# STATE OF THE RESERVATION REPORT

TRAINING YEAR 2022• CAMP EDWARDS
FINAL

Final Annual State of the Reservation Report, Camp Edwards, Training Year 2022
March 2023

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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 2022, which ran from October 1, 2021 to September 30, 2022; therefore, information provided in this report generally encompasses an individual training year rather than calendar year. The 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 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 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 2022. Data is 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 2022 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 of the Acts of 2002 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 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 2022 (October 1, 2021 – September 30, 2022).

### 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.

### 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 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 2022. 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

# TABLE OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

# LIST OF GRAPHS

# 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 |
| 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 |
| CSE | Comprehensive Site Evaluation |
| CSCRMP | Clam Shrimp Conservation and Roadway Maintenance Plan |
| 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 |
| EMC | Environmental Management Commission |
| EPA | Environmental Protection Agency |
| EPR | Enhanced Performance Round |
| EPS | Environmental Performance Standard |
| FS | Fuel Spill |
| HMMWV | High Mobility Multipurpose Wheeled Vehicle |
| 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

| | |
|---|---|
| JBCC | Joint Base Cape Cod |
| LQG | Large Quantity Generator |
| MANG | Massachusetts National Guard |
| MAANG | Massachusetts Air National Guard |
| MAARNG | Massachusetts Army 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 |
| 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 |
| ROTC | Reserve Officers Training Corps |
| SAC | Science Advisory Council |
| SDZ | Surface Danger Zone |
| SGCN | Species of Greatest Conservation Need |
| SFS | Space Force Station |
| SR/ES | Source Registration/Emissions Statement |
| SVL | Soldier Validation Lane |

## Acronyms, continued

| | |
|---|---|
| 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).

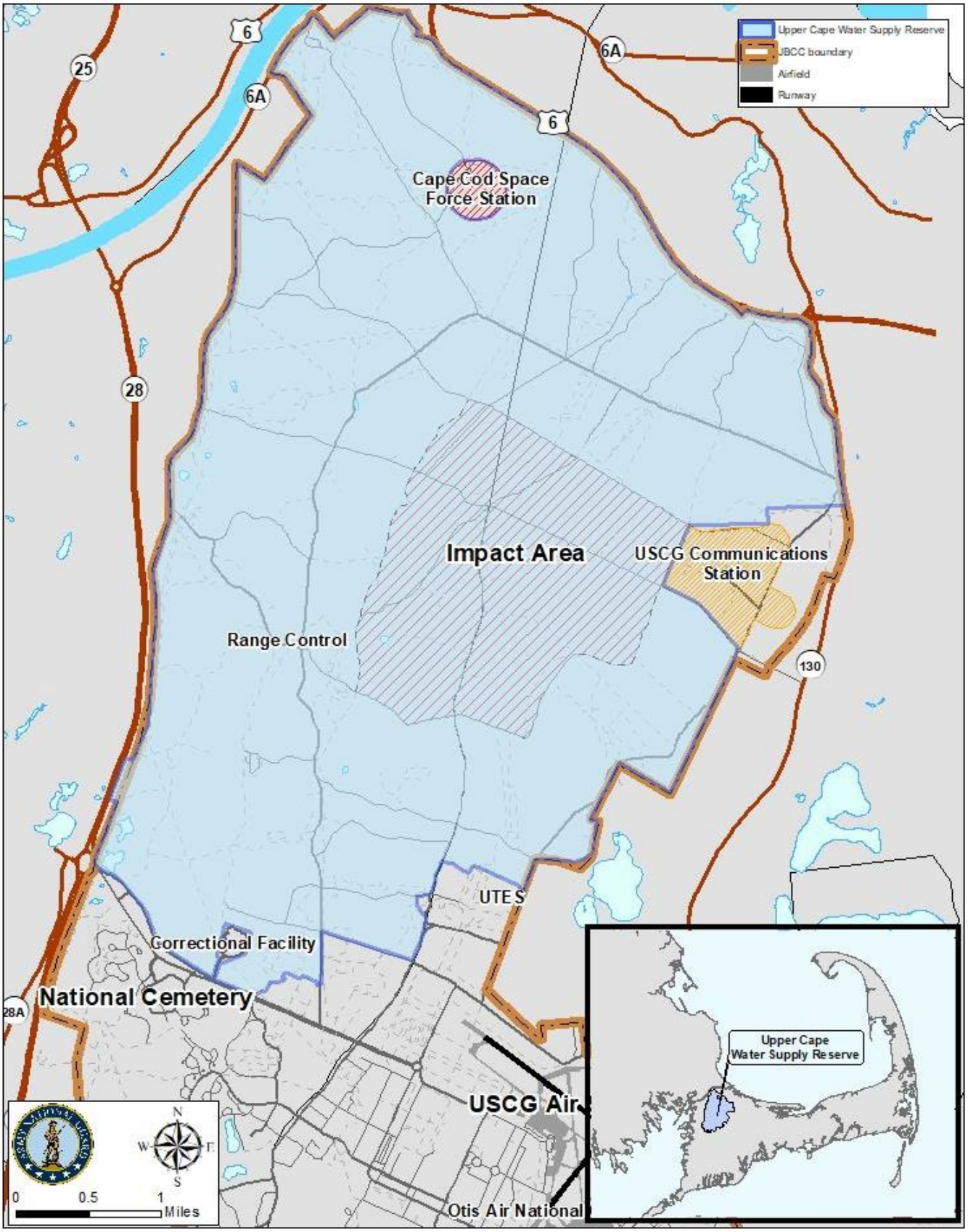
The Camp Edwards Training Area comprises 14,886 acres of the northern portion of JBCC. The remaining Camp Edwards military-controlled area of JBCC lies in the southern portion, or Cantonment Area. The Commonwealth of Massachusetts owns the land comprising Camp Edwards and leases the property to the Department 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 just north of Connery Avenue, just outside 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

Figure 1-1 Map of Joint Base Cape Cod



Grid), and a natural gas pipeline easement (Algonquin - that partially overlays the National Grid easement). 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 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 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.

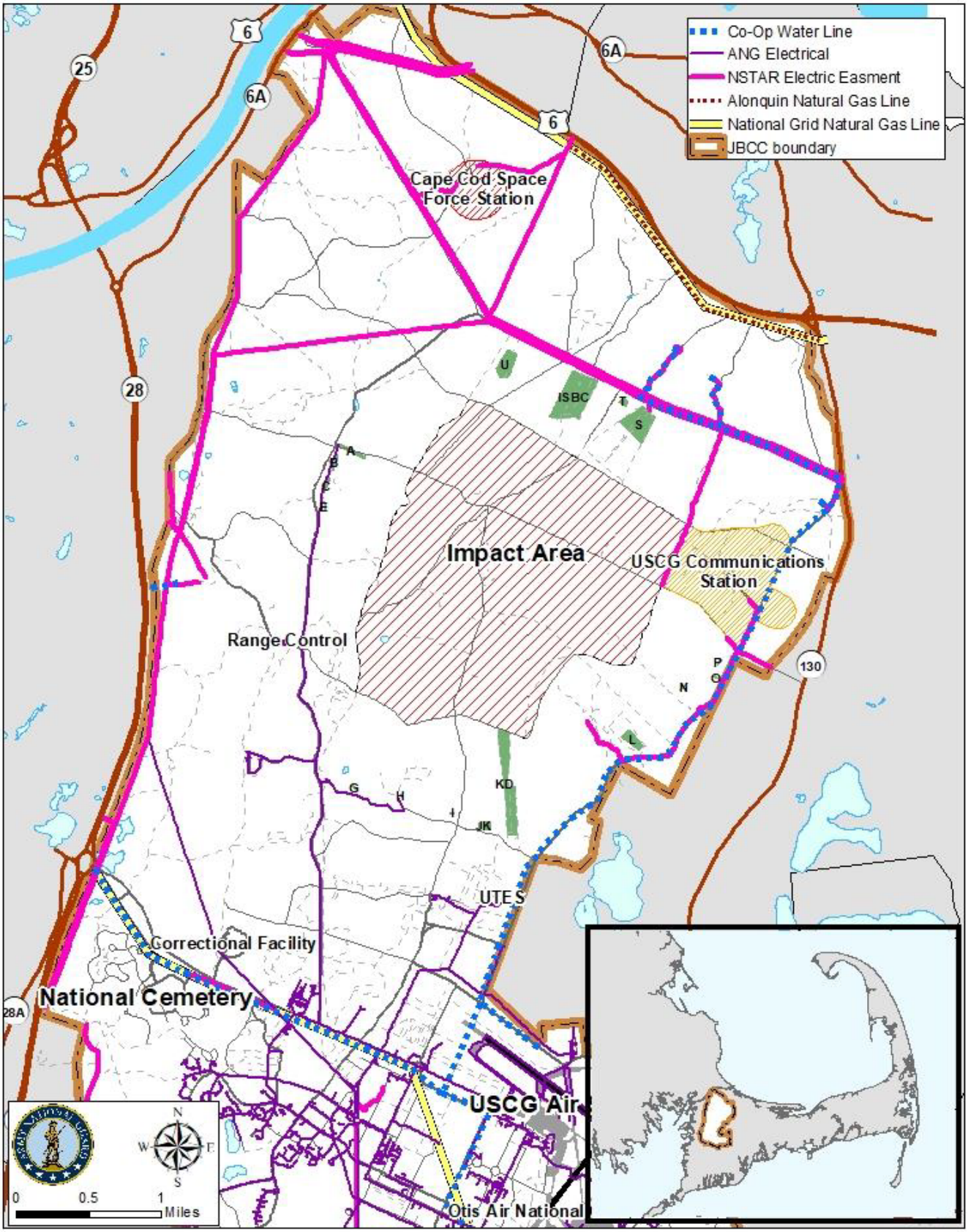
Chapter 47 of the Acts of 2002 also directed that the EMC be assisted by two advisory councils, appointed by the Governor of Massachusetts. The Community Advisory Council (CAC), consisting of 15 members, assists the EMC by providing advice on issues related to the protection of the water supply and wildlife 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.

