled "Prevalence of cutaneous myiasis during disease surveillance of eastern box turtles (*Terrapene carolina carolina*) in Cape Cod, Massachusetts" (https://bioone.org/journals/journal-of-zoo-and-wildlife-medicine/volume-54/issue-4/2022-0173/CUTANEOUS-MYIASIS-AND-ITS-RELATIONSHIP-TO-WELLNESS-IN-EASTERN-BOX/10.1638/2022-0173.short) and "Health assessment of spotted (*Clemmys guttata*) and painted (*Chrysemys picata*) turtles in Cape Cod, Massachusetts."

Dipteran larval infestations were again observed in TY 2023. The Natural Resources Office facilitated a UMass Amherst graduate student's research on dipteran larval infestations in Eastern box turtles on Camp Edwards in TY 22. Since past efforts have placed transmitters on a large number of turtles on base, the graduate student and two interns were able to track turtles, monitor their condition and monitor their movements. This data was supplemented with information gathered by Natural Resources staff in the spring and fall of that year. The graduate student compared the movements of healthy and infected turtles to determine impacts on mobility from larval infestations. The graduate student identified the species of fly infesting box turtles as *Dexosarcophaga cistudinis*. Infection did not affect turtle body condition, habitat use, or movement, but did affect shell temperature. This project included inputs and collaboration from USFWS, USGS, and NHESP. The findings from this research have been submitted for publication in the Northeastern Naturalist, titled "The effect of myiasis on Eastern Box Turtles (*Terrapene carolina carolina*) body condition, movement, and habitat use at Camp Edwards in Massachusetts." The Natural Resources Office staff are continuing to coordinate with the State Herpetologist, the veterinarian at Tufts, and the University of Illinois' Wildlife Epidemiology Lab on this potential threat to turtles as well.

TABLE 3-4 LIST OF RARE REPTILES AND AMPHIBIANS REPORTED TO NHESP

Quantities shown are not resulting of standardized surveys, and should not be interpreted as population trends

			Individuals Reported						
Common/Scientific Names	**Fed Status**	**State Status**	**TY 2017**	**TY 2018**	**TY 2019**	**TY 2020**	**TY 2021**	**TY 2022**	**TY 2023**
REPTILES and AMPHIBIANS									
Eastern Box Turtle *(Terrapene carolina carolina)*	-	SC	42	43	58	45	83	62	96
Eastern Hog-nosed Snake *(Heterodon platirhinos)*	-	SC	3	8	9	1	2	6	7

3.3.5.3 Education and Awareness

In response to five road mortalities and one mower mortality observed in 2021, the Natural Resources Office, Range Control, and others made efforts to increase awareness and education around box turtle-human interaction. Additionally, in 2022 Roads and Grounds installed permanent wildlife crossing signs at all the likely entrances to the training areas. In 2022, no road mortalities were documented, and in 2023 there were three. Outreach efforts will continue across base in hopes of continuing to reduce turtle mortality.

In TY 2023, the Natural Resources Office continued to conduct their annual training on box turtles. The training was for personnel working on base and it explains how to effectively conduct turtle sweeps and what to do if you find a turtle on base. Each year, Range Control personnel consistently report Eastern box turtle sightings to the Natural Resources Office, which are often tagged with transmitters. Flyers and notifications are distributed annually encouraging caution for Eastern Box Turtles when driving on base and multiple observations were reported to the Natural Resources Office based on this internal outreach.

In TY 2022 the USFWS and MassWildlife asked the Natural Resources Office to host and participate in an "Every Turtle Counts" outreach effort about keeping turtles in the wild and identifying some major threats. The initial public service announcement was posted in August 2022 and is available online at https://www.fws.gov/story/every-turtle-counts. USFWS also developed a longer edit of the video providing additional detail about Eastern Box Turtles, including more footage from Camp Edwards. The longer video is available online at the USFWS YouTube channel https://www.youtube.com/watch?v=BPTpK5MsXms.

3.3.6 Lepidoptera (Moths and Butterflies)

Camp Edwards and the Training Area/Reserve are home to a high number of listed and otherwise rare butterflies and moths, many of which are closely tied to a single host-plant and/or barrens habitat conditions. Nearly half (20 of 43[*]) of the listed species at Camp Edwards are butterflies (1) or moths (19). Active monitoring and incidental observations show a strongly positive response from many of these species to active habitat management efforts and soldier training support. Monitoring of populations and outreach, including public and scientific presentations, are both increasing parts of the program to more formally and fully evaluate the influence of management on these species.

The Conservation and Management Permit for range projects on Camp Edwards requires habitat mitigation in the form of mechanical forestry and prescribed fire treatments. Many of the Lepidoptera species on base are expected to greatly benefit from the reintroduction and increased frequency of fire as well as increased habitat patch diversity. The monitoring component of the CMP requires long-term Lepidoptera surveys to evaluate effects of the overall range development, fire hazard reduction actions, and mitigation actions (short and long term) on the Lepidoptera community. Monitoring of moth and butterfly species will guide adaptive management for the use of fire (e.g., seasonality, intensity, return interval). The Natural Resources Office contracted WEST Inc. to provide a robust analysis of sampling designs to make the most use of the monitoring data.

In TY 2021, the Natural Resources Office worked with WEST to develop protocols to monitor Lepidoptera populations on base. After consulting the state's invertebrate biologist, the team decided to broadly sample sites using a vegetation protocol to monitor for improved habitat conditions, a UV light trapping protocol to monitor moths at a smaller subset of sites, and a daytime caterpillar survey protocol to sample Buck Moth (*Hemileuca maia*), a species believed to indicate improved conditions for state listed moths on base. The development of these protocols was completed in early TY 2022.

The vegetation sampling was completed for the first time in TY 2021 at 20 sites. In TY 2022 and TY 2023, the Natural Resources Office contracted Davey Resource Group to implement the vegetation sampling at 30 sites. In TY 2022, GZA (two-year contract) was contracted to implement UV light trap sampling for night flying moths at 7 sites 4 times spaced out during the flight periods for target species. Sampling in TY 2023 captured two state listed species, Pink Sallow Moth (*Psectraglaea carnosa*) and Herodias Underwing (*Catocala herodias*). This represents a decrease in state listed species from TY 2022, which may be attributed to the wet season, interannual variability, or the difference in habitat at the chosen sites. Two of the species last year were likely errant individuals (Sandplain Heterocampa, *Heterocampa varia*) or not associated with the habitat sampled (Pink Streak Moth, *Dargida rubripennis;* a grassland specialist). This will be explored further in the report from all sampling events, expected in spring 2024.

In TY 2019-2023 the Natural Resources Office collaborated with a PhD candidate, Teá Montana, from the University of Massachusetts Boston, Stevenson Lab, in monitoring Lepidopteran diversity at Camp Edwards. The

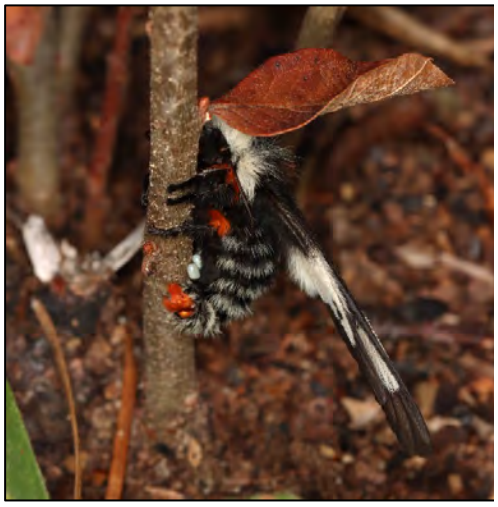
[*] 43 is the "primary" list of MESA species at Camp Edwards, which excludes 7 bird species that do not breed on-site.

focus of the research is Lepidopteran diversity across urban/rural gradients, and the Training Area/Reserve fits the rural category. With general moth expertise and a specialization in Sphinx Moths (Sphingidae) these studies have significantly expanded our knowledge understanding of moths at Camp Edwards, including inspiring and facilitating the development of in-house expertise. She introduced staff to multiple survey methods with notable results and renewed emphasis on moth documentation. Her work in TY 2023 continued to document Frosted Elfin (butterfly, *Callophrys irus*), Slender Clearwing Sphinx Moth (*Hemaris gracilis*), and Pink Streak Moth. In addition, she also observed Herodias Underwing and Buck Moth this year. Natural Resources staff also performed additional night surveys using UV flashlights to search for Frosted Elfin and Slender clearwing sphinx moth catepillars in areas of known past occurrences. Discoveries from these surveys and incidental findings (i.e. Buck Moth, Collared Cycnia [*Cycnia collaris*]) will be reported to NHESP.

The USFWS "Frosted Elfin Habitat and Butterfly Survey Protocol" was implemented at five locations on Camp Edwards with an abundance of their host plant (Wild Indigo, *Baptisia tinctoria*). Adults of this species were detected at four of the five sights. Two of these sites were new locations for Frosted Elfin, one of which has been a focal habitat restoration area in Training Area C-14. This restored Pitch Pine (Pinus rigida) – Scrub Oak (Quercus ilicifolia) habitat has received a combination of conservation forestry (2018), prescribed burning (2019), and coppice treatment of resprouting oaks (2022/2023). It also was newly documented as hosting Buck Moths in early TY 2024. Data from this survey will be submitted to USFWS to aid in their regional survey efforts in support of a range-wide status assessment and federal listing evaluation. Additional surveys were completed for Frosted Elfins using blacklight flashlights to detect caterpillars and confirm active breeding or as further effort to determine if Frosted Elfin were present.

Monarch Butterfly (*Danais plexipus*) surveys were completed at five sites using the Monarch Larva Monitoring Project protocol developed through a partnership of the Monarch Joint Venture and the University of Wisconsin-Madison Arboretum. The goal of this effort is implementing a broad and standardized larval (caterpillar) surveys across the butterfly's range to track population health and success. The surveys consist of weekly visits to consistent milkweed patches from early June through mid-September, making this a substantial level of effort. Monarch Butterfly is a Candidate Species under the Federal Endangered Species Act and a focus of collaborative conservation between DoD and USFWS. Milkweed patches showed substantial variation compared to prior years, including at least one failing to sprout while there were several new patches observed, some patches with significant expansion, and others with significant reduction. For example, within the grasslands one Monarch Butterly monitoring plot never exceeded 100 plants compared to an average of 234 plants the prior year. Another grassland milkweed patch had increased to an average of 243 plants per week compared to an average of 39 when the patch was surveyed in 2021. All sites supported both Monarch Butterfly eggs and caterpillars and K Range showed an increase compared to previous years. This data will be entered into the Monarch Joint Venture's online database.

Department of Defense installations have been urged to identify milkweed conservation areas as part of collaborative conservation and recovery implementation for the Candidate Species. Ten sites were signed as milkweed conservation areas including eigth scattered throughout the Training Area/Reserve. These areas are prioritized for maintenance with mowing and/or prescribed fire, but have mowing restrictions (avoidance) during the egg and caterpillar development timeframe. This provides an abundant, widespread, and diverse source area for Monarch Butterflies at Camp Edwards. Milkweed patches within the grassland are abundant, but were not signed as milkweed conservation areas due to the existing prioritization of sandplain grassland/heathland habitat, ensuring milkweed conservation. An interesting observation in patches of Butterfly Milkweed (*Asclepias tuberosa*) is that the state-listed Collared Cycnia (moth) can have notable impact on milkweed availability through herbivory. However, while Collared Cycnia tends towards host specificity, the Monarch Butterfly is less selective on milkweed species providing a much more widespread food source for the Monarch.



Egg-laying Buck Moth (*Hemileuca Maia*). *Photo by Jake McCumber, NR/ITAM*

The Buck Moth is a moderately large and state-listed silk moth that is somewhat unique in having a late flight period (October) and daytime activity. Buck Moths had a strong flight in early TY 2023 (October 2022). While not a formal survey protocol, somewhat opportunistic efforts led to documentation of 12 records during the fall flight from October 6 through October 12. Half of these were casual observations while driving or conducting other activities with counts ranging from 1 to 35 (average 10) and as many as 6 individuals in view at one time in the excellent barrens habitat along Gibbs Road. More targeted searches in both grasslands habitat (with scattered Scrub Oak – the species' host plant) and the northern training area all resulted in Buck Moth observations with counts ranging from 1 (early morning intentionally before flight activity) to 25 (average 12.5). Most notably Buck Moths were observed very actively using recently restored Pitch Pine – Scrub Oak habitats. A female was observed (and photographed) actively ovipositing (laying eggs) on resprouting Scrub Oak in Training Area BA-3 within a restoration area that had been masticated (understory shrub and young tree mowing) in the preceding winter and burned with prescribed fire in March 2022 leading to vigorous regeneration and excellent habitat condition. The Buck Moth is a useful indicator of habitat condition based on their need for healthy Scrub Oak condition and structural complexity, combined with daytime activity, large size, and bold black and white coloration - all increasing observability compared to many other rare moths and butterflies. The positive response to conservation efforts and successive years of strong flight period are positive indicators of ecosystem health at Camp Edwards.

3.3.7 Other Insects

Habitat condition after restoration in BA3. Photo by Jake McCumber, NR/ITAM

Formal surveys were not conducted for other listed insects beyond the Lepidoptera described above. However, more opportunistic searches were successful in documenting a new, and seemingly widespread, state-listed beetle at Camp Edwards. The Purple Tiger Beetle (*Cicindela purpurea*) is somewhat expected at Camp Edwards as it occurs just to the south at Crane Wildlife Management Area. Past surveys (tiger beetle traps (2016-2017) and opportunistic searches, however, had never documented the species. Purple Tiger Beetle was documented in at least four locations at JBCC, including two within the Training Area/Reserve. A total of 18 individuals were

TABLE 3-5 LIST OF RARE BUTTERFLIES AND MOTHS REPORTED TO NHESP

Quantities shown are not resulting of standardized surveys and should not be interpreted as population trends.

Common/Scientific Names	Fed Status	State Status	Individuals Reported TY 2017	TY 2018	TY 2019	TY 2020	TY 2021	TY 2022	TY 2023
BUTTERFLIES and MOTHS[1]									
Buck Moth (*Hemileuca maia*)	-	SC	95	0	4	2	74	133	23
Pine Barrens Speranza (*Speranza exonerata*)	-	SC	13	0	0	0	0	4	0
Sandplain Euchlaena (*Euchlaena madusaria*)	-	SC	7	0	0	1	0	0	0
Heath Metarranthis (*Metarranthis pilosaria*)	-	SC	1	0	0	0	0	0	0
Melsheimer's Sack Bearer (*Cicinnus melsheimeri*)	-	T	0	0	0	7	0	0	0
Gerhard's Underwing (*Catocala herodias*)	-	SC	10	0	0	2	0	35	6
Pine Barrens Zale (*Zale lunifera*)	-	SC	8	0	0	0	0	0	0
Barrens Dagger Moth (*Acronicta albarufa*)	-	T	0	0	0	0	0	0	0
Sandplain Heterocampa (*Heterocampa varia*)	-	T	0	N/A	N/A	N/A	N/A	1	0
Chain-dotted Geometer (*Cingilia catenaria*)	-	SC	0	0	1	0	0	0	0
Drunk Apamea (*Apamea inebriata*)	-	SC	0	0	0	0	0	0	0
Pink Sallow (*Psectraglaea carnosa*)	-	SC	5	0	0	0	0	0	6
Pink Streak (*Dargida rubripennis*)	-	T	0	0	0	3	1	1	2
Collared Cycnia (*Cycnia collaris*)	-	T	1	0	11	33	200	7	4
Coastal Heathland Cutworm (*Abagrotis benjamini*)	-	SC	1	0	0	0	0	0	0
Woolly Gray (*Lycia ypsilon*)	-	T	2	0	0	0	0	0	0
Water-willow Stem Borer (*Papaipema sulphurata*)	-	T	1	0	0	0	0	0	0
Waxed Sallow Moth (*Chaetaglaea cerata*)	-	SC	2	0	0	0	0	0	0

TABLE 3-5 LIST OF RARE BUTTERFLIES AND MOTHS REPORTED TO NHESP, cont'd

Quantities shown are not resulting of standardized surveys and should not be interpreted as population trends.

Common/Scientific Names	Fed Status	State Status	Individuals Reported TY 2017	TY 2018	TY 2019	TY 2020	TY 2021	TY 2022	TY 2023
BUTTERFLIES and MOTHS[1]									
Frosted Elfin[2] *(Callophrys irus)*	-	SC	5	5	TBD	25	57	13	64
Slender Clearwing Sphinx *(Hemaris gracilis)*	-	SC	0	0	0	5	3	26	3

[1] Moths were extensively surveyed under contract with the Lloyd Center for the Environment between 2016 and 2017. There were no surveys in 2018, and MAARNG staff is not recording flight records of Barrens Buckmoth, as they are ubiquitous around the Training Area/Reserve. 2019 quantities represent individuals or groups of individuals (a group of Barrens Buckmoth caterpillars on a single leaf is counted as one, as are a pair of Unexpected Cycnia caterpillars sharing the same butterflyweed plant).

[2] MAARNG staff did not perform surveys for *Callophrys irus* in 2019, but facilitated USFWS surveys. Results are pending, but USFWS staff found Frosted Elfins across a wider area than was previously known.

confirmed by photograph with more individuals present. Most notably, two of the sites were closely associated with and positively benefiting from soldier training and the training landscape. One of these is a driver's training area on Herbert Road in Training Area BA-3 while the other is Dig Site 1 and adjacent roads in Training Area B-11. The Purple Tiger Beetle, like many barrens species requires open sandy patches within the mosaic of habitat and this fits well with the network of small training venues and unimproved roads throughout the training area. Likely, 2023 was a particularly good year for this species and it will be interesting to see if it continues to be well represented and if more locations can be documented.

The Walsh's Anthophora (formerly Walsh's Digger Bee, *Anthophora walshii*) was not surveyed in the northern training area in TY 2023, but several individuals were photographed in the cantonment grasslands, particularly in GLU3. This highly isolated bee is closely tied to Wild Indigo, as is the Frosted Elfin Butterfly, and relatively active habitat management maintaining bare sand exposure within grassland/heathland habitat. The area opportunistically surveyed had been burned and mowed the preceding fall, which has consistently led to a strongly positive response by this species.

3.3.8 Eastern Whip-poor-will

Annual implementation of the Northeastern Nightjar Survey, as mentioned above, facilitates the evaluation of population trends throughout Camp Edwards and the Training Area/Reserve using a standardized protocol implemented throughout the eastern United States. A subset of 10 points originally set by MassWildlife has been surveyed annually since 2013 and an average of 34 sites has been surveyed along three routes starting in 2014 providing a site-wide assessment. The Eastern Whip-poor-will is likely a strong indicator of pine barrens habitat health and management condition given its sensitivity and ongoing declines throughout the region. The Eastern Whip-poor-will has a close association with woodland and shrubland habitat condition that is important to the vast majority of species of conservation concern in southeastern Massachusetts. It also has a close association with fire which maintains an open mid-story and healthy moth populations, which is the critical food resource.

Whip-poor-wills were observed at 31 of the 32 sampled points in 2023 for 0.97 occupancy, overall. However, one additional point only had Whip-poor-will recorded during preliminary surveys so the occupancy for the formal survey was 0.94, which maintains the typical trend of widespread presence. The long-term occupancy mean is 0.92 (2013 – 2023, range 0.64 – 1.0), which is strongly impacted by results from 2017 and 2019 where surveys were conducted in sub-ideal conditions. The overall average for the 2023 formal Whip-poor-will surveys was 3.8 birds per point (point means, range 0 – 7). The highest individual count was 9 at point ST-10 and four points had counts of seven by a single observer. Zone averages (Fig. 4) ranged from 2.7 (northeast) to 5.5 (southeast, center-east) with an average across zones of 4.0 birds per point.

Both focal research efforts (previous migration studies in the Training Area/Reserve) and longer-term trends from annual monitoring suggest that the overall population is healthy at Camp Edwards. Likewise, the response to management actions including prescribed burning and mechanical forestry appears to be overall positive from targeted research, long-term monitoring, and anecdotal observation. Given that 2023 was the tenth year of surveys for the three long-term monitoring routes a more detailed long-term trend analysis was completed. The summary result of this analysis is that the Eastern Whip-poor-will is showing statistically significant increases at Camp Edwards at all analyzed scales. This includes the site-wide population (increase of 0.19 bird/point/year, $p<0.05$) and across spatial zones of the base. All six geographic zones and all three survey routes showed increases trends with two zones (southeast and central-west) and one route (Route 3, mostly southwest) having statistically significance to the increasing slopes (0.25 [$p<0.01$], 0.22 [$p<0.02$], and 0.24 [$p<0.05$], respectively).

Graph 3-5 Camp Edwards Site-wide Eastern Whip-poor-will Monitoring

Graph 3-5: Whip-poor-will long-term monitoring results by geographic zone at Camp Edwards. The scatter plot above shows the mean per-point count for each zone across the 10 years of the survey effort. The regression lines fit the two zones with statistically significant trends (Zone_CW, dashed, and Zone_SE, dotted). Counts vary by zone but show relative consistency within most years.

The long term results demonstrate a healthy Eastern Whip-poor-will population at Camp Edwards; one that is highly compatible with soldier training and ongoing habitat management efforts. This is particularly noteworthy given regional and range-wide declines of this species. Camp Edwards appears to be the strongest site for the Eastern Whip-poor-will in New England based on Northeast Nightjar Survey results. Areas with high patch diversity, including a high degree of variation and woodland edge habitat intermixed with shrubland habitat and open understory woodland conditions support the highest densities of Whip-poor-wills. Small arms ranges, ordnance investigation/removal, bivouac sites, and broader scale habitat conservation through forestry and prescribed burning are all important for providing a diverse patchwork of habitat that supports abundant and diverse moths and abundant Whip-poor-wills.

TABLE 3-6 LIST OF RARE BIRDS REPORTED TO NHESP

Quantities shown are not resulting of standardized surveys and should not be interpreted as population trends.

Common/ Scientific Names	Fed Status	State Status	Individuals Reported TY 2017	TY 2018	TY 2019	TY 2020	TY 2021	TY 2022	TY 2023
BIRDS									
Grasshopper Sparrow[1] *(Ammodramus savannarum)*	-	T	15	16	20	34	36	29	30
Northern Harrier2 *(Circus cyaneus)*	-	T	Wintering	Wintering	Wintering	Wintering	Wintering	Wintering	Wintering
Upland Sandpiper[1] *(Bartramia longicauda)*	-	E	8	7	12	6	2	1	4
Eastern Meadowlark[1,4] *(Sturnella magna)*	-	SC	3	2	7	14	17	9	21
Long-eared Owl[2] (*Asio otus*)	-	SC	0	0	0	0	0	0	0
Vesper Sparrow *(Pooecetes gramineus)*	-	T	0	0	0	0	0	0	0
Whip-poor-will[3] *(Antrostomus vociferous)*	-	SC	52	110	53	99	123	101	105
Bald Eagle[2] *(Haliaeetus leucocephalus)*	-	SC	0	0	0	0	0	0	0

[1] Grassland bird numbers represent individual territories observed in a given year rather than the total number of birds observed throughout repeated surveys as was reported in past years (prior to the TY 2019 SOTRR). Upland Sandpiper counts exclude known females, but include unknown birds. Also, the numbers reported in annual reports TY 2015 and earlier included birds found on the Coast Guard airfield, which is not reported by MAARNG Natural Resources. Due to these changes, past year quantities may be different from prior versions of Appendix F, but now reflect the population more accurately.

[2] NHESP is only accepting reports of nesting raptors, rather than opportunistic observations of individuals. Reports are provided as relevant, but common wintering birds or migrants are not individually tracked or reported (e.g., Northern Harrier).

[3] As of TY 2016, quantities only reflect the results of annual survey routes during May, after totaling the minimum number (between two observers) heard at each site. In prior years, the number shown reflects the quantity reported to NHESP, which may include multiple survey windows and repeated counts. Due to Covid-19 concerns, 2020 routes were not run in duplicate, and the number represents the total number of individual birds heard calling throughout the routes.

[4] Species added to MA Endangered Species List in TY 2020. Observation quantities included for prior years but would not have been officially reported to NHESP.

3.4 SOIL CONSERVATION MANAGEMENT

All military and civilian uses and activities in the Training Area/Reserve during the year were reviewed by the Natural Resources Office to ensure that they were compatible with the limitations of the underlying soils. All users were instructed to report evidence of soil erosion to Range Control so that potential repairs to roads, bivouac areas and well pads could be identified in a timely manner. Road repair and maintenance within the Reserve/Training Area remained consistent with road type and use.

The ITAM program identified a repair plan for several areas of erosion concern on the tank trail parallel to Frank Perkins Road and all repairs were executed by the Facilities Engineering Roads and Grounds Division. Repairs totaled approximately 225 linear feet of the tank trail and were limited to within the existing width of the trail. The majority of the length was patching narrow ruts eroding on one side within the trail. The 225-feet were divided into five different sections along the 4,000-feet of tank trail within BA-7.ITAM also arranged for Roads

and Grounds repairs of severe rutting and puddling on maneuver roads within Training Area BA-3, leading north out of TTB Kelley. An Army National Guard Engineering unit repaired stormwater related erosion damage at the intersection of Estey and Frederikson roads.

All repairs were coordinated with the EMC's Environmental Officer. All projects were also coordinated closely with Natural Resources to follow the CMP for Agassiz's Clam Shrimp that ensures conservation of that species while supporting critical operations through road maintenance.

3.4.1 Erosion

Following severe rain events, the ITAM program works with Camp Edwards Facilities Engineering to patrol roads and trails and report and prioritize damage for repairs. The apparent increase in frequency of these rain events are indicators that the base will need to prioritize road maintenance and repairs in upcoming years to account for climate change-driven weather severity. Despite high overall rainfall, TY 2023 was not as difficult a year for road damage as preceding years, TY 2022 in particular. Efforts are ongoing to identify contributing features to rain-caused road damage and address these through design and targeted repairs.

3.5 VEGETATION, HABITAT AND WILDLIFE MANAGEMENT

The Natural Resources Office manages for a diversity of natural communities, plants, and animals with an ecosystem-based conservation approach. This supports a sustainable military training site and high-quality habitat for rare species, as described above, as well as common ones. Particular emphasis is on maintenance and restoration of earlier successional habitats (e.g., grasslands, shrublands, pine/shrub savannah) due to the conservation value of these habitats and rapidity at which they are lost to both natural processes (in absence of disturbance) and development. However, overall ecosystem management with a diversity of habitat maturity and composition is important to habitat management and climate resilience efforts.

Mechanical restoration, prescribed fire, resource monitoring, invasive plant management and others are important tools used within the Reserve to manage for a healthy, sustainable ecosystem and ensure the required protection of wildlife habitat and species. During TY 2023, multiple restoration efforts were continued – all of which are discussed in detail in Section 3.5.6.

Management and conservation planning for holistic ecosystem health are fundamental to Department of Defense conservation and efforts at Camp Edwards within and outside the Training Area/Reserve. Rare species habitat management integrates climate resilience, carbon sequestration, risk minimization (e.g., fire and southern pine beetle), military training objectives, habitat diversity, and other considerations. Monitoring and research continue to develop and support informed management and integration of these multiple objectives. Rigorous vegetation and moth study designs were developed in TY 2021 for long-term monitoring supporting the master development plan CMP. Breeding bird surveys continue to show positive or stable trends for Species of Greatest Conservation Need while more targeted efforts such as Eastern Whip-poor-will monitoring and research continue to show a strong, positive association with soldier training and habitat management. Climate resilience planning and assessment is ongoing for Camp Edwards with the Woodwell Climate Research Center. A critical outreach element continued to be communicating through public tours and other venues that the entirety of Camp Edwards, especially within the Training Area/Reserve, is managed for wildlife habitat – including small arms ranges and other military training venues that provide critical open field habitat for a wide variety of pollinators and other fauna within the greater pine barrens mosaic.

3.5.1 Vegetation Surveys

Two planning level surveys carried out in 2023 focused on the detection of federal and state listed plant species associated with early successional managed habitats primarily in the cantonment portion of Camp Edwards, but

also in the impact area and along some periodically mown roadsides and utility rights-of-ways in the northern training area. The contractor carrying out the surveys is in the process of reporting rare plant observations to NHESP, and the Natural Resources Office is awaiting the final report. However, preliminary steps, including time of year mow adjustments and coordinating with NHESP, are underway to protect and manage for newly discovered rare plant populations. See Section 3.3 and 3.3.1 for more about the rare plant surveys. Vegetation surveys linked to the long-term moth monitoring protocol focus on vegetation composition and structure. This long-term effort will provide valuable response and trend data for a variety of habitats to inform management planning and strengthen interpretation of faunal survey results. In TY 2023, vegetation surveys for the long-term moth monitoring project were carried out for the third year. See Section 3.3.6 for more details.

3.5.2 Bird Surveys

Training Year 2023 marked the 30th year of annual bird monitoring at Camp Edwards – a remarkable effort and data set providing for analysis of bird populations and habitat conditions. The TY 2022 *Annual State of the Reservation Report* contains a detailed analysis and summary of population trends for Species of Greatest Conservation Need as identified in the State Wildlife Action Plan. This analysis focused on the most recent decade of surveys with a revised point-count protocol allowing for better assessment of bird abundance. Based in part on that analysis results were reported at the Cape Cod Natural History Conference in a presentation entitled Bird Population Trends Reflect Pine Barrens Conservation at Camp Edwards. This highlighted how the population increases across all habitat association guilds (grassland, shrubland, pine barrens, forest) indicate successful and holistic conservation management with compatible military training.

During TY 2023 the standard set of 79 bird point-counts (14 grassland, 65 training area) were surveyed in three successive rounds for a total of 237 point-counts from May 22 through June 23. A total of 83 species were recorded, which is the highest tally in the 2013 through 2023 period of the count (updated protocol). Notably, six new species were recorded for the formal surveys (Bobolink, Mute Swan, Purple Martin, Rose-breasted Grosbeak, White-eyed Vireo, and Wood Thrush). While most of these are not new for the base it is novel for them to be recorded during the formal surveys. The average annual species tally is 72.4 (range 60 to 83) and a total of 116 species have been recorded during the formal surveys since 2013.

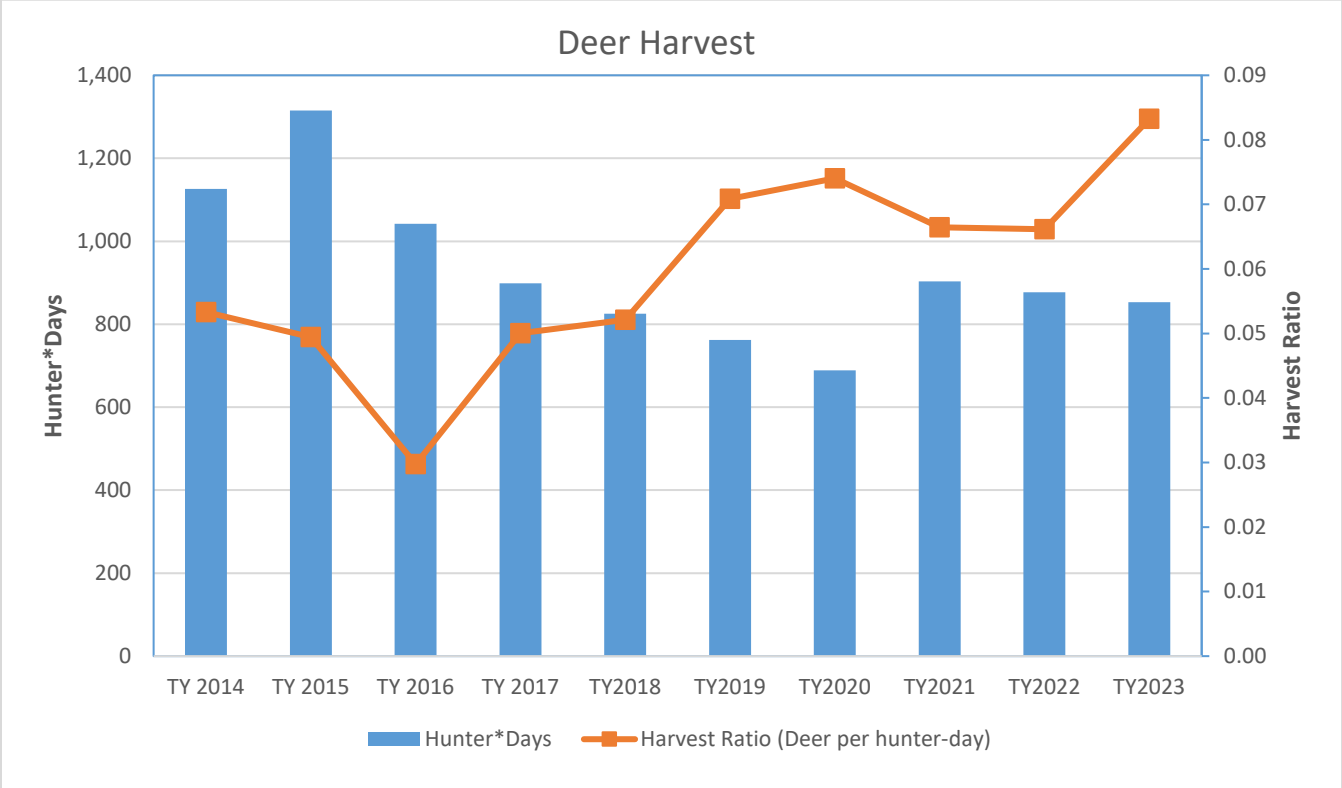
Updated population trends for Species of Greatest Conservation Need and other species of interest will be included in the TY 2024 *Annual State of the Reservation Report*.

3.5.3 Deer Hunt

The annual deer hunting season in the Training Area/Reserve during TY 2023 was again successful, with 71 deer taken during 853 hunter-days (sum of hunters per day across all days as reported by MassWildlife). The Natural Resources Program supports a hunt sufficient to maintain a harvest level that is compatible with a healthy deer herd and healthy ecosystem. MAARNG and DFW generally feel that the recent average of 60 deer per year meets the overall objective, but that additional harvest is sustainable. Browse surveys have been conducted every few to several years. DFW primarily relies on the biological data collected at the deer check to adjust the number of tags that are available each year. The 2017 browse survey indicated little to no browse pressure in the overall habitat.

The Natural Resources Program continues to provide a variety of hunting opportunities to best engage the hunting community and encourage new hunters through events such as the youth day, archery, and military sportsmen hunt. Hunting during TY 2023 included a three-day hunt by paraplegic sportsmen (November 3-5, 2022), a one-day youth hunt (September 30, 2022), a two-day opening for archery scouting (November 14-15, 2022), a three-day archery season (November 17-19, 2022), a one-day hunt for military and first responder sportsmen (December 2, 2022), a six-day shotgun season (December 5-10, 2022), and a two-day primitive (muzzleloader) season (December 15-16, 2022). Graph 3-6 shows the hunter days and deer harvest ratio since TY 2014.

Graph 3-6 Camp Edwards Deer Harvest



Note: Hunter Days is the sum of the number of hunters each day for each day of the annual hunt.

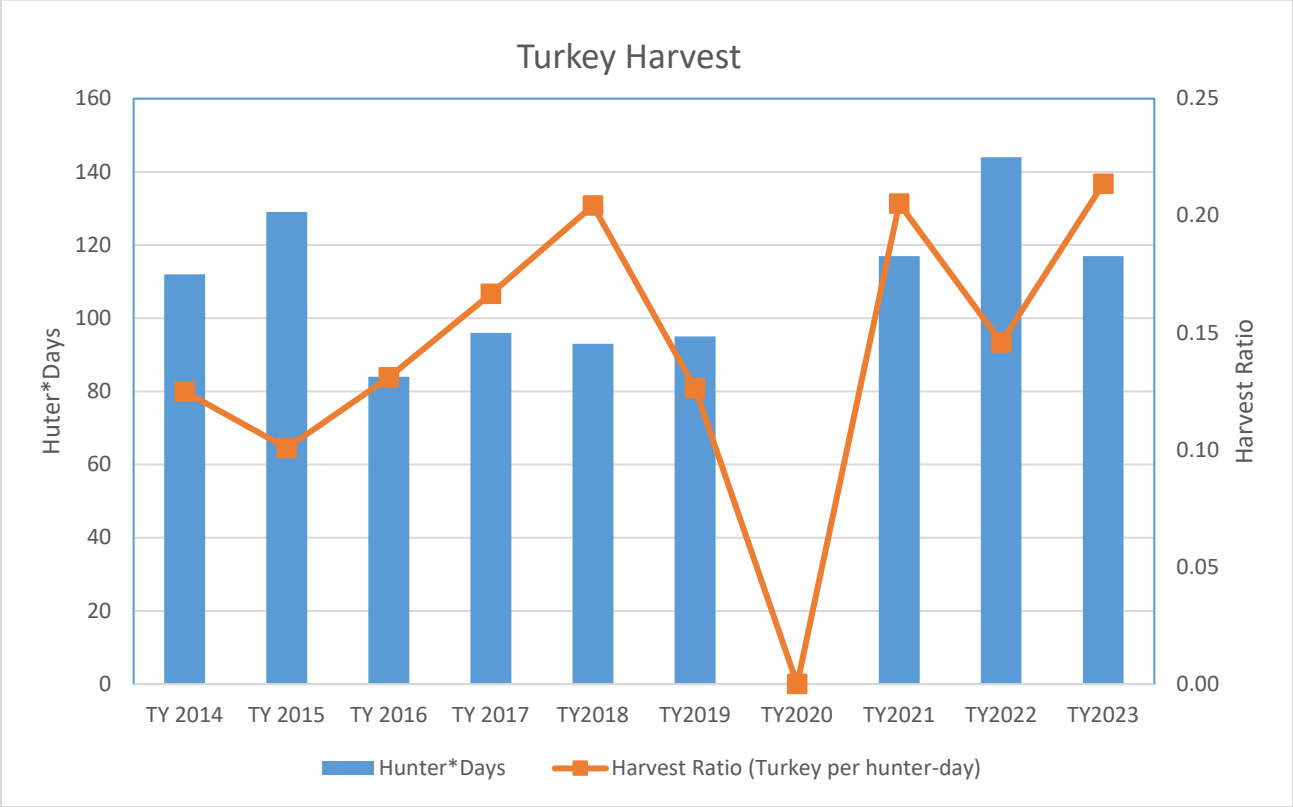
Hunter surveys were collected in TY 2023, but analysis and interpretation will occur in TY 2024 due to other priorities in TY 2023.

The goal of the hunt program is to provide recreational opportunities to the public and military and to harvest deer for the health of the herd and for ecosystem management. Deer harvests on base have been close to the 60 deer per year target for ecological and social (e.g. minimizing vehicle collisions) objectives. Casual observations of browse on site do not indicate excessive browsing, except on specific species. These species are being preferentially browsed and are often state-listed plants. The Natural Resources Office has begun efforts to exclude deer from sites where this species-specific browse has been observed. The Natural Resources Office, Range Control, and the DFW Southeast District have continued to make as many days and acres available to hunting as is possible given safety concerns and staff resources. Efforts to advertise the hunt were also aimed at increasing harvest as well as recreational use of the site.

3.5.4 Wild Turkey Hunt

There was a five-day wild turkey hunting season in the Training Area/Reserve from May 1-6, 2023, during which 18 turkeys were taken across 109 hunter-days. In addition, a one-day youth turkey hunt was held on April 22, 2023, in which eight youths participated with seven turkeys taken. Graph 3-7 provides information on the wild turkey hunts conducted in the spring since TY 2014.

Graph 3-7 Camp Edwards Turkey Harvest



Note: Hunter Days is the sum of the number of hunters each day for each day of the annual hunt. In TY 2020, the turkey hunt was canceled due to the statewide shutdown for the Covid-19 pandemic.

3.5.5 Restoration Activities

The Natural Resources Program completed significant restoration work on two training areas. These projects were conducted in Training Areas BA-3 and E-7 (Please see the map in Appendix F [available in the *Final Annual State of the Reservation Report*]).

The Natural Resources Program continued substantial habitat restoration efforts in the impact area buffer and completed major maintenance efforts within three training areas, as detailed below. Table 3-7 provides an overview list of the projects. Additionally, it launched a renewed initiative to suppress autumn olive in the cantonment grasslands.

Table 3-7 Training Area Management Projects

Training Area	Acres Treated	Primary Objective	Treatment Method
E-3	49	Habitat restoration	Whole tree harvest to thin understory and canopy coverage
B-11	35	Training site/Habitat Maintenance	Oak coppice suppression
C-14	30	Training site/Habitat Maintenance	Oak coppice suppression
BA-3	5	Training site rehabilitation	Seeded with grass pasture mix and removed regenerating oaks

3.5.5.1 – RAW3 Forest Thinning

A project in training area E-3 used whole tree harvesting to thin an overstocked woodland unit (i.e., very high density of same-aged trees) and continue to restore functionality to a neighboring restored frost bottom depression (see photograph below). This project has shown promising results, including apparent restoration of frost bottom function through radiative cooling. Open, dry glacial kettle hole depressions are an important habitat feature in southeastern Massachusetts and are increasingly rare. Where they are maintained through fire, vegetation management and natural freezing they are key biodiversity hotspots, including rare plants and insects. Comparable efforts by the Nature Conservancy were highlighted during 2023 providing some outreach on the importance of frost bottoms and the efforts to restore them (see: https://www.wbur.org/news/2023/05/12/marthas-vineyard-medicine-lots-moths).

The view from the restored frost bottom in training area E-3. *Photo by Jake McCumber, NR/ITAM*

This project continued a selective whole tree harvest in Training Area E-3 (also called RAW3 for fire planning purposes), that was initiated in 2022. The primary goal of this latest phase project was to thin the overstocked woods surrounding the restored frost bottom in RAW3. This project thinned 49 acres of pitch pine/hardwood forest. The project was divided into two stands, both of which bounded previously harvested sites. For both stands, all material produced by the harvest was removed from the site by the contractor.

Stand 1: 31 acres. This treatment was designed to provide a habitat gradient connecting to more densely stocked surrounding forest units while facilitating airflow to the newly restored frost bottom to the east. Our post-harvest goal for this unit was 60 trees per acre, preferentially preserving hardwoods mostly distributed in clumps of 5-15 trees with open spaces and scattered trees between. To achieve this, we removed 40% of pine trees ≥ 10” DBH and 70% of pine trees 4-9” DBH.

Stand 2: 18 acres. This treatment was primarily designed to reduce fuel loads along the impact area. Our post-harvest goal for this unit was 80 trees per acre, mostly distributed in clumps of 5-15 trees with open spaces and scattered trees between. To achieve this, we removed 60% of all trees <12" DBH.

3.5.5.2 – C-14 Coppice Thinning

Following a successful 2018 forest thinning harvest in Training Area C-14, hardwood stumps were regenerating rapidly and abundantly leading to high-density, bushy coppices which shade out understory, block line of sight, hinder dismounted maneuver, complicate future prescribed fire operations, and are unlikely to provide our desired distribution of standalone oaks with strong central leaders and sufficient canopy spacing. The long-term habitat management goal for the area is an open, patchily distributed pitch pine - oak woodland with scrub oak understory. The woodland condition is dominated by widely spaced, large and relatively old pitch pine with historic fires periodically having reset the oak midstory.

C-14 restoration area. *Photo by Jake McCumber, NR/ITAM*

This project took a small in-house strategy to manage this regeneration, refined and applied it on a 30-acre scale. Contractors with hand-held equipment cut the regenerating stems and, in some cases, applied herbicide directly to the resulting stumps. For 75% of the coppices in this unit, contractors cut all stems and applied a triclopyr solution directly to the stems. For the remaining 25% of stumps, contractors selected the strongest stem for retention and cut all others. No herbicide was applied to any stumps with a stem selected for retention. All cut stems were left in place for future consumption by prescribed fire. The project also addressed an increasing prevalence of Black Locust (Robinia pseudoacacia), a non-native and invasive tree, with 100% cut and spray. A total of 81 pounds of active ingredient (triclopyr) were applied..

This project will slow the total rate of regeneration on the site, preserving the military training benefits that motivated the original 2018 project. By removing this aggressive regeneration, we aim to reduce competition for nutrients and sunlight, increasing the productivity and success rates of understory species and the vigorous central leaders selected for retention. Additionally, by cutting and spraying stumps, we aim to use less herbicide and reduce the risk of off-target impacts that can occur with traditional foliar spraying.