Chapter 47 of the Acts of 2002 also established an Environmental Officer for the Training Area/Reserve. Mr. Leonard Pinaud of MassDEP is the Environmental Officer. In this capacity, he 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. He 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. His 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. He 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. He also participates in community outreach activities with the E&RC and facilitates the EMC, SAC and CAC public meetings under the legislation.

During TY 2022, the SAC met in June and September, and the CAC met in June. The EMC met in July 2022. The advisory councils discussed a number of topics, all of which are covered in this report. In November 2017, an Ad Hoc Committee to the Science Advisory Council was established. At the EMC meeting in July 2022, the SAC Ad Hoc Committee was extended for two years to 2024. Please see Section 2.2 for further discussion. Minutes from the meetings may be found at https://www.mass.gov/info-details/environmental-management-commission-emc

Figure 1-2 Utility Easements and Leases



# 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, the Soldier Validation Lane (SVL), and off-site training during TY 2022.

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 phase 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 5,789 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 2021) to the year of execution (TY 2022) units confirm geographical areas and training sites within the Training Area/Reserve.

Military training activities in the Training Area/Reserve are tracked by 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. Figure 2-1 shows the locations of the major training areas and small arms ranges in the Training Area/Reserve.

Camp Edwards Range Control manages and tracks training area use. For example, Table 2-1 shows the overall utilization of the ranges, training areas and training support areas during TY 2022, while Table 2-2 shows their utilization for each of the past ten training years. For specific training area use for TY 2022 see Table 2-3 and for the ten-year totals for training area use see Table 2-4. Range Control is operational 24 hours per day when units are training and, during the course of 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 2-2 shows color-coded personnel use by training area for TY 2022. Figure 2-3 shows a color-coded personnel use by training area for each of the past ten training years. Figure 2-4 provides a color-coded ten year personnel use by training for the past ten training years. Figure 2-5 shows color-coded daily usage by training area for TY 2022. Figure 2-6 shows a color-coded daily usage by training area for each of the past ten training years with Figure 2-7 providing a color-coded ten year daily usage by training area for the past ten training years. For example, as seen in Figure 2-7, training areas B-8 was not used and B-9 was lightly used, and area B-11 shows a high use; this is a result of the closing and opening of the B-8 and B-9 training areas due to the proximity to the Monument Beach Sportsman's Club's (Club) firing range. These training areas are within the Surface Danger Zone (SDZ) for the Club's rifle range and therefore are closed when the Club's range is operational. An SDZ is a notional, undisturbed safety area extending out from a small arms range where there is a one-in-a-million chance that a bullet may land. The MAARNG and the Club coordinate schedules to ensure safety of Soldiers and Club members.

Graph 2-1 shows personnel use by training area for TY 2022 and the average personnel use by training area for TY 2013 to TY 2022; Graph 2-2 shows days used by training area for TY 2022 and the average days used by training area for TY 2013 to TY 2022. Use of specific training areas is dependent upon its capacity to hold Soldiers, its terrain to support a given training exercise, and restoration of training venues through the cleanup and the Integrated Training Area Management (ITAM) programs. Over the last several years training has focused on collective exercises where training areas that can support these training events are used.

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 will increase. Fluctuations in training usage is also largely influenced by deployment cycles and changes to training doctrine and directives. 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 new ranges, training venues, and 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 2022. 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 differing unit training requirements, combined training needs, and deployment cycles.

TABLE 2-1 OVERVIEW OF TRAINING USE - TY 2022

| | | PERSONNEL | |
|---|---|---|---|
| **Area** | **Training Days/Events** | **Military Personnel** | **Civilian Personnel** |
| Ranges | 181 | 7,558 | 62 |
| Training Areas | 1,088 | 56,246 | 526 |
| Training Support Areas | 2,625 | 83,499 | 11,551 |
| **TOTAL** | **3,894** | **147,303** | **12,139** |

Figure 2-1 Camp Edwards Training Area and Ranges

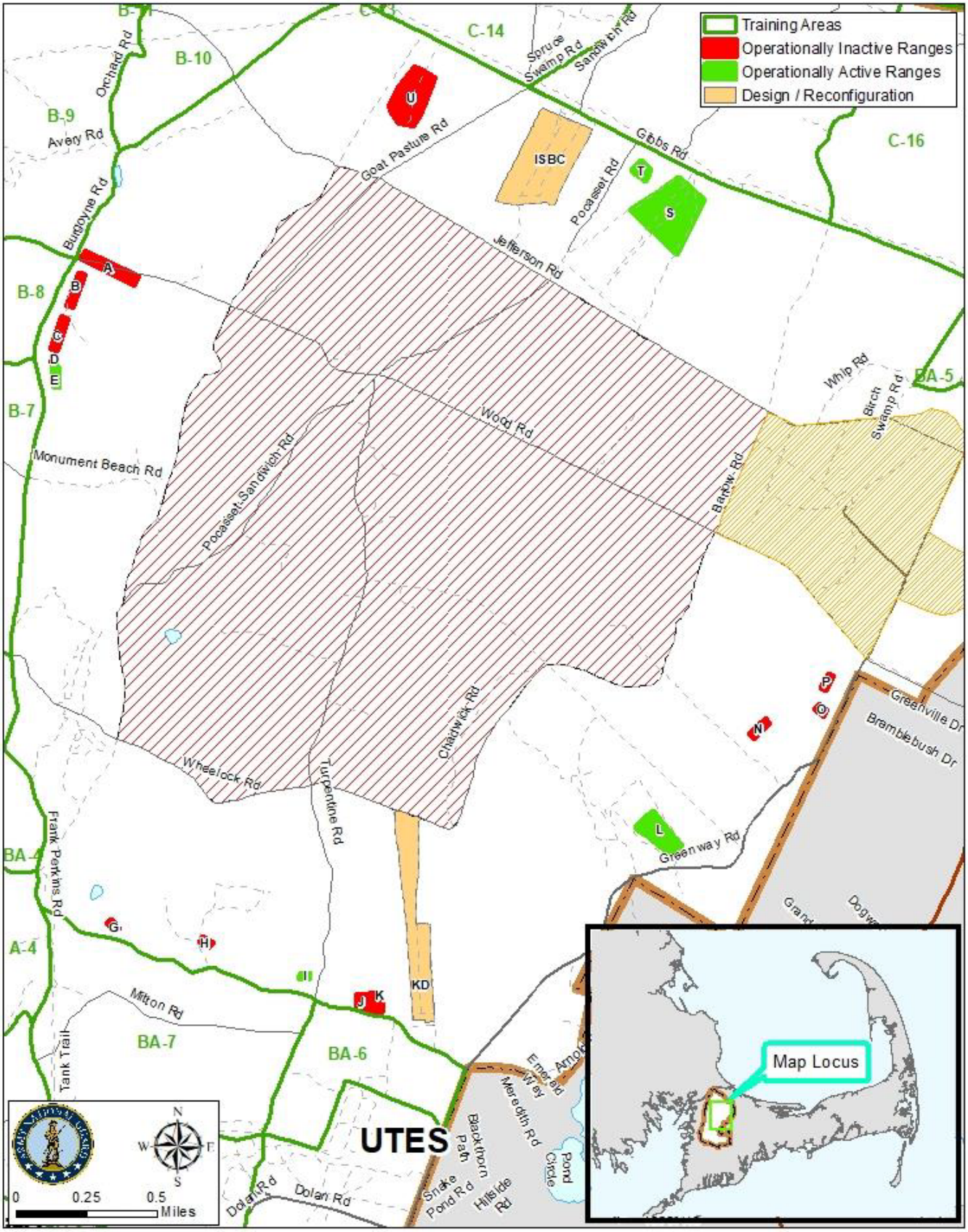


Figure 2-2 Personnel Usage by Training Area in the Training Area/Reserve, TY 2022