This restoration effort is showing notable results for habitat rejuvenation and expansion of rare species. The C-14 restoration effort was designed with habitat diversity as a primary goal, along with enhancing both wildlife habitat and soldier training benefit. Intentional use of skid trails during harvest and maintenance reduces overall soil compaction while also providing vegetation heterogeneity and wildlife movement corridors, which are critical for facilitating colonization and providing diverse structure and plant availability. TY 2023 efforts to document

colonization by target Species of Greatest Conservation Need were quite successful, including newly documented Frosted Elfin Butterflies, Slender Clearwing Sphinx Moths, and Buck Moths. This combination of breeding moths and butterflies, combined with a strongly increasing Eastern Whip-poor-will population in the area highlight successful restoration and the benefits of focusing on structural diversity. Additional intentional benefit derived from integration with barrens habitat within the powerline right-of-way. Expansion of rare species populations into restored habitat outside the right-of-way provides much greater resilience and confidence in the sustainability of rare species. A core focus of the C-14 harvest prescription was also to retain a patchy distribution of trees with more retained canopy cover than in shrubland or frost bottom focused restoration efforts, again providing for increased diversity and restoring the historic composition of the landscape based on tree inventory and known site history with widely spaced mature pines that survived multiple wildfires with oak trees overtaking the stand multiple times in decades following the fires.

3.5.5.3 – B-11 Coppice Thinning

This project took place in almost identical conditions to the C-14 coppice thinning described immediately above. The primary differences are that the B-11 harvest was conducted in 2020 so the coppices in this area were less developed than those in C-14, but resprouting stumps were denser and the area had not been burned after the forestry. The prescription and methods match those of C-14 with 75% of resprouting stumps cut and treated directly with triclopyr and 25% cut to leave the strongest stem. The project site was a 35-acre area and contractors applied a total of 290 pounds of active ingredient during September of 2023.

3.5.5.4 – U Range Habitat Project

Natural Resources assisted in a research project that thinned five acres of forest adjacent to the U Range parking lot along Gibbs Road. The project is intended to determine habitat needs/priorities of New England Cottontail rabbits and was developed by professors at State University of New York (SUNY) and funded by the United States Fish and Wildlife Service. MAARNG assisted in site selection and in recommending a suitable timber harvester.

The project thinned two 2.5-acre plots. In the first plot, the harvester cut down 75% of standing mature trees. The tree boles were removed from the site but tree tops, branches and debris were left on site to provide refuge for rabbits. In the second plot, the harvester cut down 25% of standing mature trees, with the same conditions for boles and debris. SUNY has been and will continue to monitor the sites to assess the presence of New England Cottontails.

The BA3 five-acre clearing three months after work was completed.
Photo by Jake McCumber, NR/ITAM

3.5.5.5 – In-House Management

ITAM spent considerable time and effort tending to a 5-acre clearing in Training Area BA-3. As part of a TY 2022 project, this site was cleared of all standing trees and shrubs with the intent of creating a grassland pasture suitable for hosting an entire artillery battery conducting table training. In-house personnel and equipment removed 13 dumpsters worth of woody debris

and rough graded the site to prepare for seeding. Contractors seeded the site with a custom-made mix of native cool and warm season grasses and pollinator-friendly forbs and wildflowers. Natural Resources staff cut and painted aggressively regenerating oak coppices that were shading out the freshly seeded grasses and, if left unaddressed, would make the site unsuitable for its intended training purposes. This site and treatment shows impressive results from leaving root material primarily intact, leading to a strong sprouting of native plants including blueberries (Vaccinium species), Black Huckleberry (Gaylusaccia baccata), oaks, and others, combined with native grasses and forbs.

3.5.6 Invasive and Nuisance Vegetation Management

Invasive plants are non-native species that have naturalized or colonized within natural communities and managed landscapes. They can cause significant environmental and economic harm by disrupting natural ecology and/or outcompeting native plants. Monitoring and management of invasive species is a critical element of protecting wildlife habitat within the Training Area/Reserve. Priority invasive species are primarily from the Massachusetts Invasive Plants Advisory Group (MIPAG) lists, but also include emerging invasive species as coordinated with partner agencies. Exotic invasive plants are a management concern both in the Training Area/Reserve and within the Cantonment area. Effective management of these species, notably Autumn Olive (*Elaeagnus umbellata*), Asian Bittersweet (*Celastrus orbiculatus*), and shrub honeysuckles (*Lonicera spp.*), is both labor and cost intensive. Natural Resources-ITAM has four trained and licensed Massachusetts core pesticide applicators on staff. This functionality has allowed our program to respond to invasive species as they're identified on ranges, in training areas, at facilities or in valued habitat.

Nuisance species are more selectively or situationally defined and may include native plants under certain conditions. Several native species have evolved to rapidly colonize or regenerate in response to disturbance, including restoration efforts. These often require targeted management in order to restore or maintain natural communities and training lands. As an example, Pitch Pine rapidly colonizes woodland openings (e.g., battle positions, sandplain grasslands) and forms dense monocultures that exclude most other species of plants and animals, produce unhealthy trees, present significant fire hazard, and prevent training. At the same time, Pitch Pine is a keystone of our North Atlantic Coastal Pine Barrens ecosystem. This dichotomy highlights the importance of long-term planning and conservation management focused on ecosystem and natural community health. Other native, desirable species that may situationally present a nuisance condition from a habitat perspective include Bayberry (*Morella caroliniensis*) and Sweetfern (*Comptonia peregrina*), which both can create monocultures through chemical defenses, and native oak trees that vigorously resprout after forestry and can overshade and crowd out the intended natural community of the restoration effort.

During TY 2023, Natural Resources and ITAM conducted limited in-house herbicide applications and contracted some larger scale projects. Projects occurred both within and outside the Training Area/Reserve. While all are mentioned here for awareness, those within the Training Area/Reserve receive more detail due to the focus of this report. Greater detail on restoration projects is provided above. All herbicide applications by the MAARNG are implemented through an integrated pest management process that prioritizes non-chemical treatments and holistic management efforts. Herbicides are a critical management tool for restoration and management. Within the integrated pest management structure their use is minimized to the greatest extent practical and methods and products are highly targeted and specific to the management objectives.

3.5.6.1 – Training Area/Reserve Projects

Natural Resources and ITAM both contracted large scale vegetation management projects that incorporated herbicide. Restoration efforts in areas with oak trees require follow-up maintenance specific to the abundant stems sprouting from cut stumps (coppicing). This maintenance of restoration areas is recommended by partner agencies and critical to the wildlife habitat management and documented rare species successes noted in other sections. It is also an important step in facilitating longer term maintenance with wildland fire. The Natural

Resources and ITAM Program has developed an effective strategy for managing this sprouting that greatly reduces herbicide application and is flexible to management objectives (i.e., allows for retention of select sprout densities for future trees), but is fairly labor intensive. These two ongoing restoration projects in C-14 and B-11, including treatment prescription, are described in more detail above.

Within the Training Area/Reserve Natural Resources and ITAM also continued an effort to address invasive plants that have heavily invaded along the eastern perimeter of the base. Bamboo (*Phyllostachys*; likely *P. aurea*) and Japanese Wisteria (*Wisteria floribunda*) have densely encroached within the base from external sources and have led to tree mortality, impassable road condition, and significant loss and risk to natural vegetation. Wisteria encircles and climbs trees, much like Asian Bittersweet (*Celastrus orbiculatus*) while Bamboo creates dense monocultures and both can expand somewhat rapidly. Approximately 0.1 acre was treated using a glyphosate solution and a cut and wipe technique to directly apply chemical to cut stems. A small portion of the area received a follow-up treatment with targeted spray to control densely resprouting Bamboo. A follow-up treatment of cut and wipe will likely be necessary in 2024 to control this threat to natural vegetation and wildlife habitat.

Table 3-8 Training Area/Reserve Herbicide Use

Training Area	Acres Treated	Active Ingredient	Pounds Active Ingredient	Primary Objective	Treatment Method
N/A; Bypass Bog Road	49	Glyphosate	5	Invasive plant control	Cut and sponge-wipe
B-11	35	Triclopyr	290	Training land & habitat restoration	Cut and spray of resprouting oak stumps
C-14	30	Triclopyr	81	Training land & habitat restoration	Cut and spray of resprouting oak stumps

3.5.6.2 – Cantonment Projects

Invasive plant projects were also implemented outside the Training Area/Reserve. In-house work focused on initial efforts to eliminate Autumn Olive (*Elaeagnus umbellata*) from the Cantonment grasslands and continued efforts to reduce Spotted Knapweed (*Centaurea stoebe*) and Asian Bittersweet seed sources at TTB Kelley and old UTES (both outside the Training Area/Reserve). All of these are non-native, invasive plants that negatively impact native habitats and species. In the grasslands, crew used chainsaws to remove mature Autumn Olive trees and applied selective Triclopyr-based herbicide with sponges – a best management practice well-suited for treating stumps while minimizing product use and potential for off-site impacts. At TTB Kelley and UTES given the scale of the project sites, the crew used a motorized UTV-mounted pump to precisely spray a Glyphosate solution. All Glyphosate spraying was targeted with a wand rather than boom or broadcast spraying. A total of 11 pounds of active ingredient were applied by in-house projects outside the Reserve over the course of the growing season.

Natural Resources contracted a project that treated 30 acres of woody invasives, including Autumn Olive, Multiflora Rose, Shrub Honeysuckle, and Asian Bittersweet growing in the cantonment grasslands. Using backpack pumps, contractors conducted both foliar spray and cut-and-wipe with a Triclopyr-based herbicide, applying a total of 21 pounds of active ingredient.

ITAM continued additional in-house clearing of Autumn Olive in the Cantonment grasslands. This work was the first stage of an effort to remove seed sources for a widespread Autumn Olive infestation affecting the entirety of cantonment. In 2023, Natural Resources-ITAM cleared mature Autumn Olive along 1,400 feet of tree line and

mowed 5 acres of field that was overwhelmed by autumn olive in the 1100 block of cantonment. Additionally, Natural Resources-ITAM mowed 17 acres of field overwhelmed by autumn olive and regenerating pitch pine in the 1300 block of cantonment. These efforts reset these parcels for ongoing maintenance via mowing and prescribed fire and allow them to provide their full function as grassland habitat.

3.5.7 – Pending Projects for Fiscal Year 2024

The following project was developed and funded in TY 2023 but is scheduled for execution in TY 2024.

C-14 Coppice Thinning Continued

Following a successful 2018 forest thinning harvest in Training Area C-14, hardwood stumps are regenerating at an aggressive rate, overstocking the unit with bushy coppices which shade out the understory, block line of sight, hinder dismounted maneuver, complicate future prescribed fire operations, and are unlikely to provide our desired distribution of standalone oaks with strong central leaders and sufficient canopy spacing. The long-term habitat management goal for the area is an open, patchily distributed pitch pine - oak woodland with scrub oak understory. The woodland condition is dominated by widely spaced, large and relatively old pitch pine with historic fires periodically resetting the oak midstory.

This project takes a successful strategy to manage this regeneration and continues to apply it on an additional 13 acres. The prescription will be identical to that described in Section 3.5.6.2. The project also targets any present Black Locust (*Robinia pseudoacacia*) for 100% cut and spray. At the conclusion of this final 13 acres, the entirety of the original harvest site will have been maintained with this method.

This project will slow the total rate of regeneration on the site, preserving the military training benefits that motivated the original 2018 project. By removing this aggressive regeneration, we aim to reduce competition for nutrients and sunlight, increasing the productivity and success rates of understory species and the vigorous central leaders selected for retention. Additionally, by cutting and spraying stumps, we aim to use less herbicide and reduce the risk of off-target impacts that can occur with traditional foliar spraying.

3.6 WILDLAND FIRE MANAGEMENT

Wildland fire is an important process in the fire prone Northern Atlantic Coastal Plain Pitch Pine Barrens that dominant the remnant landscape of Camp Edwards and the Upper Cape Water Supply Reserve. Wildfire can reduce military readiness through the loss of training days, threaten life and property on and around Camp Edwards, and negatively impact natural resources if the occurrence of the fire is outside the historical and/or natural range of variability. The 2023 National Cohesive Wildland Fire Management Strategy update provides common nationwide guidance on achieving effective wildland fire management; it is available at https://www.forestsandrangelands.gov/documents/strategy/natl-cohesive-wildland-fire-mgmt-strategy-addendum-update-2023.pdf. The vision statement of the national strategy is “To safely and effectively extinguish fire, when needed; use fire where allowable; manage our natural resources; and collectively, learn to live with wildland fire.” The three overarching goals in support of this vision statement are:

- Resilient Landscapes – Landscapes, regardless of jurisdictional boundaries are resilient to fire, insect, disease, invasive species and climate change disturbances, in accordance with management objectives.
- Fire Adapted Communities – Human populations and infrastructure are as prepared as possible to receive, respond to, and recover from wildland fire.
- Safe, Effective, Risk-based Wildfire Response – All jurisdictions participate in making and implementing safe, effective, efficient risk-based wildfire management decisions.

Using the principals outlined in the National Cohesive Wildland Fire Management Strategy the Natural Resources Office conducts wildland fire management to support military readiness and to meet the goals and objectives

outlined in the 2020 version of the Integrated Natural Resources Management Plan (INRMP) and 2006 version of the Integrated Wildland Fire Management Plan (IWFMP) for Camp Edwards. The current versions of the IWFMP and INRMP are available at the Environmental and Readiness Center's website: https://www.massnationalguard.org/ERC/publications.htm.

3.6.1 Wildland Fire Management Administration

Wildland fire administration such as planning, training, resource management, and reporting are undertaken in support of goals and objectives outlined in the IWFMP and INRMP for Camp Edwards. Administrative actions adhere to Army Wildland Fire Policy and National Wildfire Coordinating Group's (NWCG) standards.

3.6.1.1 Integrated Wildland Fire Management Plan

Installations characterized by unimproved grounds that present a wildfire hazard and/or installations that utilize prescribed fire as a land management tool are required to develop an IWFMP in accordance with AR 200-1 and AR 420-1.

The update of the 2007 Camp Edwards IWFMP is in the final stages of comments and editing. The IWFMP update will be prepared in a format consistent with the March 15, 2021, Army Installation Wildland Fire Program Implementation Guidance Memorandum. The final version of the IWFMP is expected to be completed by the contractor, Colorado State University, in early 2024.

3.6.1.2 Prescribed Fire Burn Plans

Prescribed fire burn plans are required for each fire application ignited by management and remain valid after approval until conditions change for the area described in the plan, usually 5 years. Prescribed fire burn plans for Camp Edwards are drafted following the requirements and standards outlined in the NWCG Standards for Prescribed Fire Planning and Implementation publication (PMS 484).

No new prescribed fire burn plans were drafted in TY 2023. There are 5 active prescribed burn plans covering 2,560 acres for broadcast burning and 1 programmatic Camp Edwards-wide prescribed fire burn plan for pile burns.

3.6.1.3 Wildland Fire Fuels Plans

To better facilitate wildland fuels management and wildfire response on the 318 acres immediately surrounding and on Sierra Range, a project package was finalized for work in TY 2023. In addition to continued management with prescribed fire on and around Sierra Range, the project outlines the repair, maintenance, and establishment of 2.64 linear miles of fire control lines.

3.6.1.4 Wildland Fire Agreements

The Natural Resources Program manages the Master Cooperative Wildland Fire Management and Stafford Act Agreement for the MAARNG that is between the Northeastern Region of the National Park Service, Eastern Region of the Bureau of Indian Affairs, Northeast Region of the USFWS, Northeastern Area State and Private Forestry of the U.S. Department of Agriculture, Connecticut Department of Energy and Environmental Protection, DCR, DFG, and Massachusetts National Guard's Military Division. The agreement establishes a commitment of the parties to improve efficiency by facilitating the coordination and exchange of personnel, equipment, supplies, services, and funds among the parties to the agreement in sustaining wildland fire management activities, such as prevention, preparedness, communication and education, fuels treatment and hazard mitigation, fire planning, response strategies, tactics and alternatives, suppression and post-fire rehabilitation and restoration.

The agreement was established in 2017 and expired in 2023. In 2023 a modification of the agreement was provided to all signing parties to extend the agreement into 2024 to allow for a renewal of the Master Cooperative Wildland Fire Management and Stafford Act Agreement.

3.6.1.5 Prescribed Fire Permits

Prescribed burns are authorized under permit by MassDEP. The authorization by MassDEP has been determined under criteria outlined in 7.07 Open Burning as contained in 310 CMR 7.00 "Air Pollution Control" regulations adopted by MassDEP pursuant to the authority granted by Massachusetts General Laws, Chapter 111, Section 142 A-N, Chapter 21C, Section 4 and 6, and Chapter 21E, Section 6 of the "Air Pollution Control Regulations." The current permit (#4F02008) for Camp Edwards was renewed on August 16, 2022 and is valid through December 31, 2024. The permit allows for up to 1,300 acres to be burned in a year and sets air quality and implementation criteria. A summary of permits and authorization for wildland fire management related to rare species management, and vegetation, habitat and wildlife management can be found in sections 3.3 and 3.5 of this report.

3.6.1.6 Wildland Fire Training

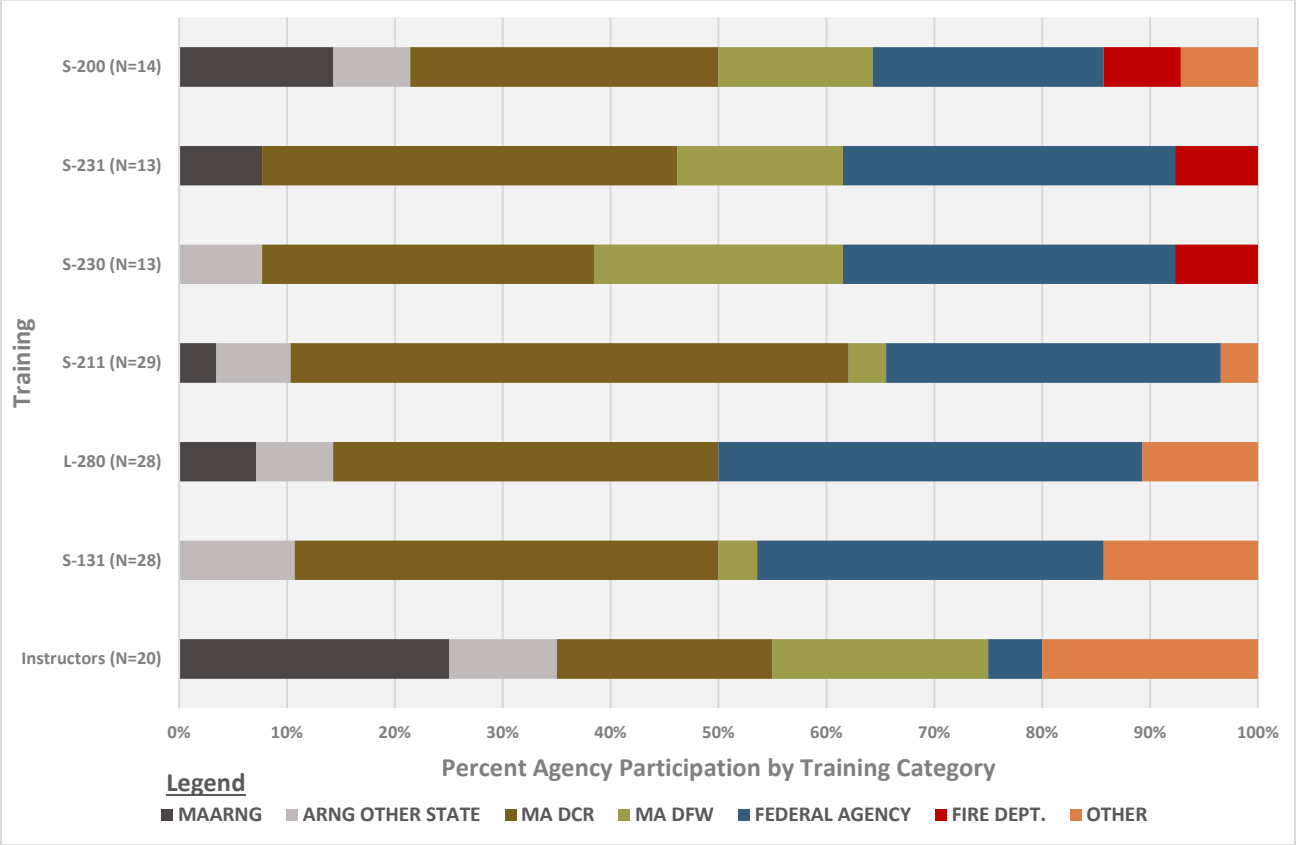
Wildland fire trainings conducted during TY 2023 consisted of classroom, hybrid online/in person, and performance-based training and evaluations. These trainings were focused on building the skill sets of the Camp Edwards Prescribed Burn Team and partner agencies to increase wildland fire operational capacity and safety. Trainings were selected to ensure effective progress towards compliance with the 2021 Army Wildland Fire Policy that requires the transition to NWCG qualifications standards. A summary of trainings and participation in the trainings is presented in Table 3-9.

TABLE 3-9 TY 2023 Wildland Fire Training Summary

Trainings, Trainee Assignments, and Qualifications	Camp Edwards Prescribed Burn Team	Partner Agency Crew
First Aid, CPR, AED	15	-
Wildland Fire Safety Training Annual Refresher (RT-130)	14	-
Firefighter Training (S-130)	2	5
Firefighter Type 1 (S-131)	-	28
Introduction to Wildland Fire Behavior (S-190)	2	5
Initial Attack Incident Commander (S-200)	2	12
Portable Pumps and Water Use (S-211)	1	28
Crew Boss, Single Resource (S-230)	-	13
Engine Boss, Single Resource (S-231)	1	12
Human Factors in The Wildland Fire Service (L-180)	2	5
Followership to Leadership (L-280)	2	26
Position Trainee Assignments (FFT1, FIRB, ENGB, or FEMO)	7	2
Qualification - Firefighter Type 2, Crewmember (FFT2)	2	N/A
Qualification - Fire Effects Monitor (FEMO)	1	N/A

The MAARNG has sponsored and hosted wildland fire trainings at Camp Edwards with the assistance of partner organizations during the past 21 years. Trainings have been offered with the intent of furthering wildland fire suppression and prescribed fire capacity at Camp Edwards and among its wildland fire partners. Six of the trainings listed in Table 3-8 were part of the 2023 weeklong wildland fire training academy. Graph 3-8 provides a breakdown of the agencies that attended the trainings and instructed at the 2023 academy.

Graph 3-8 TY 2023 Wildland Fire Training Academy, Agency Participation



3.6.1.7 Prescribed Fire Resources

To conduct wildland fire operations effectively and safely, resources in the form of qualified crew and appropriate equipment are required. The Camp Edwards Prescribed Burn Team size is remaining constant at approximately 15 active participants. Qualifications and experience of all team members is effectively being maintained and expanded on with training and prescribed burn operations. However, wildland fire assignments are currently a limiting factor to progress on some qualifications. One important qualification was lost to the team in TY 2023, the position of Fire Effects Monitor. Partner agencies such as DCR and DFW provided approximately 35 percent of the crew and equipment needed for prescribed fire operations. The JBCC Fire Department provided approximately another 25 percent of the crew and equipment needed for prescribed fire operations with the remaining 40 percent of crew and equipment coming from the Camp Edwards Prescribed Burn Team. The Natural Resource Office's fire cache and Type 6 Engine continue to be organized, maintained, and expanded as funds and time permit. Bay space at the JBCC Fire Department for the aging Natural Resource Office's Type 6 Engine is no longer available and alternatives are being sought to protect the engine from the elements.

3.6.1.8 Wildfire Reporting

The JBCC Fire Department has primary wildfire response for wildfires on Camp Edwards and within JBCC. Wildland fires originating from unplanned ignitions for the Training Years of 2022 and 2023 are summarized in Table 3-10.

TABLE 3-10 Wildfire Incidents and Acres for Camp Edwards

	TY 2022		TY 2023	
Wildfire Cause	**No. of Incidents**	**Acres**	**No. of Incidents**	**Acres**
Electrical Transmission	1	0.01	1	0.25
Military Training	3	0.50	5	11.57
TOTAL	**4**	**0.51**	**6**	**11.82**

3.6.1.9 Ignition Supplies Reporting

In January 2023 following review by the MAARNG's Natural Resources Program, JBCC Fire Department, Headquarters Camp Edwards, and the EMC's Environmental Officer, the Use and Reporting of Wildland Firefighting Water Additives Standard Operating Procedure (SOP) was adopted for use at Camp Edwards and the Upper Cape Water Supply Reserve. The SOP guides the use of Wildland Firefighting Ignition Equipment to the extent that is practicable during wildland fire operations (wildfire, prescribed fire, and wildland fire training), but does not under any circumstances hinder management decisions and actions taken by an Incident Commander when protecting life and property. When conducting planned operations such as prescribed burns and wildland fire trainings, every effort shall be made to apply the SOP to pre-operational planning. Information collected post wildland fire operations shall be used to identify products that are not currently listed in this SOP. This information will be used to update the SOP, initiate coordination efforts to prevent or guide future use of a product, and/or facilitate as required any post use mitigation efforts. A summary of TY 2023 Wildland Firefighting Equipment Ignition Fuels is provided in Table 3-11.

TABLE 3-11 TY 2023 Wildland Firefighting Equipment Ignition Fuels Summary

	Type Use			
Product Name	**Wildfire**	**Prescribed Fire**	**Wildland Fire Training**	**Total**
Dragon Balls (Potassium Permanganate)	-	50 oz	4 oz	54 oz
Catalyst for Dragon Balls (Ethylene Glycol)	-	250 ml	20 ml	270 ml
Drip Torch Fuel (3/1 Diesel to Gas Mix)	-	55 gal	-	55 gal
Fusees, Backfiring	-	-	8 fusees	8 fusees

3.6.2 Wildland Fire Operations

Wildland fire operations at Camp Edwards and within the Training Area/Reserve in support of land management objectives are designed and conducted to control the flammability and reduce the resistance to control of wildland fuels through mechanical, chemical, biological, manual means, or using prescribed fire.

3.6.2.1 Mechanical Wildland Fire Fuel Treatments

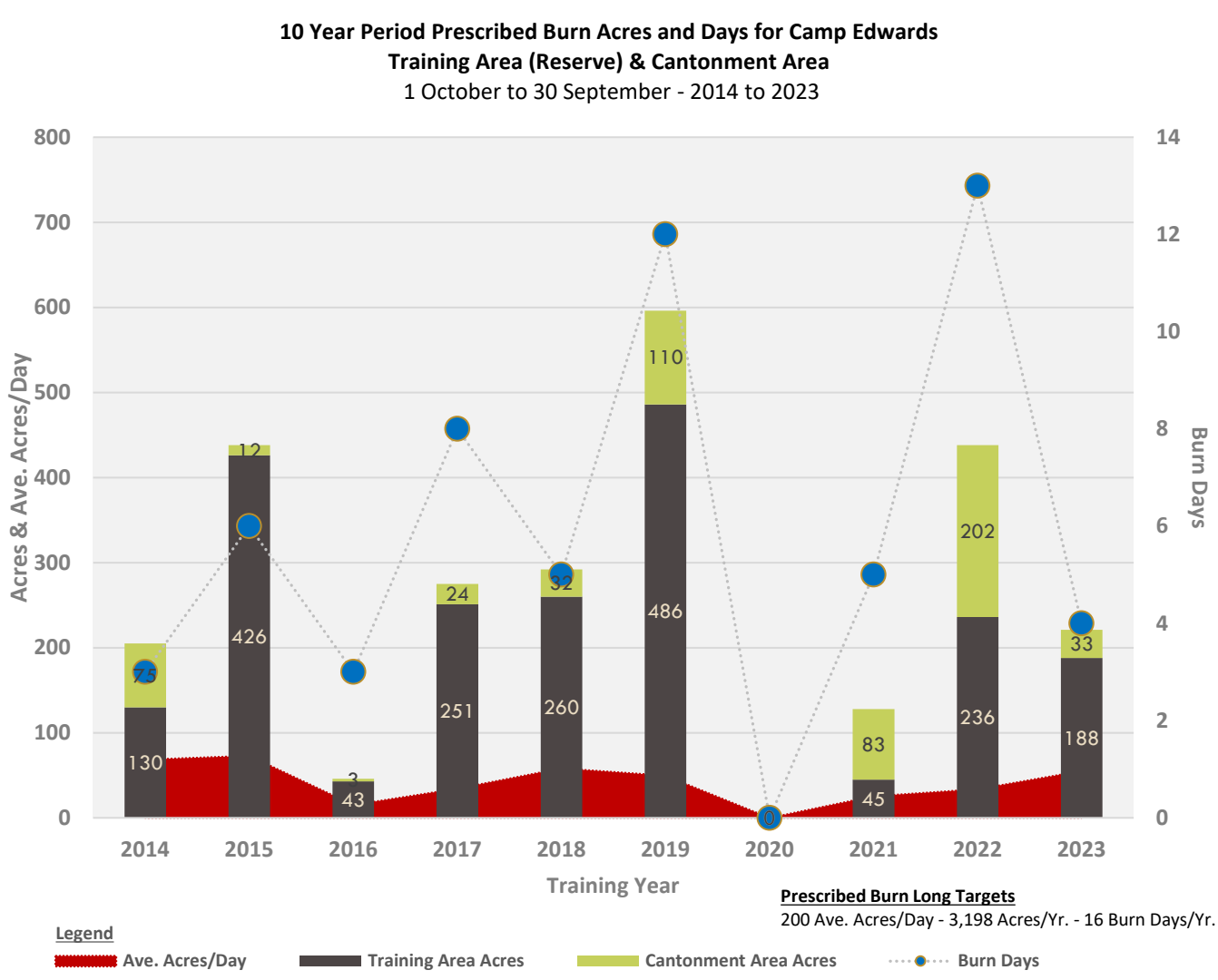
During TY 2023 no mechanical wildland fuel treatment projects designed to manipulate or remove wildland fuels to reduce the likelihood of ignition and/or to lessen potential damage and resistance to the control of wildland fire were conducted.

3.6.2.2 Prescribed Fire

Prescribed fire, wildland fire originating from a planned ignition in accordance with applicable laws, policies, and regulations to meet specific objectives is used at Camp Edwards and within the Upper Cape Water Supply to support military readiness and to meet the goals and objectives outlined in the Camp Edwards INRMP and IWFMP. To meet the wildland fire management goals at Camp Edwards approximately 3,000 acres/year,

averaging 200 acres/burn, and 16 burn days/year are required each year. However, this is a long-term programmatic objective. Current annual objectives are 600 acres within the Reserve and 80 acres within grasslands with intentional increase into the future if capabilities expand towards long-term objectives. During TY 2023, 188 acres of the Training Areas within the Upper Cape Water Supply and 33 acres in the grassland within the Cantonment Area at Camp Edwards were burned with prescribed fire (Graph 3-9). The 221 acres were burned during a total of 4 operational burn days and averaged 50 acres/day (Graph 3-9).

Graph 3-9 TY 2023 Prescribed Burn Acres and Burn Days



3.6.2.3 Wildland Fire Control Lines

Constructed and treated control lines are used for the control of wildland fire at Camp Edwards and consist of two types. Fire control roads are cleared paths wide enough to permit vehicular passage with natural or manmade changes in fuel characteristics on one or both sides and will affect fire behavior so that fires burning into them can be more readily controlled. Fuel breaks which are generally temporary treatments that make changes to fuel characteristics which affects fire behavior so that fires burning into them can be more readily controlled.

During TY 2023 all fire control roads were maintained so that they were passable by vehicles and no new fire control roads were created. Approximately 4.1 miles of existing fuel breaks were maintained with regular mowing. Approximately 1.1 miles of new "soft" fuel breaks were established to facilitate implementation of prescribed fire in BA-7, A-4, and A-5. These soft fuel breaks are typically about 12 feet wide and are understory

mowing intended to be temporary - regenerating vigorously after prescribed burns are completed. This represents about 1.5 acres of linear restoration through understory mowing, which provides valuable structural diversity within habitat and rarely requires any tree removal to facilitate access and control by wildland firefighters.

3.7 AIR QUALITY MANAGEMENT

3.7.1 Air Quality Permits

Potential air emissions from stationary sources at Camp Edwards are below the established federal and state thresholds for the designated primary air pollutants (carbon monoxide, nitrogen oxide, particulate matter, sulfur dioxide, and volatile organic compounds); therefore, Camp Edwards does not require an air quality control permit for stationary source emissions under the provisions of the Clean Air Act (CAA) or to measure and report actual emissions from its stationary sources.

The prescribed burn program requires an air quality control permit. The MassDEP Southeast Regional Office renewed the Camp Edwards smoke management and prescribed burn permit (#4F02008) on August 16, 2022. The permit is valid through December 31, 2024.

3.7.2 Air Quality Reports

310 CMR (Code of Massachusetts Regulations) 7.12(2)(b) requires that any person having control of a fuel burning facility or facilities with a maximum energy input capacity of 10,000,000 Btu/hr of natural gas report certain information to MassDEP once every three years. Because of the number of facilities at Camp Edwards, the MAARNG is required to submit a Source Registration/Emissions Statement (SR/ES) report for Camp Edwards every three years on or before the date established by the MassDEP. The Camp Edwards SR/ES report was submitted March 31, 2021 using calendar year 2020 data. The next report will be submitted in 2024 using calendar year 2023 data.

The only MAARNG stationary source emissions locations in the Training Area/Reserve on Camp Edwards are Range Control and the Ammunition Supply Point.

3.8 NOISE MANAGEMENT

The MAARNG published a Statewide Operational Noise Management Plan in December 2007 that provides a strategy for noise management at MAARNG facilities, including Camp Edwards. The plan includes a description of noise environments, including levels from small arms and aircraft training activities. Elements of the plan include education, complaint management, possible noise and vibration mitigation, noise abatement procedures, and land use management. Specific procedures are provided for noise complaints and protocols are provided for providing public notification for detonation of unexploded ordnance in place and for other unusual noise events.

3.9 STORMWATER MANAGEMENT

There were no new stormwater runoff increases in the Training Area/Reserve due to military training activities, and no new stormwater discharges from military training activities were made directly into wetland resource areas in the Training Area/Reserve.

3.10 WASTEWATER MANAGEMENT

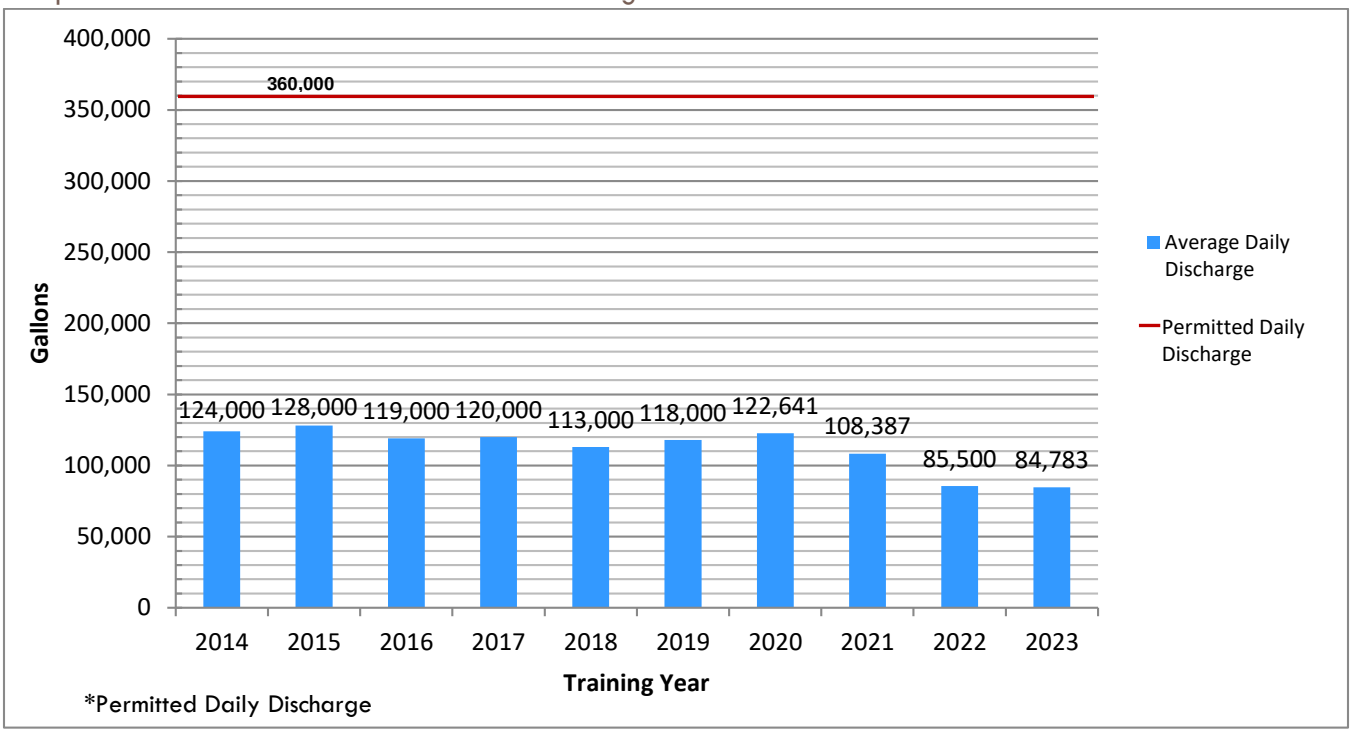
Depending on the location of facilities, wastewater and sewage from MAARNG training activities in the Training Area/Reserve was pumped from portable toilet facilities and hauled off base for disposal at licensed disposal facilities or discharged through the normal operation of existing septic systems (1,000 gallon) at Range Control

and the Ammunition Supply Point that are regulated by MassDEP. (Note: There is a septic system at the former Otis Fish & Game Club located on Camp Edwards in the southwestern corner of the Training Area/Reserve; it is not in use at this time because the building is out of service. There are septic systems within the boundary of the Training Area/Reserve, at Cape Cod AFS and the USCG Communications Station, that are not subject to Chapter 47 and the EPSs, but which are regulated by MassDEP.)

3.10.1 Wastewater Treatment Plant Discharge

The Otis ANGB wastewater treatment plant operated within the discharge volume limits of its wastewater discharge permit during TY 2023. The plant discharged 30,945,855 gallons of sewage into the sand filtration beds in the Training Area/Reserve; a daily average of 84,783 gallons versus its permitted twelve-month moving average flow of 360,000 gallons. Graph 3-10 shows the daily average pumping rate of the Otis system since TY 2014.

Graph 3-10 Wastewater Treatment Plant Discharge



3.11 SOLID WASTE MANAGEMENT

The Camp Edwards Ammunition Supply Point did not turn in any ammunition casings for recycling to the Defense Logistics Agency office in Groton, Connecticut, during TY 2023. Casings are turned in periodically when economical.

The MAARNG published a Statewide Integrated Solid Waste Management Plan for all of its Army National Guard facilities in August 2010. The plan establishes MAARNG policy, responsibilities, goals, and objectives for compliance with statutory requirements for waste minimization, recycling, and solid waste disposal. Chapter 8 of the plan includes solid waste management procedures specific to Camp Edwards, as well as identifying potential future solid waste management alternatives.

3.12 HAZARDOUS MATERIALS MANAGEMENT

Camp Edwards has appropriate protocols in place to respond to oils or hazardous materials releases, such as fuel spills, in the Training Area/Reserve. These protocols include the Soldiers Field Card that outlines how Training Area/Reserve users respond if a spill occurs, and Camp Edwards has trained staff to initiate all required spill response actions in accordance with the Camp's Spill Prevention, Control and Countermeasure plan and/or Massachusetts Contingency Plan (310 CMR 40.00) if applicable. The EMC EO is notified of all reported spills in accordance with Chapter 47. All users of the Camp Edwards training lands, including civilians, are required to complete a series of Range Control briefings. Users are directed via verbal instruction, as well as in training videos, to immediately report spills and/or releases of any size to Range Control. There were no spills in the Training Area/Reserve during TY 2023.

3.13 HAZARDOUS WASTE MANAGEMENT

The MAARNG complied with its policy of not performing maintenance activities on military vehicles in the Training Area/Reserve throughout the year. Thus, hazardous wastes normally associated with vehicle maintenance and repair facilities were not generated or stored in the Training Area/Reserve. Vehicle maintenance is completed at the UTES facility, which is outside of the Training Area/Reserve. In instances where the Installation Restoration Program or IAGWSP use the EPA identification number of the MAARNG to dispose of wastes generated by remediation activities in the Training Area/Reserve, MAARNG Environmental tracks the procedure to ensure compliance with applicable regulations.

Wastes generated within the Training Area/Reserve are managed within the existing accumulation area located at UTES, which is located outside of the Training Area/Reserve.

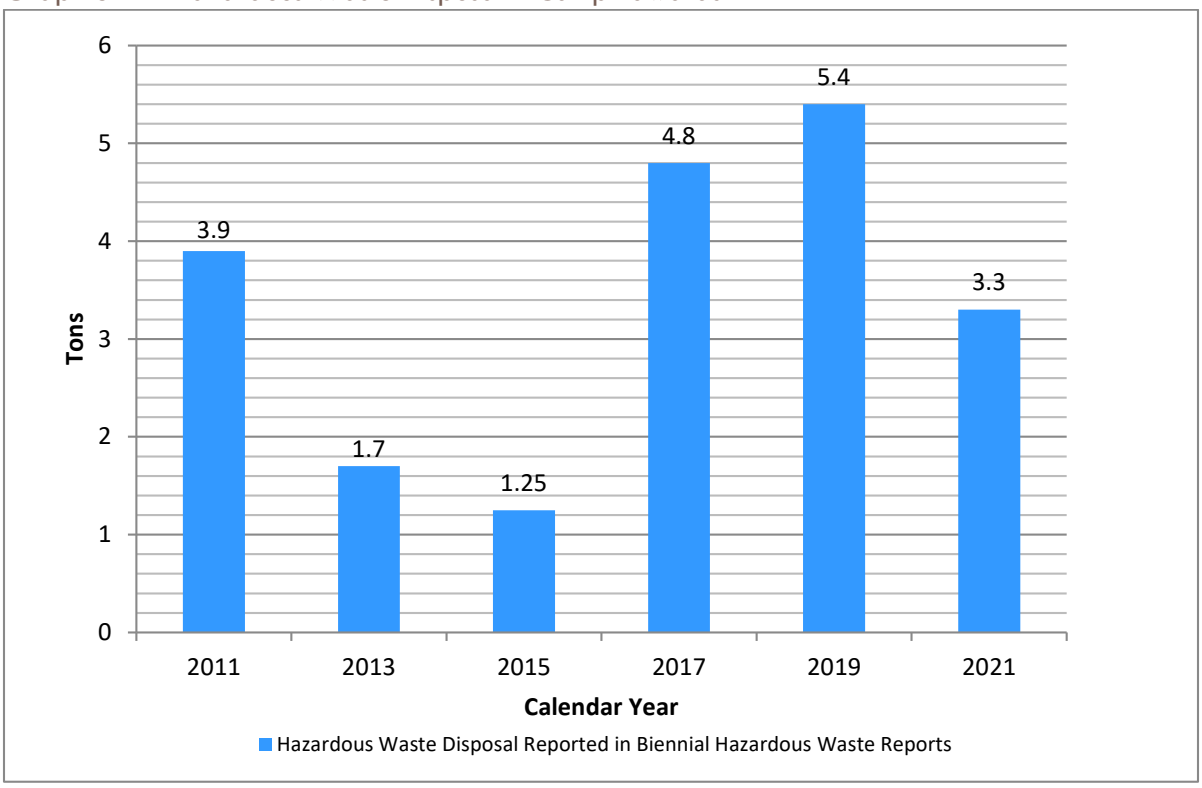
3.13.1 Hazardous Waste Disposal and Reporting

A biennial Hazardous Waste Report must be prepared and submitted to the EPA and MassDEP in March of even-numbered years reporting on hazardous waste generated by large quantity generators (LQG) during the preceding odd-numbered year. The last report for Camp Edwards was in March 2022 for hazardous waste disposed of during calendar year 2021. Graph 3-11 provides information on the volumes of hazardous waste disposal reported for the past six biennial reports. In general, the majority of the reported waste is generated from the repair and maintenance of military vehicles, aircraft, and equipment. These wastes include vehicle fuels, oils, antifreeze and associated rags and clean-up materials. The quantities of waste disposed of will fluctuate year to year based on the operational tempo of the MAARNG within that year. In addition to the amounts generated and reported in the biennial report, the MAARNG removed approximately 4,400 tons of lead-contaminated soil as part of the IAGWSP cleanup effort in 2017. This material was not reported as part of the biennial report as it was exported to Canada and hazardous waste exported outside the US is not required to be reported in the biennial report.

3.14 VEHICLE MANAGEMENT

Unauthorized All Terrain Vehicle (ATV), dirt bike, bicycle, and e-bicycle access to the Training Area continued to be a problem in TY 2023. Range Control officials provided information to the Environmental Police as to locations and times such use was identified to help them adjust their patrols accordingly. As the level of unauthorized ATV and dirt bike access increases, continued coordination with the Environmental and local police takes place. Current efforts including sign posting, cameras, Camp Edwards Range Control inspections and Environmental and State Police patrols, have seemed to slow the illegal use of the Training Area/Reserve for ATV and dirt bike riding. However, this will be an ongoing effort. The entire Training Area/Reserve is now posted as off limits. This should help with public awareness and the enforcement of no trespass laws.