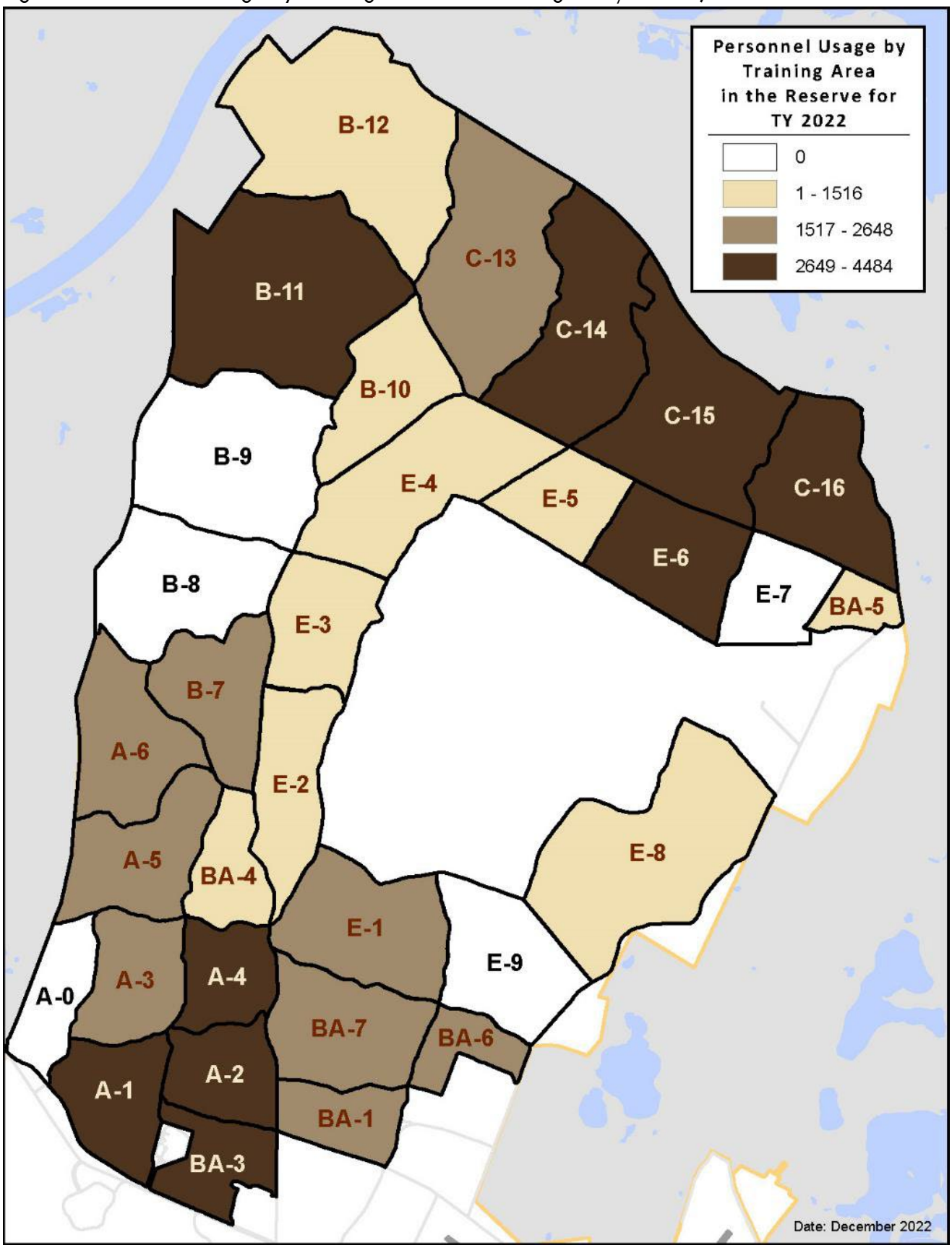
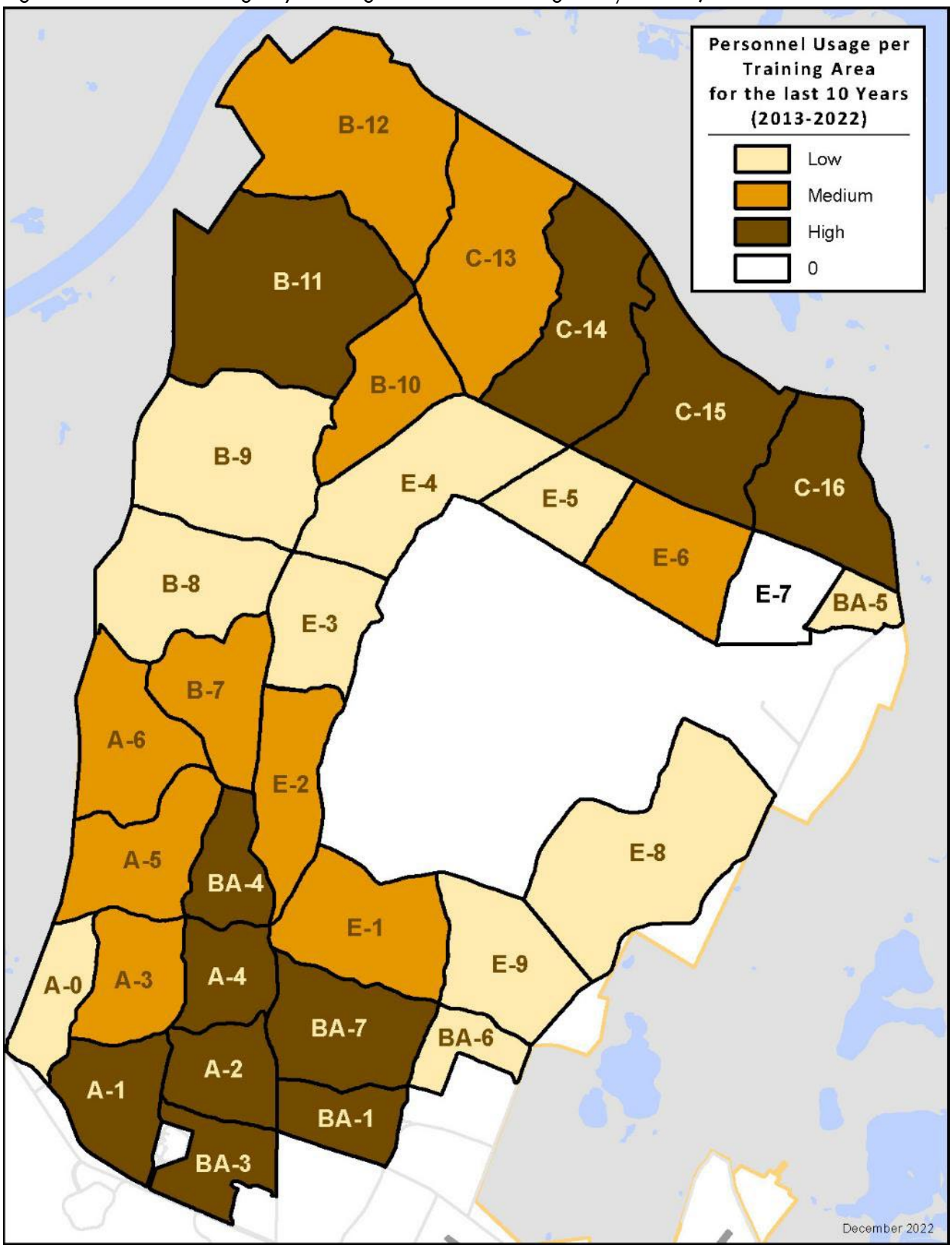
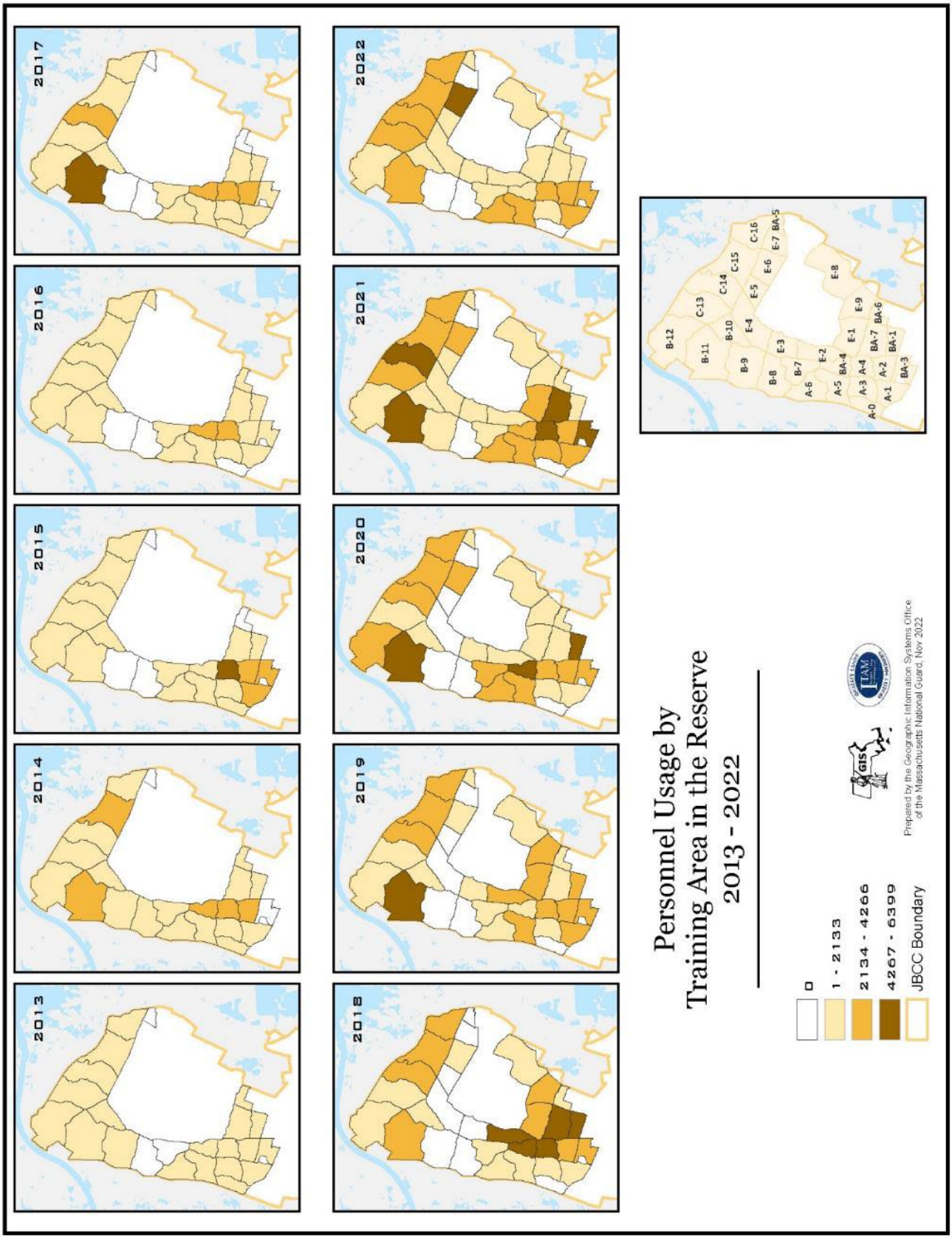


Figure 2-3 Personnel Usage by Training Area in the Training Area/Reserve, TY 2013 – TY 2022




**Low=169-8,363 personnel, Medium=8,364-19,418 personnel, High=19,419-39,769 personnel**

Figure 2-4 Ten Year Personnel Use by Training Area in the Training Area/Reserve, TY 2013 - TY 2022




Note: Prior to 2018, the E training areas were not available for use and are not delineated in the 2013 to 2017 graphics.