Graph 3-11 Hazardous Waste Disposal – Camp Edwards



3.15 GENERAL USE AND ACCESS MANAGEMENT

Public access to Camp Edwards is limited; however, under certain circumstances regulated public access to Camp Edwards may be available such as hunting during the deer and turkey seasons (See Section 3.5.4 and 3.5.5). The Boy Scouts of America utilized the Training Area/Reserve during TY 2023, and the Massachusetts Butterfly Club made use of the Training Area/Reserve for an Acadian Hairstreak Butterfly survey in July 2023. Other civilian groups that utilized the Training Area/Reserve in TY 2023 are listed in Section 2.1.2.

3.16 CULTURAL RESOURCES MANAGEMENT

All MAARNG actions in the Training Area/Reserve are reviewed by the MAARNG Cultural Resource Manager to ensure compliance with all applicable federal, state, and local cultural resource regulations. The MAARNG consults regularly with the Massachusetts State Historic Preservation Office (MA SHPO) ensuring actions are in compliance with Section 106 of the National Historic Preservation Act. In addition to the MA SHPO, the MAARNG consults regularly with the Wampanoag Tribe of Gay Head (Aquinnah) and the Mashpee Wampanoag Tribe on undertakings that may affect historic properties that the Tribe has attached religious and cultural significance.

3.17 EPS VIOLATIONS

There were no EPS violation notices issued during TY 2023. Appendix H lists violations reported since TY 2014.

3.18 MITIGATION

Details of mitigation requirements and actions for TY 2023 is discussed in the *Conservation and Management Permit Compliance and Mitigation Actions* in Appendix F.

SECTION 4
REMEDIATION PROGRAM ACTIVITIES

4.0 INTRODUCTION

This section of the Annual Report provides summaries on remediation activities in the Training Area/Reserve during TY 2023.

4.1 INVESTIGATION AND REMEDIATION PROGRAMS

There are two independent cleanup programs operating at JBCC: the Installation Restoration Program and the Impact Area Groundwater Study Program.

The IRP was initially established at the installation in 1982 under Air National Guard management. Oversight of the program was transitioned to the Air Force Center for Environmental Excellence, now known as the Air Force Civil Engineer Center (AFCEC), in 1996. The program operates under the regulatory guidance of the federal Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Most of the activity of the IRP has been focused in the Cantonment Area and in off-installation plumes emanating from the Cantonment Area. AFCEC is responsible for two IRP sites in the Training Area/Reserve: Chemical Spill-19 (CS-19) and Fuel Spill-12 (FS-12) and three Military Munitions Response Program (MMRP) sites: Old K Range, Mock Village, and Otis Gun Club. Five groundwater treatment systems are currently operating on five groundwater plumes to clean more than seven million gallons of groundwater per day. More than 92 billion gallons of groundwater have been treated to date. AFCEC ensures the protection of public health by identifying and evaluating existing water wells in plume areas, by reviewing DigSafe® notifications for new well installations, and coordination with local boards of health, other agencies, and homeowners.

The IAGWSP is being managed by the Army National Guard and is responding to four EPA Administrative Orders, three under the Safe Drinking Water Act (SDWA) and one under Resource Conservation and Recovery Act (RCRA). Investigation of the environmental impacts of legacy training in the upper 14,886 acres of JBCC began in 1996 and cleanup of groundwater contamination began in 2004. Seventeen treatment systems are currently operating on seven groundwater plumes to clean more than 3.8 million gallons of groundwater per day. More than 18.9 billion gallons of groundwater have been treated to date. While no public or private drinking water supplies are currently affected by the groundwater contamination being addressed by the IAGWSP, the contamination is being addressed to prevent any possible future exposures and the program maintains a robust Land Use Controls program that works to prevent access to or use of the groundwater from plume areas. Land Use Controls are administrative and/or legal controls that limit exposure to contaminated groundwater above regulatory standards, health advisories, and/or risk-based levels, and maintain the integrity of monitoring wells and treatment systems. Information on the IAGWSP can be obtained on its website: http://jbcc-iagwsp.org.

Both the IRP and IAGWSP have active regulatory participation and community involvement programs. The communities surrounding the installation are kept informed through neighborhood notices and meetings, media releases, community updates, fact sheets, publication and distribution of plans and reports, websites, and information repositories at local libraries.

The programs meet regularly with EPA Region 1 and MassDEP to discuss findings and determine appropriate response actions. Public comment periods are held, as necessary, to present and solicit input on proposed actions. The programs also provide updates on their activities to public meetings of the joint citizens' advisory team, the JBCC Cleanup Team. The JBCC Cleanup Team includes representatives from the surrounding communities and the regulatory agencies.

The IRP and IAGWSP each operate under different regulatory directives and mostly address different contaminants of concern. However, they share sampling results, equipment, technical innovations, and even a treatment facility. Figure 4-1 shows the areas under remediation by the IRP and the IAGWSP in the Training Area/Reserve.

4.2 INSTALLATION RESTORATION PROGRAM ACTIVITIES IN THE TRAINING AREA/RESERVE

In TY 2021, AFCEC finalized the Comprehensive Site Evaluation (CSE) Phase II (like a Site Inspection) investigation at 10 MMRP sites, including the three sites that are in the Training Area/Reserve.

- Mock Village MMRP site: A public comment period and virtual public meeting/hearing were previously conducted on the Mock Village Proposed Plan. A Streamlined Remedial Investigation/Feasibility Study (RI/FS) was prepared for the World War II-era Mock Village and has been finalized. No munitions and explosives of concern (MEC) or munitions constituents were identified at the site and a Record of Decision (ROD) prescribing Land Use Controls/Long-Term Management was finalized in TY 2022.

- Old K Range MMRP site: An RI was completed in TY 2019 at the World War II-era Old K Range and an FS was finalized in TY 2022. Numerous 2.36-inch rockets and other ordnance were discovered at the Old K Range during the CSE Phase II and RI field work. Because some of the rockets contained high explosives, this site is off limits and ordnance warning signage was placed around the perimeter of the site. A draft Proposed Plan is final, and a draft ROD is being prepared specifying the preferred remedy: Alternative 3, Long-Term Management with groundwater monitoring, unexploded ordnance construction support and full annual MEC sweeps.

- Otis Gun Club MMRP site: An RI was completed for the former Otis Gun Club and an FS was drafted but identified data gaps; therefore, a Supplemental RI was conducted to collect additional data and the report has been finalized. A Supplemental Feasibility Study is under regulatory review.

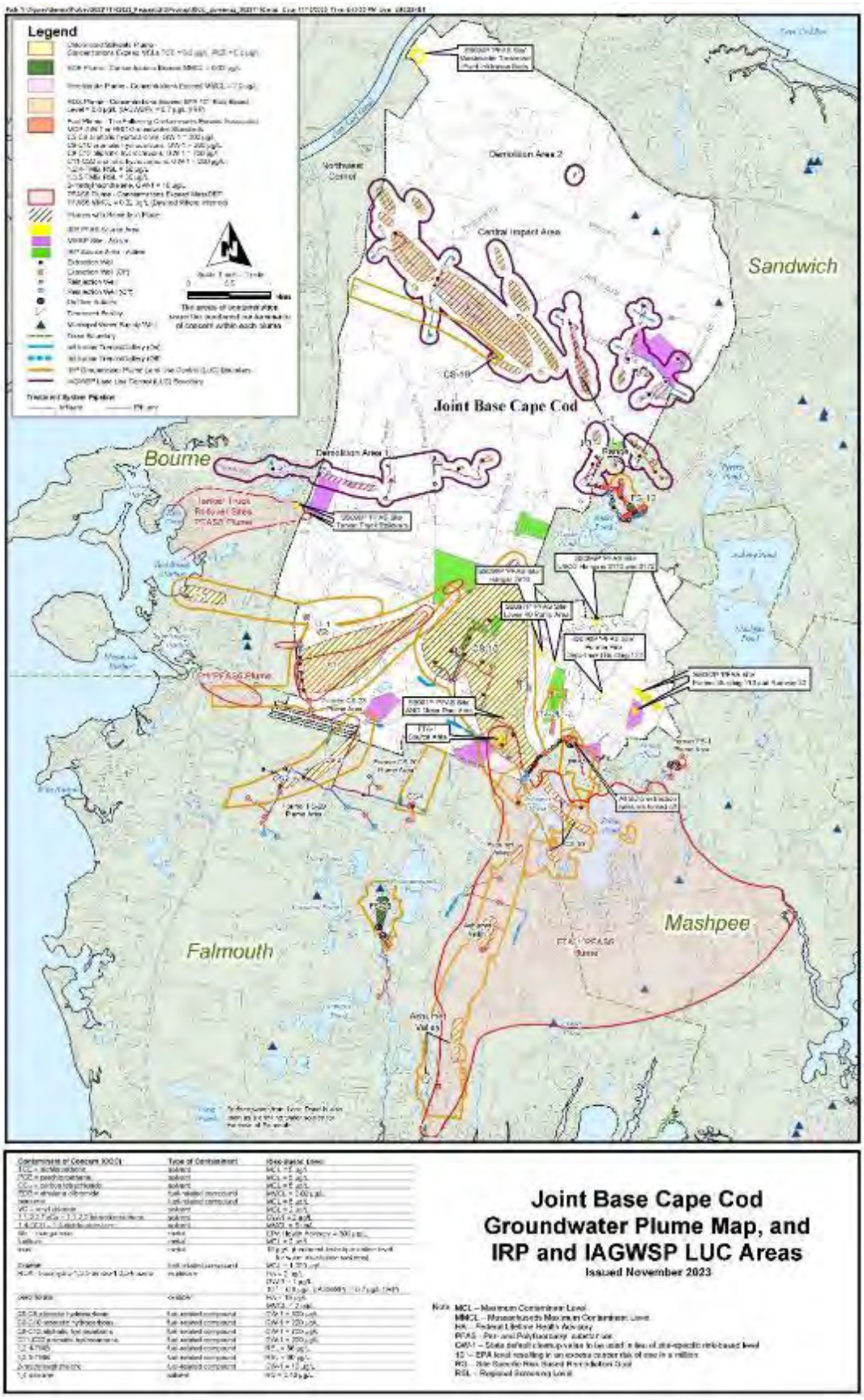
In addition to the MMRP sites, AFCEC manages two groundwater plumes in the Training Area/Reserve: CS-19 and FS-12.

- Chemical Spill-19 (CS-19): In TY 2023, groundwater monitoring was conducted at CS-19 where the contaminant of concern is RDX. RDX was detected above the EPA risk-based level of 0.97 µg/L in one of three monitoring wells sampled. The highest RDX concentration was 1.6 µg/L.

- Fuel Spill-12 (FS-12): In TY 2023, the FS-12 groundwater treatment system continued to remove ethylene dibromide (EDB) using four extraction wells operating between 240-280 gallons per minute (gpm). The maximum EDB concentration detected in groundwater at FS-12 in TY 2023 was 2.0 micrograms per liter (µg/L) compared to 740 µg/L in 1997. The Massachusetts Maximum Contaminant Level for EDB is 0.02 ug/L.

AFCEC also manages three 1.5 MW wind turbines at JBCC, two of which are in the Training Area/Reserve. The turbines offset the energy use in the IRP by 100% (approximately $1.5 million per year). The turbine operation is curtailed for the Northern Long-Eared Bat from July 15 to October 15, 30 minutes before sunset to 30 minutes after sunrise for wind speeds less than 4.5 meters per second. There were no reported bat or bird strikes during TY 2023.

Figure 4-1 JBCC Groundwater Plume Map



The map is available at jbcc-iagwsp.org/community/facts/jbcc_plume_map_040523.pdf

4.3 IMPACT AREA GROUNDWATER STUDY PROGRAM ACTIVITIES

All the IAGWSP sites are in the Training Area/Reserve. The operable units investigated by the IAGWSP include: Demolition Area 1, Northwest Corner, J-1 Range, J-2 Range, J-3 Range, L Range, Central Impact Area, Training Areas, Small Arms Ranges, Gun and Mortar Positions, Former K Range, Former A Range (closed) and the Western Boundary (closed). All of the IAGWSP's sites have final Decision Documents in place. Decision Documents record the selected response action for each site, explain why it was chosen and how it will be implemented. Significant activities that occurred during TY 2023 included:

Treatment Systems

The IAGWSP operated groundwater treatment systems for plumes associated with the former Demolition Area 1, former J-3 Range, former J-2 Range (northern and eastern), the former J-1 Range (southern and northern), and the former Central Impact Area (CIA). These systems are treating approximately 3.8 million gallons of water per day. Ongoing monitoring of treatment plant operations and groundwater wells is in place to observe changes in the plumes and make certain the selected remedies are working as predicted.

New Monitoring Wells

Eight new monitoring wells were added in TY 2023 in support of groundwater investigations at the J-2 Range Northern and J-1 Range Southern plumes (Figure 4-2). The J-2 Northern wells (MW-734 through MW-740) will be used to further define the PFAS contamination in this area; the J-1 Southern well (MW-733) will be used to confirm the southern boundary of RDX contamination.

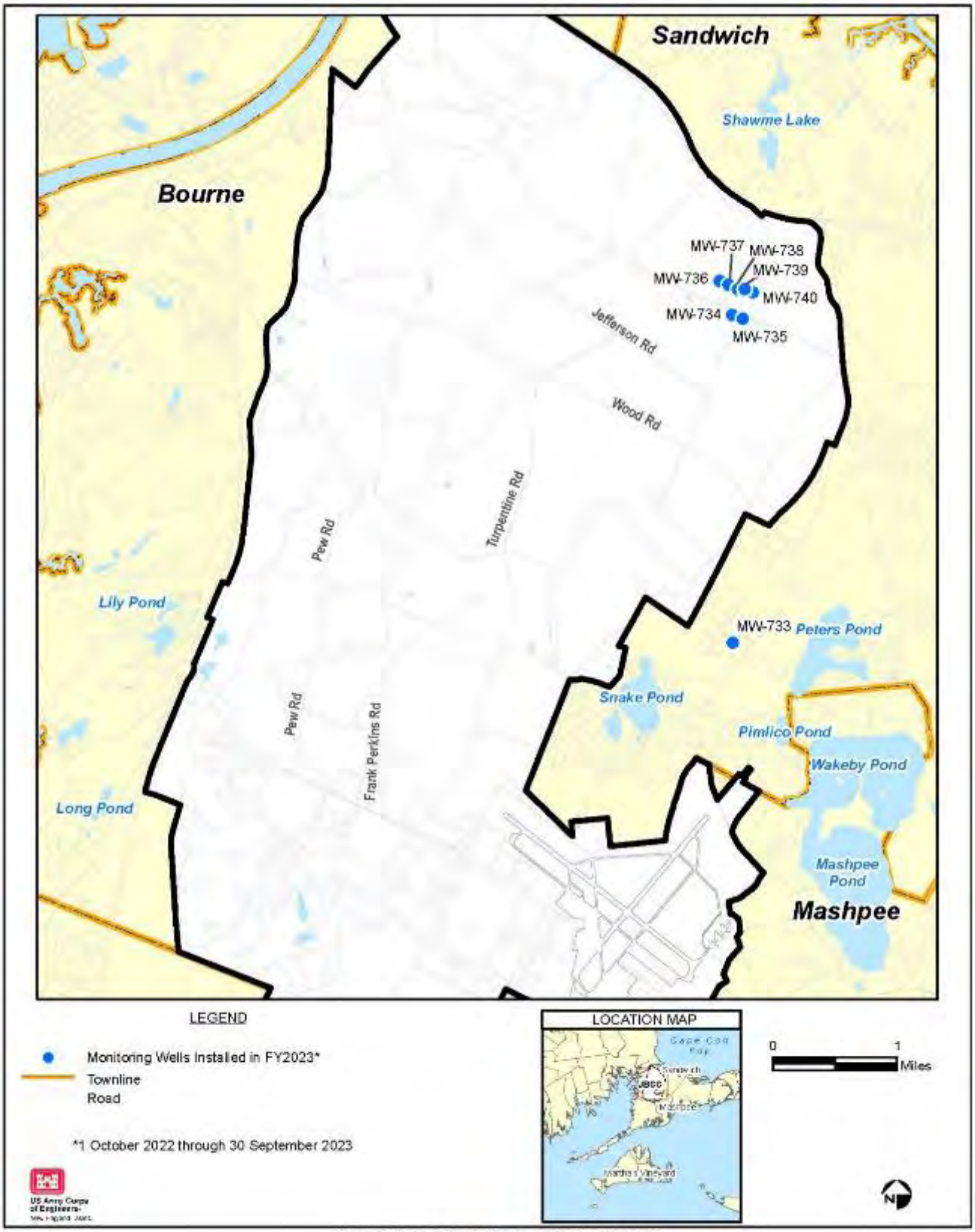
PFAS

The IAGWSP continued to conduct sampling to evaluate whether Per- and polyfluoroalkyl substances (PFAS) are present in the groundwater from sites where former open burning/open detonation (OB/OD) is known to have occurred. IAGWSP began sampling PFAS in 2019 at OB/OD munitions disposal sites because firefighting foams containing PFAS may have been used in OB/OD areas. This sampling has occurred in Demolition Area 1, and the J Ranges (J-1 Northern, J-2 Northern, J-2 Eastern and J-3 Ranges). If firefighting foams were used at these sites they likely would have been used in conjunction with the OB/OD activities and, therefore, any PFAS compounds that were released would have been co-released with other contaminants associated with those activities. Groundwater sampling conducted in TY 2023 was conducted as follow-up to detections from 2022 PFAS sampling. Review of the data is ongoing and a comprehensive report with results and recommendations for sampling of additional wells and further investigations is being developed for EPA and MassDEP review and approval. IAGWSP will continue to collect groundwater samples at the J-2 and J-3 Ranges to determine the nature and extent of PFAS in these areas.

Source Removals

In the CIA, the removal of munitions and explosives from the source of the CIA groundwater plume continued. Work on Phase IV Area 2 and Phase IV Area 3 (eight acres) of the CIA long-term source area response continued throughout the year. Teams from the Army Corps of Engineers used Metal Mapper, a multi-sensor electromagnetic detection technology, for the removal efforts. This geophysical technology is designed to discriminate between munitions and scrap metal in the subsurface. Use of the Metal Mapper allows the program to increase the efficiency of unexploded ordnance removal while reducing impacts to the surface soil and vegetation when compared to traditional excavation techniques.

Figure 4-2 Monitoring Wells Installed by IAGWSP in TY 2023



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SECTION 5
MISCELLANEOUS MILITARY AND CIVILIAN ACTIVITIES AND ENVIRONMENTAL PROGRAM PRIORITIES

5.0 MISCELLANEOUS MILITARY ACTIVITIES

5.0.1 Camp Edwards Tours and Community Involvement

Camp Edwards hosted six tours of the training area open to community members from May to October. MAARNG soldier training venues, including simulated training, small arms ranges, the Natural Resources Program, and groundwater treatment conducted by IAGWSP were the subjects of the tours. MAARNG training requirements, habitat conservation and mitigation efforts were among the items discussed by the tour leaders. Approximately 180 members of the community attended the tours. Camp Edwards also conducted numerous tours, presentations and briefings to Cape Cod-area community groups, non-profit organizations, and elected officials. In addition, the Natural Resource Office hosted six grassland bird tours in the grasslands of Camp Edwards in 2023 with approximately 20 individuals per tour.

5.1 JOINT BASE CAPE COD EXECUTIVE DIRECTOR

The primary roles of the JBCC Executive Director are to ensure inter-agency communication and coordination are implemented and practiced, and that government and community stakeholders are kept informed. Additionally, the Executive Director is responsible for looking at efficiencies that might be gained through consolidation and cost-sharing of base operations and activities.

The Executive Director serves as the Adjutant General's representative to the Joint Oversight Group that considers items of mutual concern. The Executive Director also is the military co-chair of the JBCC Military-Civilian Community Council, an advisory board formed to provide interaction between community representatives and base officials for timely and consistent notification regarding military mission projects, policies, and activities of mutual interest. Brigadier General (ret) Christopher Faux was appointed JBCC Executive Director in June 2018.

5.2 MISCELLANEOUS CIVILIAN ACTIVITIES

5.2.1 HB 919

HB 919, an Act Relative to the Environmental Protection of Joint Base Cape Cod, was filed by Representative David Vieira, Third Barnstable District, on February 16, 2023. HB 919 updates the name of JBCC from the Massachusetts Military Reservation, updates the names of the environmental agencies comprising the EMC, and makes changes in Section 6, which describes how CAC and SAC members are appointed and serve. Appointments would be changed to three-year appointments that may be renewed. HB 919 proposes changing appointments from the Governor to the EMC. The bill was heard by the Joint Committee on Environment and Natural Resources on September 27, 2023.

5.2.2 Eversource Projects

5.2.2.1 Switching Station Replacement Project

Eversource is concluding construction of a switching station replacement project (Bourne Switching Station #917) located on an easement in the Training Area/Reserve (Figure 5-1). Eversource has sited the switching station southwest of the existing switching station in order to minimize loss of training land and impact to state priority habitat. The property transfers between Eversource and the Commonwealth of Massachusetts leaves a net benefit of approximately 2.51 acres for the MAARNG for training. Because the Training Area/Reserve is land protected under Article 97 Articles of Amendment to the Constitution of the Commonwealth of Massachusetts, legislation was required to be passed to change the use of the property. Governor Charlie Baker signed Chapter 216 of the Acts of 2018 (https://malegislature.gov/Laws/SessionLaws/Acts/2018/Chapter216) to change its use in August 2018. Eversource submitted an Environmental Notification Form (EEA# 15952) to the MEPA office on December 17, 2018. Completion of the project is anticipated for Quarter 2 of 2024.

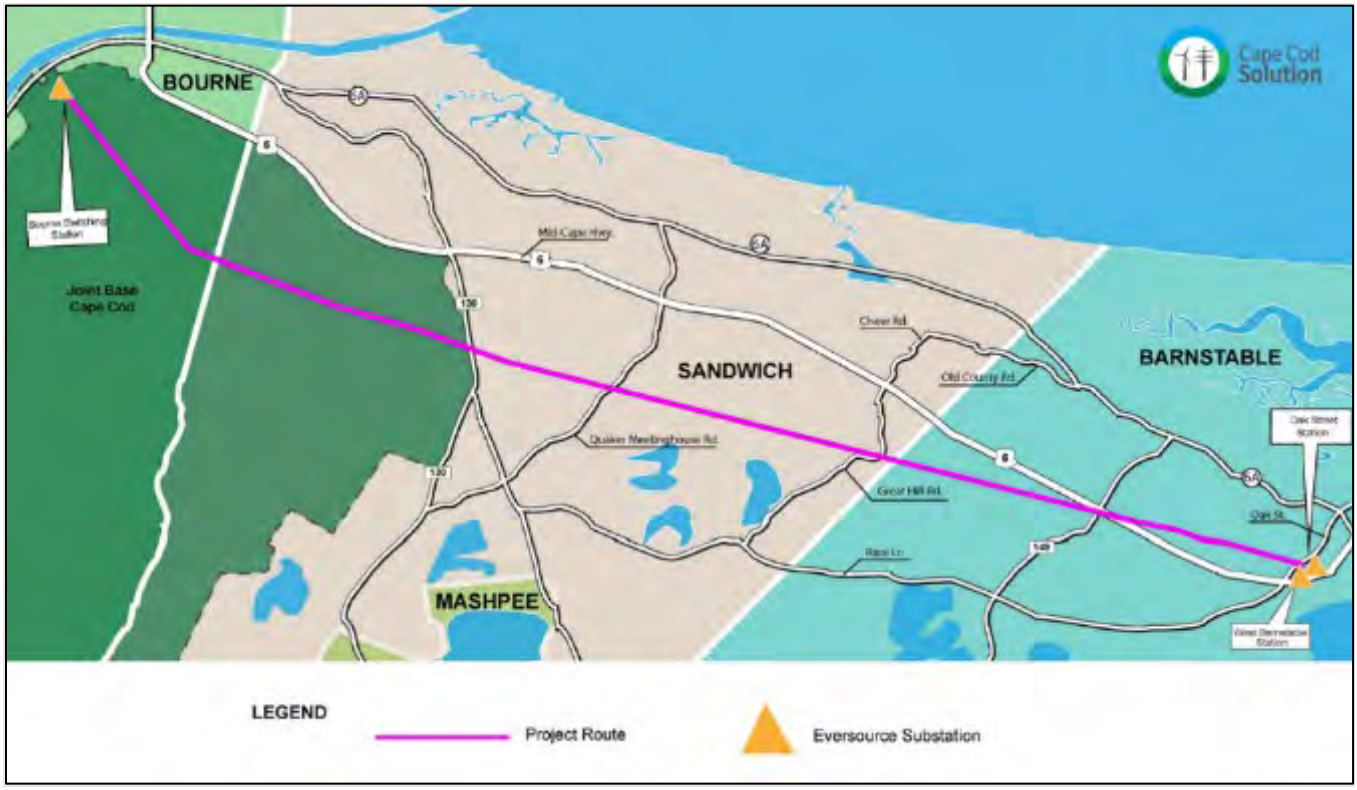
Figure 5-1 New 115kV Station and Proposed 345kV Station Locations

5.2.2.2 Cape Cod Solution Program

Another Eversource project currently underway is Phase I of the Cape Cod Solution Program, formerly known as the Mid Cape Reliability Project. The Cape Cod Solution Program is a co-optimized, multi-phase transmission program that meets growing electrical needs on Cape Cod and allows for the integration of offshore wind energy. Phase 1 is a new reliability project consisting of a new transmission line and supporting structures from the

Bourne Switching Station running down Cape Cod to the Town of Barnstable (Figure 2). This will create a redundant line that will help ensure the Cape has reliable power. The new infrastructure runs within the existing cleared utility rights-of-way along Gibbs Road within the Training Area/Reserve.

Figure 5-2 – 13-Mile Transmission within the Existing Right-of-Way



Early on, during the planning of the program, Eversource coordinated with the EMC and the MANG at Camp Edwards. Included in these discussions were the BMPs to be implemented by Eversource to meet the EPSs. Some of the BMPs included protection of rare species, habitat management, and stormwater management. A Construction Period Protection Plan for rare species was developed and preventative measures included contractor education, field biologists surveying active work areas, and radio telemetry to document rare species populations were just some of the BMPs applied during this project.

Mock turtle shells used during a wildlife survey training exercise.

To manage stormwater, a suite of BMPs were selected to minimize erosion and control sediment in active work areas. These BMPs are monitored by Eversource's compliance team at a minimum of once every seven days and after significant rain events. Erosion and sediment controls prescribed for the site include straw wattle, straw bales, silt fence, erosion control blankets, slope diversions, and more. BMPs will remain in place until the site is restored and determined stable. Phase 1 construction is expected to be finished in Spring 2024 with restoration efforts expected to be completed in Fall 2024.

Phase 2 of the Program consists of operating the new transmission line (mentioned above) at 345-kV to enable 800MW of off-shore wind to interconnect to the power grid. To support the increase in voltage, additional facilities will be constructed at each end of the new transmission line. Within JBCC, on Jarvis Road, Eversource will construct a new 345-kV switching station within the footprint of the decommissioned 115-kV switching station, minimizing disturbance to state priority habitat (Figure 1). Eversource filed with the Department of Public Utilities (DPU) and the Energy Facilities Siting Board (EFSB) in February 2023 and received the MEPA Notice of Project Change Certificate in November 2023. The EMC and the MANG at Camp Edwards have been involved stakeholders in Eversource's proposal of the Cape Cod Solution Program. Other partner agencies include MEPA, NHESP and DFW, the Cape Cod Commission, and the four Upper Cape Cod towns surrounding JBCC. The decommissioning of the old station is planned to begin in Quarter 3 2024.

A water bar used to divert stormwater to a plunge pool controls sedimentation and reduces the risk of roads washing out.

5.2.3 Cape Cod Canal Bridges Program

The Massachusetts Department of Transportation (MassDOT) is addressing the Bourne and Sagamore Bridges and improvements to the approach roadway network through the Cape Cod Bridges Program. Last year, several potential bridge types were presented to the public during MassDOT's public outreach meetings. In August 2023, the program applied for a grant for only the Sagamore Bridge through the Multimodal Project Discretionary Grant. Funding for the Bourne Bridge will be requested in the future. MassDOT is engaging in the MEPA/NEPA processes and will be completing a Draft Environmental Impact Report (MEPA) and will develop a Draft Environmental Impact Statement (NEPA). Information related to the program may be found at: https://www.mass.gov/info-details/latest-updates-cape-cod-bridges-program.

The Cape Cod Canal Transportation Study, led by MassDOT, covered areas in Bourne and Sandwich and west along Route 25 into Wareham. Some changes detailed in the Cape Cod Canal Transportation Study: Final Report could have potential impacts to JBCC and specifically the Camp Edwards Training Site. The final report is available at https://www.mass.gov/lists/cape-cod-canal-study-documents#cape-cod-canal-transportation-study:-final-report-.

5.2.4 Safe Drinking Water Act, Administrative Order 2 (AO2), Five Year Review Report

In May 2023, the US EPA issued the *Five-Year Review Report for EPA Safe Drinking Water Act Administrative Order 2 (AO2) Decision to Modify Prohibition on Live Firing and Use of Pyrotechnics, Joint Base Cape Cod, Barnstable County, Massachusetts*. In 2017, AO2 was modified to allow lead or other live ammunition and certain pyrotechnics to be used on the small arms ranges at or near the training ranges to the extent that the MAARNG received continued approval and oversight from the EMC and followed the EPSs. It also specified that US EPA would review its decision every five years. The report issued by the US EPA validated whether the

decision to modify the prohibition of firing lead ammunition and pyrotechnics is protective of human health. US EPA reviewed years of data, completed site inspections and reviewed records and sampling data. US EPA determined that the MAARNG was conforming with the requirements established in the OMMPs and the EPSs and the EMC was ensuring compliance with those standards. In a letter dated May 10, 2023, US EPA stated, "Our review concludes that the 2017 Decision to modify the AO2 prohibition on live firing and use of pyrotechnics at certain ranges is providing adequate protection of public health for the ranges evaluated in this review." The report and supporting documents are available on US EPA's website at: https://www.epa.gov/.

5.3 ENVIRONMENTAL PROGRAM PRIORITIES

5.3.1 TY 2023 Environmental Program Priorities

The following subsections provide a list of the environmental program priorities established for TY 2023 as published in the TY 2022 Annual Report for its activities associated with the Training Area/Reserve and the status of achieving them.

Natural Resources and ITAM Management

- Implement projects and planning identified in the Conservation and Management Permit that established an onsite mitigation bank and long-term habitat management and resource monitoring requirements. The majority of these actions are on an annual and ongoing basis, including monitoring efforts and prescribed burning. Annual targets are for at least 100 acres of pine barrens habitat restoration/maintenance and 50 acres of grassland habitat restoration/maintenance. Monitoring efforts are outlined in the text. **The targets of this priority were met during TY 2023 and continue forward as annual objectives for TY 2024.**
- Continue to address potential federal status changes to species at Camp Edwards through interagency consultation, planning, and partnership. This effort is ongoing with particular emphasis on the proposed change of the Northern Long-eared Bat from Threatened to Endangered under the Federal Endangered Species Act. **This priority/objective was met and is an ongoing effort. As described above some consultation processes were either completed or initiated while those not completed are ongoing or in development to address continuing change in listing status and consultation requirements.**
- Further develop supplemental plans for Natural Resources/ITAM long-term budgets and implementation, including invasive species, wildland fire, and land rehabilitation. This effort is ongoing with the continued update of the Integrated Wildland Fire Management Plan and Integrated Pest Management Plan, and development by the Woodwell Climate Research Center of a Climate Resilience Plan that will be appended to the INRMP. **Plan updates are ongoing.**
- Continue implementation and refinement of management focused monitoring of rare species, habitat management, and training capabilities. These are ongoing efforts with TY 2023 emphasis on continuing long-term efforts and informing future work (e.g., bats, cottontails) through long-term data analysis. **Ongoing/continuing effort with reporting on results of management focused long-term monitoring efforts.**
- Continue to develop wildland fire capabilities and capacity through program and personnel development and increasing available fire windows by addressing barriers to fire. Key barriers include listed species consultation and permitting (federal Endangered Species Act) and fuels management. Increasing capacity and implementation of prescribed fire is consistent with the habitat management priorities, supported by long-term monitoring of flora and fauna, and essential to reducing wildfire hazard. These are also ongoing efforts consistent with above reporting and management plans. **Challenges persist but**

planning and programming continue in an effort to increase capability and annual accomplishment.

- Continue upscaling of habitat and land management actions, including mechanical work and prescribed burning, through internal actions and partnerships, to increase long-term ecosystem health and resilience. Ongoing with emphasis on strengthening prescribed fire program and monitoring of habitat effects. **Continuing to plan and determine how to accomplish appropriate scale of management given budgets and challenges, especially with wildland fire. Continuing to develop on this effort.**
- Develop water feature conservation plans that provide for ephemeral features (e.g., vernal pools) while minimizing impacts to wildlife and training. Ongoing with emphasis on more detailed planning of two to three new vernal pools based on a contracted study that through site analysis determined suitable locations to construct pools. **An archeological survey of the proposed location is in contracting to ensure full suitability and sustainability of project siting**.
- Continue and further develop interagency partnerships with Massachusetts DFW, NHESP, USFWS, EMC, DCR, MassDEP, and others through active engagement to seek mutual benefit. **Coordination and collaboration continues to be strong with partner agencies and organizations.**

Cultural Resources Management

- Conduct applicable reviews of all IAGWSP, IRP and MAARNG proposed activities in the Training Area/Reserve for potential cultural resources impacts. (Ongoing)
- Document any new occurrences of identified cultural resources. (Ongoing)

Other E&RC Environmental Management Programs

- Coordinate required soil, lysimeter and groundwater sampling at operational active small arms ranges in accordance with approved range management plans. (Accomplished)
- Provide appropriate support to Camp Edwards for small arms range development. (Accomplished)
- Continue to support Camp Edwards through the environmental process for proposed training venues in the Training Area/Reserve. (Accomplished)
- Provide support as needed to the JBCC Executive Director Office with regards to community involvement and environmental and training issues. (Accomplished)
- Attend all scheduled EMC, CAC and SAC meetings, both internally and externally, that may involve activities within and surrounding the Training Area/Reserve. (Accomplished)
- Provide information on environmental program activities regarding the Training Area/Reserve. (Accomplished)
- Work closely with Camp Edwards, the Natural Resources Office, and the EMC to ensure training is compatible with the EPSs. (Accomplished)
- Provide support for the EMC and its advisory councils as required in Chapter 47. (Accomplished)
- Publish the final TY 2022 *State of the Reservation Report.* (Accomplished)

5.3.2 TY 2024 Environmental Program Priorities

The following subsections provide a list of environmental program priorities for Camp Edwards for activities associated with the Training Area/Reserve in TY 2024. Natural Resources and ITAM Program priorities for FY 2024 are largely the same, carried over from previous years within a well-established program.

Natural Resources and ITAM Management

- Continue to develop wildland fire capabilities and capacity through program and personnel development and increasing available fire windows by addressing barriers to fire. Key barriers include qualified planning capacity, aging and inadequate equipment, lack of adequate radio communications, a need for additional crew, greater agency administrative and credentialing requirements, and increased restrictions on potential burn windows. Increasing capacity and implementation of prescribed fire is consistent with the habitat management priorities, supported by long-term monitoring of flora and fauna, and essential to reducing wildfire hazard.
- Continue annual monitoring and survey requirements and habitat maintenance and improvement projects to meet existing conditions of the Multipurpose Machine Gun Range CMP and the Road Repair and Clam Shrimp Relocation CMP.
- Continue annual monitoring and habitat management projects related to conservation and protection of At-risk, MESA listed, or USFWS candidate species that are not directly related to a CMP (e.g., Broad Tinker's-weed, Spotted Turtles, Monarch Butterfly).
- Coordinate with NHESP and Camp Edwards internal stakeholders regarding the protection, management, and monitoring of MESA rare plant species, newly discovered during TY 2023 rare plant surveys (e.g., Papillose Nut-sedge). Continue efforts to survey for rare plant species, targeting plant community types not surveyed during TY 2023.
- Continue efforts to construct two to three ephemeral water features (i.e., vernal pools) in the northeastern portion of the training area. Efforts in TY 2024 involve coordination with Camp Edwards Cultural Program to learn the results of an archeological survey currently underway and to engage with the Conservation Office to explore potential permitting or non-permitting process that will help to document and mitigate future jurisdictional issues or confusion.
- Further develop supplemental plans for Natural Resources/ITAM long-term budgets and implementation, including invasive species, wildland fire, and land rehabilitation. This effort is ongoing with the continued update of the Integrated Wildland Fire Management Plan and Integrated Pest Management Plan, and development by the Woodwell Climate Research Center of a Climate Resilience Plan that will be appended to the INRMP.
- Continue to address potential federal status changes to species at Camp Edwards through interagency consultation, planning, and partnership. This effort is ongoing with particular emphasis on the proposed change of the Northern Long-eared Bat from Threatened to Endangered under the Federal Endangered Species Act.
- Continue to develop wildland fire capabilities and capacity through program and personnel development and increasing available fire windows by addressing barriers to fire. Key barriers include listed species consultation and permitting (federal Endangered Species Act) and fuels management. Increasing capacity and implementation of prescribed fire is consistent with the habitat management priorities, supported by long-term monitoring of flora and fauna, and essential to reducing wildfire hazard. These are also ongoing efforts consistent with above reporting and management plans.

Other E&RC Environmental Management Programs

- Coordinate required soil, lysimeter and groundwater sampling at operational active small arms ranges in accordance with approved range management plans.
- Provide appropriate support to Camp Edwards for small arms range development.
- Continue to support Camp Edwards through the environmental process for proposed training venues in the Training Area/Reserve.

- Provide support as needed to the JBCC Executive Director Office with regards to community involvement and environmental and training issues.
- Attend all scheduled EMC, CAC and SAC meetings, both internally and externally, that may involve activities within and surrounding the Training Area/Reserve.
- Provide information on environmental program activities regarding the Training Area/Reserve.
- Work closely with Camp Edwards, the Natural Resources Office, and the EMC to ensure training is compatible with the EPSs.
- Provide support for the EMC and its advisory councils as required in Chapter 47.
- Publish the final TY 2023 *State of the Reservation Report.*

APPENDIX A
LIST OF CONTACTS

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APPENDIX B
ENVIRONMENTAL PERFORMANCE STANDARDS AS AMENDED ON APRIL 6, 2017

ENVIRONMENTAL PERFORMANCE STANDARDS
APRIL 6, 2017

For Massachusetts National Guard Properties at the Massachusetts Military Reservation

CAMP EDWARDS TRAINING AREA GENERAL PERFORMANCE STANDARDS

None of the following banned military training activities shall be allowed in the Camp Edwards Training Areas:
-Artillery live fire
-Mortar live fire
-Demolition live fire training
-Artillery bag burning
-Non-approved digging, deforestation or vegetation clearing
-Use of' 'CS', riot control, or tear gas for training outside the NBC bunkers
-Use of field latrines with open bottoms
-Vehicle refueling outside designated Combat Service Area and Fuel Pad locations
-Field maintenance of vehicles above operator level

Limitations on the use of small arms ammunition and live weapon fire fall into the following two categories:

- Live weapon fire is prohibited outside of established small arms ranges. Live weapon fire is not allowed on established small arms ranges except in accordance with Environmental Performance Standard 19, other applicable Performance Standards, and a range-specific plan approved through the Environmental Management Commission (EMC).

- Blank ammunition for small arms and simulated munitions may be used in areas outside of the small arms ranges, using only blank ammunition and simulated munitions identified on an approved list of munitions. Joint review and approval for inclusion on the list shall be through by the Environmental & Readiness Center (E&RC) and the EMC.

Each user will be responsible for proper collection, management, and disposal of the wastes they generate, as well for reporting on those actions.

Use and application of hazardous materials or disposal of hazardous waste shall be prohibited except as described in the Groundwater Protection Policy.

Vehicles are only authorized to use the existing network of improved and unimproved roads, road shoulders, ranges and bivouac areas, except where necessary for land rehabilitation and management, water supply development, and remediation, or where roads are closed for land rehabilitation and management.

Protection and management of the groundwater resources in the Camp Edwards Training Area will focus on the following:

- Development of public and Massachusetts Military Reservation water supplies.
- Preservation and improvement of water quality and quantity (recharge).
- Activities compatible with the need to preserve and develop the groundwater resources.

All users of the Camp Edwards Training Area must comply with the provisions of the Groundwater Protection Policy and any future amendments or revisions to the restrictions and requirements. These will apply to all uses and activities within the overlays relative to Wellhead Protection, Zone II's within the Cantonment Area, and the Camp Edwards Training Areas.

Development of water supplies will be permitted within the Camp Edwards Training Area after review and approval by the managing agencies, principally the Department of the Army and its divisions, together with the Massachusetts Department of Environmental Protection, and the Massachusetts Division of Fish and Wildlife.

All phases of remediation activities will be permitted within the Camp Edwards Training Area after review and approval by the managing agencies, principally the Department of the Army and its divisions, together with the federal and state agencies who will have jurisdiction for remediation.

Pollution prevention and management of the Camp Edwards training ranges will focus on and include the following:

The Camp Edwards Training Area, including the Small Arms Ranges (SAR) and their associated "Surface Danger Zones," and any areas where small arms or other munitions or simulated munitions are used, shall be managed as part of a unique water supply area under an adaptive management program that integrates pollution prevention, and best management practices (BMP), including the recovery of projectiles. This will be done through individual range-specific plans that are written by the Massachusetts National Guard and approved for implementation through the EMC and any other regulatory agency having statutory and/or regulatory oversight. Adaptive, in this context, means making decisions as part of a continual process of monitoring, reviewing collected data, evaluating advances in range monitoring, design and technology, and responding with management actions as dictated by the resulting information and needs of protecting the environment while providing compatible military training within the Upper Cape Water Supply Reserve.

A range plan shall be designed and followed to reduce the potential for an unintended release to the environment outside of the established containment system(s) identified in the range-specific plans. All users must be aware of, and comply with, the Environmental Performance Standards that are applicable to all SAR activities. Any range specific requirements will be coordinated through the E&RC with the EMC, incorporating those specific requirements into the appropriate range-specific plans and range information packets. Camp Edwards SAR Pollution Prevention Plan shall be followed to prevent or minimize releases of metals or other compounds related to the normal and approved operation of each SAR. The adaptive SAR management program components required in each range-specific plan shall include:

- Consultation with applicable agencies with oversight of the training area before undertaking any actions that are subject to state and/or federal regulatory requirements.
- Specific recovery plans for the removal and proper disposition of spent projectiles, residues and solid waste associated with the weapons, ammunition, target systems, and/or their operation and maintenance.
- Reduction of adverse impacts to the maximum extent feasible, including consideration for the design/redesign and/or relocation of the activity or encouraging only those activities that result in meeting the goal of overall projectile and/or projectile constituent containment.
- Internal and external coordination of documentation for the Camp Edwards range management programs and other related Camp Edwards management programs including: the Integrated
- Training Area Management Program, Range Regulations, Camp Edwards Environmental Management System, Civilian Use Manual, and Standard Operating Procedures.
- Long-term range maintenance, monitoring and reporting of applicable parameters and analysis.

The Massachusetts National Guard shall ensure that all training areas where munitions or simulated munitions are used or come to be located, including range areas, range surface danger zones, and any other areas within the Upper Cape Water Supply Reserve that are operational ranges are maintained and monitored following approved management plans that include planning for pollution prevention, sustainable range use and where applicable, restoration.

Protection and management of the vegetation of the Camp Edwards Training Area for focus on the following:

- Preservation of the habitat for federal- and state-listed rare species and other wildlife.
- Preservation of the wetland resource areas.
- Activities compatible with the need to manage and preserve the vegetative resources.
- Realistic field training needs.
- Identification and restoration of areas impacted by training activities.

Goals for the Adaptive Ecosystem Management approach to management of the Camp Edwards properties will be as follows:

- Management of the groundwater for drinking water resources
- Conservation of endangered species.
- Management of endangered species habitat for continuation of the species.
- Ensuring compatible military training activities.
- Allowing for compatible civilian use.
- Identification and restoration of areas impacted by training activities.

The Environmental Performance Standards will be incorporated into the programs and regulations of the Massachusetts National Guard as follows. Those standards relating to natural resources management shall be incorporated as standards into each of the state and federal environmental management programs and attached as an appendix or written into the documentation accompanying the plan or program. All the Environmental Performance Standards will be attached to the Integrated Training Area Management Plan 'Trainer's Guide' and to the Camp Edwards Range Regulations. Modification of the Standards Operating Procedures will include review and conformance with the Environmental Performance Standards for trainers and soldiers at Camp Edwards.

SPECIFIC RESOURCE PERFORMANCE STANDARDS IN THE CAMP EDWARDS TRAINING AREA

1. Groundwater Resources Performance Standards

1.1. All actions, at any location within the Camp Edwards Training Areas, must preserve and maintain groundwater quality and quantity, and protect the recharge areas 1:0 existing and potential water supply wells. All areas within Camp Edwards Training Areas will be managed as State Zone U, and, where designated, Zone I, water supply areas.

1.2 The following standards shall apply to designated Wellhead Protection Areas:

- The 400-foot radius around approved public water supply wells will be protected from all access with signage. That protection will be maintained by the owner and/or operator of the well, or the leaseholder of the property.
- No new stormwater discharges may be directed into Zone I areas.

- No in ground septic system will be permitted within a Zone I area.
- No solid wastes may be generated or held within Zone I areas except as incidental to the construction, operation, and management of a well.
- Travel in Zone I areas will be limited to foot travel or to vehicles required for construction, operation, and maintenance of wells.
- No new or existing bivouac activity or area shall be located within a Zone I area.
- All other areas will be considered as Zone II designated areas and will be subject to the standards of the Groundwater Protection Policy.

1.3 Land-use activities that do not comply with either the state Wellhead Protection regulations (310 CMR 22.00 et seq.) or the Groundwater protection Policy are prohibited.

1.4 All activities will suppol1 and not interfere with either the Impact Area Groundwater Study and/or the Installation Restoration Program. All activities shall conform to the requirements of Comprehensive Environmental Response, Compensation and Liability Act, the Massachusetts Contingency Plan, and the Safe Drinking Water Act.

1.5 Extraction, use, and transfer of the groundwater resources must not de- grade [e.g. draw down surface waters] in freshwater ponds, vernal pools, wetlands, and marine waters, unless properly reviewed, mitigated, and approved by the managing and regulating agencies.

1.6 Land uses and activities in the Camp Edwards Training Areas will meet the following standards:

- Will conform to all existing and applicable federal, state and local regulations.
- Must be able to be implemented without interference with ongoing remediation projects.
- Allow regional access to the water supplies on the Massachusetts Military Reservation.

1.7 The following programs and standards will be used as the basis for protecting groundwater resources in the Camp Edwards Training Areas:

- Groundwater Protection Policy.
- Federal and Department of Defense environmental programs: Integrated Natural Resources Management Plan, Integrated Training Area Management Program, Range Regulations, Spill Prevention Control and Countermeasures Plan (or equivalent), Installation Restoration *Plan,* Impact Area Groundwater Study, or other remediation programs.
- State and federal laws and regulations pertaining to water supply.

2. Wetlands and Surface Water Performance Standards

2.1 Since there are relatively few wetland resources found at the Massachusetts Military Reservation, and since they are important to the support of habitat and water quality on the properties, the minimum standard will be no net loss of any of the wetland resources or their 100-foot buffers.

2.2 Land uses and activities will be managed to prevent and mitigate new adverse impacts and eliminate or reduce existing conditions adverse to wetlands and surface water resource areas. Impacts from remediation activities may be acceptable with implementation of reasonable alternatives.

2.3 Wetland area management priorities:

- Protection of existing; wetland resource areas for their contributions to existing and potential drinking water supplies.
- Protection of wetlands for rare species and their habitats.
- Protection of human health and safety.

2.4. Activities will be managed to preserve and protect wetlands and vernal pools as defined by applicable, federal, state, and local regulations. These activities will include replacement or replication of all wetland resource buffer areas, which are lost after completion of an activity or use.

2.5 All land altering activities within 100 feet of a certified vernal pool must be reviewed before commencement by the Massachusetts Department of Environmental Protection/Wetlands Unit and the Natural Heritage and Endangered Species Program within the Division of Fish and Wildlife for impacts to wildlife and habitat. The certification of vernal pools will be supported by the on site personnel and will proceed with the assistance of the appropriate state agencies.

2.6 All new uses or activities will be prohibited within the wetlands and their IOO-foot buffers, except those associated with an approved habitat enhancement or restoration program; those on existing improved and unimproved roads where appropriate sediment and erosion controls are put in place prior to the activity; or those where no practicable alternative to the proposed action is available. No new roads should be located within the 100-foot buffers. Existing roads within such buffers should be relocated provided that:

- The relocation does not cause greater environmental impact to other resources.
- There are funds and resources allocated for resource management and that those resources are approved and available for the relocation.

2.7 During the period of 15 February to 15 May, listed roads/trails within 500 feet of wetlands will be closed to vehicle access to protect the migration and breeding of amphibians. Emergency response and environmental management activities will not be restricted.

- Donnelly and Little Halfway Ponds maneuver trails (excluding the permanently closed section along the eastern edge of Donnelly Pond) from Frank Perkins Road north to Wood Road
- Red Maple Swamp trail from Wood Road north and east to Avery Road
- Orchard and Jefferson Roads (continuous) from Cat Road south and east to Burgoyne Road
- Maneuver trail(s) in powerline easement north of Gibbs Road from Goat Pasture Road west to the boundary of training areas C-13 and C-14
- Grassy Pond trail (side access to Sierra Range) from Gibbs Road south to Sierra Range
- Sandwich Road from the powerline easement north to the gas pipeline right of way
- Bypass Bog/Mike Range Road from entrance to Mike Range south and west to Greenway Road

2.8 No new bivouac area shall be located within 500 feet of any wetland. Any existing bivouac within a wetland buffer shall be relocated provided there are funds and resources allocated for the relocation.

3. Rare Species Performance Standards

3.1 As the Natural Heritage and Endangered Species Program of the Massachusetts Division of Fisheries & Wildlife has identified the entire Massachusetts Military Reservation as State Priority Habitat for state-listed species (version dated 2000-2001), all activities and uses must comply with the Massachusetts Endangered Species Act and its regulations.

3.2 Where activities and uses are not specifically regulated under the Camp Edwards Training Area Range and Environmental Regulations, including these Environmental Performance Standards, the MMR Environmental and Readiness Center must review the activities for conformance with the Integrated Natural Resource Management Plan, and shall- consult with the Natural Heritage and Endangered Species Program regarding potential impacts to state-listed species.

3.3 All activities impacting rare species habitat must be designed to preserve or enhance that habitat as determined by the MMR Environmental and Readiness Center in consultation with the Natural Heritage and Endangered Species Program.

3.4 Users are prohibited from interfering with state and federal listed species.

3.5 Users will report all sightings of recognized listed species, e.g. box turtles, within any area of the Massachusetts Military Reservation.

4. Soil Conservation Performance Standards

4.1 Activities and uses must be compatible with the limitations of the underlying soils. Limitations on uses and activities may be made where the soils or soil conditions would not support the activity.

4.2 Agricultural soil types will be preserved for future use.

4.3 Any perennial or intermittent stream identified by the Environmental & Readiness Center Office will be protected from siltation by retaining undisturbed vegetative buffers to the extent feasible.

4.4 Cultural resource evaluations must be completed before any earth-moving operation may take place in undisturbed areas with high potential for cultural resources, and earth moving may be limited to specific areas (See Cultural Resource Performance Standards).

4.5 An erosion control analysis will be made part of the land management programs (Integrated Natural Resource Management Plan, the Integrated Training Area Management Program, Range Regulations, Civilian Use, and Standard Operating Procedures) for the Camp Edwards Training Area, including appropriate mitigation measures where existing or potential erosion problems are identified.

4.6 For all improved and unimproved roads, ditches and drainage ways:

- All unimproved roads, ditches, roads and drainage ways identified for maintenance will be cleaned of logs, slash and debris.
- Unimproved roads and roads may not otherwise be improved unless approved for modification.
- Any trail, ditch, road, or drainage way damaged by activities will be repaired in accordance with the hazard and impact it creates.

4.7 Erosion-prone sites will be inspected periodically to identify damage and mitigation measures.

5. Vegetation Management Performance Standards

5.1 All planning and management activities impacting vegetation

- Will ensure the maintenance of native plant communities, and
- Shall be performed to maintain the biological diversity.

5.2 Revegetation of disturbed sites will be achieved by natural and artificial recolonization by native species.

5.3 Timber harvesting or clear-cutting of forested areas should not occur on steep slopes with unstable soils or with in the buffers to wetland resources.

5.4 Vegetation management will be subject to a forest management and fire protection program prepared by the users in accordance with federal standards, and carried out in a manner acceptable to the Massachusetts Military Reservation Committee and other state agencies or commissions, as may be designated by the Commonwealth of Massachusetts.

6. Habitat Management Performance Standards

6.l The Camp Edwards Training Area will be managed as a unique rare species and wildlife habitat area under n adaptive ecosystem management program that integrates ecological, socio-economic, and institutional perspectives, and which operates under the following definitions:

- Adaptive means making decisions as part of a continual process of monitoring, reviewing collected data, and responding with management actions as dictated by the resulting information and needs of the system.
- Ecosystem means a system-wide understanding of the arrangements of living and non-living things, and the forces that act upon and within the system.
- Management entails a multi-disciplinary approach where potentially competing interests are resolved with expert analysis, user and local interest considerations, and a commitment to compromise interests when the broader goal is achieved to manage the Camp Edwards Training Area as a unique wildlife habitat area.

6.2 The adaptive ecosystem management program will include:

- Coordinated documentation for the management programs, Integrated Natural Resource Management Plan, the Integrated Training Area Management Program, Range Regulations, Civilian Use, and Standard Operating Procedures.
- The Massachusetts National Guard Environmental and Readiness Center staff and necessary funding to support its ecosystem management plans, as related to the amount of training occurring.
- Cooperative agreements to create a management team of scientific and regulatory experts.
- Long-term land maintenance, monitoring of resources and trends, study and analysis.
- Recovery plans for species and habitats identified for improvement.
- Consultation with Federal and State agencies charged with oversight of the Endangered Species Program before any actions that may affect state and federal-listed species habitat.
- Reduction of adverse impacts to the maximum extent possible, including consideration for the relocation of the activity or encouraging only those activities that result in meeting a habitat management goal.
- Habitat management activities designed to promote protection and restoration of native habitat types.

7. Wildlife Management Performance Standards

7.1 Native wildlife habitats and ecosystems management will focus on the following:

- Protecting rare and endangered species, and,
- Maintaining biodiversity.

7.2 Hunting, recreation and educational trips must be approved, scheduled, planned, and supervised through Range Control.

7.3 Any activity or use will prioritize protection of life, property, and natural resource values at the boundaries of the Camp Edwards Training Area where wildlife interfaces with the surrounding built environment.

7.4 Wildlife management will include the following actions, specific to the species targeted for management:

- Development and implementation of a plan to monitor hunting of game species.
- Planning for multi-use objectives for recreation and hunting that incorporate public input and recommendations.
- Development of suitable monitoring programs for federal and state-listed species, and regular exchange of information with the Natural Heritage and Endangered Species Program.

8. Air Quality Performance Standard

8.1 All uses and activities will be responsible for compliance with both the State Implementation Plan for Air Quality and the Federal Clean Air Act.

8.2 Air quality management activities will include air sampling if required by regulation of the activity.

9. Noise Management Performance Standards

9.1 Noise management activities shall conform to the Army's Environmental Noise Management Program policies for evaluation, assessment, monitoring, and response procedures.

10. Pest Management Performance Standards

10.1 Each user will develop and implement an Integrated Pest Management Program to control pest infestations that may include outside contracting of services. Non-native biological controls should not be considered unless approved by federal and state agencies.

10.2 Each user will be held responsible for management of pests that threaten rare and endangered species, or are exotic and invasive species, Invasive plant species that may be considered pest species are those defined by the United States Fish and Wildlife Service and the Massachusetts Natural Heritage and Endangered Species Program of the Division of Fisheries and Wildlife office. Site-specific analysis will be performed before implementation of any proposed pest management plans.

10.3 Pest vegetation control must be balanced against environmental impact and any proposed pest management activities, including the use of herbicides and mechanical methods, within rare species habitat areas must be approved by the Natural Heritage and Endangered Species Program, or in the case of federally listed species, by the United States Fish and Wildlife Service.

10.4 Only herbicide formulations approved by the United States Environmental Protection Agency, the Department of Agriculture, the agency managing the user, and the Commonwealth of Massachusetts may be applied.

10.5 Herbicides and pesticides will not be applied by aerial spraying unless required by emergency conditions and approved under applicable state and federal regulations.

11. Fire Management Performance Standards

11.1 All activities and uses shall manage, prevent, detect, and suppress fires on the Camp Edwards Training Area in coordination with the local and state fire services and natural resource managers in the Environmental & Readiness Center.

11.2 Prescribed bums will be used as a habitat management and fire prevention tool. Prescribed burns will be used to reduce natural fire potential and create or maintain diverse and rare species habitat.

11 .3 Pre-suppression activities will include strategic firebreaks and other management of vegetation in high risk and high-incidence areas. The Integrated Natural Resource Management Plan and Fire Management Plan will be consulted for proposed actions.

11.4 Other than the above, no open fires are allowed.

12. Stormwater Management Performance Standards

12.1 All stormwater facilities shall comply with the State Department of Environmental Protection Guidelines for Stormwater Management, including Best Management Practices and all other applicable standards for control and mitigation of increased storm water flow rates and improvement of water quality.

12.2 All increases in stormwater runoff will be controlled within the user's property.

12.3 No new stormwater discharges will be made directly into wetlands or wetland resource areas.

13. Wastewater Performance Standards

13.1 All wastewater and sewage disposal will be in conformance with the applicable Federal and Massachusetts Department of Environmental Protection agency regulations.

14. Solid Waste Performance Standards

14.1 All solid waste streams (i.e., wastes not meeting the criteria for hazardous wastes) will be monitored and managed to substitute, reduce, recycle, modify processes, implement best management practices, and/or reuse waste, thereby reducing the total tonnage of wastes,

14.2 All users will be held responsible for collection, removal and disposal outside of the Camp Edwards Training Areas of solid wastes generated by their activities.

14.3 All users must handle solid wastes using best management practices to minimize nuisance odors, windblown litter, and attraction of vectors.

14.4 No permanent disposal of solid waste within the Groundwater protection Policy area/Camp Edwards field training areas will be permitted.

15. Hazardous Materials Performance Standards

15.1 Where they are permitted, use and application of hazardous materials shall be otherwise minimized in accordance with pollution prevention and waste minimization practices, including material substitution.

15 .2 No permanent disposal of hazardous wastes within the Groundwater protection Policy area/Camp Edwards field training areas will be permitted.

15.3 Fuel Management

15.3.1 Spill Prevention, Control, and Countermeasure Plan, is in place to reduce potential for a release. Camp Edwards Spill Response Plan is in place to respond to a release if an event should occur. All users will comply with these plans at the Camp Edwards Training Area.

15.3.2 If found, non-complying underground fuel storage tanks will be removed in accordance with state and federal laws and regulations to include remediation of contaminated soil.

15 .3.3 No storage or movement of fuels for supporting field activities, other than in vehicle fuel tanks, will be permitted except in approved containers no greater than five gallons in capacity.

15.3.4 New storage tanks are prohibited unless they meet the following requirements:

- Are approved for maintenance heating, or, permanent emergency generators and limited to propane or natural gas fuels.
- Conform to the Groundwater Protection Policy and applicable codes.

15.4 Non-fuel Hazardous Material Storage

15.4 .1 No storage above those quantities necessary to support field training activities will be allowed within the Camp Edwards Training Area except where necessary to meet regulatory requirements, and where provided with secondary containment.

15.4.2 When required by applicable regulation, the user shall implement a Spill Prevention, Control and Containment/Emergency Response or other applicable response plan.

16. Hazardous Waste Performance Standards

16.1 All uses shall comply with applicable local, state, and federal regulations governing hazardous waste generation, management, and disposal (including overlays relative to Wellhead Protection, Zone II' s within the Cantonment Area) .

16.2 Accumulations of hazardous waste shall be handled in accordance with regulations governing accumulation and storage.

16.3 Existing facilities must implement pollution prevention and waste minimization procedures (process modifications, material substitution, recycling, and best management practices) to minimize waste generation and hazardous materials use.

16.4 Occupants and users will be held responsible for removing all solid or hazardous wastes generated during the period of use/tenancy/visitation upon their departure or in accordance with other applicable or relevant regulations.

16.5 Remedial activities undertaken under the Installation Restoration Program, the Impact Area Groundwater Study Program, the Massachusetts Contingency Plan, or other governing remediation programs are exempt from additional regulation (e.g., waste generation volume limits). Removal, storage, and disposal of contaminated material are required to comply with all state, and federal regulations.

16.6 Post-remedial uses and activities at previously impacted sites will be allowed in accordance with terms and conditions of the applicable regulations.

16.7 All hazardous wastes will be transported in accordance with federal Department of Transportation regulations governing shipment of these materials.

16.8 Transport shall reduce the number of trips for transfer and pick-up of hazardous wastes for disposal to extent feasible. Tills may include planning appropriate routes that minimize proximity to sensitive natural resource areas, and reducing internal transfers of material, including transfers from bulk storage tanks to drums, tankers, carboys, or other portable containers or quantities.

16.9 No permanent disposal of hazardous wastes within the Groundwater Protection Policy area/Camp Edwards field training areas will be permitted.

17. Vehicle Performance Standards

17.1 Vehicles within the Camp Edwards Training Area will be limited to the existing improved and unimproved road system except where required for natural resource management or property maintenance or where off-road activity areas are located and approved by the Environmental and Readiness Center in consultation with the Massachusetts Division of Fisheries and Wildlife.

17.2 Unimproved, established access ways will be limited to use by vehicles in accordance with soil conditions as described in the Soil Conservation Performance Standards.

17.3 The number of military and civilian vehicles within the Camp Edwards Training Area will be controlled using appropriate scheduling and signage.

18. General Use and Access Performance Standards

18.1 General User Requirements. Requirements that will apply to all users, both public and private, in the Camp Edwards Training Area include the following:

- All acts that pollute the groundwater supply are prohibited.
- No litter or refuse of any sort may be thrown or left in or on any property.
- All users will be held responsible for providing, maintaining, and re- moving closed-system, sanitary facilities necessary for their use and activity.
- No person shall wade or swim in any water body except for activities approved by the Massachusetts National Guard including remediation, scientific study, or research.
- Vehicles may only be driven on roads authorized and designated for such use and parked in designated areas, and may not cross any designated wetland.
- Public users may not impede the military training activities.

18.2. Civilian Use Manual. To guide public conduct on the Massachusetts Military Reservation, a Civilian Use Manual will be prepared and periodically updated. All civilian users will obtain and follow this Manual.

18.3. Siting and Design Performance Standards

18.3.1 New or expanded buildings should not be proposed within the Camp Edwards Training Areas, with the following exceptions:

- Buildings to support allowed training, operations and activities, including upgrading of those facilities currently in place,
- Buildings used for the purposes of remediation activities,
- Buildings used for the purposes of development, operation and maintenance of water supplies,
- Buildings used for the purpose of natural resource and land management.

19. Range Performance Standards

19.1. All operational ranges including but not limited to small arms ranges (SAR) shall be managed to minimize harmful impacts to the environment within the Upper Cape Water Supply Reserve. Range management at each range shall include to the maximum extent practicable metal recovery and recycling, prevention of fragmentation and ricochets, and prevention of sub-surface percolation of residue associated with the range operations. Camp Edwards shall be held responsible for the implementation of BMPs by authorized range users, including collection and removal of spent ammunition and associated debris.

19.2. Small arms ranges shall only be used in accordance with approved range plans. These plans shall be designed to minimize to the maximum extent practicable the release of metals or other contaminates to the environment outside of specifically approved containment areas/systems. Occasional ricochets that result in rounds landing outside of these containment areas is expected and every effort to minimize and correct these occurrences shall be taken. Failure to follow the approved range plans shall be considered a violation of this EPS.

19.3. All operational SARs shall be closely monitored by the Massachusetts National Guard to assess compliance of the approved range plans as well as the implementation and effectiveness of the range specific BMPs.

19.4. Camp Edwards/Massachusetts National Guard Environmental and Readiness Center shall staff and request appropriate funding to support its SAR management plans.

19.5. All users must use and follow Camp Edwards' Range Control checklists and procedures to:

- Minimize debris on the range (e.g. shell casings, used targets)
- Minimize or control residues on the ranges resulting from training (e.g., unburned constituents, metal shavings from the muzzle blast)
- Ensure the range is being used for the designated purpose in accordance with all applicable plans and approvals

19.6. Camp Edwards is responsible for following range operation procedures and maintaining range pollution prevention systems. Range BMPs shall be reviewed annually for effectiveness and potential improvements in their design, monitoring, maintenance, and operational procedures in an effort to continually improve them. Each year the annual report shall detail the range-specific activities including, but not limited to, the number of rounds fired, number of shooters and their organization, and the number of days the range was in use. The annual report will also detail active SAR groundwater well and lysimeter results, as well as any range maintenance/management activities that took place that training year and the result of such activities, i.e. lbs. of brass and projectiles recovered and recycled, etc. The Massachusetts National Guard shall provide regular and unrestricted access for the EMC to all its data and information, and will provide immediate access to environmental samples from the range, including range management and monitoring systems and any other applicable activities operating on the ranges.

19.7. Range plans and BMPs for training areas shall be reviewed and/or updated at least every three years. Management plans for new and upgraded ranges shall be in place prior to construction or utilization of the range. Range plans, at a minimum, will address long-term sustainable use, hydrology and hydrogeology, physical design, operation, management procedures, record keeping, pollution prevention, maintenance, monitoring, and applicable technologies to ensure sustainable range management. Range plans shall be integrated with other training area planning processes and resources.

19.8. The Massachusetts National Guard shall establish procedures for range maintenance and where applicable, maintenance and/or clearance operations to permit the sustainable, compatible, and safe use of operational ranges for their intended purpose within the Upper Cape Water Supply Reserve. In determining the frequency and degree of range maintenance and clearance operations, the Massachusetts National Guard shall consider, at a minimum, the environmental impact and safety hazards, each range's intended use, lease requirements, and the quantities and types of munitions or simulated munitions expended on that range.

APPENDIX C
SMALL ARMS RANGE AND SOLDIER VALIDATION LANE INFORMATION

Operations Maintenance and Monitoring Activities

OPERATIONS, MAINTENANCE & MONITORING ACTIVITIES
TANGO RANGE
TY 2023

Date	Activity
2 Oct 22	Pre/Post Firing Inspection
12 Oct 22	Soil Sampling
13, 15 Oct 22	Pre/Post Firing Inspection
21 Oct 22	Pre/Post Firing Inspection
28, 29 Oct 22	Pre/Post Firing Inspection
3, 6 Nov 22	Pre/Post Firing Inspection
4 Nov 22	EMC/E&RC Inspection
6 Dec 22	Monthly Inspection
17 Jan 23	Monthly Inspection
23 Feb 23	Monthly Inspection
22 Mar 23	Monthly Inspection/Maintenance: Routine Berm Maintenance
23 Mar 23	Pre/Post Firing Inspection
24 Mar 23	EMC/E&RC Inspection
25 Mar 23	Pre/Post Firing Inspection
31 Mar 23	Pre/Post Firing Inspection
21 Apr 23	Pre/Post Firing Inspection
21 Apr 23	EMC/E&RC Inspection
28 Apr 23	Pre/Post Firing Inspection
5 May 23	Pre/Post Firing Inspection
19 May 23	Pre/Post Firing Inspection
26 May 23	Pre/Post Firing Inspection
1, 2 Jun 23	Pre/Post Firing Inspection
3 Jun 23	Pre/Post Firing Inspection
4 Jun 23	Pre/Post Firing Inspection
21, 22 Jun 23	Pre/Post Firing Inspection
23, 24 Jun 23	Pre/Post Firing Inspection
26, 27 Jun 23	Pre/Post Firing Inspection
8 Jul 23	Pre/Post Firing Inspection
20 Jul 23	EMC/E&RC Inspection
5 Aug 23	Pre/Post Firing Inspection
7 Sep 23	EMC/E&RC Backstop Berm Inspection
16 Sep 23	Pre/Post Firing Inspection
22 Sep 23	Pre/Post Firing Inspection
29 Sep 23	Pre/Post Firing Inspection

OPERATIONS, MAINTENANCE & MONITORING ACTIVITIES
SIERRA RANGE
TY 2023

Date	Activity
02 Oct 22	Pre/Post Firing Inspection
11 Oct 22	Soil, Lysimeter and Groundwater Sampling
13, 16 Oct 22	Pre/Post Firing Inspection
21, 22 Oct 22	Pre/Post Firing Inspection
29 Oct 22	Pre/Post Firing Inspection
30 Oct 22	Pre/Post Firing Inspection
3, 6 Nov 22	Pre/Post Firing Inspection
4 Nov 22	EMC/E&RC Inspection
6 Dec 22	Monthly Inspection
17 Jan 23	Monthly Inspection
23 Feb 23	Monthly Inspection
3 Mar 23	Pre/Post Firing Inspection
10 Mar 23	Pre/Post Firing Inspection
22 Mar 23	Inspection/Maintenance: Routine Berm Maintenance
23 Mar 23	Pre/Post Firing Inspection
24 Mar 23	EMC/E&RC Inspection
26 Mar 23	Pre/Post Firing Inspection
30 Mar 23	Pre/Post Firing Inspection
31 Mar 23	Pre/Post Firing Inspection
7 Apr 23	Pre/Post Firing Inspection
28 Apr 23	Pre/Post Firing Inspection
5, 6 May 23	Pre/Post Firing Inspection
19 May 23	Pre/Post Firing Inspection
26 May 23	Pre/Post Firing Inspection
3 Jun 23	Pre/Post Firing Inspection
2 Jun 23	Pre/Post Firing Inspection
5 Jun 23	Pre/Post Firing Inspection
21, 22 Jun 23	Pre/Post Firing Inspection
23, 27 Jun 23	Pre/Post Firing Inspection
26 Jun 23	Pre/Post Firing Inspection
7 Jul 23	Pre/Post Firing Inspection
8 Jul 23	Pre/Post Firing Inspection
20 Jul 23	EMC/E&RC Inspection
4 Aug 23	Pre/Post Firing Inspection
7 Sep 23	EMC/E&RC Backstop Berm Inspection
15 Sep 23	Pre/Post Firing Inspection
22, 23 Sep 23	Pre/Post Firing Inspection
29 Sep 23	Pre/Post Firing Inspection
30 Sep 23	Pre/Post Firing Inspection

OPERATIONS, MAINTENANCE & MONITORING ACTIVITIES
INDIA RANGE
TY 2023

Date	Activity
12 Oct 22	Lysimeter Sampling
14 Oct 22	Soil Sampling
28 Oct 22	Pre/Post Firing Inspection
29 Oct 22	Pre/Post Firing Inspection
30 Oct 22	Pre/Post Firing Inspection
15 Nov 22	Monthly Inspection
6 Dec 22	Monthly Inspection
17 Jan 23	Monthly Inspection
15 Feb 23	Monthly Inspection
31 Mar 23	Pre/Post Firing Inspection
21, 22 Apr 23	Pre/Post Firing Inspection
7 May 23	Pre/Post Firing Inspection
1 Jun 23	Pre/Post Firing Inspection
21, 25 Jun 23	Pre/Post Firing Inspection
20 Jul 23	EMC/E&RC Inspection
7 Sep 23	EMC/E&RC Back Stop Berm Inspection

OPERATIONS, MAINTENANCE & MONITORING ACTIVITIES
ECHO RANGE
TY 2023

Date	Activity
13 Oct 22	Soil Sampling
14 Oct 22	Groundwater Sampling
14 Oct 22	Pre/Post Firing Inspection
21, 22 Oct 22	Pre/Post Firing Inspection
29 Oct 22	Pre/Post Firing Inspection
4, 5 Nov 22	Pre/Post Firing Inspection
4 Nov 22	EMC/E&RC Inspection
6 Nov 22	Pre/Post Firing Inspection
6 Dec 22	Monthly Inspection
17 Jan 23	Monthly Inspection
3, 4 Feb 23	Pre/Post Firing Inspection
23 Feb 23	Monthly Inspection
3 Mar 23	Pre/Post Firing Inspection
23 Mar 23	Maintenance: Routine
24 Mar 23	EMC/E&RC Inspection
31 Mar 23	Pre/Post Firing Inspection
13, 15 Apr 23	Pre/Post Firing Inspection
1 Apr 23	Pre/Post Firing Inspection
21 Apr 23	EMC/E&RC Inspection
22 Apr 23	Pre/Post Firing Inspection
12 May 23	Pre/Post Firing Inspection
19 May 23	Pre/Post Firing Inspection
2 Jun 23	Pre/Post Firing Inspection
3 Jun 23	Pre/Post Firing Inspection
4 Jun 23	Pre/Post Firing Inspection
21 Jun 23	Pre/Post Firing Inspection
20 Jul 23	EMC/E&RC Inspection
4 Aug 23	Pre/Post Firing Inspection
11 Aug 23	Pre/Post Firing Inspection
7 Sep 23	EMC/E&RC Backstop Berm Inspection
15 Sep 23	Pre/Post Firing Inspection
23 Sep 23	Pre/Post Firing Inspection
29 Sep 23	Pre/Post Firing Inspection

OPERATIONS, MAINTENANCE & MONITORING ACTIVITIES
LIMA RANGE
TY 2023

Date	Activity
13 Oct 22	Lysimeter Sampling
14 Oct 22	Soil Sampling
22 Oct 22	Pre/Post Firing Inspection
4 Nov 22	EMC/E&RC Inspection
15 Nov 22	Monthly Inspection
13 Dec 22	Monthly Inspection
10 Jan 23	Monthly Inspection
7 Feb 23	Monthly Inspection
21 Mar 23	Monthly Inspection
11 Apr 23	Monthly Inspection
5 May 23	Pre/Post Firing Inspection
22 Jun 23	Monthly Inspection
19 Jul 23	Monthly Inspection
16 Aug 23	Monthly Inspection
12 Sep 23	Monthly Inspection

Lead Ammunition Use

Echo Range

LEAD AMMUNITION USE HISTORY ECHO RANGE				
Training Year	**.40 Cal Lead**	**12 Gauge Buckshot**	**9 mm Lead**	**Total**
TY 2023	0	30[1]	80,996	81,026
TY 2022	0	0	78,021	78,021
TY 2021	3,476	0	51,438	54,914
TY 2020	0	0	14,308	14,308
TY 2019	0	0	4,350	4,350
TY 2018	0	0	0	0
TY 2017	0	0	0	0
TY 2016	0	0	0	0
TY 2015	0	0	347[2]	347
TY 2008 - TY 2014	0	0	0	0
TY 2007	0	0	100[2]	100
TOTAL	**3,476**	**30**	**229,560**	**233,066**

Notes: Echo Range became operational in Fall 2019.
[1] During TY 2023, 12 Gauge Buckshot was used on Echo Range as part of an approved, non-standard training event.
[2] Firing at Echo Range in TY 2007 and TY 2015 were part of tests for reintroducing lead ammunition.

LEAD AMMUNITION USE HISTORY CUMULATIVE							
Training Year	**Echo Range**	**Sierra Range**	**KD Range**	**Tango Range**	**Juliet[1] Range**	**Kilo[1] Range**	**Total**
TY 2023	81,026	0	0	0	0	0	81,026
TY 2022	78,021	0	0	0	0	0	78,021
TY 2021	54,914	0	0	0	0	0	54,914
TY 2020	14,308	0	0	0	7,690	84,032	106,030
TY 2019	4,350	0	0	0	30,089	81,179	115,618
TY 2018	0	0	0	0	36,583	119,342	155,925
TY 2017	0	0	0	16,495	51,897	115,662	184,054
TY 2016	0	0	0	4,200	61,052	49,638	114,890
TY 2015	347[2]	0	1,993[4]	6,960	65,266	69,973	144,539
TY 2014	0	0	0	3,220	36,937	80,356	120,513
TY 2013	0	0	0	9,950	40,196	73,742	123,888
TY 2012	0	0	0	12,117	31,026	59,912	103,055
TY 2011	0	2,120[3]	0	37,122	63,541	125,154	227,937
TY 2010	0	0	0	90,328	34,371	60,362	185,061
TY 2009	0	0	0	137,362	16,262	29,783	183,407
TY 2008	0	0	0	17,725	0	0	17,725
TY 2007	100[2]	0	0	8,547	0	0	8,647
TOTAL	**233,066**	**2,120**	**1,993**	**344,026**	**474,910**	**949,135**	**2,005,250**

Notes: [1] Juliet and Kilo ranges are currently operationally inactive ranges; their STAPP systems were dismantled in Fall 2020.
[2] Firing at Echo Range in TY 2007 and TY 2015 were part of tests for reintroducing lead ammunition.
[3] Firing at Sierra Range in TY 2011 was part of a Line of Sight Analysis test.
[4] Firing at KD Range in TY 2015 was part of a planning-level noise assessment.

Copper Ammunition Use

Sierra, India, and Tango Ranges

COPPER AMMUNITION USE HISTORY

Training Year	Sierra Range 5.56 Copper	India Range 5.56 Copper	India Range 7.62 Copper	Tango Range[1] 5.56 Copper	ISBC Range 5.56 Copper	Echo Range 5.56 Copper	Total
TY 2023	212,298	26,700	0	80,726	2,620[2]	0	322,344
TY 2022	251,672	41,041	0	56,946	14,098[2]	16,150[3]	379,907
TY 2021	221,756	73,400	0	0	0	19,975[3]	315,131
TY 2020	131,274	90,849	0	0	0	0	222,123
TY 2019	98,426	71,098	0	0	0	0	169,524
TY 2018	98,393	105,143	0	0	0	0	203,536
TY 2017	95,905	105,099	4,793	0	0	0	205,797
TY 2016	80,747	60,571	0	0	0	0	141,318
TY 2015	66,086	12,947	0	0	0	0	79,033
TY 2014	46,804	27,872	0	0	0	0	74,676
TY 2013	34,493	10,918	0	0	0	0	45,411
TY 2012	34,359	6,601	0	0	0	0	40,960
TOTAL	**1372213**	**632,239**	**4,793**	**137,672**	**16,718**	**36,125**	**2,199,760**

Note: [1]Tango Range became operationally active for copper ammunition in TY 2022.

[2]Copper ammunition was used on the operationally inactive ISBC Range for two approved, non-standard training events during TY 2022 and an approved, non-standard training event in TY 2023.

[3]Copper ammunition was used on Echo Range during two non-standard training events in TY 2021 and two approved, non-standard training events in TY 2022.

Small Arms Range Sampling Reports

Soil Sampling Results

Fall 2023

Sample	Method	Analysis Date	Sample ID	Chemical Name	Result	Qualifier	MDL	RDL	QL	Units	DL Units
SSERNG001_Oct23-10022023	SW6010D	10/27/2023 0:02	280-182584-9	Antimony	1.4	U	0.71	1.4	1.9	mg/kg	mg/kg
SSERNG001_Oct23-10022023	SW6010D	10/27/2023 0:02	280-182584-9	Calcium	530		14	48	97	mg/kg	mg/kg
SSERNG001_Oct23-10022023	SW9056A	10/25/2023 1:58	280-182584-9	Chloride	30	U	12	30	30	mg/kg	mg/kg
SSERNG001_Oct23-10022023	SW6010D	10/27/2023 0:02	280-182584-9	Copper	3.9	J	0.21	0.77	4.8	mg/kg	mg/kg
SSERNG001_Oct23-10022023	SW6010D	10/27/2023 0:02	280-182584-9	Iron	8300		8	19	77	mg/kg	mg/kg
SSERNG001_Oct23-10022023	SW6010D	10/27/2023 0:02	280-182584-9	Lead	13		0.3	0.77	0.87	mg/kg	mg/kg
SSERNG001_Oct23-10022023	SW6010D	10/27/2023 0:02	280-182584-9	Magnesium	680		7.6	19	29	mg/kg	mg/kg
SSERNG001_Oct23-10022023	SW9045D	10/16/2023 11:14	280-182584-9	pH adj. to 25 deg C	6	HF	0.1	0.1	0.1	pH units	pH units
SSERNG001_Oct23-10022023	SW6010D	10/27/2023 0:02	280-182584-9	Phosphorus	260		1.6	5.8	48	mg/kg	mg/kg
SSERNG001_Oct23-10022023	SW6010D	10/27/2023 0:02	280-182584-9	Potassium	590		40	150	290	mg/kg	mg/kg
SSERNG001_Oct23-10022023	SW6010D	10/27/2023 0:02	280-182584-9	Sodium	84	J	28	97	480	mg/kg	mg/kg
SSERNG001_Oct23-10022023	SW9056A	10/27/2023 13:11	280-182584-9	Sulfate	12	J	9.2	25	50	mg/kg	mg/kg
SSERNG001_Oct23-10022023	SW9045D	10/16/2023 11:14	280-182584-9	Temperature	19.2	HF	1	1	1	deg C	deg C
SSERNG001_RP1_Oct23-10022023	SW6010D	10/27/2023 0:30	280-182584-15	Antimony	1.2	U	0.57	1.2	1.6	mg/kg	mg/kg
SSERNG001_RP1_Oct23-10022023	SW6010D	10/27/2023 0:30	280-182584-15	Calcium	350		11	39	78	mg/kg	mg/kg
SSERNG001_RP1_Oct23-10022023	SW9056A	10/25/2023 5:57	280-182584-15	Chloride	12	J	12	30	30	mg/kg	mg/kg
SSERNG001_RP1_Oct23-10022023	SW6010D	10/27/2023 0:30	280-182584-15	Copper	6.2		0.17	0.62	3.9	mg/kg	mg/kg
SSERNG001_RP1_Oct23-10022023	SW6010D	10/27/2023 0:30	280-182584-15	Iron	9800		6.4	16	62	mg/kg	mg/kg
SSERNG001_RP1_Oct23-10022023	SW6010D	10/27/2023 0:30	280-182584-15	Lead	13		0.24	0.62	0.7	mg/kg	mg/kg
SSERNG001_RP1_Oct23-10022023	SW6010D	10/27/2023 0:30	280-182584-15	Magnesium	670		6.2	16	23	mg/kg	mg/kg
SSERNG001_RP1_Oct23-10022023	SW9045D	10/16/2023 11:14	280-182584-15	pH adj. to 25 deg C	5.9	HF	0.1	0.1	0.1	pH units	pH units
SSERNG001_RP1_Oct23-10022023	SW6010D	10/27/2023 0:30	280-182584-15	Phosphorus	270		1.3	4.7	39	mg/kg	mg/kg
SSERNG001_RP1_Oct23-10022023	SW6010D	10/27/2023 0:30	280-182584-15	Potassium	600		32	120	230	mg/kg	mg/kg
SSERNG001_RP1_Oct23-10022023	SW6010D	10/27/2023 0:30	280-182584-15	Sodium	78	J	22	78	390	mg/kg	mg/kg
SSERNG001_RP1_Oct23-10022023	SW9056A	10/27/2023 15:15	280-182584-15	Sulfate	13	JM	9.2	25	50	mg/kg	mg/kg
SSERNG001_RP1_Oct23-10022023	SW9045D	10/16/2023 11:14	280-182584-15	Temperature	19.6	HF	1	1	1	deg C	deg C
SSERNG001_RP2_Oct23-10022023	SW6010D	10/27/2023 0:35	280-182584-16	Antimony	1.1	U	0.55	1.1	1.5	mg/kg	mg/kg
SSERNG001_RP2_Oct23-10022023	SW6010D	10/27/2023 0:35	280-182584-16	Calcium	540		11	38	75	mg/kg	mg/kg
SSERNG001_RP2_Oct23-10022023	SW9056A	10/25/2023 6:14	280-182584-16	Chloride	14	J	11	30	30	mg/kg	mg/kg
SSERNG001_RP2_Oct23-10022023	SW6010D	10/27/2023 0:35	280-182584-16	Copper	8.4		0.16	0.6	3.8	mg/kg	mg/kg
SSERNG001_RP2_Oct23-10022023	SW6010D	10/27/2023 0:35	280-182584-16	Iron	8300		6.2	15	60	mg/kg	mg/kg
SSERNG001_RP2_Oct23-10022023	SW6010D	10/27/2023 0:35	280-182584-16	Lead	13		0.23	0.6	0.68	mg/kg	mg/kg
SSERNG001_RP2_Oct23-10022023	SW6010D	10/27/2023 0:35	280-182584-16	Magnesium	670		5.9	15	23	mg/kg	mg/kg
SSERNG001_RP2_Oct23-10022023	SW9045D	10/16/2023 11:16	280-182584-16	pH adj. to 25 deg C	6.1	HF	0.1	0.1	0.1	pH units	pH units
SSERNG001_RP2_Oct23-10022023	SW6010D	10/27/2023 0:35	280-182584-16	Phosphorus	270		1.2	4.5	38	mg/kg	mg/kg
SSERNG001_RP2_Oct23-10022023	SW6010D	10/27/2023 0:35	280-182584-16	Potassium	580		31	120	230	mg/kg	mg/kg
SSERNG001_RP2_Oct23-10022023	SW6010D	10/27/2023 0:35	280-182584-16	Sodium	74	J	22	75	380	mg/kg	mg/kg

Sample	Method	Analysis Date	Sample ID	Chemical Name	Result	Qualifier	MDL	RDL	QL	Units	DL Units
SSERNG001_RP2_Oct23-10022023	SW9056A	10/27/2023 15:27	280-182584-16	Sulfate	11	J	9.1	25	50	mg/kg	mg/kg
SSERNG001_RP2_Oct23-10022023	SW9045D	10/16/2023 11:16	280-182584-16	Temperature	20.6	HF	1	1	1	deg C	deg C
SSERNG002_Oct23-10022023	SW6010D	10/27/2023 0:07	280-182584-10	Antimony	1.3	U	0.62	1.3	1.7	mg/kg	mg/kg
SSERNG002_Oct23-10022023	SW6010D	10/27/2023 0:07	280-182584-10	Calcium	530		12	42	84	mg/kg	mg/kg
SSERNG002_Oct23-10022023	SW9056A	10/25/2023 2:15	280-182584-10	Chloride	12	J	11	30	30	mg/kg	mg/kg
SSERNG002_Oct23-10022023	SW6010D	10/27/2023 0:07	280-182584-10	Copper	4.3		0.18	0.67	4.2	mg/kg	mg/kg
SSERNG002_Oct23-10022023	SW6010D	10/27/2023 0:07	280-182584-10	Iron	8200		7	17	67	mg/kg	mg/kg
SSERNG002_Oct23-10022023	SW6010D	10/27/2023 0:07	280-182584-10	Lead	12		0.26	0.67	0.76	mg/kg	mg/kg
SSERNG002_Oct23-10022023	SW6010D	10/27/2023 0:07	280-182584-10	Magnesium	650		6.7	17	25	mg/kg	mg/kg
SSERNG002_Oct23-10022023	SW9045D	10/16/2023 11:14	280-182584-10	pH adj. to 25 deg C	6	HF	0.1	0.1	0.1	pH units	pH units
SSERNG002_Oct23-10022023	SW6010D	10/27/2023 0:07	280-182584-10	Phosphorus	270		1.4	5.1	42	mg/kg	mg/kg
SSERNG002_Oct23-10022023	SW6010D	10/27/2023 0:07	280-182584-10	Potassium	600		35	130	250	mg/kg	mg/kg
SSERNG002_Oct23-10022023	SW6010D	10/27/2023 0:07	280-182584-10	Sodium	82	J	24	84	420	mg/kg	mg/kg
SSERNG002_Oct23-10022023	SW9056A	10/27/2023 13:22	280-182584-10	Sulfate	11	JM	9.1	25	50	mg/kg	mg/kg
SSERNG002_Oct23-10022023	SW9045D	10/16/2023 11:14	280-182584-10	Temperature	20.4	HF	1	1	1	deg C	deg C
SSERNG003_Oct23-10022023	SW6010D	10/27/2023 0:12	280-182584-11	Antimony	1.5	U	0.72	1.5	2	mg/kg	mg/kg
SSERNG003_Oct23-10022023	SW6010D	10/27/2023 0:12	280-182584-11	Calcium	540		14	49	98	mg/kg	mg/kg
SSERNG003_Oct23-10022023	SW9056A	10/25/2023 2:32	280-182584-11	Chloride	30	U	11	30	30	mg/kg	mg/kg
SSERNG003_Oct23-10022023	SW6010D	10/27/2023 0:12	280-182584-11	Copper	4.6	J	0.21	0.78	4.9	mg/kg	mg/kg
SSERNG003_Oct23-10022023	SW6010D	10/27/2023 0:12	280-182584-11	Iron	8200		8.1	20	78	mg/kg	mg/kg
SSERNG003_Oct23-10022023	SW6010D	10/27/2023 0:12	280-182584-11	Lead	12		0.3	0.78	0.88	mg/kg	mg/kg
SSERNG003_Oct23-10022023	SW6010D	10/27/2023 0:12	280-182584-11	Magnesium	710		7.8	20	29	mg/kg	mg/kg
SSERNG003_Oct23-10022023	SW9045D	10/16/2023 11:14	280-182584-11	pH adj. to 25 deg C	6.1	HF	0.1	0.1	0.1	pH units	pH units
SSERNG003_Oct23-10022023	SW6010D	10/27/2023 0:12	280-182584-11	Phosphorus	280		1.6	5.9	49	mg/kg	mg/kg
SSERNG003_Oct23-10022023	SW6010D	10/27/2023 0:12	280-182584-11	Potassium	620		40	160	290	mg/kg	mg/kg
SSERNG003_Oct23-10022023	SW6010D	10/27/2023 0:12	280-182584-11	Sodium	84	J	28	98	490	mg/kg	mg/kg
SSERNG003_Oct23-10022023	SW9056A	10/27/2023 13:34	280-182584-11	Sulfate	11	J	9.1	25	50	mg/kg	mg/kg
SSERNG003_Oct23-10022023	SW9045D	10/16/2023 11:14	280-182584-11	Temperature	19.5	HF	1	1	1	deg C	deg C
SSERNG004_Oct23-10022023	SW6010D	10/27/2023 0:16	280-182584-12	Antimony	1.5	U	0.71	1.5	1.9	mg/kg	mg/kg
SSERNG004_Oct23-10022023	SW6010D	10/27/2023 0:16	280-182584-12	Calcium	460		14	49	97	mg/kg	mg/kg
SSERNG004_Oct23-10022023	SW9056A	10/25/2023 2:49	280-182584-12	Chloride	30	U	11	30	30	mg/kg	mg/kg
SSERNG004_Oct23-10022023	SW6010D	10/27/2023 0:16	280-182584-12	Copper	5.1		0.21	0.78	4.9	mg/kg	mg/kg
SSERNG004_Oct23-10022023	SW6010D	10/27/2023 0:16	280-182584-12	Iron	10000		8	19	78	mg/kg	mg/kg
SSERNG004_Oct23-10022023	SW6010D	10/27/2023 0:16	280-182584-12	Lead	16		0.3	0.78	0.87	mg/kg	mg/kg
SSERNG004_Oct23-10022023	SW6010D	10/27/2023 0:16	280-182584-12	Magnesium	730		7.7	19	29	mg/kg	mg/kg
SSERNG004_Oct23-10022023	SW9045D	10/16/2023 11:14	280-182584-12	pH adj. to 25 deg C	6.1	HF	0.1	0.1	0.1	pH units	pH units
SSERNG004_Oct23-10022023	SW6010D	10/27/2023 0:16	280-182584-12	Phosphorus	230		1.6	5.8	49	mg/kg	mg/kg