Figure 2-5 Daily Usage per Training Area in the Training Area/Reserve, TY 2022

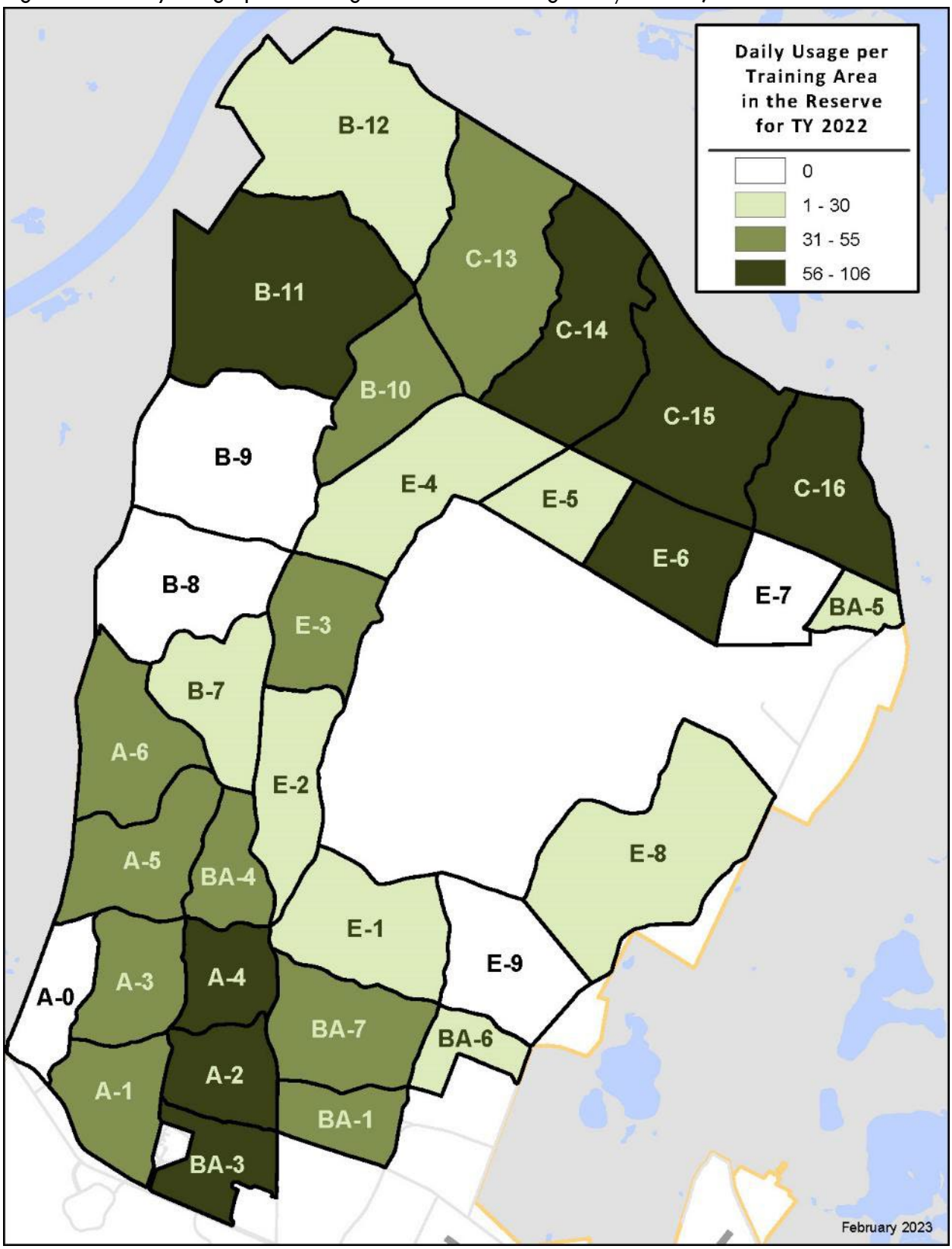
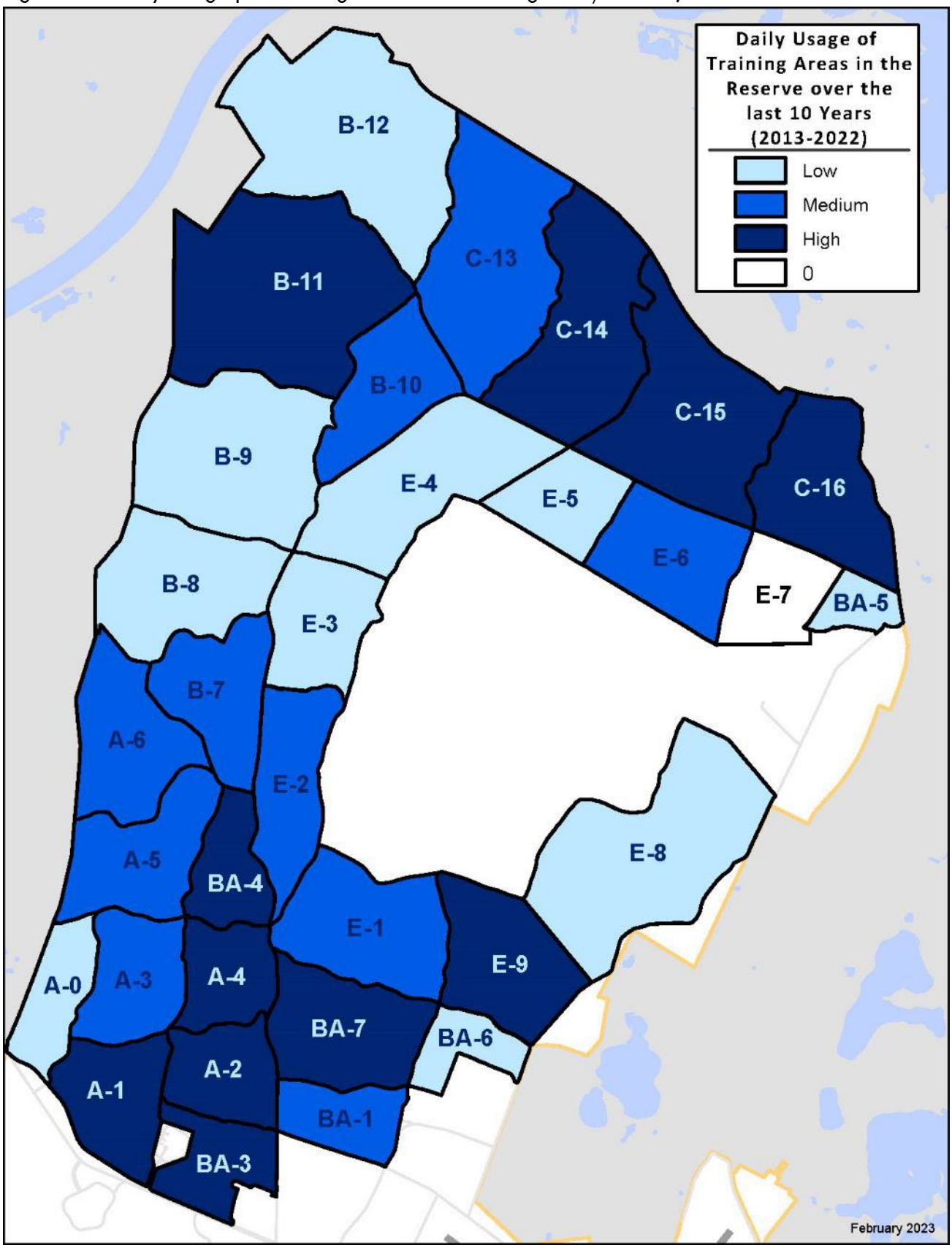
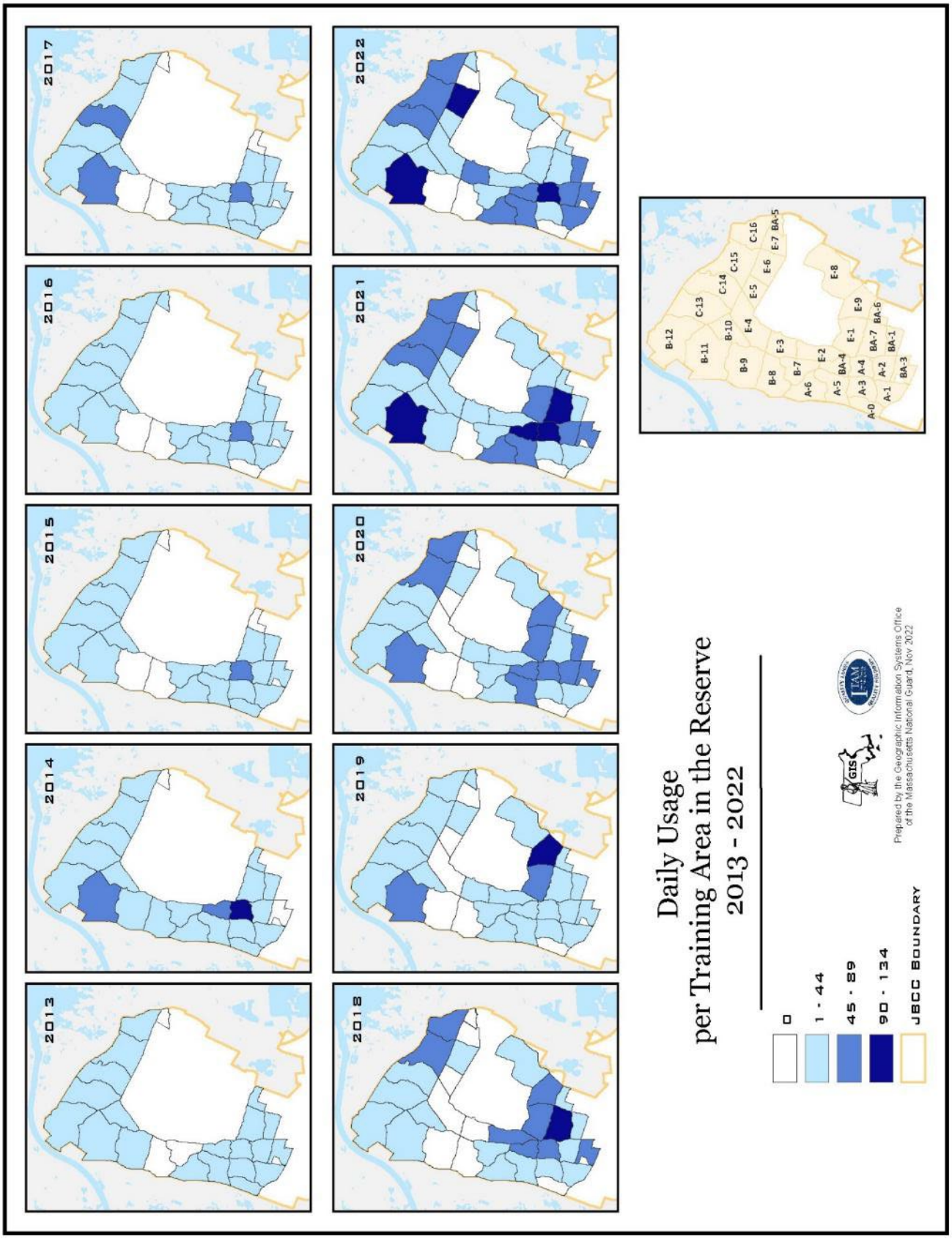