Sample	Method	Analysis Date	Sample ID	Chemical Name	Result	Qualifier	MDL	RDL	QL	Units	DL Units
SSERNG004_Oct23-10022023	SW6010D	10/27/2023 0:16	280-182584-12	Potassium	630		40	160	290	mg/kg	mg/kg
SSERNG004_Oct23-10022023	SW6010D	10/27/2023 0:16	280-182584-12	Sodium	88	J	28	97	490	mg/kg	mg/kg
SSERNG004_Oct23-10022023	SW9056A	10/27/2023 13:45	280-182584-12	Sulfate	11	J	9.1	25	50	mg/kg	mg/kg
SSERNG004_Oct23-10022023	SW9045D	10/16/2023 11:14	280-182584-12	Temperature	20.8	HF	1	1	1	deg C	deg C
SSERNG005_Oct23-10022023	SW6010D	10/27/2023 0:21	280-182584-13	Antimony	1.1	U	0.54	1.1	1.5	mg/kg	mg/kg
SSERNG005_Oct23-10022023	SW6010D	10/27/2023 0:21	280-182584-13	Calcium	560		10	37	74	mg/kg	mg/kg
SSERNG005_Oct23-10022023	SW9056A	10/25/2023 3:06	280-182584-13	Chloride	12	J	11	30	30	mg/kg	mg/kg
SSERNG005_Oct23-10022023	SW6010D	10/27/2023 0:21	280-182584-13	Copper	4.5		0.16	0.59	3.7	mg/kg	mg/kg
SSERNG005_Oct23-10022023	SW6010D	10/27/2023 0:21	280-182584-13	Iron	8200		6.1	15	59	mg/kg	mg/kg
SSERNG005_Oct23-10022023	SW6010D	10/27/2023 0:21	280-182584-13	Lead	14		0.23	0.59	0.67	mg/kg	mg/kg
SSERNG005_Oct23-10022023	SW6010D	10/27/2023 0:21	280-182584-13	Magnesium	700		5.9	15	22	mg/kg	mg/kg
SSERNG005_Oct23-10022023	SW9045D	10/16/2023 11:14	280-182584-13	pH adj. to 25 deg C	6.1	HF	0.1	0.1	0.1	pH units	pH units
SSERNG005_Oct23-10022023	SW6010D	10/27/2023 0:21	280-182584-13	Phosphorus	280		1.2	4.5	37	mg/kg	mg/kg
SSERNG005_Oct23-10022023	SW6010D	10/27/2023 0:21	280-182584-13	Potassium	610		30	120	220	mg/kg	mg/kg
SSERNG005_Oct23-10022023	SW6010D	10/27/2023 0:21	280-182584-13	Sodium	75	J	21	74	370	mg/kg	mg/kg
SSERNG005_Oct23-10022023	SW9056A	10/27/2023 13:56	280-182584-13	Sulfate	9.5	J	9.1	25	50	mg/kg	mg/kg
SSERNG005_Oct23-10022023	SW9045D	10/16/2023 11:14	280-182584-13	Temperature	20.2	HF	1	1	1	deg C	deg C
SSERNG006_Oct23-10022023	SW6010D	10/27/2023 0:26	280-182584-14	Antimony	1.3	U	0.62	1.3	1.7	mg/kg	mg/kg
SSERNG006_Oct23-10022023	SW6010D	10/27/2023 0:26	280-182584-14	Calcium	520		12	42	84	mg/kg	mg/kg
SSERNG006_Oct23-10022023	SW9056A	10/25/2023 4:15	280-182584-14	Chloride	30	U	12	30	30	mg/kg	mg/kg
SSERNG006_Oct23-10022023	SW6010D	10/27/2023 0:26	280-182584-14	Copper	11		0.18	0.67	4.2	mg/kg	mg/kg
SSERNG006_Oct23-10022023	SW6010D	10/27/2023 0:26	280-182584-14	Iron	8600		7	17	67	mg/kg	mg/kg
SSERNG006_Oct23-10022023	SW6010D	10/27/2023 0:26	280-182584-14	Lead	28		0.26	0.67	0.76	mg/kg	mg/kg
SSERNG006_Oct23-10022023	SW6010D	10/27/2023 0:26	280-182584-14	Magnesium	730		6.7	17	25	mg/kg	mg/kg
SSERNG006_Oct23-10022023	SW9045D	10/16/2023 11:14	280-182584-14	pH adj. to 25 deg C	5.9	HF	0.1	0.1	0.1	pH units	pH units
SSERNG006_Oct23-10022023	SW6010D	10/27/2023 0:26	280-182584-14	Phosphorus	250		1.4	5.1	42	mg/kg	mg/kg
SSERNG006_Oct23-10022023	SW6010D	10/27/2023 0:26	280-182584-14	Potassium	590		35	130	250	mg/kg	mg/kg
SSERNG006_Oct23-10022023	SW6010D	10/27/2023 0:26	280-182584-14	Sodium	83	J	24	84	420	mg/kg	mg/kg
SSERNG006_Oct23-10022023	SW9056A	10/27/2023 14:08	280-182584-14	Sulfate	9.2	JM	9.2	25	50	mg/kg	mg/kg
SSERNG006_Oct23-10022023	SW9045D	10/16/2023 11:14	280-182584-14	Temperature	19.6	HF	1	1	1	deg C	deg C
SSIRNG001_Oct23-10032023	SW6010D	10/26/2023 23:58	280-182584-8	Antimony	1.2	U	0.58	1.2	1.6	mg/kg	mg/kg
SSIRNG001_Oct23-10032023	SW6010D	10/26/2023 23:58	280-182584-8	Calcium	920		11	40	80	mg/kg	mg/kg
SSIRNG001_Oct23-10032023	SW9056A	10/25/2023 1:41	280-182584-8	Chloride	14	J	12	30	30	mg/kg	mg/kg
SSIRNG001_Oct23-10032023	SW6010D	10/26/2023 23:58	280-182584-8	Copper	35		0.17	0.64	4	mg/kg	mg/kg
SSIRNG001_Oct23-10032023	SW6010D	10/26/2023 23:58	280-182584-8	Iron	10000		6.6	16	64	mg/kg	mg/kg
SSIRNG001_Oct23-10032023	SW6010D	10/26/2023 23:58	280-182584-8	Lead	67		0.25	0.64	0.72	mg/kg	mg/kg
SSIRNG001_Oct23-10032023	SW6010D	10/26/2023 23:58	280-182584-8	Magnesium	990		6.3	16	24	mg/kg	mg/kg

Sample	Method	Analysis Date	Sample ID	Chemical Name	Result	Qualifier	MDL	RDL	QL	Units	DL Units
SSIRNG001_Oct23-10032023	SW9045D	10/16/2023 11:14	280-182584-8	pH adj. to 25 deg C	6.2	HF	0.1	0.1	0.1	pH units	pH units
SSIRNG001_Oct23-10032023	SW6010D	10/26/2023 23:58	280-182584-8	Phosphorus	480		1.3	4.8	40	mg/kg	mg/kg
SSIRNG001_Oct23-10032023	SW6010D	10/26/2023 23:58	280-182584-8	Potassium	810		33	130	240	mg/kg	mg/kg
SSIRNG001_Oct23-10032023	SW6010D	10/26/2023 23:58	280-182584-8	Sodium	86	J	23	80	400	mg/kg	mg/kg
SSIRNG001_Oct23-10032023	SW9056A	10/27/2023 13:00	280-182584-8	Sulfate	9.6	J	9.2	25	50	mg/kg	mg/kg
SSIRNG001_Oct23-10032023	SW9045D	10/16/2023 11:14	280-182584-8	Temperature	20.6	HH	1	1	1	deg C	deg C
SSLRNG001_Oct23-10032023	SW6010D	10/26/2023 23:35	280-182584-7	Antimony	1.2	U	0.59	1.2	1.6	mg/kg	mg/kg
SSLRNG001_Oct23-10032023	SW6010D	10/26/2023 23:35	280-182584-7	Calcium	410		11	40	81	mg/kg	mg/kg
SSLRNG001_Oct23-10032023	SW9056A	10/25/2023 0:50	280-182584-7	Chloride	17	J	12	30	30	mg/kg	mg/kg
SSLRNG001_Oct23-10032023	SW6010D	10/26/2023 23:35	280-182584-7	Copper	8.3		0.17	0.64	4	mg/kg	mg/kg
SSLRNG001_Oct23-10032023	SW6010D	10/26/2023 23:35	280-182584-7	Iron	13000		6.7	16	64	mg/kg	mg/kg
SSLRNG001_Oct23-10032023	SW6010D	10/26/2023 23:35	280-182584-7	Lead	17		0.25	0.64	0.73	mg/kg	mg/kg
SSLRNG001_Oct23-10032023	SW6010D	10/26/2023 23:35	280-182584-7	Magnesium	1300		6.4	16	24	mg/kg	mg/kg
SSLRNG001_Oct23-10032023	SW9045D	10/16/2023 11:14	280-182584-7	pH adj. to 25 deg C	6.2	HF	0.1	0.1	0.1	pH units	pH units
SSLRNG001_Oct23-10032023	SW6010D	10/26/2023 23:35	280-182584-7	Phosphorus	190		1.3	4.8	40	mg/kg	mg/kg
SSLRNG001_Oct23-10032023	SW6010D	10/26/2023 23:35	280-182584-7	Potassium	930		33	130	240	mg/kg	mg/kg
SSLRNG001_Oct23-10032023	SW6010D	10/26/2023 23:35	280-182584-7	Sodium	94	J	23	81	400	mg/kg	mg/kg
SSLRNG001_Oct23-10032023	SW9056A	10/27/2023 12:26	280-182584-7	Sulfate	18	JM	9.2	25	50	mg/kg	mg/kg
SSLRNG001_Oct23-10032023	SW9045D	10/16/2023 11:14	280-182584-7	Temperature	19.3	HH	1	1	1	deg C	deg C
SSSRNG001_Oct23-10032023	SW6010D	10/26/2023 23:17	280-182584-1	Antimony	2.5		0.54	1.1	1.5	mg/kg	mg/kg
SSSRNG001_Oct23-10032023	SW6010D	10/26/2023 23:17	280-182584-1	Calcium	890		10	37	74	mg/kg	mg/kg
SSSRNG001_Oct23-10032023	SW9056A	10/24/2023 23:08	280-182584-1	Chloride	17	J	11	30	30	mg/kg	mg/kg
SSSRNG001_Oct23-10032023	SW6010D	10/26/2023 23:17	280-182584-1	Copper	38		0.16	0.59	3.7	mg/kg	mg/kg
SSSRNG001_Oct23-10032023	SW6010D	10/26/2023 23:17	280-182584-1	Iron	8300		6.1	15	59	mg/kg	mg/kg
SSSRNG001_Oct23-10032023	SW6010D	10/26/2023 23:17	280-182584-1	Lead	19		0.23	0.59	0.66	mg/kg	mg/kg
SSSRNG001_Oct23-10032023	SW6010D	10/26/2023 23:17	280-182584-1	Magnesium	950		5.8	15	22	mg/kg	mg/kg
SSSRNG001_Oct23-10032023	SW9045D	10/16/2023 11:14	280-182584-1	pH adj. to 25 deg C	7.3	HF	0.1	0.1	0.1	pH units	pH units
SSSRNG001_Oct23-10032023	SW6010D	10/26/2023 23:17	280-182584-1	Phosphorus	290		1.2	4.4	37	mg/kg	mg/kg
SSSRNG001_Oct23-10032023	SW6010D	10/26/2023 23:17	280-182584-1	Potassium	680		30	120	220	mg/kg	mg/kg
SSSRNG001_Oct23-10032023	SW6010D	10/26/2023 23:17	280-182584-1	Sodium	70	J	21	74	370	mg/kg	mg/kg
SSSRNG001_Oct23-10032023	SW9056A	10/27/2023 11:18	280-182584-1	Sulfate	11	JM	9.1	25	50	mg/kg	mg/kg
SSSRNG001_Oct23-10032023	SW9045D	10/16/2023 11:14	280-182584-1	Temperature	21.1	HH	1	1	1	deg C	deg C
SSSRNG002_OCT23-10102023	SW6010D	11/1/2023 20:59	280-183152-4	Antimony	1.2	U	0.58	1.2	1.6	mg/kg	mg/kg
SSSRNG002_OCT23-10102023	SW6010D	11/1/2023 20:59	280-183152-4	Calcium	590	J1	11	39	78	mg/kg	mg/kg
SSSRNG002_OCT23-10102023	SW9056A	11/16/2023 13:10	280-183152-4	Chloride	14	JH	11	30	30	mg/kg	mg/kg
SSSRNG002_OCT23-10102023	SW6010D	11/1/2023 20:59	280-183152-4	Copper	45	J1	0.17	0.63	3.9	mg/kg	mg/kg
SSSRNG002_OCT23-10102023	SW6010D	11/1/2023 20:59	280-183152-4	Iron	11000	J1	6.5	16	63	mg/kg	mg/kg

Sample	Method	Analysis Date	Sample ID	Chemical Name	Result	Qualifier	MDL	RDL	QL	Units	DL Units
SSSRNG002_OCT23-10102023	SW6010D	11/1/2023 20:59	280-183152-4	Lead	9.6		0.24	0.63	0.71	mg/kg	mg/kg
SSSRNG002_OCT23-10102023	SW6010D	11/1/2023 20:59	280-183152-4	Magnesium	960	J1	6.2	16	24	mg/kg	mg/kg
SSSRNG002_OCT23-10102023	SW9045D	10/26/2023 16:05	280-183152-4	pH adj. to 25 deg C	5.9	HF	0.1	0.1	0.1	pH units	pH units
SSSRNG002_OCT23-10102023	SW6010D	11/9/2023 12:19	280-183152-4	Phosphorus	240	J1	1.2	4.4	37	mg/kg	mg/kg
SSSRNG002_OCT23-10102023	SW6010D	11/9/2023 12:19	280-183152-4	Potassium	800		30	120	220	mg/kg	mg/kg
SSSRNG002_OCT23-10102023	SW6010D	11/1/2023 20:59	280-183152-4	Sodium	61	J	23	78	390	mg/kg	mg/kg
SSSRNG002_OCT23-10102023	SW9056A	11/16/2023 13:10	280-183152-4	Sulfate	14	JH	9.1	25	50	mg/kg	mg/kg
SSSRNG002_OCT23-10102023	SW9045D	10/26/2023 16:05	280-183152-4	Temperature	22	HF	1	1	1	deg C	deg C
SSSRNG003_OCT23-10102023	SW6010D	11/1/2023 21:36	280-183152-5	Antimony	1.2	U	0.59	1.2	1.6	mg/kg	mg/kg
SSSRNG003_OCT23-10102023	SW6010D	11/1/2023 21:36	280-183152-5	Calcium	790		11	40	80	mg/kg	mg/kg
SSSRNG003_OCT23-10102023	SW9056A	11/16/2023 13:27	280-183152-5	Chloride	30	UH	12	30	30	mg/kg	mg/kg
SSSRNG003_OCT23-10102023	SW6010D	11/1/2023 21:36	280-183152-5	Copper	90		0.17	0.64	4	mg/kg	mg/kg
SSSRNG003_OCT23-10102023	SW6010D	11/1/2023 21:36	280-183152-5	Iron	9500		6.6	16	64	mg/kg	mg/kg
SSSRNG003_OCT23-10102023	SW6010D	11/1/2023 21:36	280-183152-5	Lead	21		0.25	0.64	0.72	mg/kg	mg/kg
SSSRNG003_OCT23-10102023	SW6010D	11/1/2023 21:36	280-183152-5	Magnesium	830		6.4	16	24	mg/kg	mg/kg
SSSRNG003_OCT23-10102023	SW9045D	10/26/2023 16:05	280-183152-5	pH adj. to 25 deg C	6.5	HF	0.1	0.1	0.1	pH units	pH units
SSSRNG003_OCT23-10102023	SW6010D	11/9/2023 12:54	280-183152-5	Phosphorus	270		1.4	5.3	44	mg/kg	mg/kg
SSSRNG003_OCT23-10102023	SW6010D	11/9/2023 12:54	280-183152-5	Potassium	730		36	140	260	mg/kg	mg/kg
SSSRNG003_OCT23-10102023	SW6010D	11/1/2023 21:36	280-183152-5	Sodium	64	J	23	80	400	mg/kg	mg/kg
SSSRNG003_OCT23-10102023	SW9056A	11/16/2023 13:27	280-183152-5	Sulfate	25	UH	9.2	25	50	mg/kg	mg/kg
SSSRNG003_OCT23-10102023	SW9045D	10/26/2023 16:05	280-183152-5	Temperature	21.8	HF	1	1	1	deg C	deg C
SSSRNG004_OCT23-10102023	SW6010D	11/1/2023 21:45	280-183152-6	Antimony	1.2	U	0.57	1.2	1.6	mg/kg	mg/kg
SSSRNG004_OCT23-10102023	SW6010D	11/1/2023 21:45	280-183152-6	Calcium	1000		11	39	78	mg/kg	mg/kg
SSSRNG004_OCT23-10102023	SW9056A	11/16/2023 12:53	280-183152-6	Chloride	11	JH	11	30	30	mg/kg	mg/kg
SSSRNG004_OCT23-10102023	SW6010D	11/1/2023 21:45	280-183152-6	Copper	7.9		0.17	0.63	3.9	mg/kg	mg/kg
SSSRNG004_OCT23-10102023	SW6010D	11/1/2023 21:45	280-183152-6	Iron	12000		6.5	16	63	mg/kg	mg/kg
SSSRNG004_OCT23-10102023	SW6010D	11/1/2023 21:45	280-183152-6	Lead	33		0.24	0.63	0.7	mg/kg	mg/kg
SSSRNG004_OCT23-10102023	SW6010D	11/1/2023 21:45	280-183152-6	Magnesium	1100		6.2	16	23	mg/kg	mg/kg
SSSRNG004_OCT23-10102023	SW9045D	10/26/2023 16:05	280-183152-6	pH adj. to 25 deg C	6.3	HF	0.1	0.1	0.1	pH units	pH units
SSSRNG004_OCT23-10102023	SW6010D	11/9/2023 13:02	280-183152-6	Phosphorus	250		1.3	4.7	40	mg/kg	mg/kg
SSSRNG004_OCT23-10102023	SW6010D	11/9/2023 13:02	280-183152-6	Potassium	820		32	130	240	mg/kg	mg/kg
SSSRNG004_OCT23-10102023	SW6010D	11/1/2023 21:45	280-183152-6	Sodium	79	J	23	78	390	mg/kg	mg/kg
SSSRNG004_OCT23-10102023	SW9056A	11/16/2023 12:53	280-183152-6	Sulfate	25	UH	9.1	25	50	mg/kg	mg/kg
SSSRNG004_OCT23-10102023	SW9045D	10/26/2023 16:05	280-183152-6	Temperature	21.7	HF	1	1	1	deg C	deg C
SSTRNG001_Oct23-10032023	SW6010D	10/26/2023 23:26	280-182584-5	Antimony	0.68	J	0.5	1	1.4	mg/kg	mg/kg
SSTRNG001_Oct23-10032023	SW6010D	10/26/2023 23:26	280-182584-5	Calcium	1200		9.5	34	68	mg/kg	mg/kg
SSTRNG001_Oct23-10032023	SW9056A	10/25/2023 0:16	280-182584-5	Chloride	16	J	12	30	30	mg/kg	mg/kg

Sample	Method	Analysis Date	Sample ID	Chemical Name	Result	Qualifier	MDL	RDL	QL	Units	DL Units
SSTRNG001_Oct23-10032023	SW6010D	10/26/2023 23:26	280-182584-5	Copper	11		0.15	0.54	3.4	mg/kg	mg/kg
SSTRNG001_Oct23-10032023	SW6010D	10/26/2023 23:26	280-182584-5	Iron	13000		5.6	14	54	mg/kg	mg/kg
SSTRNG001_Oct23-10032023	SW6010D	10/26/2023 23:26	280-182584-5	Lead	26		0.21	0.54	0.61	mg/kg	mg/kg
SSTRNG001_Oct23-10032023	SW6010D	10/26/2023 23:26	280-182584-5	Magnesium	1500		5.4	14	20	mg/kg	mg/kg
SSTRNG001_Oct23-10032023	SW9045D	10/16/2023 11:14	280-182584-5	pH adj. to 25 deg C	6.5	HF	0.1	0.1	0.1	pH units	pH units
SSTRNG001_Oct23-10032023	SW6010D	10/26/2023 23:26	280-182584-5	Phosphorus	400		1.1	4.1	34	mg/kg	mg/kg
SSTRNG001_Oct23-10032023	SW6010D	10/26/2023 23:26	280-182584-5	Potassium	1100		28	110	200	mg/kg	mg/kg
SSTRNG001_Oct23-10032023	SW6010D	10/26/2023 23:26	280-182584-5	Sodium	88	J	70	68	340	mg/kg	mg/kg
SSTRNG001_Oct23-10032023	SW9056A	10/27/2023 12:03	280-182584-5	Sulfate	19	JM	9.2	25	50	mg/kg	mg/kg
SSTRNG001_Oct23-10032023	SW9045D	10/16/2023 11:14	280-182584-5	Temperature	19.5	HF	1	1	1	deg C	deg C
SSTRNG001_RP1_Oct23-10032023	SW6010D	10/27/2023 0:40	280-182584-17	Antimony	0.77	J	0.6	1.2	1.6	mg/kg	mg/kg
SSTRNG001_RP1_Oct23-10032023	SW6010D	10/27/2023 0:40	280-182584-17	Calcium	1300		12	41	82	mg/kg	mg/kg
SSTRNG001_RP1_Oct23-10032023	SW9056A	10/25/2023 6:31	280-182584-17	Chloride	17	J	12	30	30	mg/kg	mg/kg
SSTRNG001_RP1_Oct23-10032023	SW6010D	10/27/2023 0:40	280-182584-17	Copper	11		0.18	0.65	4.1	mg/kg	mg/kg
SSTRNG001_RP1_Oct23-10032023	SW6010D	10/27/2023 0:40	280-182584-17	Iron	13000		6.8	16	65	mg/kg	mg/kg
SSTRNG001_RP1_Oct23-10032023	SW6010D	10/27/2023 0:40	280-182584-17	Lead	26		0.25	0.65	0.74	mg/kg	mg/kg
SSTRNG001_RP1_Oct23-10032023	SW6010D	10/27/2023 0:40	280-182584-17	Magnesium	1600		6.5	16	25	mg/kg	mg/kg
SSTRNG001_RP1_Oct23-10032023	SW9045D	10/16/2023 11:16	280-182584-17	pH adj. to 25 deg C	6.2	HF	0.1	0.1	0.1	pH units	pH units
SSTRNG001_RP1_Oct23-10032023	SW6010D	10/27/2023 0:40	280-182584-17	Phosphorus	410		1.3	4.9	41	mg/kg	mg/kg
SSTRNG001_RP1_Oct23-10032023	SW6010D	10/27/2023 0:40	280-182584-17	Potassium	1200		33	130	250	mg/kg	mg/kg
SSTRNG001_RP1_Oct23-10032023	SW6010D	10/27/2023 0:40	280-182584-17	Sodium	83	J	24	82	410	mg/kg	mg/kg
SSTRNG001_RP1_Oct23-10032023	SW9056A	10/27/2023 15:38	280-182584-17	Sulfate	19	JM	9.2	25	50	mg/kg	mg/kg
SSTRNG001_RP1_Oct23-10032023	SW9045D	10/16/2023 11:16	280-182584-17	Temperature	17.8	HF	1	1	1	deg C	deg C
SSTRNG001_RP2_Oct23-10032023	SW6010D	10/27/2023 1:02	280-182584-18	Antimony	0.83	J	0.61	1.3	1.7	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023	SW6010D	10/27/2023 1:02	280-182584-18	Calcium	1200		12	42	83	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023	SW9056A	10/25/2023 6:48	280-182584-18	Chloride	17	J	11	30	30	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023	SW6010D	10/27/2023 1:02	280-182584-18	Copper	11		0.18	0.67	4.2	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023	SW6010D	10/27/2023 1:02	280-182584-18	Iron	14000	J1	6.9	17	67	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023	SW6010D	10/27/2023 1:02	280-182584-18	Lead	27		0.26	0.67	0.75	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023	SW6010D	10/27/2023 1:02	280-182584-18	Magnesium	1500		6.6	17	25	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023	SW9045D	10/16/2023 11:16	280-182584-18	pH adj. to 25 deg C	6.5	HF	0.1	0.1	0.1	pH units	pH units
SSTRNG001_RP2_Oct23-10032023	SW6010D	10/27/2023 1:02	280-182584-18	Phosphorus	400		1.4	5	42	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023	SW6010D	10/27/2023 1:02	280-182584-18	Potassium	1200		34	130	250	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023	SW6010D	10/27/2023 1:02	280-182584-18	Sodium	88	J	24	83	420	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023	SW9056A	10/27/2023 15:49	280-182584-18	Sulfate	17	J	9.1	25	50	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023	SW9045D	10/16/2023 11:16	280-182584-18	Temperature	20.6	HF	1	1	1	deg C	deg C
SSTRNG001_RP2_Oct23-10032023LR	SW9045D	10/16/2023 11:17	280-182584-18	pH adj. to 25 deg C	6.5		0.1	0.1	0.1	pH units	pH units

Sample	Method	Analysis Date	Sample ID	Chemical Name	Result	Qualifier	MDL	RDL	QL	Units	DL Units
SSTRNG001_RP2_Oct23-10032023LR	SW9045D	10/16/2023 11:17	280-182584-18	Temperature	20.5		1	1	1	deg C	deg C
SSTRNG001_RP2_Oct23-10032023MS	SW6010D	10/27/2023 1:11	280-182584-18	Antimony	74.7		0.61	1.2	1.7	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023MS	SW6010D	10/27/2023 1:11	280-182584-18	Calcium	5210		12	41	83	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023MS	SW6010D	10/27/2023 1:11	280-182584-18	Copper	86.9		0.18	0.66	4.1	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023MS	SW6010D	10/27/2023 1:11	280-182584-18	Iron	15100	4	6.8	17	66	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023MS	SW6010D	10/27/2023 1:11	280-182584-18	Lead	108		0.26	0.66	0.75	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023MS	SW6010D	10/27/2023 1:11	280-182584-18	Magnesium	5600		6.6	17	25	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023MS	SW6010D	10/27/2023 1:11	280-182584-18	Phosphorus	1980		1.3	5	41	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023MS	SW6010D	10/27/2023 1:11	280-182584-18	Potassium	5730		34	130	250	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023MS	SW6010D	10/27/2023 1:11	280-182584-18	Sodium	3960		24	83	410	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023SD	SW6010D	10/27/2023 1:16	280-182584-18	Antimony	74.7		0.61	1.2	1.7	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023SD	SW6010D	10/27/2023 1:16	280-182584-18	Calcium	5220		12	42	83	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023SD	SW6010D	10/27/2023 1:16	280-182584-18	Copper	87.4		0.18	0.67	4.2	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023SD	SW6010D	10/27/2023 1:16	280-182584-18	Iron	15000	4	6.9	17	67	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023SD	SW6010D	10/27/2023 1:16	280-182584-18	Lead	108		0.26	0.67	0.75	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023SD	SW6010D	10/27/2023 1:16	280-182584-18	Magnesium	5620		6.6	17	25	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023SD	SW6010D	10/27/2023 1:16	280-182584-18	Phosphorus	1990		1.3	5	42	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023SD	SW6010D	10/27/2023 1:16	280-182584-18	Potassium	5730		34	130	250	mg/kg	mg/kg
SSTRNG001_RP2_Oct23-10032023SD	SW6010D	10/27/2023 1:16	280-182584-18	Sodium	3980		24	83	420	mg/kg	mg/kg
SSTRNG002_Oct23-10032023	SW6010D	10/26/2023 23:31	280-182584-6	Antimony	1.2	L	0.57	1.2	1.6	mg/kg	mg/kg
SSTRNG002_Oct23-10032023	SW6010D	10/26/2023 23:31	280-182584-6	Calcium	1000		11	39	78	mg/kg	mg/kg
SSTRNG002_Oct23-10032023	SW9056A	10/25/2023 0:33	280-182584-6	Chloride	15	J	11	30	30	mg/kg	mg/kg
SSTRNG002_Oct23-10032023	SW6010D	10/26/2023 23:31	280-182584-6	Copper	12		0.17	0.63	3.9	mg/kg	mg/kg
SSTRNG002_Oct23-10032023	SW6010D	10/26/2023 23:31	280-182584-6	Iron	10000		6.5	16	63	mg/kg	mg/kg
SSTRNG002_Oct23-10032023	SW6010D	10/26/2023 23:31	280-182584-6	Lead	25		0.24	0.63	0.7	mg/kg	mg/kg
SSTRNG002_Oct23-10032023	SW6010D	10/26/2023 23:31	280-182584-6	Magnesium	1100		6.2	16	23	mg/kg	mg/kg
SSTRNG002_Oct23-10032023	SW9045D	10/16/2023 11:14	280-182584-6	pH adj. to 25 deg C	6.2	HF	0.1	0.1	0.1	pH units	pH units
SSTRNG002_Oct23-10032023	SW6010D	10/26/2023 23:31	280-182584-6	Phosphorus	350		1.3	4.7	39	mg/kg	mg/kg
SSTRNG002_Oct23-10032023	SW6010D	10/26/2023 23:31	280-182584-6	Potassium	900		32	130	230	mg/kg	mg/kg
SSTRNG002_Oct23-10032023	SW6010D	10/26/2023 23:31	280-182584-6	Sodium	86	J	23	78	390	mg/kg	mg/kg
SSTRNG002_Oct23-10032023	SW9056A	10/27/2023 12:14	280-182584-6	Sulfate	12	JM	9.1	25	50	mg/kg	mg/kg
SSTRNG002_Oct23-10032023	SW9045D	10/16/2023 11:14	280-182584-6	Temperature	20	HF	1	1	1	deg C	deg C

Small Arms Range Sampling Reports

Lysimeter Sampling Results

Fall 2023

Sample	Method	Analysis Date	Sample ID	Chemical Name	Result	Qualifier	MDL	RDL	QL	Units	DL Units
LYIRNG001_Oct23-10042023	SW6020B	10/24/2023 16:02	280-182584-24	Antimony	0.0037		0.0004	0.001	0.002	mg/l	mg/l
LYIRNG001_Oct23-10042023	SW6020B	10/24/2023 16:02	280-182584-24	Calcium	2.6		0.032	0.1	0.2	mg/l	mg/l
LYIRNG001_Oct23-10042023	SW9056A	10/22/2023 6:39	280-182584-24	Chloride	2.2	J	1	2.5	3	mg/l	mg/l
LYIRNG001_Oct23-10042023	SW6020B	10/24/2023 16:02	280-182584-24	Copper	0.012		0.0007	0.002	0.002	mg/l	mg/l
LYIRNG001_Oct23-10042023	SW9060	10/17/2023 14:18	280-182584-24	Dissolved Organic Carbon - Quad	3.7		0.35	0.8	1	mg/l	mg/l
LYIRNG001_Oct23-10042023	SW6020B	10/24/2023 16:02	280-182584-24	Iron	0.12	J	0.0087	0.04	0.2	mg/l	mg/l
LYIRNG001_Oct23-10042023	SW6020B	10/24/2023 16:02	280-182584-24	Lead	0.0039		0.0002	7E-04	0.001	mg/l	mg/l
LYIRNG001_Oct23-10042023	SW6020B	10/24/2023 16:02	280-182584-24	Magnesium	0.59		0.0042	0.015	0.2	mg/l	mg/l
LYIRNG001_Oct23-10042023	SW6010D	10/23/2023 23:20	280-182584-24	Phosphorus	27	J	14	50	3000	ug/l	ug/l
LYIRNG001_Oct23-10042023	SW6020B	10/24/2023 16:02	280-182584-24	Potassium	0.92	J	0.052	0.076	1	mg/l	mg/l
LYIRNG001_Oct23-10042023	SW6020B	10/24/2023 16:02	280-182584-24	Sodium	1.6		0.073	0.15	1	mg/l	mg/l
LYIRNG001_Oct23-10042023	SW9056A	10/22/2023 6:39	280-182584-24	Sulfate	2.5	U	1	2.5	5	mg/l	mg/l
LYIRNG001_Oct23-10042023	SM2320B	10/10/2023 14:38	280-182584-24	Total Alkalinity	11		3.1	6.4	10	mg/l	mg/l
LYIRNG002_OCT23-10102023	SM2320B	10/21/2023 1:32	280-183152-2	Alkalinity, Total	25		3.1	6.4	10	mg/l	mg/l
LYIRNG002_OCT23-10102023	**SW6020B**	**11/8/2023 12:07**	**280-183152-2**	**Antimony**	**0.008**		**0.0004**	**0.001**	**0.002**	**mg/l**	**mg/l**
LYIRNG002_OCT23-10102023	SW6020B	11/8/2023 12:07	280-183152-2	Calcium	14		0.032	0.1	0.2	mg/l	mg/l
LYIRNG002_OCT23-10102023	SW9056A	11/15/2023 11:40	280-183152-2	Chloride	7	HM	1	2.5	3	mg/l	mg/l
LYIRNG002_OCT23-10102023	SW6020B	11/8/2023 12:07	280-183152-2	Copper	0.33		0.0007	0.002	0.002	mg/l	mg/l
LYIRNG002_OCT23-10102023	SW9060	10/26/2023 21:05	280-183152-2	Dissolved Organic Carbon - Quad	16		0.35	0.8	1	mg/l	mg/l
LYIRNG002_OCT23-10102023	SW6020B	11/8/2023 12:07	280-183152-2	Iron	0.02	J	0.0087	0.04	0.2	mg/l	mg/l
LYIRNG002_OCT23-10102023	SW6020B	11/8/2023 12:07	280-183152-2	Lead	0.0003	J	0.0002	7E-04	0.001	mg/l	mg/l
LYIRNG002_OCT23-10102023	SW6020B	11/8/2023 12:07	280-183152-2	Magnesium	3.3		0.0042	0.015	0.2	mg/l	mg/l
LYIRNG002_OCT23-10102023	SW6010D	11/8/2023 13:07	280-183152-2	Phosphorus	8600		14	50	3000	ug/l	ug/l
LYIRNG002_OCT23-10102023	SW6020B	11/8/2023 12:07	280-183152-2	Potassium	1.5		0.052	0.076	1	mg/l	mg/l
LYIRNG002_OCT23-10102023	SW6020B	11/8/2023 12:07	280-183152-2	Sodium	5		0.073	0.15	1	mg/l	mg/l
LYIRNG002_OCT23-10102023	SW9056A	11/15/2023 11:40	280-183152-2	Sulfate	11	H	1	2.5	5	mg/l	mg/l
LYLRNG001_Oct23-10042023	SW6020B	10/24/2023 15:56	280-182584-21	Antimony	0.001	U	0.0004	0.001	0.002	mg/l	mg/l
LYLRNG001_Oct23-10042023	SW6020B	10/24/2023 15:56	280-182584-21	Calcium	2.7		0.032	0.1	0.2	mg/l	mg/l
LYLRNG001_Oct23-10042023	SW9056A	10/22/2023 8:10	280-182584-21	Chloride	3.4		1	2.5	3	mg/l	mg/l
LYLRNG001_Oct23-10042023	SW6020B	10/24/2023 15:56	280-182584-21	Copper	0.0068		0.0007	0.002	0.002	mg/l	mg/l
LYLRNG001_Oct23-10042023	SW9060	10/17/2023 13:14	280-182584-21	Dissolved Organic Carbon - Quad	8.4		0.35	0.8	1	mg/l	mg/l
LYLRNG001_Oct23-10042023	SW6020B	10/24/2023 15:56	280-182584-21	Iron	0.043	J	0.0087	0.04	0.2	mg/l	mg/l
LYLRNG001_Oct23-10042023	SW6020B	10/24/2023 15:56	280-182584-21	Lead	0.0003	J	0.0002	7E-04	0.001	mg/l	mg/l

Sample	Method	Analysis Date	Sample ID	Chemical Name	Result	Qualifier	MDL	RDL	QL	Units	DL Units
LYLRNG001_Oct23-10042023	SW6020B	10/24/2023 15:56	280-182584-21	Magnesium	0.55		0.0042	0.015	0.2	mg/l	mg/l
LYLRNG001_Oct23-10042023	SW6010D	10/23/2023 23:07	280-182584-21	Phosphorus	140	J	14	50	3000	ug/l	ug/l
LYLRNG001_Oct23-10042023	SW6020B	10/24/2023 15:56	280-182584-21	Potassium	1.9		0.052	0.076	1	mg/l	mg/l
LYLRNG001_Oct23-10042023	SW6020B	10/24/2023 15:56	280-182584-21	Sodium	1.9		0.073	0.15	1	mg/l	mg/l
LYLRNG001_Oct23-10042023	SW9056A	10/22/2023 8:10	280-182584-21	Sulfate	2	J	1	2.5	5	mg/l	mg/l
LYLRNG001_Oct23-10042023	SM2320B	10/10/2023 14:22	280-182584-21	Total Alkalinity	6	J	3.1	6.4	10	mg/l	mg/l
LYLRNG002_Oct23-10042023	**SW6020B**	**10/24/2023 15:58**	**280-182584-22**	**Antimony**	**0.001**	**U**	**0.0004**	**0.001**	**0.002**	**mg/l**	**mg/l**
LYLRNG002_Oct23-10042023	SW6020B	10/24/2023 15:58	280-182584-22	Calcium	16		0.032	0.1	0.2	mg/l	mg/l
LYLRNG002_Oct23-10042023	SW9056A	10/22/2023 7:10	280-182584-22	Chloride	1.6	J	1	2.5	3	mg/l	mg/l
LYLRNG002_Oct23-10042023	SW6020B	10/24/2023 15:58	280-182584-22	Copper	0.0007	J	0.0007	0.002	0.002	mg/l	mg/l
LYLRNG002_Oct23-10042023	SW9060	10/17/2023 13:35	280-182584-22	Dissolved Organic Carbon - Quad	3.8		0.35	0.8	1	mg/l	mg/l
LYLRNG002_Oct23-10042023	SW6020B	10/24/2023 15:58	280-182584-22	Iron	0.027	J	0.0087	0.04	0.2	mg/l	mg/l
LYLRNG002_Oct23-10042023	SW6020B	10/24/2023 15:58	280-182584-22	Lead	0.0007	U	0.0002	7E-04	0.001	mg/l	mg/l
LYLRNG002_Oct23-10042023	SW6020B	10/24/2023 15:58	280-182584-22	Magnesium	0.76		0.0042	0.015	0.2	mg/l	mg/l
LYLRNG002_Oct23-10042023	SW6010D	10/23/2023 23:11	280-182584-22	Phosphorus	50	U	14	50	3000	ug/l	ug/l
LYLRNG002_Oct23-10042023	SW6020B	10/24/2023 15:58	280-182584-22	Potassium	1.3		0.052	0.076	1	mg/l	mg/l
LYLRNG002_Oct23-10042023	SW6020B	10/24/2023 15:58	280-182584-22	Sodium	1.7		0.073	0.15	1	mg/l	mg/l
LYLRNG002_Oct23-10042023	SW9056A	10/22/2023 7:10	280-182584-22	Sulfate	2.5	U	1	2.5	5	mg/l	mg/l
LYLRNG002_Oct23-10042023	SM2320B	10/10/2023 14:27	280-182584-22	Total Alkalinity	50		3.1	6.4	10	mg/l	mg/l
LYSRNG001_Oct23-10042023	SW6020B	10/24/2023 16:00	280-182584-23	Antimony	0.0011	J	0.0004	0.001	0.002	mg/l	mg/l
LYSRNG001_Oct23-10042023	SW6020B	10/24/2023 16:00	280-182584-23	Calcium	20		0.032	0.1	0.2	mg/l	mg/l
LYSRNG001_Oct23-10042023	SW9056A	10/22/2023 10:10	280-182584-23	Chloride	5.8		1	2.5	3	mg/l	mg/l
LYSRNG001_Oct23-10042023	SW6020B	10/24/2023 16:00	280-182584-23	Copper	0.0041		0.0007	0.002	0.002	mg/l	mg/l
LYSRNG001_Oct23-10042023	SW9060	10/17/2023 13:56	280-182584-23	Dissolved Organic Carbon - Quad	8.1		0.35	0.8	1	mg/l	mg/l
LYSRNG001_Oct23-10042023	SW6020B	10/24/2023 16:00	280-182584-23	Iron	0.037	J	0.0087	0.04	0.2	mg/l	mg/l
LYSRNG001_Oct23-10042023	SW6020B	10/24/2023 16:00	280-182584-23	Lead	0.0007	U	0.0002	7E-04	0.001	mg/l	mg/l
LYSRNG001_Oct23-10042023	SW6020B	10/24/2023 16:00	280-182584-23	Magnesium	1.8		0.0042	0.015	0.2	mg/l	mg/l
LYSRNG001_Oct23-10042023	SW6010D	10/23/2023 23:16	280-182584-23	Phosphorus	50	U	14	50	3000	ug/l	ug/l
LYSRNG001_Oct23-10042023	SW6020B	10/24/2023 16:00	280-182584-23	Potassium	0.11	J	0.052	0.076	1	mg/l	mg/l
LYSRNG001_Oct23-10042023	SW6020B	10/24/2023 16:00	280-182584-23	Sodium	5.5		0.073	0.15	1	mg/l	mg/l
LYSRNG001_Oct23-10042023	SW9056A	10/22/2023 10:10	280-182584-23	Sulfate	2	J	1	2.5	5	mg/l	mg/l
LYSRNG001_Oct23-10042023	SM2320B	10/10/2023 14:32	280-182584-23	Total Alkalinity	60		3.1	6.4	10	mg/l	mg/l
LYSRNG002_OCT23-10102023	SM2320B	10/21/2023 1:38	280-183152-3	Alkalinity, Total	7.6	J	3.1	6.4	10	mg/l	mg/l
LYSRNG002_OCT23-10102023	SW6020B	11/8/2023 12:09	280-183152-3	Antimony	0.001	U	0.0004	0.001	0.002	mg/l	mg/l

Sample	Method	Analysis Date	Sample ID	Chemical Name	Result	Qualifier	MDL	RDL	QL	Units	DL Units
LYSRNG002_OCT23-10102023	SW6020B	11/8/2023 12:09	280-183152-3	Calcium	0.68		0.032	0.1	0.2	mg/l	mg/l
LYSRNG002_OCT23-10102023	SW9056A	11/15/2023 11:51	280-183152-3	Chloride	3	H	1	2.5	5	mg/l	mg/l
LYSRNG002_OCT23-10102023	SW6020B	11/8/2023 12:09	280-183152-3	Copper	0.0013	J	0.0007	0.002	0.002	mg/l	mg/l
LYSRNG002_OCT23-10102023	SW9060	10/26/2023 21:27	280-183152-3	Dissolved Organic Carbon - Quad	2.7		0.35	0.8	1	mg/l	mg/l
LYSRNG002_OCT23-10102023	SW6020B	11/8/2023 12:09	280-183152-3	Iron	0.04	U	0.0087	0.04	0.2	mg/l	mg/l
LYSRNG002_OCT23-10102023	SW6020B	11/8/2023 12:09	280-183152-3	Lead	0.0007	U	0.0002	7E-04	0.001	mg/l	mg/l
LYSRNG002_OCT23-10102023	SW6020B	11/8/2023 12:09	280-183152-3	Magnesium	0.14	J	0.0042	0.015	0.2	mg/l	mg/l
LYSRNG002_OCT23-10102023	SW6010D	11/8/2023 13:11	280-183152-3	Phosphorus	50	U	14	50	3000	ug/l	ug/l
LYSRNG002_OCT23-10102023	SW6020B	11/8/2023 12:09	280-183152-3	Potassium	2.9		0.052	0.076	1	mg/l	mg/l
LYSRNG002_OCT23-10102023	SW6020B	11/8/2023 12:09	280-183152-3	Sodium	1.5		0.073	0.15	1	mg/l	mg/l
LYSRNG002_OCT23-10102023	SW9056A	11/15/2023 11:51	280-183152-3	Sulfate	1.2	JH	1	2.5	5	mg/l	mg/l

Small Arms Range Sampling Reports

Groundwater Sampling Results

Fall 2023

Sample	Method	Analysis Date	Sample ID	Chemical Name	Result	Qualifier	MDL	RDL	QL	Units	DL Units
MW-465S-OCT23-10102023	SM2320B	10/21/2023 1:43	280-183152-7	Alkalinity, Total	18		3.1	6.4	10	mg/l	mg/l
MW-465S-OCT23-10102023	SW6020B	11/8/2023 12:11	280-183152-7	Antimony	0.001	U	0.0004	0.001	0.002	mg/l	mg/l
MW-465S-OCT23-10102023	SW6020B	11/8/2023 12:11	280-183152-7	Calcium	4.2		0.032	0.1	0.2	mg/l	mg/l
MW-465S-OCT23-10102023	SW9056A	11/15/2023 12:59	280-183152-7	Chloride	5.7	H	1	2.5	3	mg/l	mg/l
MW-465S-OCT23-10102023	SW6020B	11/8/2023 12:11	280-183152-7	Copper	0.0018	U	0.00071	0.0018	0.002	mg/l	mg/l
MW-465S-OCT23-10102023	SW9060	10/26/2023 21:48	280-183152-7	Dissolved Organic Carbon - Quad	0.72	J	0.35	0.8	1	mg/l	mg/l
MW-465S-OCT23-10102023	SW6020B	11/8/2023 12:11	280-183152-7	Iron	0.04	U	0.0087	0.04	0.2	mg/l	mg/l
MW-465S-OCT23-10102023	SW6020B	11/8/2023 12:11	280-183152-7	Lead	0.0007	U	0.00023	0.0007	0.001	mg/l	mg/l
MW-465S-OCT23-10102023	SW6020B	11/8/2023 12:11	280-183152-7	Magnesium	1.9		0.0042	0.015	0.2	mg/l	mg/l
MW-465S-OCT23-10102023	SW6010D	11/8/2023 13:15	280-183152-7	Phosphorus	21	J	14	50	3000	ug/l	ug/l
MW-465S-OCT23-10102023	SW6020B	11/8/2023 12:11	280-183152-7	Potassium	0.5	J	0.052	0.076	1	mg/l	mg/l
MW-465S-OCT23-10102023	SW6020B	11/8/2023 12:11	280-183152-7	Sodium	4.7		0.073	0.15	1	mg/l	mg/l
MW-465S-OCT23-10102023	SW9056A	11/15/2023 12:59	280-183152-7	Sulfate	7.2	H	1	2.5	5	mg/l	mg/l
MW-466S-OCT23-10102023	SM2320B	10/21/2023 1:48	280-183152-8	Alkalinity, Total	30		3.1	6.4	10	mg/l	mg/l
MW-466S-OCT23-10102023	SW6020B	11/8/2023 12:14	280-183152-8	Antimony	0.001	U	0.0004	0.001	0.002	mg/l	mg/l
MW-466S-OCT23-10102023	SW6020B	11/8/2023 12:14	280-183152-8	Calcium	5.9		0.032	0.1	0.2	mg/l	mg/l
MW-466S-OCT23-10102023	SW9056A	11/15/2023 13:44	280-183152-8	Chloride	6	H	1	2.5	3	mg/l	mg/l
MW-466S-OCT23-10102023	SW6020B	11/8/2023 12:14	280-183152-8	Copper	0.0018	U	0.00071	0.0018	0.002	mg/l	mg/l
MW-466S-OCT23-10102023	SW9060	10/26/2023 22:06	280-183152-8	Dissolved Organic Carbon - Quad	0.61	J	0.35	0.8	1	mg/l	mg/l
MW-466S-OCT23-10102023	SW6020B	11/8/2023 12:14	280-183152-8	Iron	0.04	U	0.0087	0.04	0.2	mg/l	mg/l
MW-466S-OCT23-10102023	SW6020B	11/8/2023 12:14	280-183152-8	Lead	0.0007	U	0.00023	0.0007	0.001	mg/l	mg/l
MW-466S-OCT23-10102023	SW6020B	11/8/2023 12:14	280-183152-8	Magnesium	2.7		0.0042	0.015	0.2	mg/l	mg/l
MW-466S-OCT23-10102023	SW6010D	11/8/2023 13:20	280-183152-8	Phosphorus	23	J	14	50	3000	ug/l	ug/l
MW-466S-OCT23-10102023	SW6020B	11/8/2023 12:14	280-183152-8	Potassium	0.63	J	0.052	0.076	1	mg/l	mg/l
MW-466S-OCT23-10102023	SW6020B	11/8/2023 12:14	280-183152-8	Sodium	7.4		0.073	0.15	1	mg/l	mg/l
MW-466S-OCT23-10102023	SW9056A	11/15/2023 13:44	280-183152-8	Sulfate	8	H	1	2.5	5	mg/l	mg/l
MW-4675_OCT23-10112023	SM2320B	10/21/2023 1:27	280-183152-1	Alkalinity, Total	28		3.1	6.4	10	mg/l	mg/l
MW-4675_OCT23-10112023	SW6020B	11/8/2023 12:05	280-183152-1	Antimony	0.00057	J	0.0004	0.001	0.002	mg/l	mg/l
MW-4675_OCT23-10112023	SW6020B	11/8/2023 12:05	280-183152-1	Calcium	4.6		0.032	0.1	0.2	mg/l	mg/l
MW-4675_OCT23-10112023	SW9056A	11/15/2023 14:07	280-183152-1	Chloride	6.6	H	1	2.5	3	mg/l	mg/l
MW-4675_OCT23-10112023	SW6020B	11/8/2023 12:05	280-183152-1	Copper	0.0014	J	0.00071	0.0018	0.002	mg/l	mg/l
MW-4675_OCT23-10112023	SW9060	10/26/2023 19:57	280-183152-1	Dissolved Organic Carbon - Quad	2.4		0.35	0.8	1	mg/l	mg/l
MW-4675_OCT23-10112023	SW6020B	11/8/2023 12:05	280-183152-1	Iron	0.5		0.0087	0.04	0.2	mg/l	mg/l
MW-4675_OCT23-10112023	SW6020B	11/8/2023 12:05	280-183152-1	Lead	0.0017		0.00023	0.0007	0.001	mg/l	mg/l
MW-4675_OCT23-10112023	SW6020B	11/8/2023 12:05	280-183152-1	Magnesium	1.7		0.0042	0.015	0.2	mg/l	mg/l
MW-4675_OCT23-10112023	SW6010D	11/8/2023 13:02	280-183152-1	Phosphorus	30	J	14	50	3000	ug/l	ug/l
MW-4675_OCT23-10112023	SW6020B	11/8/2023 12:05	280-183152-1	Potassium	1.7		0.052	0.076	1	mg/l	mg/l

Sample	Method	Analysis Date	Sample ID	Chemical Name	Result	Qualifier	MDL	RDL	QL	Units	DL Units
MW-4675_OCT23-10112023	SW6020B	11/8/2023 12:05	280-183152-1	Sodium	7		0.073	0.15	1	mg/l	mg/l
MW-4675_OCT23-10112023	SW9056A	11/15/2023 14:07	280-183152-1	Sulfate	6.6	H	1	2.5	5	mg/l	mg/l
MW-469S_OCT23-10112023	SM2320B	10/21/2023 1:54	280-183152-9	Alkalinity, Total	6.9	J	3.1	6.4	10	mg/l	mg/l
MW-469S_OCT23-10112023	SW6020B	11/8/2023 12:16	280-183152-9	Antimony	0.001	JC	0.0004	0.001	0.002	mg/l	mg/l
MW-469S_OCT23-10112023	SW6020B	11/8/2023 12:16	280-183152-9	Calcium	2.2		0.032	0.1	0.2	mg/l	mg/l
MW-469S_OCT23-10112023	SW9056A	11/15/2023 13:56	280-183152-9	Chloride	8.5	H	1	2.5	5	mg/l	mg/l
MW-469S_OCT23-10112023	SW6020B	11/8/2023 12:16	280-183152-9	Copper	0.002		0.00071	0.0018	0.002	mg/l	mg/l
MW-469S_OCT23-10112023	SW9060	10/26/2023 22:24	280-183152-9	Dissolved Organic Carbon - Quad	1.1		0.35	0.8	1	mg/l	mg/l
MW-469S_OCT23-10112023	SW6020B	11/8/2023 12:16	280-183152-9	Iron	0.059	J	0.0087	0.04	0.2	mg/l	mg/l
MW-469S_OCT23-10112023	SW6020B	11/8/2023 12:16	280-183152-9	Lead	0.00026	J	0.00023	0.0007	0.001	mg/l	mg/l
MW-469S_OCT23-10112023	SW6020B	11/8/2023 12:16	280-183152-9	Magnesium	1.6		0.0042	0.015	0.2	mg/l	mg/l
MW-469S_OCT23-10112023	SW6010D	11/8/2023 13:24	280-183152-9	Phosphorus	40	J	14	50	3000	ug/l	ug/l
MW-469S_OCT23-10112023	SW6020B	11/8/2023 12:16	280-183152-9	Potassium	0.59	J	0.052	0.076	1	mg/l	mg/l
MW-469S_OCT23-10112023	SW6020B	11/8/2023 12:16	280-183152-9	Sodium	5.5		0.073	0.15	1	mg/l	mg/l
MW-469S_OCT23-10112023	SW9056A	11/15/2023 13:56	280-183152-9	Sulfate	6.9	H	1	2.5	5	mg/l	mg/l

Small Arms Range Sampling Reports

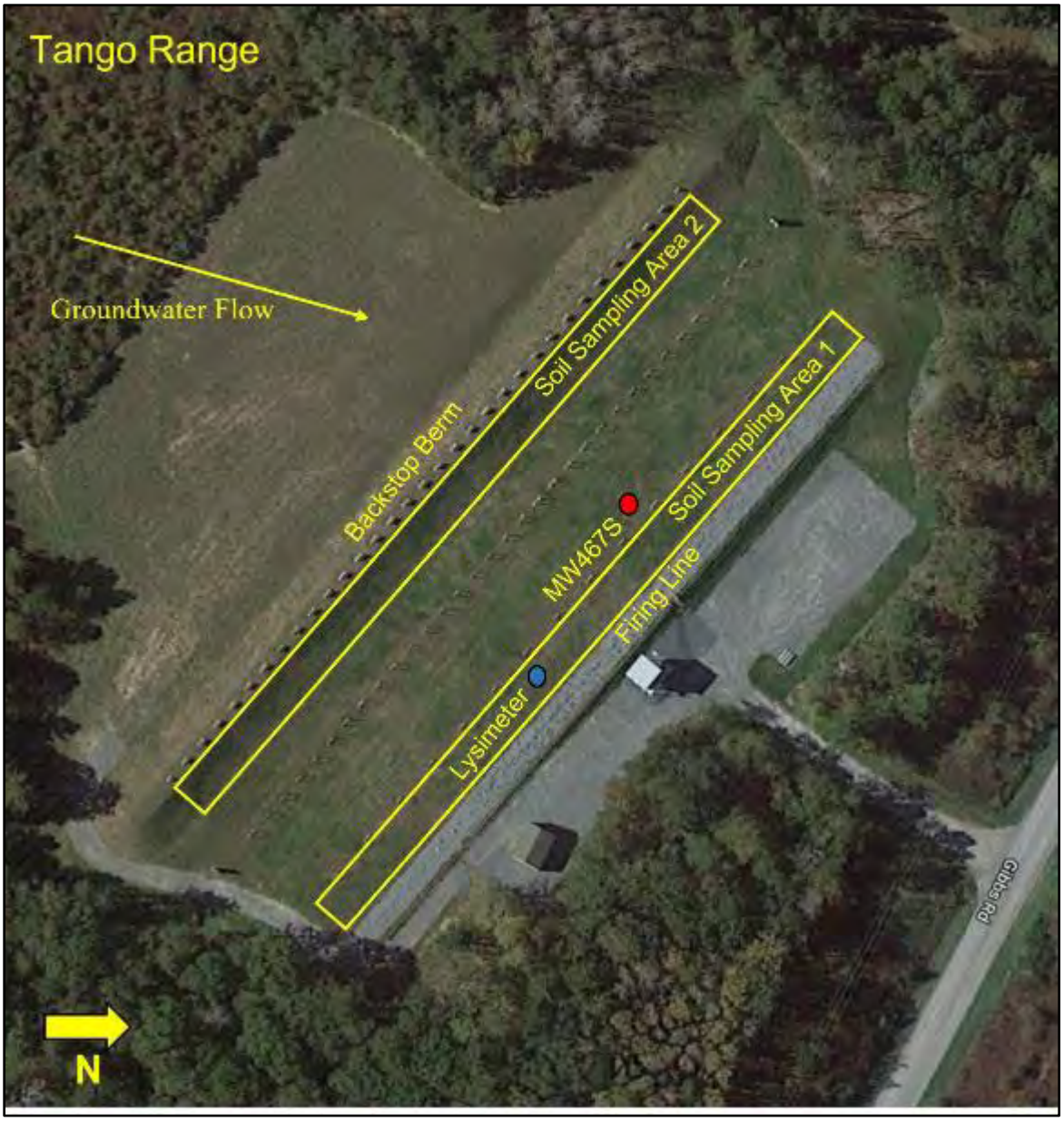
XRF Sampling Results

Fall 2023

Site	Location ID	Date Sampled	Date Analyzed	Test Method	Analyte	Result Value (ppm)
Sierra Range	4	10/10/2023	10/18/2023	XRF	Copper	35
Sierra Range	4	10/10/2023	10/18/2023	XRF	Copper	35
Sierra Range	4	10/10/2023	10/18/2023	XRF	Copper	30
Sierra Range	Lane 6	10/10/2023	10/18/2023	XRF	Copper	38
Sierra Range	Lane 6	10/10/2023	10/18/2023	XRF	Copper	32
Sierra Range	Lane 6	10/10/2023	10/18/2023	XRF	Copper	34
Sierra Range	Lane 4	10/10/2023	10/18/2023	XRF	Copper	ND
Sierra Range	Lane 4	10/10/2023	10/18/2023	XRF	Copper	ND
Sierra Range	Lane 4	10/10/2023	10/18/2023	XRF	Copper	ND

Notes:
m – meter
ppm – parts per million
XRF = X-ray Fluorescence

Small Arms Range Sample Area Figures



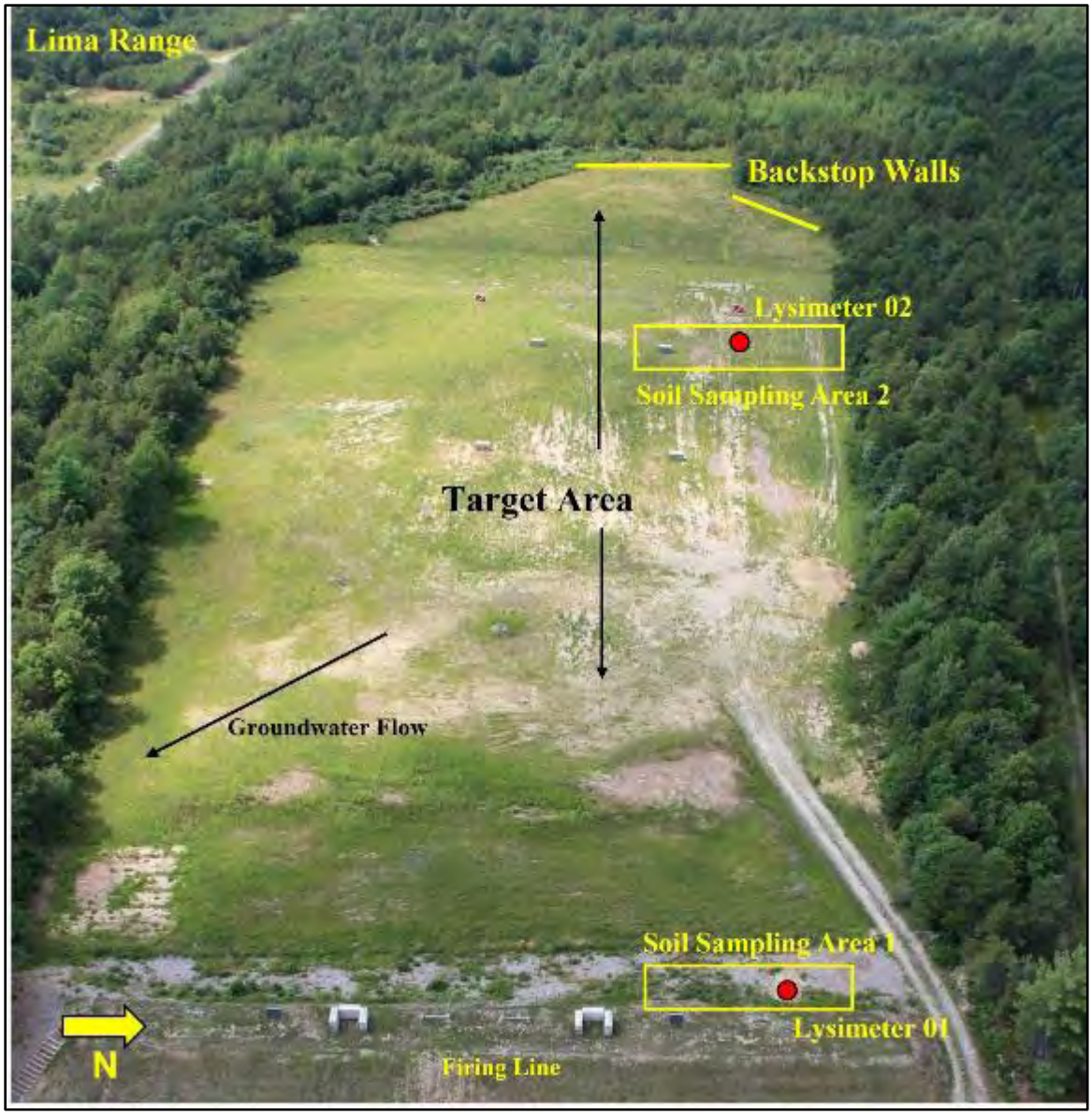
Tango Range (EPR copper only), Structures, and Sampling Areas
Camp Edwards, Massachusetts

The lysimeter noted on the graphic above was installed November 9, 2023.

Sierra Range (EPR copper only) Sampling Areas
Camp Edwards, Massachusetts
MW=Monitoring Well

India Range (EPR copper only) Sampling Areas
Camp Edwards, Massachusetts
MW=Monitoring Well

Echo Range Sampling Areas
Camp Edwards, Massachusetts
MW=Monitoring Well



Lima Range
Camp Edwards, Massachusetts.

Soldier Validation Lane Annual Report

Camp Edwards --- Massachusetts Army National Guard

Soldier Validation Lane Annual Monitoring Report

January, 2024

(NHESP Tracking No.: 08-24210)

Soldier Validation Lane Use

No site composition changes occurred in FY23.

SVL Assessments after 2022 Training Season

All sites with containers were visited on December 28th, 2023 to evaluate training impacts during the 2023 training season. The assessment methodology matched the assessment performed in the Baseline Condition Assessment Report and FYs 12-21, to provide a means of comparison. The containers replicate buildings (conex), and prop materials are utilized to create a more realistic setting, such as barrels, bicycles, grills, tires, wall sections, etc. No major changes were made to sites during 2023 and management activity was limited to mowing by the Training Lands Specialist in November 2023.

Conclusion

All regulatory conditions were followed during use of the SVLs and BPs for training. Erosion and rutting impacts have remained static at most sites on the lanes as expected, with regular levels of vehicle use and regular storm water runoff on dirt roads. Some photos of the erosion and rutting have been included below. MAARNG will continue to strive to minimize environmental impacts from these lanes by following the established guidelines.

Photos

Figure 1: SVL1

Figure 2: SVL 2, main entrance (left), rear coming from SVL 1 (right)

Figure 3: NBC Open ground and conex buildings

Figure 4: Entrance to BP 12 showing rutting

Figure 5: BP 20 Open ground and conex buildings

Figure 6: BP 24 Showing front (left) and back (right) of conex buildings

APPENDIX D
ENVIRONMENTAL LAWS AND REGULATIONS

ENVIRONMENTAL LAWS AND REGULATIONS GOVERNING MAARNG ACTIVITIES IN THE TRAINING AREA/RESERVE			
Reserve EPS	**Federal Law / Regulation**	**State Law / Regulation**	**DoD Regulation**
Groundwater Resources	Clean Water Act Safe Drinking Water Act	Drinking Water Quality Standards (310 CMR 22.00) State Wellhead Protection (310 CMR 22.21) Water Management Act (310 CMR 36.00)	AR 200-1 AR 200-2 Camp Edwards Regulation (CER) 385-63
Wetlands and Surface Water	Clean Water Act Coastal Zone Management Act Floodplains Management (EO 11988) Protection of Wetlands (EO 11990) Rivers and Harbors Act of 1899 Sikes Act Wetlands Management (EO 11990)	Massachusetts Wetlands Protection Act (M.G.L. c. 131, s40; 310 CMR 100.00)	AR 200-2 CER 385-63
Rare Species	Federal Endangered Species Act Sikes Act	Massachusetts Endangered Species Act (M.G.L. c. 131A, 321 CMR 10.00)	AR 200-1 AR 200-2 AR 200-3 CER 385-63
Soil Conservation	Sikes Act Soils and Water Conservation Act Use of Off-Road Vehicles on Public Lands (EO 11989)		AR 200-1 AR 200-2 AR 200-3 CER 385-63
Vegetation Management	American Indian Religious Freedom Act Environmental Justice (EO 12898) Exotic Organisms (EO 11987) Sikes Act		AR 200-1 AR 200-2 AR 200-3 CER 385-63
Habitat Management	Sikes Act	Massachusetts Endangered Species Act (M.G.L. c. 131A, 321 CMR 10.00)	AR 200-1 AR 200-2 AR 200-3 CER 385-63
Wildlife Management	Fish and Wildlife Conservation Act Migratory Bird Conservation Act Migratory Bird Treaty Act Sikes Act		AR 200-1 AR 200-2 AR 200-3 CER 385-63
Air Quality	Clean Air Act	State Air Quality Regulations (310 CMR 4.00)	AR 200-1 AR 200-2 CER 385-63

ENVIRONMENTAL LAWS AND REGULATIONS GOVERNING MAARNG ACTIVITIES IN THE TRAINING AREA/RESERVE			
Reserve EPS	**Federal Law / Regulation**	**State Law / Regulation**	**DoD Regulation**
Noise Management	Federal Interagency Committee Land Noise Control Act Occupational Safety & Health Act Use Planning Standards on Urban Noise, Guidelines for Considering Noise in Land Planning and Control (June 1990)		AR 200-1 AR 200-2
Pest Management	Animal Damage Control Act Federal Insecticide, Fungicide, and Rodenticide Act Noxious Weed Act Resource Conservation and Recovery Act Sikes Act Toxic Substances Control Act		DoD 4150.7 AR 200-1 AR 200-2 AR 200-5 AR 420-47
Fire Management	Clean Air Act Sikes Act The National Fire Code Uniform Fire Code	State Air Quality Regulations (310 CMR 4.00)	AR 200-1 AR 200-2 AR 200-3 AR 420-90 CER 385-63
Storm Water Management	Clean Water Act NPDES discharge permitting and limitations	Massachusetts Wetlands Protection Act (M.G.L. c. 131 s.40, 310 CMR 10.00.)	AR 200-1 AR 200-2
Wastewater	Clean Water Act	Title V (310 CMR 15.00)	AR 200-1 CER 385-63
Solid Waste	Resource Conservation and Recovery Act Toxic Substances Control Act	State Solid Waste Handling and Disposal (310 CMR 16.00/19.00)	AR 200-1 AR 200-2 AR 420-47 CER 385-63
Hazardous Materials	Asbestos Hazard Emergency Response (40 CFR 763) Federal Insecticide, Fungicide and Rodenticide Act Hazard Communication Standard Program (29 CFR 1910.1200) Lead Contamination Control Act OSHA (29 CFR 1910, 29 USC 91-596) Poison Prevention Packaging Act Toxic Substances Control Act	Hazardous Substances Labeling Law (105 CMR 650.00)	AR 200-1 AR 200-2 CER 385-63

ENVIRONMENTAL LAWS AND REGULATIONS GOVERNING MAARNG ACTIVITIES IN THE TRAINING AREA/RESERVE			
Reserve EPS	**Federal Law / Regulation**	**State Law / Regulation**	**DoD Regulation**
Hazardous Waste	Clean Air Act Clean Water Act Emergency Preparedness and Community Right-To-Know Act Federal Facilities Compliance Act Hazardous Waste Operations and Emergency Response Medical Waste Tracking National Fire Code Oil Pollution Act Pollution Prevention Act Resource Conservation and Recovery Act The National Contingency Plan Underground Storage Tank Program (RCRA, Title I) Uniform Building and Fire Codes Comprehensive Environmental Response, Compensation, and Liability Act	Department of Transportation regulations regarding shipping and transportation, Hazardous Waste Management and Transportation (310 CMR 30.000) Management of Medical Waste (105 CMR 480) Pesticide use (333 CMR 1.00 – 12.00) Solid waste facilities management (310 CMR 16.00/19.00) State right-to-know requirements (105 CMR 670.00) Title V (310 CMR 15.00) Toxic use reduction (310 CMR 5.00) Underground storage tanks standards (527 CMR 4.00 and 9.0) Massachusetts Contingency Plan (310 CMR 40.00)	AR 200-1 AR 200-2 AR 420-47 CER 385-63
Vehicle	Use of Off-Road Vehicles on Public Lands (EO 11989)		AR 200-2 CER 385-63
General Use And Access	Use of Off-Road Vehicles on Public Lands (EO 11989)		AR 200-1 AR 200-2 CER 385-63

ENVIRONMENTAL LAWS AND REGULATIONS GOVERNING MAARNG ACTIVITIES IN THE TRAINING AREA/RESERVE			
Reserve EPS	**Federal Law / Regulation**	**State Law / Regulation**	**DoD Regulation**
Cultural Resources (This EPS refers to archeological resources only; the list of regulations cited here has therefore been restricted to those that pertain to protection of archeological resources)	Antiquities Act of 1906 Archeological and Historic Preservation Act of 1974 Archeological Resources Protection Act of 1979 Consultation and Coordination with Indian Tribal Governments (Executive Order 13175) Curation of Federally Owned/Administered Archeological Collections Executive Memorandum of April 19, 1994 – Government-to-Government Relations with American Tribal Governments National Environmental Policy Act of 1966, as amended Native American Graves Protection and Repatriation Act of 1990	Massachusetts General Laws, Chapter 9, sections 26-27C as amended by Chapter 254 of the Acts of 1988 (950 CMR 71.00) Massachusetts Environmental Policy Act (MEPA) Massachusetts General Laws Chapter 30, sections 61 through 62H, inclusive (301 CMR 11.00) Massachusetts General Laws, Chapter 38, section 6B: Chapter 9, sections 26A and 27C; Chapter 7, section 38A; Chapter 114, section 17; as amended by Chapter 659 of the Acts of 1983 and Chapter 386 of the Acts of 1989	AR 200-2 AR 200-4 DA PAM 200-4 Office of the Secretary of Defense, Annotated Policy Document for the American Indian and Alaska Native Policy (27 October 1999)

DOD Regulations include all regulations and directives of the Department of Defense, Department of the Army, and National Guard Bureau.
AR = Army Regulation
CER – Camp Edwards Regulation
CFR – Code of Federal Regulations
CMR - Code of Massachusetts Regulations
DA PAM = Department of Army Pamphlet
EO – Executive Order
M.G.L – Massachusetts General Laws
RCRA – Resource Conservation and Recovery Act

APPENDIX E
WATER SUPPLY INFORMATION

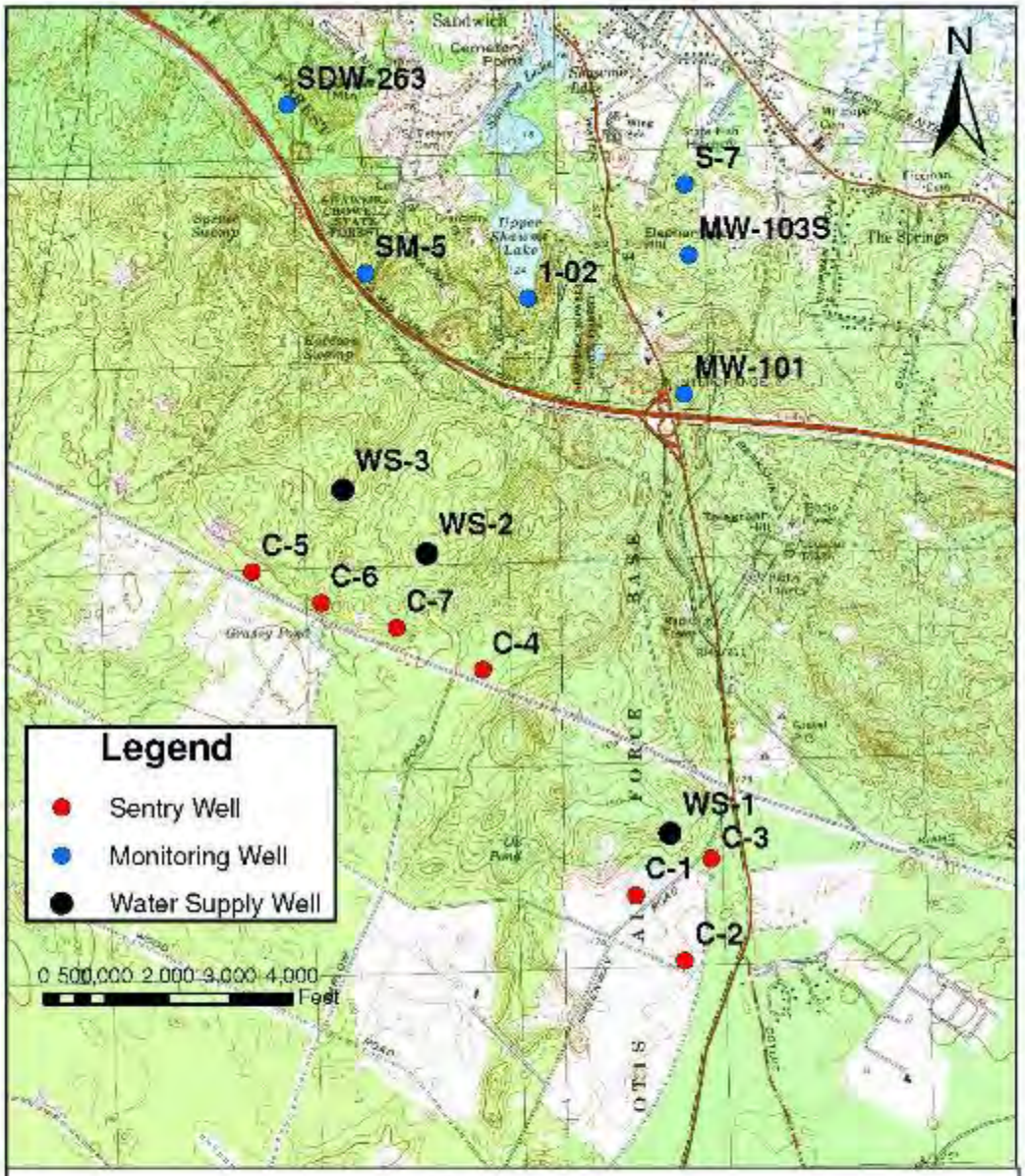


Figure 1
Long-term Monitoring Well Network
Upper Cape Regional Water Supply Cooperative
Cape Cod, Massachusetts

102nd Intelligence Wing
2022 Consumer Confidence Report

2022 Consumer Confidence Report

For
Otis Air National Guard Base
Otis ANGB, Massachusetts
MassDEP PWS ID #4096001

This report is a snapshot of the drinking water quality that we provided last year. Included are details about where your water comes from, what it contains, and how it compares to state and federal standards. We are committed to providing you with this information because informed customers are our best allies.

PUBLIC WATER SYSTEM INFORMATION

Address: 158 Reilly St., Box 12 Otis Air National Guard Base on Joint Base Cape Cod, Massachusetts

Contact Person: Mr. Duarte Corte-Real

Telephone #: (508) 968-4102

Water System Improvements
Our water system is routinely inspected by the Massachusetts Department of Environmental Protection (MassDEP). MassDEP inspects our system for its technical, financial, and managerial capacity to provide safe drinking water to you. To ensure that we provide the highest quality of water available, your water system is operated by a Massachusetts certified operator who oversees the routine operations of our system. As part of our ongoing commitment to service, the MassDEP Drinking Water Program has determined that the public water supply system at Otis Air National Guard Base is compliant with all national Primary Drinking Water Standards and MassDEP Drinking Water Regulations.

Opportunities for Public Participation
If you would like to participate in discussions regarding your water quality, you may attend the following meetings or educational events: *Please see the Otis Notice for any future meetings.*

YOUR DRINKING WATER SOURCE

Where Does My Drinking Water Come From?
Your water is provided by the following sources listed below:

Our drinking water supply is provided entirely by groundwater. J-Well (4096001-01G), which is located on Herbert Road, is our primary pumping station. We are also interconnected to the Upper Cape Regional Water Supply Cooperative. The Cooperative's water sources come from three wells located in the northeastern corner of Joint Base Cape Cod. On average, we provide up to 300,000 gallons of high-quality water every day. All of the Otis public water supply is drawn from the Sagamore Lens of the Cape Cod single-source aquifer. This lens runs from the Cape Cod Canal eastward into the town of Yarmouth. To learn more about our watershed on the Internet, go to the U.S. Environmental Protection Agency's (EPA) "How's My Waterway" website at the following link: https://www.epa.gov/waterdata/hows-my-waterway.

Source Name	MassDEP Source ID#	Source Type	Location of Source
J-Well	4096001-01G	Groundwater	Herbert Road

Is My Water Treated?
Our water system makes every effort to provide you with safe and pure drinking water. To improve the quality of the water delivered to you, we treat the system with potassium carbonate, sodium fluoride, and sodium hypochlorite. The water in this geographic area is naturally acidic, with an average pH of 5.9 (7.0 is neutral). Acidic water can be harmful to the distribution system. Potassium carbonate is used to buffer the water to as close to a neutral pH as possible. At the request of the U.S. Coast Guard, which is the owner and operator of the family housing area, sodium fluoride is added to the water. This compound has proven effective in strengthening teeth. Finally, sodium hypochlorite is used to disinfect the water supply by killing bacteria. The water quality of our system is constantly monitored by us and MassDEP to determine the effectiveness of existing water treatment

and to determine if any additional treatment is required. We add a disinfectant to protect you against microbial contaminants.

How Are These Sources Protected?
The Source Water Assessment and Protection (SWAP) Program, established under the federal Safe Drinking Water Act, requires every state to inventory land uses within the recharge areas of all public water supply sources, to assess the susceptibility of drinking water sources to contamination from these land uses, and to publicize the results to provide support for improved protection. MassDEP has prepared a SWAP Report for the water supply source(s) serving this water system. The SWAP Report assesses the susceptibility of public water supplies.

What is My System's Ranking?
A susceptibility ranking of HIGH was assigned to this system due to the absence hydrogeological barriers (i.e., clay) that can prevent contaminant migration.

Where Can I See The SWAP Report?
Information on obtaining the complete SWAP Report is available by contacting the Water Supply Superintendent at (508) 968-4102. To access the SWAP Report on the Internet, go to the Source Water Assessment & Protection (SWAP) Program Website at the following link: *https://www.mass.gov/service-details/the-source-water-assessment-protection-swap-program*

Members can help protect sources by:
- practicing good septic system maintenance
- proper disposal of hazardous chemicals and materials
- limiting pesticide and fertilizer use, etc.

SUBSTANCES FOUND IN TAP WATER

Sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals, and in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity.

Contaminants that may be present in source water include:

Microbial contaminants – such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.

Inorganic contaminants – such as salts and metals, which can be naturally-occurring or result from urban stormwater runoff, industrial, or domestic wastewater discharges, oil and gas production, mining, and farming.

Pesticides and herbicides – which may come from a variety of sources such as agriculture, urban stormwater runoff, and residential uses.

Organic chemical contaminants – including synthetic and volatile organic chemicals, which are by-products of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, and septic systems.

Radioactive contaminants – which can be naturally occurring or be the result of oil and gas production and mining activities.

In order to ensure that tap water is safe to drink, the Department of Environmental Protection (MassDEP) and U.S. Environmental Protection Agency (EPA) prescribe regulations that limit the amount of certain contaminants in water provided by public water systems. The Food and Drug Administration (FDA) and Massachusetts Department of Public Health (DPH) regulations establish limits for contaminants in bottled water that must provide the same protection for public health.

All drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More

information about contaminants and potential health effects can be obtained by calling the EPA's Safe Drinking Water Hotline (800-426-4791)

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and some infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/Centers for Disease Control and Prevention (CDC) guidelines on lowering the risk of infection by cryptosporidium and other microbial contaminants are available from the Safe Drinking Water Hotline (800-426-4791)

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. Otis Air National Guard Base is responsible for providing high quality drinking water but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead in your water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline or at http://www.epa.gov/safewater/lead

IMPORTANT DEFINITIONS

Maximum Contaminant Level (MCL) –The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.

Maximum Contaminant Level Goal (MCLG) –The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.

Secondary Maximum Contaminant Level (SMCL) – These standards are developed to protect the aesthetic qualities of drinking water and are not health based.

Unregulated Contaminants
Unregulated contaminants are those for which EPA has not established drinking water standards. The purpose of unregulated monitoring is to assist EPA in determining their occurrence in drinking water and whether future regulation is warranted.

Massachusetts Office of Research and Standards Guideline (ORSG) – This is the concentration of a chemical in drinking water, at or below which adverse health effects are unlikely to occur after chronic (lifetime) exposure. If exceeded, it serves as an indicator of the potential need for further action.

Maximum Residual Disinfectant Level (MRDL) – The highest level of a disinfectant (chlorine, chloramines, chlorine dioxide) allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.

Maximum Residual Disinfectant Level Goal (MRDLG) – The level of a drinking water disinfectant (chlorine, chloramines, chlorine dioxide) below which there is no known expected risk to health.
MRDLG's do not reflect the benefits of the use of disinfectants to control microbial contaminants.

ppm = parts per million, or milligrams per liter (mg/l)
ppb = parts per billion, or micrograms per liter (ug/l)
ppt = parts per trillion, or nanograms per liter
pCi/l = picocuries per liter (a measure of radioactivity)
NTU = Nephelometric Turbidity Units
ND = Not Detected
N/A = Not Applicable
mrem/year = millirems per year (a measure of radiation absorbed by the body)

WATER QUALITY TESTING RESULTS

What Does This Data Represent?
The water quality information presented in the table is from the most recent round of testing done in accordance with the regulations. All data shown was collected during the last calendar year unless otherwise noted in the table (within the last 5 years).

Substance (unit of measurement)	Date(s) Collected	90th percentile	Action Level	MCLG	# of sites sampled	# of sites above Action Level	Possible Source of Contamination
Lead (ppb)	28-30 Sep 2021	0.0016	15	0	40	0	Corrosion of household plumbing systems; Erosion of natural deposits
Copper (ppm)	28-30 Sep 2021	0.44	1.3	1.3	40	0	Corrosion of household plumbing systems; Erosion of natural deposits; Leaching from wood preservatives

Regulated Contaminant	Date(s) Collected	Highest Amount Detected	Range Detected	MCL (MRDL)	MCLG (MRDLG)	Violation (Y/N)	Possible Source(s) of Contamination
Inorganic Contaminants							
Asbestos (MFL)	2022	ND	N/A	7	7	N	Decay of asbestos cement watermains; Erosion of natural deposits
Barium (ppm)	2021	0.028	0.00-0.028	2	2	N	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits
Cyanide (ppb)	2021	<0.10	N/A	200	200	N	Discharge from metal factories; discharge from plastic and fertilizer factories
Fluoride* (ppm)	2022	0.10	0.00-0.10	4	4	N	Erosion of natural deposits; water additive which promotes strong teeth; discharge from fertilizer and aluminum factories
*Fluoride also has a secondary contaminant level (SMCL) of 2 ppm.							
Nitrate (ppm)	2022	2.42	0.74-2.42	10	10	N	Runoff from fertilizer use; leaching from septic tanks; sewage; erosion of natural deposits
Nitrite (ppm)	2020	0.44	0.00-0.44	1	1	N	Runoff from fertilizer use; leaching from septic tanks; sewage; erosion of natural deposits
Perchlorate (ppb)	2022	ND	N/A	2.0	N/A	N	Rocket propellants, fireworks, munitions, flares, blasting agents

Regulated Contaminant	Date(s) Collected	Highest Amount Detected	Range Detected	MCL (MRDL)	MCLG (MRDLG)	Violation (Y/N)	Possible Source(s) of Contamination
Organic Contaminants							
PFAS6 (ppt)	2022	5.14	0.00-5.14	20	N/A	N	Discharges and emissions from industrial and manufacturing sources associated with the production or use of these PFAS, including production of moisture and oil resistant coatings on fabrics and other materials. Additional sources include the use and disposal of products containing these PFAS, such as fire-fighting foams.
Radioactive Contaminants							
Gross Alpha ▲ (pCi/l) (minus uranium)	2021	-.461 +/-1.15	N/A	15	0	N	Erosion of natural deposits
▲The MCL for beta particles is 4 mrem/year. EPA considers 50 pCi/L to be the level of concern for beta particles.							
Radium 226 & 228 (pCi/L) (combined values)	2021	-.178 +/-.296	000 to 178	5	0	N	Erosion of natural deposits
Disinfectants and Disinfection By-Products							
Total Trihalomethanes (TTHMs) (ppb)	QTR3 (2022)	22.2	0.01-22.2	80	N/A	N	Byproduct of drinking water chlorination
Haloacetic Acids [HAA5] (ppb)	QTR3 (2022)	6.70	0.01-6.70	60	N/A	N	Byproduct of drinking water disinfection
Chlorine (ppm) (free, total or combined)	Monthly (2022)	2.0	0.01-2.0	4	4	N	Water additive used to control microbes

Unregulated and Secondary Contaminants

Unregulated contaminants are those for which there are no established drinking water standards. The purpose of unregulated contaminant monitoring is to assist regulatory agencies in determining their occurrence in drinking water and whether future regulation is warranted.

Unregulated Contaminants	Date(s) Collected	Result or Range Detected	Average Detected	SMCL	ORSG	Possible Source
Bromodichloromethane (ppb)	2022	1.12-6.22	3.67	N/A	N/A	Trihalomethane; by-product of drinking water chlorination
Bromoform (ppb)	2022	0.54-2.04	1.29	N/A	N/A	Trihalomethane; by- product of drinking water chlorination
Chloroform (ppb)	2022	1.51-8.65	5.08	N/A	70	By-product of drinking water chlorination (In non-chlorinated sources it may be naturally occurring)
Dibromochloromethane (ppb)	2022	1.17-5.32	3.24	N/A	N/A	Trihalomethane; By-product of drinking water chlorination
Manganese* (ppb)	2020	<0.005	<0.005	50	300	Erosion of natural deposits
* US EPA has established a lifetime health advisory (HA) value of 300 ppb for manganese to protect against concerns of potential neurological effects, and a one-day and 10-day HA of 1000 ppb for acute exposure.						