Figure 2-6 Daily Usage per Training Area in the Training Area/Reserve, TY 2013 – TY 2022



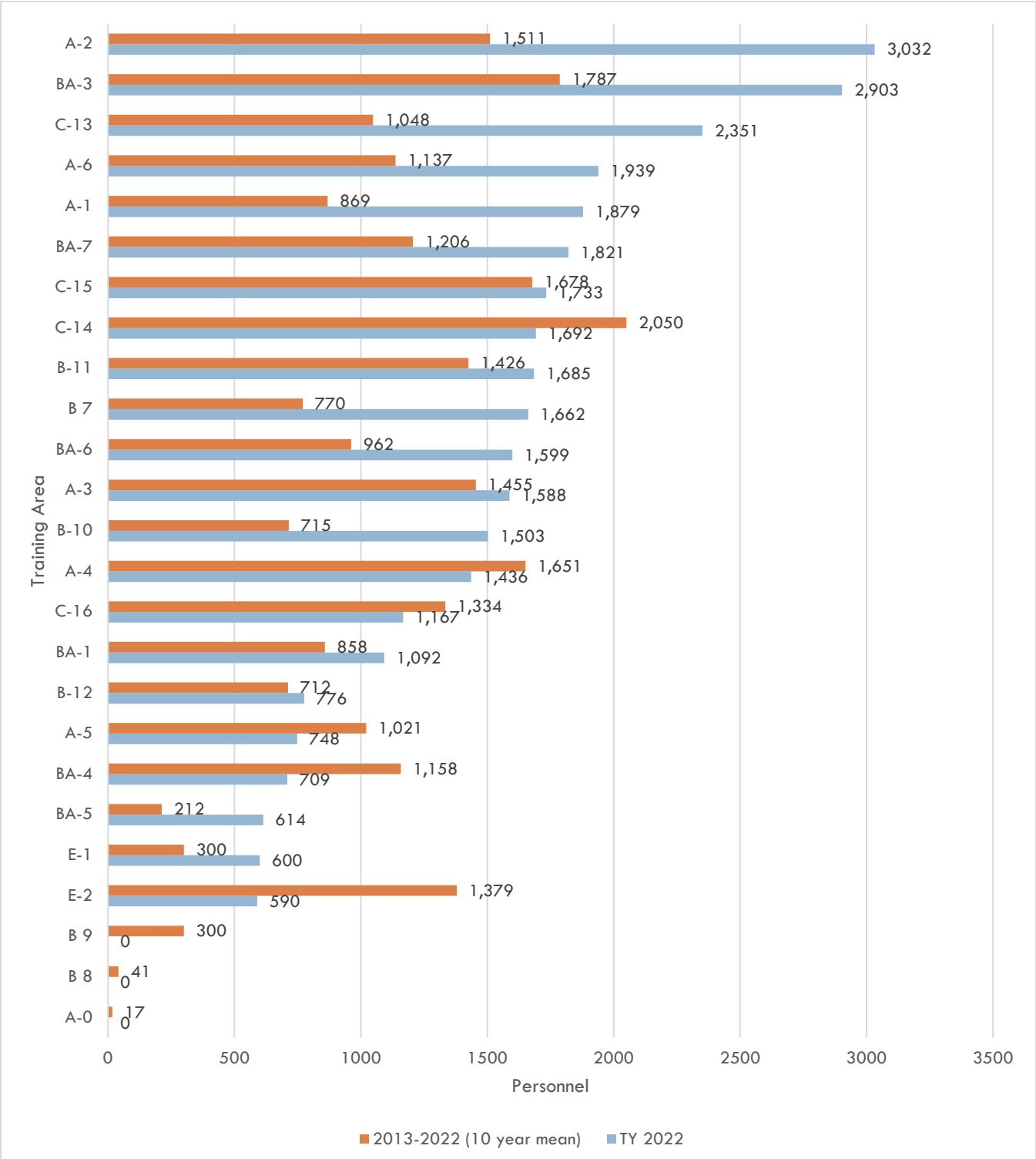

**Low=4-113 days, Medium=114-307 days, High=308-706 days**

Figure 2-7 Ten Year Daily Usage by Training Area in the Training Area/Reserve, TY 2013 – TY 2022




Note: Prior to 2018, the E training areas were not available for use and are not delineated in the 2013 to 2017 graphics.

Graph 2-1 Personnel Use by Training Area



Graph 2-2 Days Used by Training Area

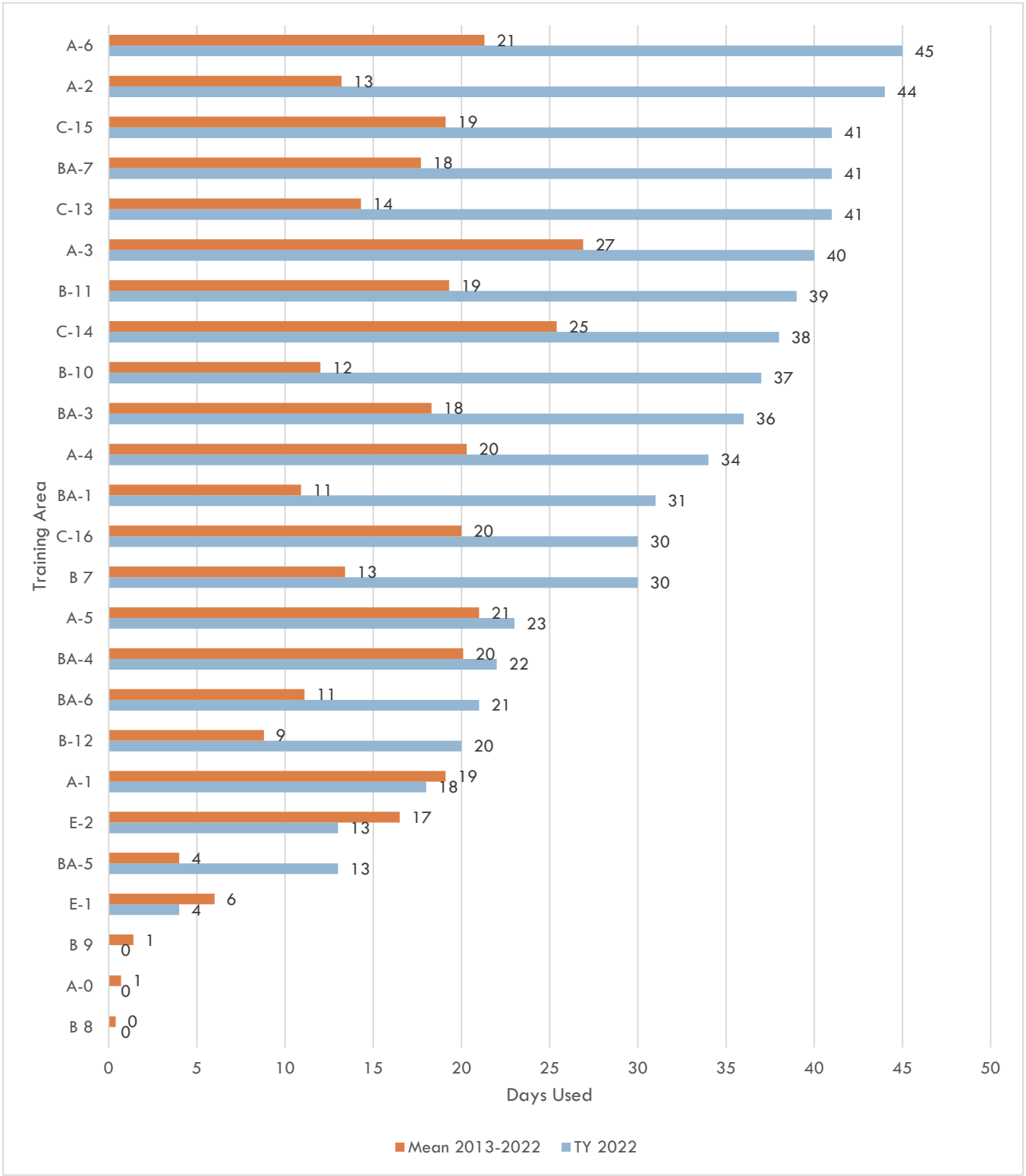


TABLE 2-2 TRAINING USE HISTORY

| Training Year | Training Days/Events | Military Personnel | Civilian Personnel |
|---|---|---|---|
| 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 |
| TY 2013 | 1,052 | 46,361 | 1,650 |
| **TOTAL** | **24,816** | **1,180,160** | **51,197** |

In the table above, civilian usage numbers in TY 2019-2022 are higher than in past training years; this is due in part to the Cape Cod Police Academy's use of Camp Edwards facilities over the past four years as well as a Federal Emergency Management Agency training that took place in TY 2019.

## 2.2 SCIENCE ADVISORY 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, such as 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 committee did not meet during TY 2022. At the SAC meeting in September 2022, the MAARNG brought forward several potential topics, including monitoring, lysimeter placement and soil sampling locations, that may be discussed at future SAC Ad Hoc Committee meetings.

## 2.3 RANGE UPDATE

The current operational active small arms ranges on Camp Edwards are Sierra, India, Lima, Echo, and Tango ranges. Juliet and Kilo ranges are currently operational inactive as their STAPP™ systems have been dismantled (see Section 2.4.2). 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. 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 EO. The pre, post, and detailed inspection form has been revised for the OMMPs in March 2022.

From the monitoring of the small arms ranges, it has been shown that there are no exceedances of the OMMP action levels in soil or ground water at the ranges. For porewater (lysimeters) there have been exceedances of the OMMP action levels for antimony (Sb) at ranges using legacy soil for backstop berms. Those ranges include

India, Juliet, Kilo, and Tango Ranges. There were no porewater exceedances at the firing line or mid-range lysimeters. For discussion on Sb exceedances on the ranges see Section 2.8.1.

## 2.4 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. To safely use Tango Range, target and firing lines were moved 25 meters north to move them out of the SDZ of the adjoining Sierra Range, such that both ranges can be used simultaneously. Soldiers zero their weapons at Tango Range and then move to the adjacent Sierra Range to conduct weapons qualification.