Unregulated Contaminants	Date(s) Collected	Result or Range Detected	Average Detected	SMCL	ORSG	Possible Source
Chloride	2022	8.4-9.3	8.85	250	N/A	Runoff and leaching from natural deposits; seawater influence
Copper	2022	0.010-0.020	0.015	1	N/A	Internal corrosion of household plumbing; erosion of natural deposits
Sulfate	2022	3.1-3.7	3.4	250	N/A	Runoff and leaching from natural deposits; industrial wastes
Zinc	2022	0.011-0.013	0.012	5	N/A	Corrosion of household plumbing systems; erosion of natural deposits
Sodium (ppm)	2021	18	0.00-18	N/A	20	Discharge from the use and improper storage of sodium-containing de-icing compounds or in water-softening agents

COMPLIANCE WITH DRINKING WATER REGS

Does My Drinking Water Meet Current Health Standards?

We are committed to providing you with the best water quality available. We are proud to report that last year your drinking water met all applicable health standards regulated by the state and federal government.

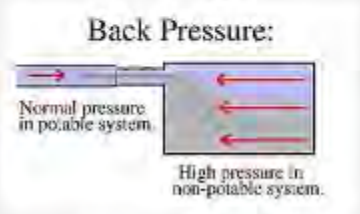
EDUCATIONAL INFORMATON

Cross-Connection Control and Backflow Prevention

Our water system makes every effort to ensure that the water delivered to throughout the installation is clean, safe, and free of contamination. Our members work hard to protect the quality of the water delivered to our customers from the time the water is extracted via deep wells from underground aquifers or withdrawal point from a surface water source, throughout the entire treatment and distribution system. But what happens when the water reaches your building? Is there still a need to protect the water quality from contamination caused by a cross-connection? If so, how?

What is a cross-connection?
A cross-connection occurs whenever the drinking water supply is or could be in contact with potential sources of pollution or contamination. Cross-connections exist in piping arrangements or equipment that allows the drinking water to come in contact with non-potable liquids, solids, or gases (hazardous to humans) in event of a backflow.

What is a backflow?
Backflow is the undesired reverse of the water flow in the drinking water distribution lines. This backward flow of water can occur when the pressure created by equipment or a system such as a boiler or air-conditioning is higher than the water pressure inside the water distribution line (back pressure), or when the pressure in the distribution line drops due to routine occurrences such as water main breaks or heavy water demand causing the water to flow backward inside the water distribution system (back siphonage). Backflow is a problem that many water consumers are unaware of, a problem that each and every water customer has a responsibility to help prevent.



What can I do to help prevent a cross-connection?
Without the proper protection something as simple as a garden hose has the potential to contaminate or pollute the drinking water lines in your house. In fact, over half of the country's cross-connection incidents involve unprotected garden hoses. There are very simple steps that you as a drinking water user can take to prevent such hazards, they are:

- NEVER submerge a hose in soapy water buckets, pet watering containers, pool, tubs, sinks, drains, or chemicals.
- NEVER attached a hose to a garden sprayer without the proper backflow preventer.
- Buy and install a hose bibb vacuum breaker in any threaded water fixture. The installation can be as easy as attaching a garden hose to a spigot. This inexpensive device is available at most hardware stores and home-improvement centers.
- Identify and be aware of potential cross-connections to your water line.
- Buy appliances and equipment with backflow preventers.
- Buy and install backflow prevention devices or assemblies for all high and moderate hazard connections.

If you are the owner or manager of a property that is being used as a commercial, industrial, or institutional facility you must have your property's plumbing system surveyed for cross-connection by your water purveyor. If your property has NOT been surveyed for cross-connection, contact your water department to schedule a cross-connection survey.

ADDITIONAL INFORMATION

Brown, Red, Orange, or Yellow Water.
Brown, red, orange, or yellow water is usually caused by rust. The different colors can be attributed to varying chemical oxidation states of the iron (rust) and by varying concentrations of the rust in the water. There are two major sources that can cause water to be rusty:

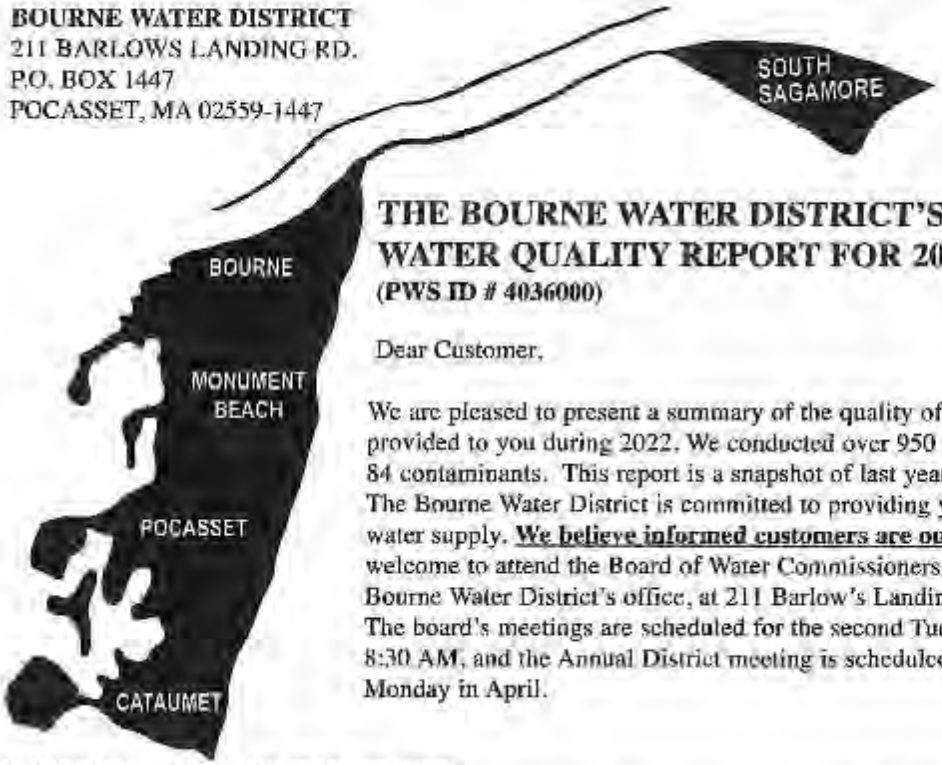
•The water mains, or
•The water pipes in your building

Rusty water occurs from sediment or rust from the inside walls of the water mains. The rust can be disturbed and temporarily suspended in water with unusual water flows from water main breaks or maintenance or by *flushing of a hydrant*. This discolored water is not a health threat.

When the water is discolored it is recommended to either not wash laundry or to use a rust stain remover or regular detergent but not chlorine bleach as it will react with the iron to form a permanent stain. The other major cause of brown, red, orange or yellow water is rusty water pipes in your building. Water that is being discolored by rusty pipes is not a health hazard.

Bourne Water District
2022 Consumer Confidence Report

BOURNE WATER DISTRICT
211 BARLOWS LANDING RD.
P.O. BOX 1447
POCASSET, MA 02559-1447



THE BOURNE WATER DISTRICT'S WATER QUALITY REPORT FOR 2022

(PWS ID # 4036000)

Dear Customer,

We are pleased to present a summary of the quality of the drinking water provided to you during 2022. We conducted over 950 tests for more than 84 contaminants. This report is a snapshot of last year's water quality. The Bourne Water District is committed to providing you with a reliable water supply. **We believe informed customers are our best allies.** You are welcome to attend the Board of Water Commissioners meetings held at the Bourne Water District's office, at 211 Barlow's Landing Road in Pocasset. The board's meetings are scheduled for the second Tuesday of the month at 8:30 AM, and the Annual District meeting is scheduled on the fourth Monday in April.

WATER SOURCES AND TREATMENT

The Bourne Water District is supplied by 10 different sources, 7 of our own gravel packed well sites and 3 gravel packed well sites from the Upper Cape Regional Water Supply Cooperative. Four of our well sites are in the Monument Beach area of the Town Forest. Two wells are in the Cataumet area of the Town of Bourne. One well is on Joint Base Cape Cod. We have one transfer station on Connery Ave. The Bourne Water District treats all supplies with hydrated lime for corrosion control. The hydrated lime is used to raise the pH of the water. This makes the water less aggressive to the copper pipe and lead joints in your homes to prevent exposure to lead and copper.

WHAT DOES THE FOLLOWING TABLE MEAN?

Action Level (AL) The concentration of a contaminant which if exceeded triggers treatment or other requirements.
Maximum Contaminant Level (MCL) The highest level of a contaminant that is allowed in the drinking water. The MCL is set as close to the MCLG as feasible using the best available treatment technology.
Maximum Contaminant Level Goal (MCLG) The level of a contaminant in the drinking water below which there is no known or expected risk to health. The MCLG allow for a margin of safety.
90th Percentile Out of every 10 houses sampled, 9 were below this level.

KEY TO TABLE

AL = Action Level
MCL = Maximum Contaminant Level
MCLG = Maximum Contaminant Level Goal
MFL = million fibers per liter
Mrem/year = millirems per year (a measure of radiation absorbed by the body)
NTU = Nephelometric Turbidity Units
pci/l = picocuries per liter (a measurement of radioactivity)
ppm = parts per million, or milligrams per liter (mg/l)
ppb = parts per billion, or micrograms per liter (ug/l)
ppt = parts per trillion, or nanograms per liter
ppq = parts per quadrillion, or picograms per liter
TT = Treatment Technique

DISTRIBUTION SYSTEM WATER QUALITY This report summarizes only those items detected during Sampling-not all contaminants that are monitored

Microbial Results	Highest Detected	Range Detected	MCL	MCLG	Violation	Possible Source of Contamination
Total Coliform Bacteria**	3	0-3	0	0	No	Naturally present in the environment
Fecal Coliform or E. Coli	0	0	0	0	No	Human and Animal Fecal Waste

*Compliance with the Fecal Coliform/E.Coli MCL is determined upon additional repeat testing

** Total Coliform: Coliform are bacteria that are naturally present in the environment and are used as an indicator that other potentially harmful bacteria may be present

Lead and Copper	Dates collected	90th Percentile	Action Level	MCGL	# of sites sampled	# Sites above Action Level	Violation	Possible Source of Contamination
Lead (ppb)	9/1/2022 thru 12/31/2022	0.0023	15	0	30	0	No	Corrosion of household plumbing systems; Erosio of natural deposits
Copper (ppm)	9/1/2022 thru 12/31/2022	0.154	1.3	1.3	30	0	No	Corrosion of household plumbing systems; Erosio of natural deposits

TESTING FOR LEAD: If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. Bourne Water District is responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead in your water, you may wish to have your water tested. Information about lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline or at http://www.epa.gov/safewater/lead.

Regulated Contaminants	Date(s) collected	Highest Detect Value	Range Detected	MCL	MCGL	Violation	
Inorganic Contaminants:							
Nitrate * (ppm)	2022	0.73	0.06-0.73	10	10	No	Runoff from fertilizer use; leaching from septic tanks; sewage; erosion of natural deposits
Organic Contaminants							
Tetrachloroethylene (PCE) (ppb)	2022	2.54	0-2.54	5	-	No	Discharge from factories and dry cleaners
Chloroform (ppb)	2022	1.64	.59-1.64	ORSG 70	NA	No	By-product of drinking water chlorination
Di-1,2 Dibromomethane (ppb)	2022	2.01	1.29-2.01	70	NA	No	Runoff; sewage; erosion of natural deposits

Secondary Contaminants	Date(s) collected	Highest Detect Value	Range Detected	SMCL	OSRG	Possible Source of Contamination
Magnesium (ppm)	2022	3.3	1.0-3.3	-	-	Natural Mineral and Organic Matter
Chloride (ppm)	2022	36	6.4-36	250	NA	Natural Mineral, Road Salt
Iron (ppb)	2022	0.06	0-.06	300	NA	Erosion of Natural Deposits and residential contaminants
Manganese (ppb)*	2022	0.017	0-.017	50	NA	Erosion of Natural Deposits
Potassium (ppm)	2022	1.1	.5-1.1	-	-	Natural Mineral and Organic Matter
Sulfate (ppm)	2022	5.8	2.3-5.8	250	250	Natural Sources
Zinc (ppm)	2022	0.023	.005-.023	5	NA	Erosion of Natural Deposits; and industrial discharge
Aluminum	2022	0.05	.011-.05		0.2	

PER and POLYFLUOROALKYL						
PFOS total nf 6 (ppt)	2022	5.03	0-5.03		30 ppt	

NATIONAL PRIMARY DRINKING WATER REGULATION COMPLIANCE

Coliforms are bacteria that are naturally present in the environment and are used as an indicator that other, potentially harmful, waterborne pathogens may be present or that a potential pathway exits through which contamination may enter the drinking water distribution system. We found coliforms indicating the need to look for potential problems in water treatment or distribution. When this occurs, we are required to conduct assessment(s) to identify problems and to correct any problems that were found during these assessments.

During 2022 we were required to conduct one level 1 assessment. One Level 1 assessment was completed. In addition, we were required to take one corrective action and we completed the action.

During 2022 two Level 2 assessments were required to be completed for our water system. Two Level 2 assessments were completed. In addition, we were required to take six corrective actions and we completed all six of these actions.

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead and copper in drinking water is primarily from materials and components associated with service lines and home plumbing. The Bourne Water District is responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead and copper exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead and copper in your water, you may wish to have your water tested. Information on lead and copper in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline or at http://www.epa.gov/safewater/lead.

Sodium; ORSG = 20 Sodium sensitive individuals, such as those experiencing hypertension, kidney failure or congestive heart failure, should be aware of the levels of sodium in their drinking water where exposures are carefully being controlled.
Massachusetts Office of Research and Standard Guidelines (ORSG): This is the concentration of a chemical in drinking water, at or below which, adverse health effects are likely to occur after chronic (lifetime) exposure, with a margin of safety. If exceeded, it serves as an indicator of the potential need for further action.

If you are interested in a more detailed report, contact Robert Prophett at 508-563-2294.

REQUIRED ADDITIONAL HEALTH INFORMATION:
To insure that tap water is safe to drink, Department of Environmental Protection (DEP) and Environmental Protection Agency (EPA) prescribes limits on the amounts of certain contaminants in water provided by public water systems. Food and Drug Administration (FDA) and the Massachusetts Department of Public Health regulations establish limits for contaminants in bottled water. Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency Safe Drinking Water Hotline (1-800-426-4791).The sources of drinking water (both tap and bottled) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally occurring minerals and radioactive material and can pick up substances resulting from the presence of animals or from human activity. Contaminants that may be present in the sources include:

(A) Microbial contaminants such as viruses and bacteria which may come from sewage treatment plants, septic systems, agricultural livestock operations and wildlife.

(B) Inorganic contaminants such as salts and metals which can be naturally-occurring or result from urban storm runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming.

(C) Pesticides and herbicides, which may come from a variety of sources such as agriculture, storm water runoff and residential uses.

(D) Organic chemical contaminants, including synthetic and volatile organics which are by-products of industrial processes and petroleum production and can also come from gas stations, urban storm water runoff and septic systems.

(E) Radioactive contaminants, which can be naturally occurring or be the results of oil and gas production and mining activities. In order to ensure that tap water is safe to drink, EPA prescribes regulations which limit the amount of certain contaminants in water provided by public water systems. FDA regulations establish limits for contaminants in bottled water which must provide the same protection for public health.

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/CDC guidelines on appropriate means to lessen the risk of infections by Cryptosporidium are available from the Safe Drinking Water Hotline (1-800-426-4791).

SOURCE WATER ASSESSMENT
The Bourne Water District had a source water assessment performed by the MA. Department of Environmental Protection in 2002. The Source Water Assessment and Protection (SWAP) program, established under the Federal Safe Drinking Water Act requires every state to:

- Inventory land uses within the recharge areas of all public water supply sources.
- Assess the susceptibility of drinking water sources to contamination from these land uses.
- Publicize the results to provide support for improved protection.

A susceptibility ranking of high was assigned to the Bourne Water District using the information collected during the assessment by the DEP. The high ranking was due to the potential contamination from land uses such as auto repair shops, truck terminal, furniture refinishing, auto salvage operation, an industrial park and activities in the recharge area (Zone II's) of some of the wells. The complete SWAP report is available at the Bourne Water District's office. For more information contact Robert Prophett at 508-563-2294.

CROSS CONNECTION

A cross connection is a connection between a drinking water pipe and a polluted source. The pollution can come from your own home. For instance, you're going to spray fertilizer on your lawn, and you hook up your hose to the sprayer that contains the fertilizer. If the water pressure drops (say because of a fire hydrant being used or water main break) when the hose is connected to the fertilizer sprayer, the fertilizer may be sucked back into the drinking water pipes through your hose. Using an anti-siphon backflow-prevention device on your sprayer or hose bib can prevent this problem.
The Bourne Water District recommends using devices with an anti-siphon feature or equipping hose bibs with hose bib vacuum breakers to prevent against back flow. For additional information on cross connections and on the status of your water system's cross connection program, please contact Robert Prophett at 508-563-2294.

UPPER CAPE REGIONAL WATER SUPPLY COOPERATIVE
2022 Consumer Confidence Report (PWS ID # 4261024)

The Upper Cape Regional Drinking Water Supply Cooperative consists of three groundwater supply wells located in Sandwich, MA on Joint Base Cape Cod (JBCC). A Board of Managers representing four-member public water supply systems manages the Cooperative. The Cooperative has the capacity to provide a supplemental supply of water to its member public water systems, which include the Town of Falmouth, the Bourne Water District, the Mashpee Water District and the Sandwich Water District. The Cooperative also supplies water to the Otis Air National Guard public water system on JBCC and the Barnstable County Jail.
Wells #1, #2 and #3 are located in a forested area of the northeastern portion of the JBCC. In July 2004, the Department of Environmental Protection completed a source water assessment (SWAP) report for the Cooperative water supply wells. A SWAP report is a planning tool to support local and state efforts to improve water supply protection by identifying land uses within water supply protection areas that may be potential sources of contamination. The report identifies potential sources of contamination including a gas station, a medical facility and a military facility, and helps focus protection efforts on appropriate Best Management Practices. A susceptibility ranking of high was assigned to the Cooperative using information that was collected during the assessment. A copy of the report is available, upon request, from the Cooperative. JBCC has adopted a Groundwater Protection Plan to prohibit inappropriate activities on JBCC property within the Zone II areas of community public water supply wells. In addition, the Environmental Management Commission provides oversight over activities on the northern portion of the JBCC. For questions regarding SWAP or other information contained within this document call Marisa Picone-Devine at 508-888-7262.
Our system, out of an abundance of caution and concerns about PFAS, sampled for PFAS compounds (PFBS, PFHpA, PFHxS, PFNA, PFOA, and PFOS) at all three wells in 2019 and 2020; there were no detections of any of the analytes in any of the samples.

2022 WATER QUALITY DATA

Listed below are the substances detected in water samples collected during the most recent sampling period from the three (3) wells that comprise the Upper Cape Drinking Water Supply Cooperative.

Inorganic Contaminants	Year Sampled	Highest Result	Range of Detections	MCL	MCLG	Violation (Y / N)	Possible Sources
Barium	2020	0.022 ppm	0.022 ppm	2 ppm	2 ppm	No	Discharge of drilling wastes; Discharge from metal refineries; Erosion of natural deposits
Nitrate	2022	0.74 ppm	0.74 ppm	10 ppm	10 ppm	No	Runoff from fertilizer use; Leaching from septic tanks, sewage; Erosion of natural deposits
Radioactive Contaminants	Year Sampled	Highest Result	Range of Detections	MCL	MCLG	Violation (Y / N)	Possible Sources
Gross Alpha	2021	~3.10 (+/- .931) pCi/l	~3.10 (+/- .931) pCi/l	15 pCi/l	0	No	Erosion of Natural Deposits
Radium 226 & 228	2021	0.377 pCi/l	0 – 0.377 pCi/l	5 pCi/l	0	No	Decay of natural and manmade deposits
Unregulated and Secondary Contaminants	Year Sampled	Amount Detected	Range of Detections	SMCL	MRDG	Violation	Possible Sources
Chloroform	2022	2.7 ppb	1.51 - 2.7 ppb	NA	70 ppb	No	Tri-halomethanes by-product of drinking water chlorination. In non-chlorinated sources, chloroform may be naturally occurring
Chloride	2022	9.3 ppm	8.4 - 9.3 ppm	250 ppm		NO	Runoff and leaching from natural deposits; Seawater influence
Copper	2022	0.020 ppm	0.010–.020 ppm	1 ppm	–	No	Internal corrosion of household plumbing systems; erosion of natural deposits
Sodium	2020	5.4 ppm	5.4 ppm	–	20 ppm	No	Natural erosion; road salt
Sulfate	2022	2.7 ppm	2.1 – 2.7 ppm	250 ppm	–	No	Runoff and leaching from natural deposits; industrial wastes
Zinc	2022	0.013 ppm	0.013 – 0.013 ppm	5 ppm	–	No	Corrosion of household plumbing systems; erosion of natural deposits

APPENDIX F
CONSERVATION AND MANAGEMENT PERMIT COMPLIANCE AND MITIGATION ACTIONS

Conservation and Management Permit Compliance and Mitigation Actions

Camp Edwards: Fiscal Year 2023

The Massachusetts Army National Guard maintains two Conservation and Management Permits (CMPs) under the Massachusetts Endangered Species Act (MESA, 321 CMR 10.00). The CMPs were developed within the framework of the Integrated Natural Resources Management Plan (INRMP) for Camp Edwards consistent with the Sikes Act and all implementing regulations for the MA Division of Fisheries and Wildlife (MADFW) and MA Army National Guard (MAARNG), including the Upper Cape Water Supply Reserve. The CMPs provide a collaborative and progressive path forward for training and operations at Camp Edwards while ensuring Net Benefit for state-listed species and their habitats at Joint Base Cape Cod (JBCC) directly through CMP associated actions as well as overall natural resources conservation and training lands management at JBCC.

The CMPs are held and administered by MAARNG and the MA Military Division and focus primarily on Camp Edwards' lands and operations. However, the "master plan" CMP was developed collaboratively with MA Air National Guard and includes both past mitigation commitments and implementation, as well as providing for potential future facilities actions for both services. This report includes updates and accomplishments for Fiscal Year 2023 (October of 2022 through September of 2023). Reportable actions include facilities maintenance and development as provided by the permits, construction support actions, mitigation efforts, program administration, and planned activities for the coming fiscal year(s).

Acronyms and Definitions

This report uses many acronyms and abbreviations, as well as specific terms and titles. The majority are included here for clarity.

Acronym	Term
AgCS	Agassiz's Clam Shrimp (MESA fact sheet, NatureServe)
AmCS	American Clam Shrimp (MESA fact sheet, NatureServe)
CMP(s)	Conservation and Management Permit(s) (CMP overview)
CS	Clam Shrimp
CSCRMP	Clam Shrimp Conservation and Road Maintenance Plan
EBT	Eastern Box Turtle (MESA fact sheet)
EMC	Environmental Management Commission
EWPW	Eastern Whip-poor-will MESA overview)
FCRA	Forest Canopy Reserve Area
FY(xx)	Fiscal Year (xx is two digit year); 01 OCT – 30 SEP
IAGWSP	Impact Area Groundwater Study Program (website)
INRMP	Integrated Natural Resources Management Plan (2021 INRMP)
JBCC	Joint Base Cape Cod (JBCC overview)
MA	Massachusetts
MAANG	Massachusetts Air National Guard (website)
MAARNG	Massachusetts Army National Guard (website)
MADFW	Massachusetts Division of Fisheries and Wildlife (website)
MANG	Massachusetts National Guard (joint) (website)
MEPA	Massachusetts Environmental Policy Act (website)
MESA	Massachusetts Endangered Species Act (MESA overview)
MPMG	Multi-Purpose Machine Gun (Range)
NEPA	National Environmental Policy Act (website)
NHESP	Natural Heritage and Endangered Species Program (website)
PBMFA	Pine Barrens Mitigation Focal Area
SGCN	Species of Greatest Conservation Need (State Wildlife Action Plan)
SMRC	Special Military Reservation Commission
UCWSR	Upper Cape Water Supply Reserve
UMass	University of Massachusetts
USFWS	United States Fish and Wildlife Service
UV	Ultraviolet

Cover photos
Top (from left): Eastern Box Turtle (*Terrapene carolina*) by Sophia Roemer; Purple Tiger Beetle (*Cicindela purpurea*) by Jake McCumber; Walsh's Digger Bee (Anthophora walshii) by Jake McCumber.
Bottom: Ripe fruits on Broad Tinker's-weed (*Triosteum perfoliatum*) by Jake McCumber.

A note on photos:
All photos in this report are by MAARNG Natural Resources and Training Lands staff in federal fiscal year 2023 unless otherwise specified. Photographer credits are in italics following captions.

Pelochrista argentifurcatana is a tiny moth found in xeric barrens habitats in northeastern North America. It has very few recorded observations, but is not listed or NatureServe ranked. Four of the ten Massachusetts observations are from Camp Edwards, all within Mitigation Focal Areas. Early-successional habitat patches within pine barrens are critical to maintaining this and many obscure species beyond those listed under the MA Endangered Species Act. A Pitch Pine (*Pinus rigida*) needle provides size reference for this individual at BP10 in 2023. *Jake McCumber*

Agassiz's Clam Shrimp and Training Area Roads Conservation and Management Permit

Conservation Permit #: 018-327.DFW
NHESP Files #: 17-37184
Project: Road Repair and Clam Shrimp Relocation
Date: 08-NOV-2018; amended 14-JUL-2021

Background. A CMP was developed and issued to the MAARNG in 2018 to provide for localized road repair at Camp Edwards while providing for conservation of the Endangered Agassiz's Clam Shrimp (*Eulimnadia agassizii*, AgCS). The original permit allowed for the repair of specific sites (i.e., road puddles) that were known AgCS habitat but required road repair. Three sites were modified *in situ* to improve the road condition, while still providing habitat for clam shrimp. Five sites were repaired with habitat replaced through active construction or repair of vernal pool or road puddle sites and relocation of clam shrimp or sediment. Three years of monitoring, as required by the CMP, were completed for FY18, FY19, and FY20. An additional fourth year of monitoring was completed in FY21 due to the previous year's drought conditions and the focal conservation interest of the species for MAARNG.


Monitoring for Agassiz's Clam Shrimp. *Erin Hilley*

During the FY21 monitoring MAARNG confirmed American Clam Shrimp (*Limnadia lenticularis*, AmCS), a state-listed species of special concern, not previously identified on the base. AmCS were encountered in three monitoring puddles (see FY21 CMP and Mitigation Actions report for more details on this finding).

MAARNG coordinated with MassWildlife in 2021 to amend the CMP to widen the scope of the permit and develop a plan for ongoing necessary road repairs in the Training Area while preserving habitat for rare clam shrimp species long-term. The backbone of the CMP Amendment is the Clam Shrimp Conservation and Road Maintenance Plan (CSCRMP) which carries forward elements of the original CMP, including monitoring and Net Benefit through a combination of clam shrimp relocation and in-place site repair. The updated CMP establishes multiple categories of roads (Critical Roads, Impact Area Interior Roads, and Training Area Roads) and establishes processes and standards for road puddle repair. Additionally, it establishes five zones of the northern training area for supporting a baseline number of puddles within each zone as primary habitat for AgCS and AmCS.

The two primary recurring efforts of the CMP Amendment are annual clam shrimp monitoring and development of annual or semi-annual road work plans submitted to MassWildlife for review and approval. FY23 highlights for both efforts are discussed below.

Annual Monitoring. The sixth consecutive year of annual monitoring was completed in FY23. A subset of twelve puddles situated throughout the northern training area were monitored by MAARNG staff and seasonal field technicians from May through October. Puddles containing standing water were measured for area, depth, temperature and pH, and all aquatic life observed was recorded. Ten of the 12 puddles, or 83 percent, contained Agassiz's clam shrimp. All clam shrimp collected were identified in the lab by Natural Resources staff and field technicians and keyed out to AgCS. Clam shrimp are collected under an annually renewed NHESP Scientific

Collection Permit. Collections are donated to NHESP. This was a productive year for AgCS; up from 67 percent in 2022, and up from all three years previous to 2022 which were at 50 percent and lower. Precipitation was intermittent and consistent through the season, which refreshed puddles for multiple generations of clam shrimp and aided detection for monitoring. In some years, puddles go dry for much of the summer or don't contain water long enough for clam shrimp eggs to hatch and develop. This reduces detection rates even if clam shrimp are present in the form of eggs.

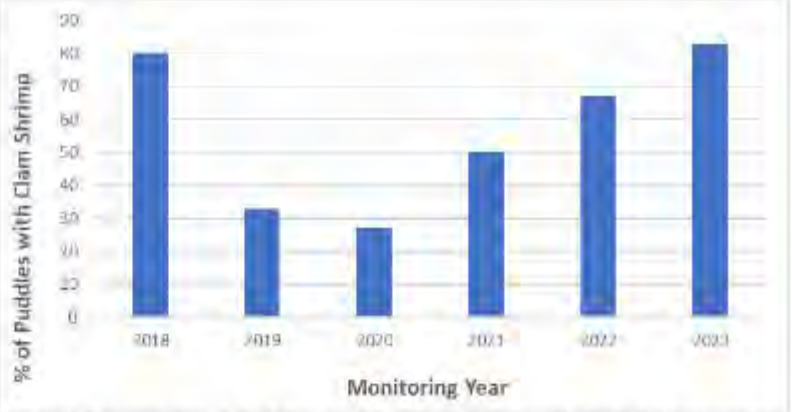


Chart 1. Percentage of puddles with confirmed Agassiz's Clam Shrimp during formal monitoring. A set of puddles is selected annually for iterative surveys following a mutually developed protocol that accounts for mitigation sites, novel sites, and return visits through long term annual monitoring.

All data and results have been provided separately to MassWildlife and observation reporting through Heritage Hub (https://www.mass.gov/info-details/overview-of-the-heritage-hub) has been completed.

In addition to the positive monitoring findings, additional highlights from TY 2023 underscore the resiliency of AgCS in a dynamic and seemingly inhospitable habitat (i.e., roadway puddles) and shows that soldier training and protection of rare species coexist effectively at Camp Edwards with intentional management.

The FRED (Fredrikson Road) puddle was a focal restoration project for FY2023 highlighted as upcoming work in last year's report. In January 2023 Natural Resources and Training Lands staff worked to drain, fill, and reform FRED with a smaller footprint at the side of the road to allow vehicle passage. Agassiz's Clam Shrimp were documented during puddle monitoring within six months of the restoration. Prior to modifying FRED puddle, two five-gallon buckets were filled with sediment from the puddle, which was added back to the reformed puddle once the work was complete. The sediment contained the durable eggs from the clam shrimp therefore helping to repopulate the puddle and demonstrating successful species, habitat, and road management.

Before and after photos of successfully restored FRED puddle, which was occupied by Agassiz's clam shrimp both prior to and after efforts to restore road access and ephemeral clam shrimp habitat. *Erin Hilley*

During the summer of 2023, AgCS were documented in the PEW (Pew Road) puddle. This puddle had documentation of AgCS in the past, but the puddle was negatively impacted in January 2023 during unapproved road work that resulted from miscommunication. Corrective measures were implemented immediately, including site restoration. The restoration included intended improvements, similar to the FRED restoration, as PEW previously exceeded repair criteria identified in the approved maintenance plan (full road width, very deep). The incident has ultimately been constructive in improving internal communication and understanding of approval processes and clam shrimp persist within the puddle feature.

In another example of AgCS resilience, in FY23, Natural Resources-ITAM seasonal field technicians documented AgCS in a mitigation puddle named WHEE3 (Wheelock Road) two years after the puddle was filled during road grading. In November 2021, the puddle had been graded over. Two years later, the puddle has reformed independently through normal road use and AgCS were found active without further intervention. In the summer/fall of 2021, months prior to being graded over, AgCS were intentionally introduced to the small and nondescript ephemeral puddle. AgCS were observed to be persisting in WHEE3 including following a drying period, meaning that introduced adults successfully reproduced and deposited eggs to hatch in response to precipitation. The rediscovery of AgCS, in a naturally reformed puddle two years after introduction and subsequent filling shows how well adapted they are to this dynamic environment. This series of events prior to rediscovery was documented in more detail in previous reporting.

The above anecdotes demonstrate the complexity of management at Camp Edwards, but also the commitment to continual improvement of processes and communication with the wide array of base users and stakeholders (internal and external). The overall road management and clam shrimp conservation strategy is proving to be highly effective with notably improved training area use and access along with abundant and well distributed clam shrimp and puddle features. Each situation with a communication gap has been directly addressed with responsible parties and others to avoid repeat events. Each event was previously reported and here we are providing the positive results clam shrimp presence thanks to the commitment to conservation.

Road Work Plans. A significant component of the Clam Shrimp Conservation and Roadway Maintenance Plan is the submission of annual road work plans developed by MAARNG for MassWildlife review and approval. This involves internal coordination meetings with Natural Resources, Integrated Training Area Management (ITAM), Impact Area Groundwater Study Program (IAGWSP), Camp Edwards, and the Camp Edwards Department of Facilities and Engineering. Potential impacts to clam shrimp and clam shrimp habitat, as well as other wildlife and natural resources concerns, are evaluated by Natural Resources staff. Required and voluntary mitigation, based on evaluated impacts and a Net Benefit standard, is proposed and included in the road work plan.

Natural Resources Office submitted Road Work Plan 3-Apr2023 in April 2023, which included two puddle improvement projects planned for the fall and winter 2023/24. Both puddles, BP1-1 and BP1-4, have supported AgCS in the past. Their current size has made them nearly impassable at certain times of the year due to water depth, overall size, and permanent to near-permanent inundation. Size, depth, and duration are the three threshold criteria used to determine when a puddle can or should be repaired. The CMP Clam Shrimp Conservation and Roadway Maintenance Plan provides a guide for the type of mitigation required, if any, when repairing puddles with weight given to known clam shrimp sites. BP1-1 and BP1-4 are an obstacle to vehicles but they also attract breeding amphibians including spotted salamanders, resulting in a potential sink when the roads receive increased traffic. MAARNG Natural Resources Program staff will modify BP1-1 and BP1-4 through methods borrowed on in previous projects. A Final Conditions Report is submitted to MassWildlife when work is complete.

The Natural Resources-ITAM Office has coordinated with the internal stakeholders to develop the FY2024 Road Work Plan, which will be submitted in April 2024.

MA National Guard Master Development Plan Conservation and Management Permit

Conservation Permit #: 020-358.DFW
NHESP Files #: 18-37434
Project: Camp Edwards Multi-Purpose Machine Gun (MPMG) Range and Master Development Plan
Date: 29-SEP-2020

Background. The Massachusetts Army National Guard received a Conservation and Management Permit in 2020 that established a master planning framework for projects implemented at Joint Base Cape Cod by both Air and Army National Guard. A comprehensive mitigation plan was developed, including an on-site mitigation bank covering multiple habitats. The primary projects incorporated into the master planning mitigation strategy include MPMG Range at the current KD Range, Infantry Squad Battle Course at the formerly used Infantry Battle Course, expansion of Tango and Sierra ranges, cantonment modernization including a running track and classroom buildings, and potential solar development. The mitigation plan combines project design and impact minimization, take avoidance, land transfers, extensive habitat improvement, and long-term monitoring to provide for Net Benefit of a large number of state-listed species. It also establishes a framework for ongoing site development (including additional or modified projects) and land use planning while providing for proactive mitigation and demonstrable net benefit for state-listed species.

Buck Moth (*Hemileuca maia*) laying eggs in restored Pitch Pine – Scrub Oak habitat in Training Area BA-3, October 2022. Buck Moths were abundant following forestry and prescribed fire that rejuvenated understory scrub oak (*Quercus ilicifolia*) and heath species (*Vaccinium*, etc.). *Jake McCumber*

The mitigation plan focuses on species guilds (pine barrens and sandplain grassland) for the majority of species with similar habitat condition needs and/or threats (e.g., loss of open canopy condition through forest closure). The Eastern Box Turtle (*Terrapene carolina*, EBT) is treated separately as it has differing needs and threats compared to the other species. Mitigation focal areas, tied to the guilds, have been identified to localize various mitigation actions for maximized benefit. Standards for mitigation have been developed for each type of guild and focal area to ensure sufficient conservation commitments are included in the plan and to provide assurances to MADFW for net benefit. For example, pine barrens mitigation will require 20% to 40% of habitat improvement work to be in the form of mechanical forestry, as the majority of the pine barrens guild species are threatened and declining due to tree encroachment and canopy closure where suitable and protected habitat exists. In addition to pine barrens and grassland focal areas, forest canopy retention areas are identified for box turtle hibernation and these areas are prioritized for maintenance of later successional forest condition and closed tree canopy.

Natural Resources & Training Lands staff conducting state-listed plant surveys within glacial frost bottom habitat surrounded by Pitch Pine – Scrub Oak. *Erin Hilley.*

Real Property Actions. There were no significant real property actions relative to the CMP during FY23. The Military Division State Quartermaster continues to have occasional contact with the Department of Fish and Game relative to Care, Custody, and Control Agreements for parcels previously transferred (Tracts 1-4). The same office is still determining how to meet deed registry requirement for state lands. Finally,

Parcel H of Unit K, (150 of the 195 acres within the Primary Sandplain Grassland Focal Area) remains on the Military Division inventory with transfer to MADFW dependent on construction projects. Habitat mitigation and monitoring activities within the area remain ongoing.

Buck Moth (foreground, right of center) warming in the morning sun in the Primary Sandplain Grassland Mitigation Focal Area; looking north across the western subunits from Grassland Unit (GLU) 4E. October 2022 *Jake McCumber*

Construction Projects. The reporting year did see progress on minor projects under the CMP, but none of the major projects had construction progress to report.

- MultiPurpose Machine Gun (MPMG) Range: Approval and construction of the flagship project under the CMP remains delayed. MAARNG anticipates award of a construction contract during fiscal year 2024. Any firm progress will be communicated along with anticipated timelines and permit compliance elements. This includes updated turtle protection, construction contracts, etc. Turtle protection actions (tracking tagged turtles, efforts to detect new turtles, etc.) remain ongoing.
- Tango Range: Tango Range primary redevelopment was completed at the end of FY21 and minor improvements to support the construction of minor support buildings was completed in FY22, as previously reported. The support buildings are contracted with turtle protection measures applied. Work is anticipated this winter, after which the final compliance report for Tango Range will be submitted. Mitigation acreage (1) is shown in Table 1 under 2022.
- Physical Fitness Track & Field: The construction of the physical fitness track and field was contracted during FY23. MAARNG worked with LEC Environmental Consultants, a subcontractor of the designer, to develop, submit, and implement compliance documents and the turtle protection plan. MADFW approved the work under the permit on October 2nd, 2023. Habitat take associated with this project is shown in Table 1 as a debit of 3 acres relative to the mitigation bank consistent with the proposal in LEC's letter dated September 23rd, 2023. The project scope was reduced, at least at the current time, compared to that included in the original CMP application from 2020 as the turf field was removed from the scope, as was clearing between the track and the gym. As with Tango Range, this project was determined to not be a take of state-listed species or habitat on its own, but has been mitigated and treated as other projects in the CMP for comprehensive conservation.

Tango Range Operations Area with tower at right and storage shed to be replaced at center. The turtle barrier is installed with surveys completed inside during October 2023. *Jake McCumber*

Mitigation Implementation. The framework of the CMP was erected to encourage early and abundant investment in monitoring and active mitigation efforts supporting the overall mitigation bank and evaluation of long-term monitoring results. MAARNG has consistently, effectively, and extensively managed for and monitored state-listed species, their habitats, and overall ecosystem health. CMP reportable and funded actions are a specific subset of MESA-related conservation, which itself is a subset of overall natural resources management and ecosystem sustainability efforts. All of these efforts are guided by and captured within the Camp Edwards Integrated Natural

Resources Management Plan (link below) and frequent coordination with Sikes Act partner agencies (MADFW, US Fish and Wildlife Service), multiple other partner agencies, conservation collaboratives, universities, and others. CMP mitigation actions are implemented within mitigation focal areas (Pine Barrens, Sandplain Grassland, Forest Canopy Reserves). They also meet specified objectives of the CMP, associated plans, and interagency coordination (e.g., annual review meetings). The master development plan CMP effectively doubled the NR-ITAM project budget for active conservation efforts, including monitoring and habitat restoration and management. https://www.massnationalguard.org/ERC/publications/Natural_Cultural/Final-INRMP-21.pdf

Habitat mitigation and management efforts integrate very effectively with other initiatives, including fuel reduction, training support, and even climate considerations as shown in this post-harvest photo in Training Area E-3 south of the frost bottom restoration. *Jake McCumber*

Mitigation investment for specific CMP implementation contracts and projects totaled $334,893 with the bulk of that going towards habitat improvement projects in mitigation focal areas. Some of the monitoring contracts are on rotating schedules, such as two-year contracts so those expenses fluctuate more. An estimated additional $118,000 was invested in internal staff salary supporting mitigation projects within the CMP with primary emphasis on monitoring and overseeing monitoring contracts. This represents a total investment of nearly half a million dollars towards the CMP in FY23. All requested mitigation funding and projects were approved by National Guard Bureau for FY23, but only about 44% of dedicated mitigation funding was received. However, other funds were appropriately used for mitigation projects. Permit requirements were met and management targets were either met or approached being met. Table 1 does not include staff time and salary nor does it include other state-listed species projects not directly associated with the CMP (e.g., bat monitoring, clam shrimp, state-listed species habitat restoration outside the focal areas, etc.).

Several major mitigation efforts were completed, ongoing, and/or initiated in FY23, addressing all the above-listed components of the master CMP. The mitigation actions implemented during FY23 totaled 217.5 acres of active habitat restoration. Little prescribed burning was conducted within mitigation focal areas during FY23 with 10 acres during the fall of 2022 and 2.5 acres during spring of 2023; both in Training Area BA-7. Primary prescribed burns during the reporting year were conducted outside mitigation areas as maintenance and improvement of the general ecosystem is critical at Camp Edwards. Total burn days within the northern training area were limited by a number of factors so annual targets for prescribed burning were not met, but overall achievement and investment in mitigation through fire are well on track. Overall, fire represents approximately 56% and 52% of habitat mitigation in pine barrens and grassland habitat, respectively. Especially early on mechanical restoration (e.g., thinning) is expected to have a relatively large percentage as in many areas it facilitates the use of prescribed fire and meeting overall habitat objectives for structure and diversity. Mitigation implementation in pine barrens habitat for FY23 was nearly evenly split between new restoration (RAW3/E-3 forest thinning) and maintenance in prior restoration areas (C-14 coppice treatment). Extensive resource monitoring, including many in-house efforts, were completed or underway in FY23 in addition to the active habitat management.

Sum of Mitigation Acreage	Fiscal Year					Grand
Project Type	2019	2020	2021	2022	2023	Total
Pine Barrens	520	401	184	188.5	88.5	1395
Construction: Pine Barrens		-6		-1	-3	-10
Mitigation: Initial treatment, fire	448			77.5		525.5
Mitigation: Initial treatment, mechanical	72	106	164	27	49	418
Mitigation: Maintenance treatment, fire			20	85	12.5	117.5
Mitigation: Maintenance treatment, other		40			30	70
Mitigation: Real Property		261				261
Sandplain Grassland	42	80	47	79	113	361
Mitigation: Initial treatment, fire	42			65	33	140
Mitigation: Initial treatment, mechanical		80				80
Mitigation: Maintenance treatment, fire			47			47
Mitigation: Maintenance treatment, other				14	80	94
Grand Total	**562**	**481**	**231**	**267.5**	**201.5**	**1743**

Table 1. Acreage totals for mitigation banking under the Master Plan CMP by federal fiscal year and project type. Maintenance actions meet the perpetual maintenance requirement. Negative numbers represent Take under MESA and draw against the "account" with a coefficient (typically 4x) to account for mitigation ratios. Reported numbers follow formal approval and standards.

Contract Cost	Fiscal Year					Grand
Mitigation Project Type	2019	2020	2021	2022	2023	Total
Administrative	$48,020	$45,169	$11,262	$32,557	$10,000	$147,008
Construction support		$221,876		$540		$222,416
Monitoring	$62,810	$103,248	$123,739	$151,431	$73,893	$515,120
Other		$9,700				$9,700
Initial treatment, fire	$64,480					$64,480
Initial treatment, mechanical	$179,986	$88,458	$148,900		$175,900	$593,244
Maintenance treatment, other		$55,950	$8,000	$118,840	$75,100	$257,890
Grand Total	**$355,295**	**$524,401**	**$291,900**	**$303,368**	**$334,893**	**$1,809,858**

Table 2. Direct contract expenditure on mitigation projects per federal fiscal year implementing the Master Plan CMP. Significant additional expenditure is spent on internal staff time developing, overseeing, and implementing mitigation and monitoring projects under this CMP.