At the July 19, 2022, EMC meeting the MAARNG requested that the EMC authorize its Environmental Officer to approve the redesign and rewrite of the OMMP for the redeveloped Tango Range at Camp Edwards. The EMC voted to authorize the EMC EO to take those actions. In a September 6, 2022, letter, the EMC EO approved the Tango Range Design Plans and the Tango Range OMMP, and the range is operational.

### 2.4.1 Range Maintenance and Sampling

A list of Range Control's inspection activities at Tango Range in TY 2022 is included in Appendix C.

In October 2022, groundwater and surface soil samples were collected from Tango Range as prescribed in the OMMP. 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 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 2022 are available in Appendix C. A lysimeter is planned to be installed on Tango Range for 2023.

## 2.5 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.

### 2.5.1 Range Maintenance and Sampling

Maintenance activities during TY 2022 at Sierra Range included filling bullet pockets in the berms. A list of Range Control's inspection and maintenance activities at Sierra Range in TY 2022 is included in Appendix C.

In October 2022, groundwater, porewater, and surface soil samples were collected from Sierra Range as prescribed in the OMMP. 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 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 2022 are available in Appendix C.

## 2.6 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.

### 2.6.1 Range Maintenance and Sampling

At India Range, maintenance activities included repairing and filling bullet pockets. A list of Range Control's inspection and maintenance activities at India Range in TY 2022 is included in Appendix C.

In October 2022, groundwater, porewater, and surface soil samples were collected from India Range as prescribed in the OMMP. 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 to show no exceedance of the Action Levels specified in the OMMP. For porewater there was an action level exceedance (6 ppb) for antimony at 7.8 ppb. This exceedance is consistent, slight decrease, with past exceedances for this lysimeter. Porewater antimony action level exceedances are discussed in Section 2.8.1.

A figure showing the monitoring wells, lysimeters and soil sampling locations on India Range and the sampling results for TY 2022 are available in Appendix C.

## 2.7 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.

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.

### 2.7.1 Range Maintenance and Sampling

Maintenance activities included repairing bullet pockets on the backstop berm. Bullets Pockets are repaired by the addition and or by moving soil from beneath the pocket back into the bullet pocket. Berms and bullet pockets are inspected prior to and after each use. Bullet pocket harvesting has not been identified as being needed at this date. The MAARNG coordinates with the EMC with regards to berm maintenance and projectile harvesting. A list of Range Control's maintenance and inspection activities at Echo Range in TY 2022 is included in Appendix C.

In October 2022, 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 action level exceedances for soil or groundwater. There are no lysimeters on Echo range.

A figure showing the monitoring well and soil sampling locations on Echo Range and the sampling results for TY 2022 are available in Appendix C.

## 2. 8 JULIET AND KILO RANGES

The Juliet Range and Kilo Range STAPP™ systems (installed to capture and contain lead ammunition) were dismantled in Fall 2020. Lead rifle ammunition is no longer authorized for most MAARNG units, and it is not authorized for use at Camp Edwards, which is why Juliet and Kilo ranges, with their associated STAPP™ systems, are no longer required. Juliet and Kilo Ranges are now in operational inactive status. Annual sampling continued in 2022 for those ranges (see Section 2.8.1). For 2023, monitoring of these ranges will be conducted by the IAGWSP and reported as required. These ranges will not be presented in the 2023 Sate of the Reservation Report.

### 2.8.1 Range Sampling

Juliet and Kilo Ranges are now in operational inactive status. Sampling of porewater on the ranges continued in 2022.

In October 2022, porewater and groundwater samples were collected from the Juliet and Kilo ranges per the OMMP. 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 groundwater analyses continue to show no trends or significant concentrations when compared to the Action Levels specified in the OMMPs and as compared to background levels. Porewater results indicate an exceedance of the Action Level (6 ppb) for antimony in a lysimeters on Kilo Range (11 ppb). Figures showing lysimeter locations and data are available in Appendix C. Of note lysimeter 3 on Juliet Range was damaged during the STAPP system removals and is no longer available for sampling

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

Another 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 Appendix C.

## 2.9 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.

### 2.9.1 Range Maintenance and Sampling

Maintenance activities included fixing the bunker targets. The MAARNG has replaced the posts and netting used on Lima Range to contain the 40 mm practice rounds with two six-foot-concrete block berms. The block berms will be a more permanent and easily managed for the capture and recovery of the rounds. A list of Range Control's inspection and maintenance activities Lima Range in TY 2022 is included in Appendix C.

In October 2022 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 2022 are available in Appendix C.

## 2.10 RANGE USAGE DATA

A total of 1,861,266 rounds of copper ammunition has been fired at Camp Edwards since its use was approved: 1,159,915 at Sierra Range, 610,332 at India Range, and 56,946 at Tango Range. The total number of copper ammunition rounds fired includes 14,098 at the inactive operational ISBC Range, which was used for two approved, non-standard training events in June and July 2022; and 19,975 rounds fired on Echo range during two non-standard training events in TY 2021. Graph 2-3 provides a summary of copper ammunition fired at Sierra, India and Tango ranges since use of copper ammunition was approved at them. The graph shows an upward trend in copper ammunition use. During TY 2020, the MAARNG transitioned to all copper-based rifle ammunition. Information on the number of copper ammunition fired on Sierra, India, and Tango ranges each training year from 2013 through 2022 is provided in Appendix C.

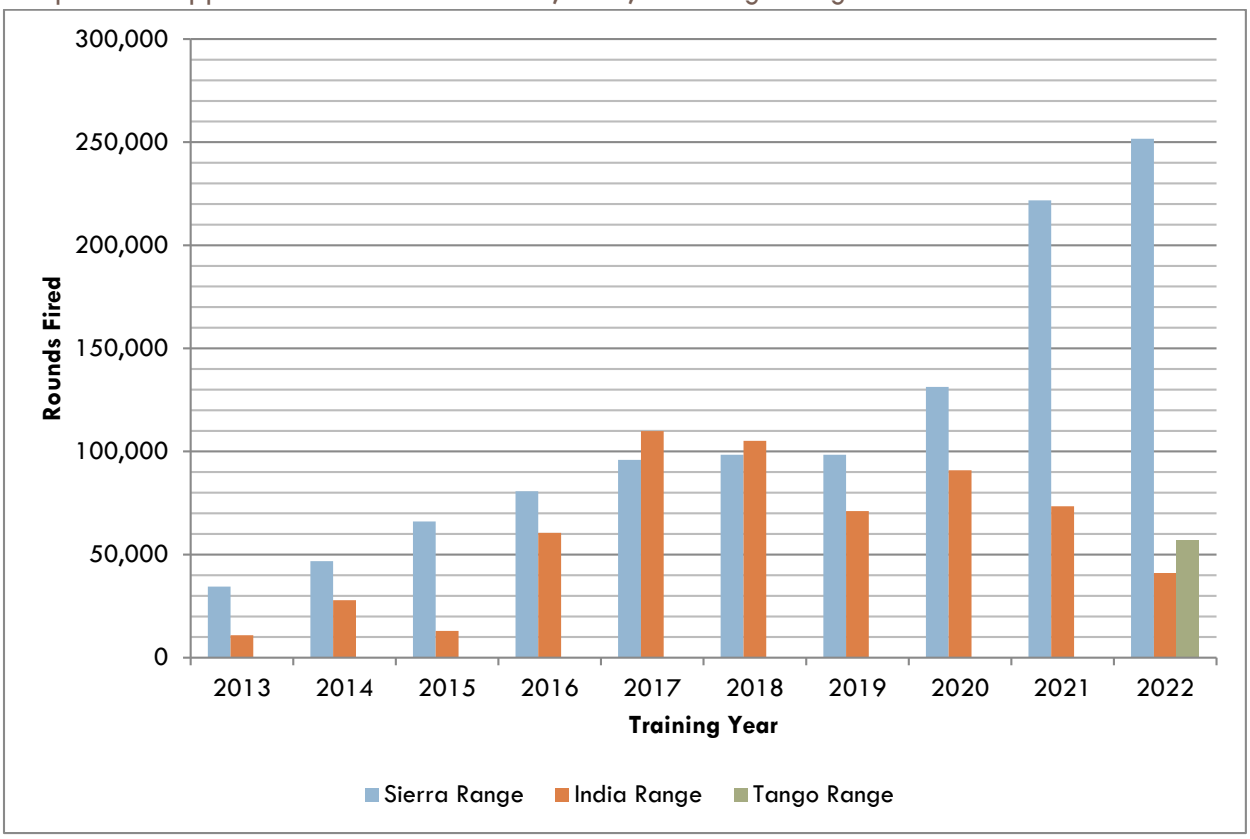
A total of 11,641 M781 40mm Training Rounds have been fired at Lima Range since its use was approved. Graph 2-4 provides information on the number of M781 40mm Training Rounds fired at Lima Range. The graph reflects the cyclic requirement for qualification for grenadiers. Units that have grenadiers only have one to two soldiers with that requirement in the unit; not every soldier uses this weapon.

Since TY 2019, a total of 148,564 rounds of 9mm lead ammunition has been fired at Echo Range. Graph 2-5 shows the number of 9mm rounds of lead ammunition fired on Echo Range. Information on lead ammunition fired from TY 2007 through TY 2022, including amounts and types, is provided in Appendix C.

The was no civilian use of the small arms ranges during TY 2022.

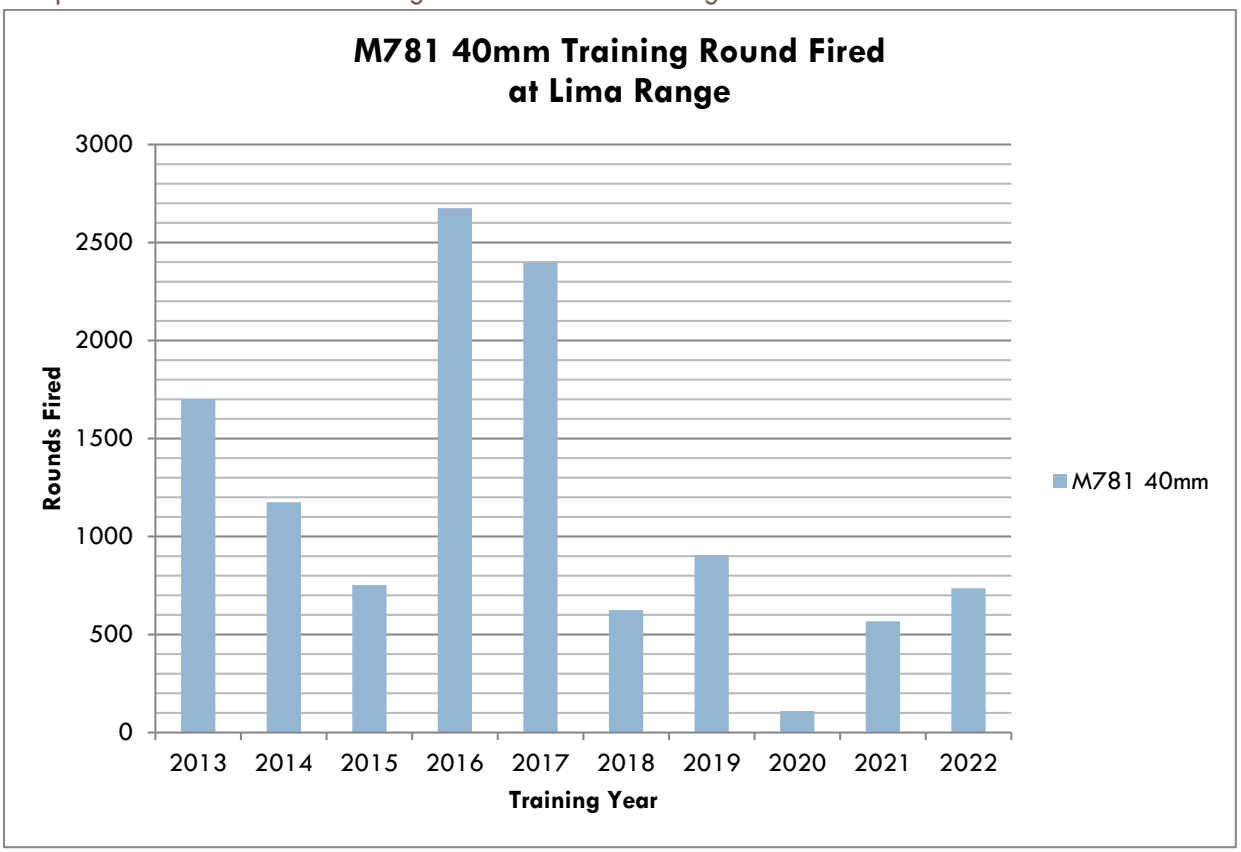
During TY 2022, some type of weapons firing was conducted on at least one of the ranges on 76 calendar days.

Graph 2-3 Copper Ammunition Use – Sierra, India, and Tango Ranges

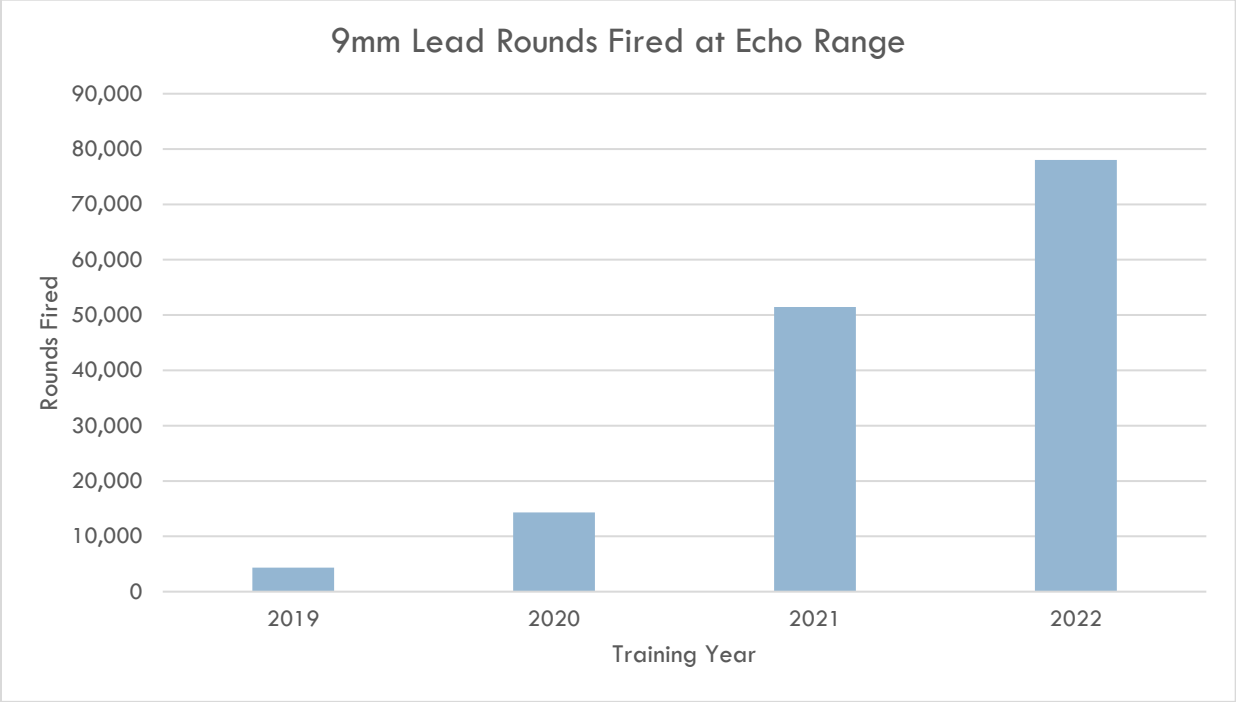



Note: Tango Range became operational during TY 2022.

Graph 2-4 M781 40MM Training Round Use – Lima Range



Graph 2-5 9mm Lead Ammunition Round Use – Echo Range




In accordance with the OMMP for each range, the MANG 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.

### 2.10.1 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.

Photograph 2-1 A soldier in the Training Area/Reserve during the Combined Arms Exercise held in Summer 2022.

Information on utilization of the training areas and major locations within them during TY 2022 is provided in Table 2-3. The total overall utilization of the training areas for the past 10 training years is included in Table 2-4. 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 2022, some type of training was conducted in at least one of the training areas on 189 calendar days. The numbers in Tables 2-3 and 2-4 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 2022, hunter days in the Training Area/Reserve accounted for around 1.8 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.

Other military users of the training areas during TY 2022 included the US Army, the US Army Reserve, the US Coast Guard, the US Coast Guard Reserve, the US Air Force, the US Navy, the US Marine Corp, Massachusetts ANG, and Army National Guard units from New York, Connecticut, Maine, and Vermont.

Civilian organizations using the training areas during TY 2022 included BAE Systems, the Brookline Special Response Team, Federal Bureau of Investigation-Boston, the Massachusetts Institute of Technology-Lincoln Lab, and environmental remediation and restoration contractors.

TABLE 2-3 TRAINING AREA USE - TY 2022

| Location | Training Days | Personnel | | Vehicles (Wheeled) # | Vehicles (Tracked) # |
|---|---|---|---|---|---|
| | | Military | Civilian | | |
| SVL-OBJ 1 | 48 | 1,166 | 332 | 0 | 0 |
| SVL-OBJ 2 | 9 | 236 | 36 | 0 | 0 |
| SVL-OBJ 3 | 7 | 110 | 0 | 0 | 0 |
| SVL-OBJ 4 | 15 | 411 | 0 | 0 | 0 |
| OP 1 | 8 | 340 | 0 | 0 | 0 |
| OP 2 | 5 | 250 | 0 | 0 | 0 |
| OP 9 | 4 | 24 | 0 | 0 | 0 |
| OP 10 | 4 | 30 | 0 | 0 | 0 |
| BP 2 | 21 | 456 | 50 | 0 | 0 |
| BP 7 | 3 | 46 | 0 | 0 | 0 |
| BP 12 | 7 | 167 | 0 | 0 | 0 |
| BP 14 | 14 | 259 | 0 | 0 | 0 |
| BP 16 | 14 | 256 | 0 | 0 | 0 |
| BP 20 | 10 | 231 | 0 | 0 | 0 |
| BP 24 | 9 | 370 | 0 | 0 | 0 |
| BP 27 | 4 | 600 | 0 | 0 | 0 |
| NBC 01 | 11 | 609 | 0 | 0 | 0 |
| NBC 02 | 4 | 305 | 0 | 0 | 0 |
| NBC 03 | 4 | 305 | 0 | 0 | 0 |
| NBC 04 | 4 | 305 | 0 | 0 | 0 |
| NBC 05 | 4 | 305 | 0 | 0 | 0 |
| Training Roads | 46 | 7,029 | 0 | 9 | 0 |
| A 1 | 18 | 1,879 | 0 | 0 | 0 |
| A 2 | 44 | 3,032 | 0 | 0 | 0 |
| A 3 | 40 | 1,588 | 0 | 0 | 0 |
| A 4 | 34 | 1,436 | 0 | 0 | 0 |
| A 5 | 23 | 748 | 0 | 0 | 0 |
| A 6 | 45 | 1,939 | 0 | 0 | 0 |
| B 7 | 30 | 1,662 | 0 | 0 | 0 |
| B 10 | 37 | 1,503 | 0 | 0 | 0 |
| B 11 | 39 | 1,685 | 0 | 0 | 0 |
| B 12 | 20 | 776 | 0 | 0 | 0 |
| BA 1 | 31 | 1,092 | 0 | 0 | 0 |
| BA 3 | 36 | 2,903 | 0 | 0 | 0 |
| BA 4 | 22 | 709 | 0 | 0 | 0 |
| BA 5 | 13 | 614 | 0 | 0 | 0 |