Lush Pitch Pine – Scrub Oak habitat north of I Range in Training Area E-1; summer 2023. This patch, within the MPMG Area Pine Barrens Mitigation Focal Area, has had mastication and prescribed fire to restore a healthy barren that is now thriving with Eastern Whip-poor-wills, frost bottoms, and many other state-listed and federal at-risk species. *Jake McCumber*

Projects undertaken in FY23 as mitigation efforts are summarized below. Projects and efforts that are programmatic in nature or otherwise not specifically meeting requirements of the Permit are not included, but are reported in both the Annual State of the Reservation Report and Camp Edwards INRMP Annual Review. All state-listed species observations are reported through MassWildlife's Heritage Hub database.

- **Species Protection**
  - **MPMG Range** – Extensive Eastern Box Turtle (*Terrapene carolina*) protection planning and effort exists in support of the MPMG Range Project, which has been described in detail in previous reports. In TY 2023 MPMG turtle protection efforts were focused on basic monitoring of area turtles, including opportunistically tagging new turtles found in the area. AECOM (contracted support) tracked turtles outfitted with radio-transmitter tags at the proposed range location to change out transmitters and to get fall hibernacula locations. A summary of their activities will be submitted to Natural Heritage in the winter of 2023-2024.
  - **Tango Range** – No new work was completed during FY23, but turtle protection and surveys were completed at the range operations area at the beginning of FY24 (October) consistent with prior approvals and turtle protection plans.
  - **Track and Field (1800 area)** – LEC Environmental Consultants, Inc. provided turtle protection oversight in coordination with MassWildlife and MAARNG for the physical fitness track and field construction.
- **Species Monitoring (CMP focused)**
  - **Eastern Box Turtle (EBT)**
    - In FY21, MAARNG NR-ITAM contracted the University of Illinois Wildlife Epidemiology Laboratory to implement an intensive box turtle health assessment. Some of the results were published in January 2024 in The Journal of Zoo and Wildlife Medicine entitled "Cutaneous myiasis and its relationship to wellness in eastern box turtles (*Terrapene carolina carolina*) in Cape Cod, Massachusetts."

      https://bioone.org/journals/journal-of-zoo-and-wildlife-medicine/volume-54/issue-4/2022-0173/CUTANEOUS-MYIASIS-AND-ITS-RELATIONSHIP-TO-WELLNESS-IN-EASTERN-BOX/10.1638/2022-0173.short?tabeArticleLink
    - MAARNG NR-ITAM applied radio transmitters and monitored previously transmittered turtles for an end of year total of 64 EBT during FY23 as part of the long-term box turtle monitoring requirement. This includes oppor-tunistic turtle observations from a number of programs, including NR-ITAM, Camp Edwards Range Control, IAGWSP, other site users, soldiers within training units, and the following projects.
    - Nine EBT mortalities were documented in FY23, including 3 without transmitters. Three were road mortalities and the remainder (6) are unknown. Four of the unknown mortalities were discovered by other researchers and the NR-ITAM Office is awaiting details on any apparent cause of death.

Kristina McEvoy, a 2023 Conservation Technician, with a box turtle newly found in September while conducting status checks for known, tracked turtles in the proposed MPMG Range area. *Jake McCumber*

    - MAARNG NR-ITAM contracted a "planning level survey" effort targeted at providing baseline data on box turtle presence and approximate density in a variety of habitat conditions distributed

throughout Camp Edwards. By the conclusion of surveys in October 2022, 15 EBT were detected and 13 individuals were outfitted with radio transmitters for long-term tracking.

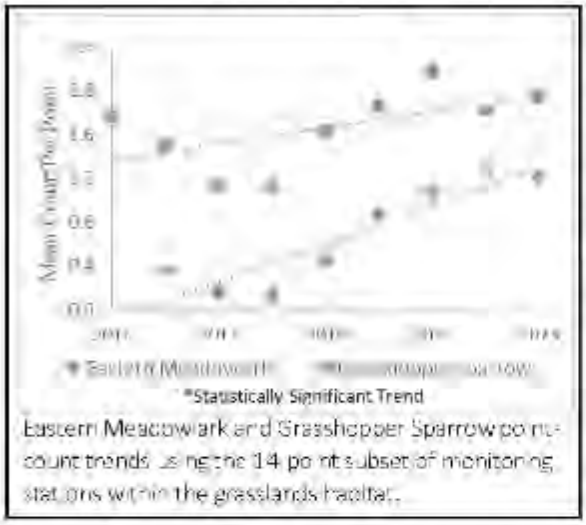
- The Natural Resources Office facilitated a UMass Amherst graduate student's research on dipteran larval infestations in Eastern box turtles on Camp Edwards in FYs 22 and 23. Movements of healthy and infected turtles were compared to determine impacts on mobility from larval infestations. The species of fly infesting box turtles was identified as *Dexosarcophaga cistudinis*. Infection did not affect turtle body condition, habitat use, or movement, but did affect shell temperature. This project included inputs and collaboration from USFWS, USGS, and NHESP. The findings from this research have been submitted for publication in the Northeastern Naturalist, titled "The effect of myiasis on Eastern Box Turtles (*Terrapene carolina carolina*) body condition, movement, and habitat use at Camp Edwards in Massachusetts."
- MAARNG NR-ITAM hosted a PhD student from the University of Massachusetts (UMass) Amherst's Massachusetts Cooperative Fish and Wildlife Research Unit studying prescribed fire influence on EBTs . Unfortunately, this project was canceled due to external circumstances.

- **Breeding Bird Point-counts** – Point-count surveys were conducted from 22 May through 23 June, 2023. Three surveys were conducted at each of 79 points throughout Camp Edwards, including 14 grassland (cantonment) points and 65 points in the northern training area. This represents a total of 237 individual count surveys events. A total of 83 species were documented during the month of surveys, which was the highest count documented from 1994 through 2023. Mean species count from 1994-2012 was 62.8, which has increased to 72.4 per year (range 60-83) in the 2013 through current period with an updated protocol and static point set. Long-term trend analysis was completed for the newer point-count protocol covering data collected from 2013 through 2022 and provided in the previous report. Trend analysis should be updated in 2024 and will reported at that time. The primary chart for Species of Greatest Conservation Need is still included below. Trend analysis and habitat management efforts for birds, based on this data and the results provided in the FY22 report, was presented at the 2023 Cape Cod Natural History Conference (above), sharing the profound results realized through active habitat stewardship and documented through intensive monitoring efforts.

Presenting positive results from Camp Edwards and advocating pine barrens conservation. *Mass Audubon via Facebook*

- Grassland birds: Grassland bird trends were updated in FY23 and were presented to the Paskamansett Bird Club in November. Overall, positive and results have been documented within the grasslands. The video is available online at: https://www.youtube.com/watch?v=_LzZFfqJ3N0. Two state-listed species, Grasshopper Sparrow (*Ammodramus savannarum*) and Eastern

Meadowlark (*Sturnella magna*), are showing significant increases within the Camp Edwards grasslands (at left), despite severe declines throughout Massachusetts and the rest of the northeastern United States. Two key species with apparent decreases are Upland Sandpiper (*Bartramia longicauda*) and Horned Lark (*Eremophila alpestris*), but both species have responded very positively to the grassland management on the Coast Guard airfield. The overall Joint Base Cape Cod trends are increasing. This demonstrates effective patch management across grassland areas (e.g., Crane Wildlife Management Area, Camp Edwards grasslands, Air Station Cape Cod) as different zones provide for somewhat different habitat and species providing a more functional and diverse system. Vesper Sparrow (*Pooecetes gramineus*) continues the recent trend of not being detected during surveys at Camp Edwards. It is uncertain if this species might be residing in unsurveyed habitat patches or no longer occurs at Camp Edwards as it has declined throughout the region. It's lack of detection is incongruous with species of similar habitat association that are thriving at Camp Edwards.



Eastern Meadowlark and Grasshopper Sparrow point-count trends using the 14 point subset of monitoring stations within the grasslands habitat.

- **Eastern Whip-poor-will (*Antrostomus vociferous*, EWPW)** – FY23 marked the ten-year point for the current form of nightjar surveys at Camp Edwards with three routes run annually following the Northeast Nightjar Survey protocol and a total of 32 survey locations. A detailed report of the year's results and a ten-year analysis of the data is at the end of this report. In brief summary, the annual per-point count average was 3.8 with an occupancy rate of 0.97, meaning nearly all survey points had calling Eastern Whip-poor-will. The maximum count at a point was 9 birds, representing a remarkable density and this species of significant conservation concern has shown a very positive response to habitat restoration and management, including conservation forestry and prescribed burning. The Eastern Whip-poor-will has a statistically significant increasing trend at Camp Edwards with a slope of 0.19 bird/point/year ($p<0.05$). All zones of the base and all routes have increasing trends.
- **Lepidoptera (Moths and Butterflies)**
  - Pine Barrens Moths: FY23 had the second year of light trap sampling for rare moths following the statistical sampling design developed for the CMP. It also had the third year of annual vegetation sampling associated with the pine barrens moth monitoring. The moth monitoring effort was the second year of a two-year contract with GZA GeoEnvironmental. Seven stations were trapped on four separate nights with blacklight traps. A total of 169 moth species were identified, including two state-listed species: Herodias Underwing (*Catocala Herodias*) and Pink Sallow (*Psectraglaea carnosa*). While the number of state-listed species identified was lower than usual, it is expected for moth populations to fluctuate significantly and the overall sampling rate is fairly low with a focus towards long-term monitoring. The primary impact was likely frequent rain that limited available sampling nights and directly impacted sampling nights through precipitation and fog. Vegetation sampling was contracted with Davey Resource Group and 30 sites were surveyed.
  - Frosted Elfin Butterfly and Slender Clearwing Moth: The Frosted Elfin Butterfly (*Callophrys irus*) is state-listed and being considered for federal listing. The Slender Clearwing Moths (*Hemaris gracilis*) is state-listed and generally overlaps in habitat with the Frosted Elfin. Five sites were surveyed using the US Fish and Wildlife Service "Frosted Elfin Habitat and Butterfly Survey Protocol" in FY23. In general, this protocol has been applied to sample a set of sites regularly while also investigating new locations with the protocol, which combines adult flight surveys, caterpillar surveys, and host plant surveys. Fifteen adult flight surveys were conducted, supplemented by two larval flashlight surveys. Four of the five survey areas had Frosted Elfin present, while the fifth

location had a Frosted Elfin observed nearby, but outside the survey plot. A total of 20 individuals were counted during formal surveys, with an average of one and range from zero to nine. Two of the survey areas detected new population areas for the Frosted Elfin at Camp Edwards, continuing the annual increase of known locations for the species. Of greatest interest is the discovery of active colonization of restored habitat by both the Frosted Elfin and Slender Clearwing. The southern portion of Training Area C-14 has been a focus of Pitch Pine – Scrub Oak habitat restoration since 2018 with a combination of mechanical forestry, prescribed fire, and mechanical/chemical coppice management. Survey efforts in FY23 documented abundant host plants for both species (Wild Indigo [*Baptisia tinctoria*] for Frosted Elfin and Lowbush and Pallid Blueberry [*Vaccinium angustifolium* and *V. pallidum*] for Slender Clearwing). Multiple adult and several larval Frosted Elfin were documented along with multiple Slender Clearwing larvae within the restoration area. The restoration was intentionally designed to expand habitat away from the linear utility rights-of-way and rehabilitate stand structure of the area from the 1990s to support rare species.

Frosted Elfin Butterfly photographed in cantonment grassland/heathland habitat, May 2023. *Jake McCumber*

- General Moths: More opportunistic moth survey and documentation has continued forward from 2019. During FY23 a continued partnership with Teá Kesting-Handly, a graduate student from UMass Boston, led to multiple UV-light moth surveys with the two primary locations situated within mitigation focal areas SGMFA (Primary) and PBMFA (West). These efforts have led to documentation of several listed species and other species of significant conservation concern. Additionally, informal diurnal photography efforts by Jake McCumber continue to document rare barrens species. Of particular management interest is documentation of many barrens specialists that are poorly represented in New England or throughout their ranges, but persisting in fire maintained habitat at Camp Edwards. The growing suite of online identification aids and digital photography are significant facilitators allowing for better documentation, in particular, of microlepidoptera. FY23 was a good year for documenting habitat specialist state-listed species including Pink Streak Moth (*Dargida rubripennis*), Collared Cycnia (*Cycnia collaris*), and Buck Moth (*Hemileuca maia*), in addition to above mentioned species.
- Acadian Hairstreak: Surveys for Acadian Hairstreak (proposed for state listing) were completed by GZA GeoEnvironmental, Inc., under contract by MAARNG NR-ITAM, on four days in mid-July at 7 survey sites, but only one Acadian Hairstreak was observed.

- **Purple Tiger Beetle (*Cicindela purpurea*)** – The Purple Tiger Beetle was documented for the first time at Camp Edwards in 2023. Several individuals were documented at five different locations. Eighteen different individuals were photographed, representing likely a third of the individuals observed. Typical observations ranged from three to six individuals at a location. Repeated observations were made within the Primary Sandplain Grassland Mitigation Focal Area, with particular focus on the interior dirt roads within and near Parcel H of Unit K. This includes both spring (April, May) and fall (September) observations, demonstrating an effective population. While not within project or mitigation areas, it is also notable that other Purple Tiger Beetle observations occurred on training roads within Pitch Pine – Scrub Oak habitat and at actively used soldier dig sites – areas used for heavy equipment training and generally kept as open sand with sparse, dry-site vegetation. This specie warrants continued

opportunistic surveys to better document their distribution within cantonment and the northern training area.

- **State-listed Plants –** The CMP does not have specific state-listed plant monitoring requirements, but does reference monitoring and reporting will be done.
  - Frost bottom species: Six frost bottom rare plant sites were surveyed for Broad Tinker's-weed (*Triosteum perfoliatum*) in 2023 with presence documented at three sites. Adder's Tongue Fern (*Ophioglossum pusillum*) was observed at one of four sites surveyed.
  - Sandplain species: A planning level survey was conducted targeting rare (e.g., listed or watchlisted) plants within sandplain grassland/heathland habitat. This effort provided an update on the presence, status, and distribution of a variety of rare plants at Camp Edwards, including the addition of two listed species for Camp Edwards. Stiff Yellow Flax (*Linum medium var. texanum*, state Threatened) was observed at two locations within the SGMFA-Primary in August of 2023. Papillose Nut-sedge (*Scleria pauciflora*, state Endangered) was found in multiple locations, including a large population at KD Range, adjacent to the PBMFA-MPMG. A Permit amendment is in process with an approved conservation plan for the species. Finally, Grass-leaved Ladies'-tresses Orchid (*Spiranthes vernalis*, state Threated) was found to be relatively numerous and widespread in sandplain grassland/heathland, including within the SGMFA-Primary.

Conducting 2023 frost bottom rare plant surveys with *Triosteum perfoliatum* in foreground. *Erin Hilley*

- **Habitat Management and Planning**
  - **Planning –** Planning effort has primarily focused on updating the Camp Edwards Integrated Wildland Fire Management Plan. This important guiding document will facilitate long-term success of the mitigation and other conservation efforts at Camp Edwards.
  - **Pine Barrens Mechanical Restoration –** A whole-tree harvest project was contracted in FY22 for winter (FY23) implementation in Training Area E-3 (Burn Unit RAW3, PBMFA-West). This action was a third phase of ongoing restoration of restoring diverse, transitional habitat. Phase one focused on restoring a large kettle hole frost bottom, which is showing effective ecological function with this rare phenomenon. Phase two was reduced in scale due to increased forestry costs and primarily thinned woodland canopy surrounding the frost bottom to improve function and provide gradual transition. Phase three continued this transition with thinning of canopy trees across an additional 49 acres. Two stands were treated with post-harvest density of 60 and 80 trees per acre, respectively. These treatments facilitate frost bottom function, provide greatly improved pine barrens habitat and structural diversity, and increase forest resilience. This is the highest priority type of restoration effort as it is maximizing habitat and structural diversity, restoring impact area type habitat in areas where habitat maintenance actually can be implemented, and significantly reducing risk from pests and other threats like wildfire.
  - **Other Habitat Maintenance/Restoration**
    - An invasive plant management project, contracted in FY22 and completed in the beginning months of FY23 (Oct-Nov) included 50 acres of low woody invasive shrubs and vines in Grassland Unit 04a and 04d. Fourteen acres was follow-up treatment to persistent and overlooked plants from the 2021 treatment (04a) and the remaining acreage followed prescribed burns carried out in the spring 2021 (04a) and spring 2022 (04d).

- An additional invasive shrub treatment was contracted and completed in FY23 that prioritized treatment of Honeysuckle (*Lonicera japonica*) and Autumn Olive (*Eleagnus umbellata*) in GLU4B (northeastern corner of SGMFA-Primary). It was successfully completed in late September, 2023. Herbicide application is a critical piece of habitat conservation and restoration and is implemented with numerous best management practices and use minimization.
- Phase one (30 acres) of a coppice treatment of tree oak regeneration in the C-14 restoration area (PBMFA-North) was contracted in FY22 for completion in October and November (FY23). These coppice treatments are critical to restoring functioning pitch pine – scrub oak natural community and similar habitats. Selective and targeted methods are used, including hand cutting all resprout stems from some stumps and sponge-wiping cuts with herbicide while other stumps had all but one stem cut and no herbicide applied. These treatments facilitate long-term habitat development when coupled with prescribed fire. They have facilitated relatively rapid colonization by rare and listed barrens flora and fauna documented in FY23, including Narrow-leaved Bush-clover (*Lespedeza angustifolia*), Frosted Elfin Butterfly, Slender Clearwing Moth, and Barrens Buckmoth.

Ongoing habitat restoration in Training Area C-14 (PBMFA-North). The area to the left (south) has been treated with prescribed fire and selective removal of tree oak sprouts. At the time of the photo (October 2022) the north side had received neither following the 2018 thinning. *Jake McCumber*

- **Prescribed Burning** – Three prescribed burns were completed within mitigation areas during FY2023 with two operations (12.5 acres) within PBMFA – South and one operation (33 acres) within SGMFA – Primary. These numbers were below annual targets due to a variety of factors that hinder wildland fire, including weather conditions and competing programmatic priorities and schedules. However, these fluctuations were planned and accounted for within mitigation planning and the actions provided quality habitat maintenance and FY24 accomplishment is well on track.

Preparing to burn pitch pine – scrub oak habitat in Pine Barrens Mitigation Focal Area – South (Training Area 3A-7), November, 2022. Occasionally conducting smaller "set up" burns serves multiple functions. One of these is to treat fuels (i.e., vegetation) in more challenging conditions or locations to facilitate a larger operation in the future. Another significant benefit is providing a mosaic of fire effects for flora and fauna through variation in timing and patch size. *Erin Hilley*

Fiscal Year 2024 Planning and Implementation

Army National Guard budgets have again been substantially reduced in FY24, impacting facilities and environmental programs throughout the country. Further, under a continuing resolution federal funding has not been provided for FY24 projects and uncertainty exists as to when and how much funding may be provided. All projects submitted for funding were approved by National Guard Bureau for FY24 and plans are in place to obligate funds when they are provided. The robust and proactive structure of the master plan CMP was specifically developed to minimize or eliminate negative impacts from low funding years as extensive mitigation has been completed, as reported above, while minimal construction implementation has occurred under the Permit.

Mechanical restoration in mitigation areas is likely to be reduced for FY24 with a greater emphasis on meeting wildland fire objectives. Monitoring and research efforts will be focal for FY24 with the continued implementation of the long-term moth monitoring protocol and other annual, long-term monitoring.

- **Project Scoping, Design Minimization, and NHESP Review**
  - **MPMG Range –** Completion of the Environmental Management Commission process will hopefully be in 2024 along with approval and contracting for construction. Submission and completion of all pre-Work required information and tasks will be completed as appropriate and able prior to construction along with any adjustments to turtle protection plans or schedules. A Permit amendment is currently in process to account for the detection of Scleria pauciflora at the KD Range location for which an approved conservation plan has already been developed.
  - **Tango Range –** Final reporting was in development and preparation for submission to NHESP to seek a certificate of compliance. However, funding was provided to include Range Operations Control Area (ROCA) buildings as previously reported and addressed above. Completion is anticipated by fall 2024 with final reporting and project close-out by the end of 2024.
  - **India and Sierra Ranges –** Consistent with Tango Range, support buildings are contracted for construction within the ROCA. Project designs and plans have been approved by MassWildlife and construction is anticipated to run through 2024. Mitigation has already been applied for Tango Range. India and Sierra Ranges do not require mitigation as there is no species or habitat take associated with the ROCA modernization.
  - **Track and Field (1800 area) –** As this project is in construction it is anticipated that project close-out and final reporting will be provided to MassWildlife by the end of 2024.

Eastern Hog-nosed Snake (*Heterodon platyrhinos*) is a state-listed species that benefits from the diverse barrens mosaic at Camp Edwards, including woodland openings such as ranges. Wildlife exclusions and surveys protect these snakes in addition to box turtles and other small vertebrates. *Sean Rigney*

  - **ISBC Range –** Design finalization and project timing for ISBC Range are uncertain. Turtle protection planning and other required support (e.g., permit compliance letter) will need to be contracted, followed by submission and completion of all pre-Work required. MassWildlife will be provided project designs, turtle protection plans, and other documents as developed if the project is to move forward.

- **Species Protection**
  - **MPMG Range** – Resumption of turtle protection efforts including silt fence installation and construction support consistent with approved turtle protection plan. This will include replacing the silt fence at the soil staging site (if used), continued monitoring, and communication with Natural Heritage.
  - **Tango, India, and Sierra Ranges** – Protection measures (silt fence) are in place and monitoring will continue through the construction period. Pre-construction surveys were completed in October, 2023.
  - **Track and Field** –Compliance with turtle protection plan and reporting.

- **Species Monitoring**
  - **Eastern Box Turtles** – Ongoing in-house monitoring of box turtles found both opportunistically and during targeted surveys in 2019-2023 near future construction projects as well as those found during planning level surveys. Review of telemetry, mortality, and spring emergence data is being completed by AECOM in FY24.
  - **Bird Surveys** – Continuation of annual surveys, including cantonment and training area point count surveys and Eastern Whip-poor-will surveys.
  - **Lepidoptera (Moths and Butterflies)** – Implementation of moth monitoring plan, including vegetation surveys, UV trap sampling (if funding becomes available), and pilot larval surveys for Barrens Buckmoth, depending on resources. Formal Frosted Elfin surveys will be conducted along with supplemental larval surveys for Frosted Elfin and Slender Clearwing Moth.

The Pink Streak Moth is a state-listed obligate of Switchgrass (Panicum virgatum) within barrens and sandplain habitats. It has been documented recently during both formal light trapping surveys and more opportunistic light-sheets. *Jake McCumber*

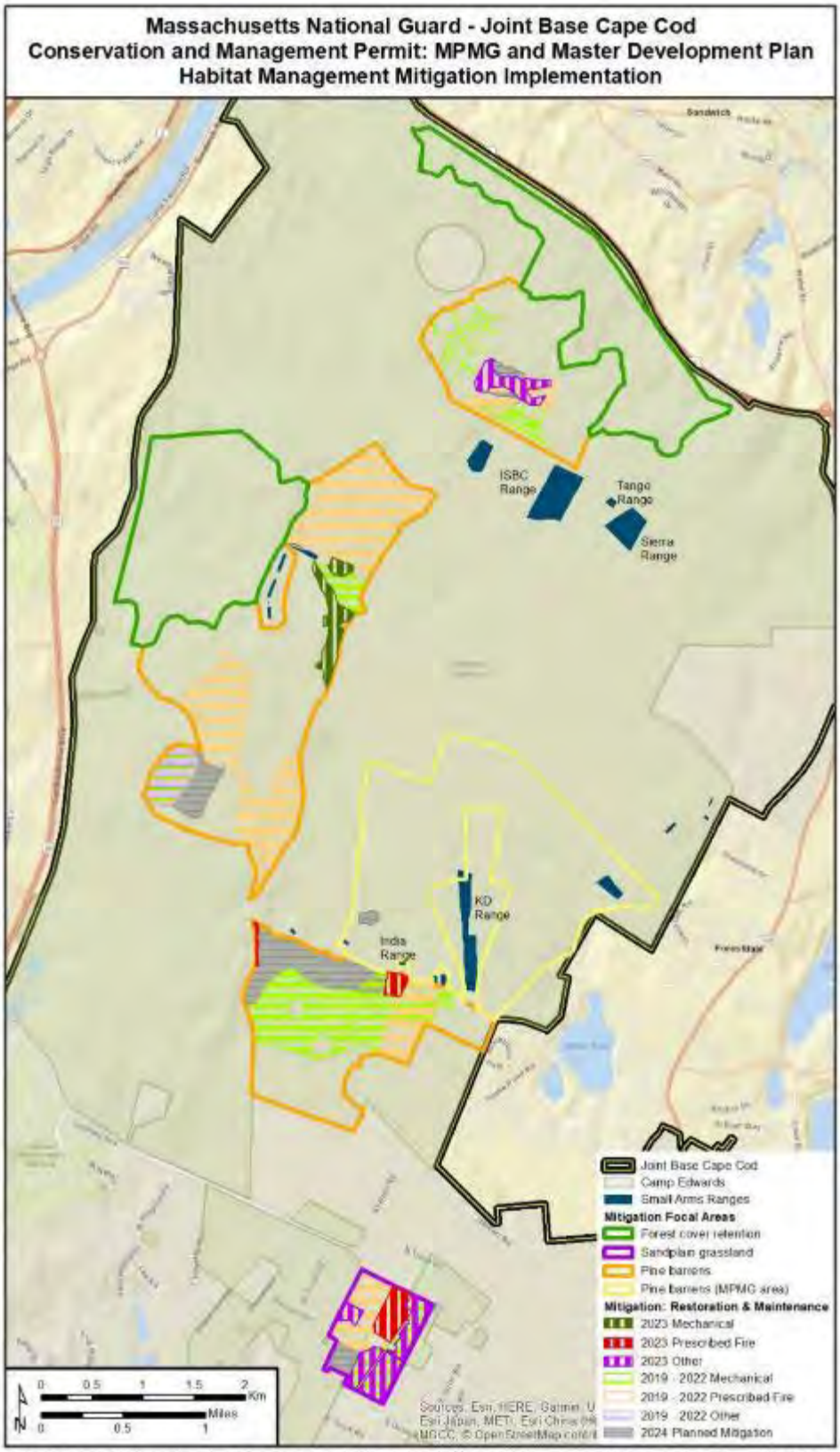
- **Habitat Management and Planning (see map below)**
  - **Prescribed Fire** – Priority prescribed burn areas for mitigation include:
    - PBMFA-West: Training Areas A-5 and BA-4 maintenance fires for pitch pine – scrub oak and pitch pine – heath habitat up to approximately 61 acres.
    - PBMFA-South: Training Areas BA-6 and BA-7 maintenance fires for pitch pine – scrub oak and pitch pine – heath habitat up to approximately 178 acres.
    - SGMFA-Primary: Approximately 90 acres are prioritized between fall and spring burn seasons. Targets include the more wooded northeastern portion of the mitigation area to facilitate transition to savannah habitat. The remainder is maintenance within open sandplain grassland along the eastern and southern portions of the MFA.
  - **Mechanical and Other Restoration** –
    - Long-term and small scale patch mowing of understory shrubs and small trees will continue in Training Area BA-6 (PBMFA South) to provide complex structural diversity in support of both training and habitat objectives. Approximately 7 acres will be mowed in FY24.
    - An 18-acre coppice treatment (phase 2) of tree oak regeneration in the C-14 restoration area (PBMFA-North) was contracted in FY23 for completion in October 2023 (FY24). These coppice treatments are critical to restoring functioning pitch pine – scrub oak natural community and similar habitats. Selective methods are used including cutting all resprout stems from some stumps and sponge-wiping cuts with herbicide while other stumps will have all but one stem cut and no

herbicide applied. These treatments facilitate long-term habitat development, coupled with prescribed fire and have facilitated colonization by rare and listed barrens flora and fauna.

- Habitat maintenance of a 5-acre sandplain patch within PBMFA – MPMG area is planned in order to maintain essential mosaic habitat including woodland openings of grassland and heathland within pine barrens to support a number of listed species. The area is known as Demo-1 and was the site of a major restoration effort in 2004. It may provide an effective expansion site for rare plants, including *Scleria pauciflora*.

- **Rare species and mitigation outreach:** while outreach for rare species is not required or discussed in the CMP, other than contractor education, public outreach on rare species is important for long-term support of conservation efforts at Camp Edwards and elsewhere, including mitigation efforts.
  - **Camp Edwards Tours** – Base-wide Camp Edwards tours remain well attended and received. Mission activities and habitat conservation are the primary topics, including extensive discussion of rare species, habitat needs, and ongoing mitigation efforts under the CMP. These tours have garnered notable interest in listed fauna and early successional habitat. FY23 tours averaged 1.5 per month from May through October.
  - **Grassland Bird Tours** – MAARNG hosted six public tours in May and June of 2023 focused on localized specialties of sandplain grassland habitat at Camp Edwards. These have long been productive outreach with the public and bird enthusiasts for both grasslands habitat conservation and military conservation.
  - **Public presentations** – MAARNG personnel gave multiple other public or wide audience outreach presentations focused on state-listed species and rare habitat management during FY23. Population trends for bird Species of Greatest Conservation Need at Camp Edwards were presented at the Cape Cod Natural History Conference along with a poster detailing Aggassiz's Clam Shrimp conservation and natural history. We hosted a MA Butterfly Club tour and discussion of Camp Edwards management, including a survey for Acadian Hairstreak Butterflies (*Satyrium acadica*), which is proposed for state-listing, and other barrens specialties. A variety of other small talks and engagements occurred through the year. All such outreach events focused on the importance and benefits of rare species conservation and habitat management with particular focus on pine barrens and sandplain grasslands.

Grassland bird tours at Camp Edwards are highly popular with bird enthusiasts and the general public. They are an exceptional outreach opportunity to engage about rare species and habitat management, including the keys to grassland management of fire, mowing, and herbicide. These tours are often people's first introduction to fire ecology, habitat management concepts, and species like the Grasshopper Sparrow. *Jake McCumber*



Camp Edwards mitigation implementation (habitat restoration and management) from 2019 through 2023, including ongoing and planned 2024 efforts. Mitigation areas from the Conservation and Management Permit are shown in bold outlines. Habitat management efforts outside mitigation areas are not shown.

APPENDIX G
RARE SPECIES REPORTED TO NATURAL HERITAGE AND ENDANGERED SPECIES PROGRAM

Appendix G - LIST OF RARE SPECIES REPORTED TO NHESP												
Quantities shown are not resulting of standardized surveys and should not be interpreted as population trends.												
			Individuals Reported									
Common/Scientific Names	**Fed Status[1]**	**State Status[2]**	**TY 2014**	**TY 2015**	**TY 2016**	**TY 2017**	**TY 2018**	**TY 2019**	**TY 2020**	**TY 2021**	**TY 2022**	**TY 2023**
BIRDS												
Grasshopper Sparrow[3] *(Ammodramus savannarum)*	-	T	26	23	16	15	16	20	34	36	29	30
Northern Harrier[4] *(Circus cyaneus)*	-	T	12	Wintering	Wintering	Wintering	Wintering	Wintering	Wintering	Wintering	Wintering	Wintering
Upland Sandpiper[5] *(Bartramia longicauda)*	-	E	2	4	9	8	7	12	6	2	1	4
Eastern Meadowlark[3,5] *(Sturnella magna)*	-	SC	1	0	8	3	2	7	14	17	9	21
Long-eared Owl[4] *(Asio otus)*	-	SC	1	0	0	0	0	0	0	0	0	0
Vesper Sparrow *(Pooecetes gramineus)*	-	T	1	0	0	0	0	0	0	0	0	0
Whip-poor-will[6] *(Antrostomus vociferous)*	-	SC	156	96	87	52	110	53	99	136	137	105
Bald Eagle[4] *(Haliaeetus leucocephalus)*	-	SC	0	3	0	0	0	0	0	0	0	0
REPTILES and AMPHIBIANS												
Eastern Box Turtle *(Terrapene carolina carolina)*	-	SC	15	13	38	42	43	58	45	83	62	96
Eastern Hog-nosed Snake *(Heterodon platirhinos)*	-	SC	0	0	2	3	8	9	1	2	6	7
PLANTS												
Adder's Tongue Fern[8] *(Ophioglossum pusillum)*	-	T	1467	256	98	247	0	25	646	N/A	225	215

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Common/Scientific Names	**Fed Status[1]**	**State Status[2]**	**TY 2014**	**TY 2015**	**TY 2016**	**TY 2017**	**TY 2018**	**TY 2019**	**TY 2020**	**TY 2021**	**TY 2022**	**TY 2023**
Grass-leaved Ladies' Tresses *(Spiranthes vernalis)*	-	T	0	0	0	0	0	0	0	6	0	31
Broad Tinker's Weed[8] *(Triosteum perfoliatum)*	-	E	297	N/A	113	127	0	200	6	N/A	1883	3,161
American Arborvitae[9] (*Thuja occidentalis*)	-	E	0	0	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Stiff Yellow Flax (Linum texanum var. medium)	-	T	0	0	0	0	0	0	0	0	0	92
Papillose Nut-sedge (Scleria pauciflora)	-	E	0	0	0	0	0	0	0	0	0	41,081
BEETLES												
Purple Tiger Beetle (Cicindela purpurea)	-	SC	0	0	0	0	0	0	0	0	0	25
BEES												
Walsh's Anthophora[10] *(Anthophora walshii)*	-	E	0	0	0	5 (1)	0	32 (9)	4	N/A	1	9
BUTTERFLIES and MOTHS[11]												
Buck Moth (*Hemileuca maia*)	-	SC	4	13	90	95	0	4	2	74	133	23
Pine Barrens Speranza *(Speranza exonerata)*	-	SC	0	0	44	13	0	0	0	0	4	0
Sandplain Euchlaena *(Euchlaena madusaria)*	-	SC	0	0	3	7	0	0	1	0	0	0
Heath Metarranthis *(Metarranthis pilosaria)*	-	SC	0	0	1	1	0	0	0	0	0	0
Melsheimer's Sack Bearer *(Cicinnus melsheimeri)*	-	T	0	0	2	0	0	0	7	0	0	0

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BUTTERFLIES and MOTHS[11]												
Gerhard's Underwing *(Catocala herodias)*	-	SC	0	0	33	10	0	0	2	0	35	6
Pine Barrens Zale *(Zale lunifera)*	-	SC	0	0	13	8	0	0	0	0	0	0
Barrens Dagger Moth *(Acronicta albarufa)*	-	T	0	0	1	0	0	0	0	0	0	0
Sandplain Heterocampa *(Heterocampa varia)*	-	T				0	N/A	N/A	N/A	N/A	1	0
Chain-dotted Geometer *(Cingilia catenaria)*	-	SC	0	0	0	0	0	1	0	0	0	0
Drunk Apamea *(Apamea inebriata)*	-	SC	0	0	1	0	0	0	0	0	0	0
Pink Sallow *(Psectraglaea carnosa)*	-	SC	0	0	9	5	0	0	0	0	0	6
Pink Streak *(Dargida rubripennis)*	-	T	0	0	25	0	0	0	3	1	1	2
Collared Cycnia *(Cycnia collaris)*	-	T	0	0	0	1	0	11	33	200	7	4
Coastal Heathland Cutworm *(Abagrotis benjamini)*	-	SC	0	0	0	1	0	0	0	0	0	0
Woolly Gray *(Lycia ypsilon)*	-	T	0	0	0	2	0	0	0	0	0	0
Water-willow Stem Borer *(Papaipema sulphurata)*	-	T	0	0	0	1	0	0	0	0	0	0
Waxed Sallow Moth *(Chaetaglaea cerata)*	-	SC	0	0	0	2	0	0	0	0	0	0

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BUTTERFLIES and MOTHS[11]												
Frosted Elfin[12] *(Callophrys irus)*	-	SC	0	0	5	5	5	TBD	25	57	13	64
Slender Clearwing Sphinx *(Hemaris gracilis)*	-	SC	0	0	0	0	0	0	5	3	26	3
CRUSTACEANS[13]												
Agassiz's Clam Shrimp *(Eulimnadia agassizii)*	-	E	0	1	0	6	38	9	3	5	N/A	12
American Clam Shrimp *(Limnadia lenticularis)*	-	SC	0	0	0	0	0	0	0	3	N/A	0
MAMMALS												
Northern Long-Eared Bat[14, 15] *(Myotis septentionalis)*	T	E	8	22 (2)	15 (1)	2	1	3	1	TBD	N/A	0
Little Brown Bat[14, 16] *(Myotis lucifugus)*	UR	E	4	40	22	4	2	6	2	TBD	N/A	5
Tricolored Bat[14,16] (Perimyotis subflavus)	UR	E	11	11	7	3	2	3	1	TBD	N/A	3
Eastern Small-Footed Bat[14, 16] *(Myotis leibii)*[14, 16]	UR	E	0	0	0	0	0	1	1	TBD	N/A	0

[1] Federal Status: E = Endangered, T = Threatened, UR = Under Review (status assessment or listing determination ongoing)

[2] State Status: E = Endangered, T = Threatened, SC = Special Concern

[3] Grassland bird numbers represent individual territories observed in a given year rather than the total number of birds observed throughout repeated surveys as was reported in past years (prior to the TY 2019 SOTRR). Upland Sandpiper counts exclude known females, but include unknown birds. Also, the numbers reported in annual reports TY 2015 and earlier included birds found on the Coast Guard airfield, which is not reported by MAARNG Natural Resources. Due to these changes, past year quantities may be different from prior versions of Appendix G, but now reflect the population more accurately.

[4] NHESP is only accepting reports of nesting raptors, rather than opportunistic observations of individuals. Reports are provided as relevant, but common wintering birds or migrants are not individually tracked or reported (e.g., Northern Harrier).

[5] Species added to MA Endangered Species List in TY 2020. Observation quantities included for prior years but would not have been officially reported to NHESP.

[6] As of TY 2016, quantities only reflect the results of annual survey routes during May, after totaling the minimum number (between two observers) heard at each site. In prior years, the number shown reflects the quantity reported to NHESP, which may include multiple survey windows and repeated counts. Due to Covid-19 concerns, 2020 routes were not run in duplicate, and the number represents the total number of individual birds heard calling throughout the routes.

[7] In most years a subset of O. pusillum sites are surveyed. In 2023, the five known extant sites were surveyed. This needs to be considered if comparing total numbers accross years. In 2018, only sites with historic records and no recent records were surveyed, and this should not be interpreted as a loss of rare plants between 2017 and 2018. The total number of 2019 numbers are likely under representative, as surveys occurred late in the season.

[8] Triosteum perfoliatum surveys, starting in 2022, are carried out using recent findings from a genetics study that suggest that the two species of Triosteum on the base, the other non-rare T. aurantiacum, are the same genetically and should be treated as the rare T. perfoliatum. Totals for years previous to 2022 consist only of Triosteum individuals that showed certain identification features now not relied on.

[9] NHESP is not interested in tracking this population, as it is likely of anthropogenic origin (pers. comm. with State Botanist, Bob Wernerehl).

[10] MAARNG contracted a targeted survey for *Anthophora walshii* in 2019 after an exploratory bee survey in 2017. The first number represents the number of flying/foraging records, and in parentheses the records of nesting activity. Unconfirmed nests were not counted.

[11] Caterpillar clusters are reported as a single observation. Barrens Buckmoths received dedicated flight count attention in 2021 and 2022, thus the large increase in reported observations. Caterpillar clusters are reported as a single observation. Barrens Buckmoths received dedicated flight count attention in 2021 and 2022, thus the large increase in reported observations.

[12] MAARNG staff did not perform surveys for Callophrys irus in 2019, but facilitated USFWS surveys. Results are pending, but USFWS staff found Frosted Elfins across a wider area than was previously known.

[13] Counts represent the number of sites (i.e., puddles or pools) where clam shrimp were observed during annual surveys. Annual surveys include a subset of sites that have contained clam shrimp in the past, have not contained clam shrimp in the past, and that have not been surveyed previously.

[14] Acoustic monitoring collects “call sequence” data and the true number of individuals is unknown. Numbers in the table reflect the number of survey sites with acoustic detections confirmed through manual call vetting. Numbers are reported to NHESP, but not tracked by them due to current uncertainty in using acoustic identifications.

[15] Number in parentheses is captured individuals trackable by NHESP due to species identification confirmation versus acoustic data.

[16] "UR" indicates a species is currently under review for listing on the federal Endangered Species Act.

APPENDIX H
ENVIRONMENTAL PERFORMANCE STANDARDS VIOLATIONS HISTORY

EPS VIOLATIONS HISTORY			
TRAINING YEAR	REPORTED VIOLATION	EXPLANATION OF VIOLATION	CORRECTIVE ACTION
TY 2023	None	-----	-----
TY 2022	General Performance Standard	There was unauthorized use of yellow and white smoke grenades outside of the approved non-standard training plan. White smoke grenades were not approved for use; yellow smoke grenades were used in an unapproved location. The MAARNG reported the nonconformance to the EMC on March 31, 2022.	Full-time range and civilian staff were counseled on their failure to follow established processes for consultation and approval for any non-standard training event; staff were directed that only written non-standard training plans, signed by the EMC EO and the MAARNG representative will be executed, and no verbal authorizations will be authorized. Refresher training was conducted with part-time staff to ensure compliance.
TY 2021	Range Performance EPS (EPS 19)	Additional targets were placed on the 25-meter line on Sierra Range. Transition firing was conducted on Echo Range. No consultation for approval was conducted with Camp Edwards Plans and Training, the Environmental & Readiness Center and the EMC's Environmental Officer. The MAARNG reported the nonconformance to the EMC on February 18, 2021.	Full-time Range Control staff were counseled on the importance of following established processes of consultation and approval for any non-standard training event; the Range Control maintenance manager was directed that he shall not alter or install additional targets on a range unless there is an approval in writing or the range is being prepared for an approved proof of concept for a future training event; OIC formalized non-standard training requests (exceptions to policy) in a Standard Operating Procedure; full-time Range Control staff was retrained; and those personnel involved in approving the non-standard training were given written counseling. In addition to corrective actions instituted by the MAARNG, the EMC required that the full-time Range Control staff undergo annual training on EPS 19.0 and the BMPs and OMMPs; newly assigned Range Control staff undergo training on EPS 19.0 and the BMPs and OMMP prior to being given authority for operational control of the small arms ranges; documenting the corrective actions and additional EMC requirements in Camp Edwards Operations and Training Regulation 350-2 and forwarding that to the EMC for review.
TY 2020	Training Area Fire Management EPS (EPS 11)	Three burn barrels (55-gallon drums) were found at SVLs 1 and 2. The MAARNG reported the nonconformance to the EMC on October 25, 2019.	All full-time and Mobilization Day staff are instructed to review Training Area Clearing processes and be re-briefed on guiding regulations and standards that apply to the Training Area/Reserve. Clear and obvious signage stating that open burning is prohibited has been posted at Range Control. The Camp Edwards Operations and Training Regulation

			350-2 has been updated to clearly state the requirement for clearing training areas and that open burning is prohibited on Camp Edwards.
TY 2019	General Performance Standard	Three L600 M119 whistling booby trap simulators were used; they are not on the approved munitions list and were not authorized for use. The MAARNG reported a nonconformance to the EMC on September 17, 2019.	All levels: command, units training and the ASP will be provided a list of items permanently and temporarily authorized for a particular training event. The ASP will make a change in their ammunition reservation program that will not allow unauthorized ammunition or simulators to be reserved. Camp Edwards Range Control will do a final munition check as units check in for their reserved training area or venue.
TY 2018	Rare Species EPS (EPS 3)	A road puddle containing state-listed Agassiz clam shrimp was filled by a unit training at Dig Site 1. The MAARNG forwarded a formal notice of violation to the EMC on May 16, 2018.	Camp Edwards will, after relocation of the clam shrimp and in concert with the CMP, fill the puddles, use signage to avoid infilling of relevant puddles, and educate users as to how they are supposed to coordinate with Camp Edwards before taking actions outside of their training plan while in the Training Area/Reserve.
TY 2017	None	-----	-----
TY 2016	General Performance Standard	Eight thousand paintball rounds were fired by a unit on the IMT range (Dig Site 3) without permission or prior coordination. The MAARNG forwarded a formal notice of violation to the EMC on November 9, 2015.	Unit soldiers cleaned and cleared the area of debris, discussion of the seriousness of the violation with the Unit Commander and told of actions needed for compliance when wanting to train with any unapproved munition. Camp Edwards staff conducted a Range Officer in Charge and Range Safety brief audit to validate content and effectiveness. Range Control staff will conduct assessments of units while they are training in the Training Area/Reserve to ensure activities are within established performance standards.
TY 2015	Vehicle Performance Standard EPS (EPS 17)	A pickup truck was driven into, off road, and placed in Training Area BA-7 as a temporary training aid. The MAARNG forwarded a formal notice of violation to the EMC on June 5, 2015.	Camp Edwards staff conducted a Range Officer in Charge and Range Safety brief audit to validate content and effectiveness. Range Control staff will conduct assessments of units while they are training in the Training Area/Reserve to ensure activities are within established performance standards.
TY 2014	None	-----	-----