TABLE 2-3 TRAINING AREA USE - TY 2022, cont'd

| Location | Training Days | Personnel | | Vehicles (Wheeled) # | Vehicles (Tracked) # |
|---|---|---|---|---|---|
| | | Military | Civilian | | |
| BA 6 | 21 | 1,599 | 0 | 0 | 0 |
| BA 7 | 41 | 1,821 | 0 | 0 | 0 |
| C 13 | 41 | 2,351 | 0 | 0 | 0 |
| C 14 | 38 | 1,692 | 108 | 0 | 0 |
| C 15 Trenchline | 4 | 97 | 0 | 0 | 0 |
| C 15 | 41 | 1,733 | 0 | 0 | 0 |
| C 16 | 30 | 1,167 | 0 | 0 | 0 |
| Wheelock Hill | 3 | 65 | 0 | 0 | 0 |
| Land Nav 1 | 21 | 1,194 | 0 | 0 | 0 |
| Land Nav 2 | 28 | 1,574 | 0 | 0 | 0 |
| Land Nav 3 | 29 | 1,502 | 0 | 0 | 0 |
| Land Nav 4 Alpha | 16 | 606 | 0 | 0 | 0 |
| Land Nav 4 Bravo | 14 | 546 | 0 | 0 | 0 |
| Land Nav 4 Charlie | 22 | 979 | 0 | 0 | 0 |
| Dig Site 1 | 14 | 1,319 | 0 | 0 | 0 |
| Dig Site 2 | 23 | 1,918 | 0 | 0 | 0 |
| Dig Site 3 | 15 | 707 | 0 | 0 | 0 |
| **Total** | **1,088** | **56,246** | **562** | **9** | **0** |

TABLE 2-4 TRAINING AREA USE HISTORY

| Training Year | Training Days/Events | Personnel | | Vehicles (Wheeled) | Vehicles (Tracked) |
|---|---|---|---|---|---|
| | | Military | Civilian | | |
| 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 |
| TY 2013 | 247 | 11,164 | 181 | 1,484 | 7 |
| **TOTAL** | **7,667** | **452,324** | **9,178** | **13,163** | **31** |

### 2.10.2 Vehicle Use, Fueling and Maintenance

Vehicle use in the training areas during TY 2022 was nine wheeled vehicles. No tracked vehicles were used. These numbers do not include vehicles from the Impact Area Groundwater Study Program (IAGWSP) program and contractors. 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) 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 training events and restoration work. 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.

### 2.10.3 Training Support Areas (Simulators, 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 2-5 presents the total number of training days/events and personnel that used each TSA during TY 2022. Overall historical use of the TSA for the past 10 training years is included in Table 2-6. Figure 2-8 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. For example, the Cape Cod Police Academy Cadets and Cadre are counted as using the facility and areas on a daily basis.

Civilian organizations using the TSA in the Cantonment Area of Camp Edwards during TY 2022 included Allied Universal Security, Barnstable County Sheriff's Department, Brookline SRT, Cape Cod Police Academy, Cape Cod Regional Law Enforcement Council SWAT Team, Civil Air Patrol, Eversource, FBI Boston, the Massachusetts State Police, Massachusetts Emergency Management Agency, Southeastern Massachusetts Technical Rescue Team, the Sea Cadets, the United States Geological Survey, and the US Postal Service Inspector General, Northeast.

TABLE 2-5 TRAINING SUPPORT AREA USE - TY 2022

| Training Support Area | Training Days/Events | Personnel | |
|---|---|---|---|
| | | Military | Civilian |
| 1100 Training Area (Drivers Training) | 52 | 7,650 | 0 |
| 3400 Training Area/Rail Load Ramp | 16 | 1,240 | 0 |
| 3500 Training Area | 14 | 170 | 0 |
| ACFT Running Track | 58 | 10,550 | 0 |
| Asymmetric Threat Classroom | 5 | 105 | 0 |
| Battle Simulation Ctr - Bldg 1206 | 137 | 9,783 | 1,400 |
| Battle Simulation Ctr - Rear Offices | 117 | 876 | 110 |
| Battle Simulation - Bldg 1213, 1st Floor | 68 | 2,627 | 500 |
| Battle Simulation - Bldg 1213, 2nd Floor | 79 | 3,391 | 500 |
| Battle Simulation - TOC Pads | 35 | 3,110 | 0 |
| Bldg 3499 - IWQ | 26 | 1,962 | 0 |
| Calero MOUT | 61 | 2,045 | 479 |
| Call for Fire Trainer II 1:30 | 56 | 1,548 | 0 |
| VBS3 Classroom - Bldg 3494 | 27 | 1,139 | 0 |
| Connery Field | 41 | 5,810 | 0 |

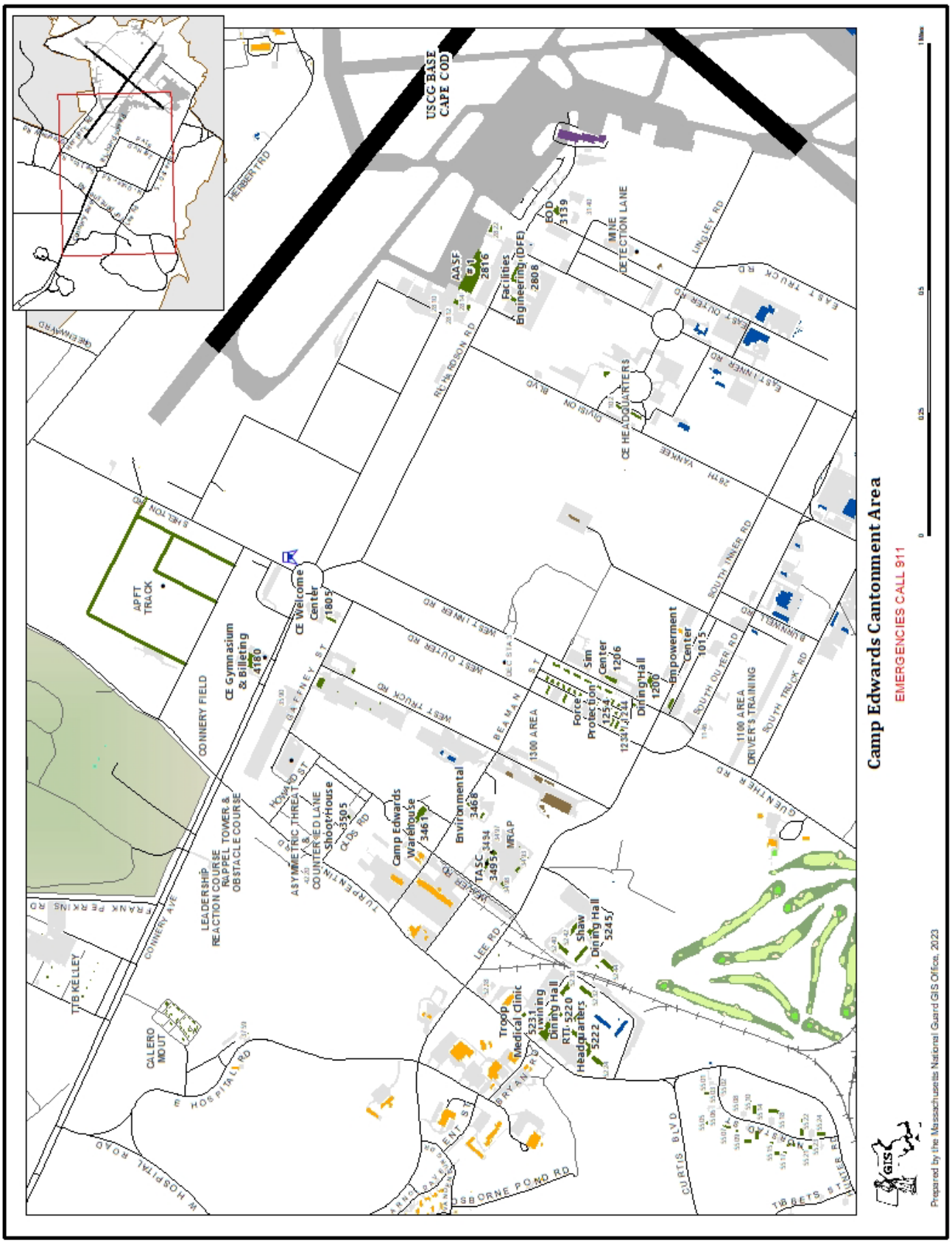
TABLE 2-5 TRAINING SUPPORT AREA USE - TY 2022, cont'd

| Training Support Area | Training Days/Events | Personnel | |
|---|---|---|---|
| | | Military | Civilian |
| Counter IED Visual Indicator Lane | 6 | 457 | 0 |
| Counter IED Search House (HME)/Site Exploitation | 2 | 192 | 0 |
| Engagement Skill Trainer 2000 - A | 132 | 778 | 0 |
| Engagement Skill Trainer 2000 - B | 204 | 3,556 | 116 |
| Engagement Skill Trainer 2000 - C | 162 | 3,188 | 0 |
| 1243-High Risk Entry Facility-Control | 25 | 451 | 250 |
| 1244-High Risk Entry Facility | 25 | 451 | 250 |
| Lee Parade Field | 8 | 730 | 1,250 |
| Leadership Reaction Course | 28 | 794 | 304 |
| Obstacle Course | 30 | 889 | 274 |
| Shaw Field | 23 | 2,805 | 0 |
| Unstabilized Gunnery | 6 | 29 | 0 |
| Vault 1 - TSC | 142 | 440 | 0 |
| Vault 2 - TSC | 363 | 726 | 0 |
| Vault 3 - TSC | 363 | 726 | 0 |
| Virtual Convoy Operations Trainer #98 (VCOT - TSC) | 9 | 76 | 0 |
| Weapons Cleaning - Bldg 3498 | 26 | 467 | 0 |
| Welcome Center | 108 | 3,100 | 457 |
| YD Memorial Park | 17 | 926 | 300 |
| 5219 - JBCC Theater | 148 | 10,712 | 5,223 |
| Structural Collapse Site | 6 | 0 | 138 |
| **TY 2022 Total** | **2,625** | **83,499** | **11,551** |

TABLE 2-6 TRAINING SUPPORT AREA USE HISTORY

| Training Year | Training Days/Events | Personnel | | |
|---|---|---|---|---|
| | | Military | Civilian | Total |
| 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 |
| TY 2013 | 742 | 42,654 | 1,404 | 44,058 |
| **TOTAL** | **15,365** | **669,741** | **42,201** | **714,755** |

Figure 2-8 Training Support Areas



## 2.11 OFF-SITE TRAINING

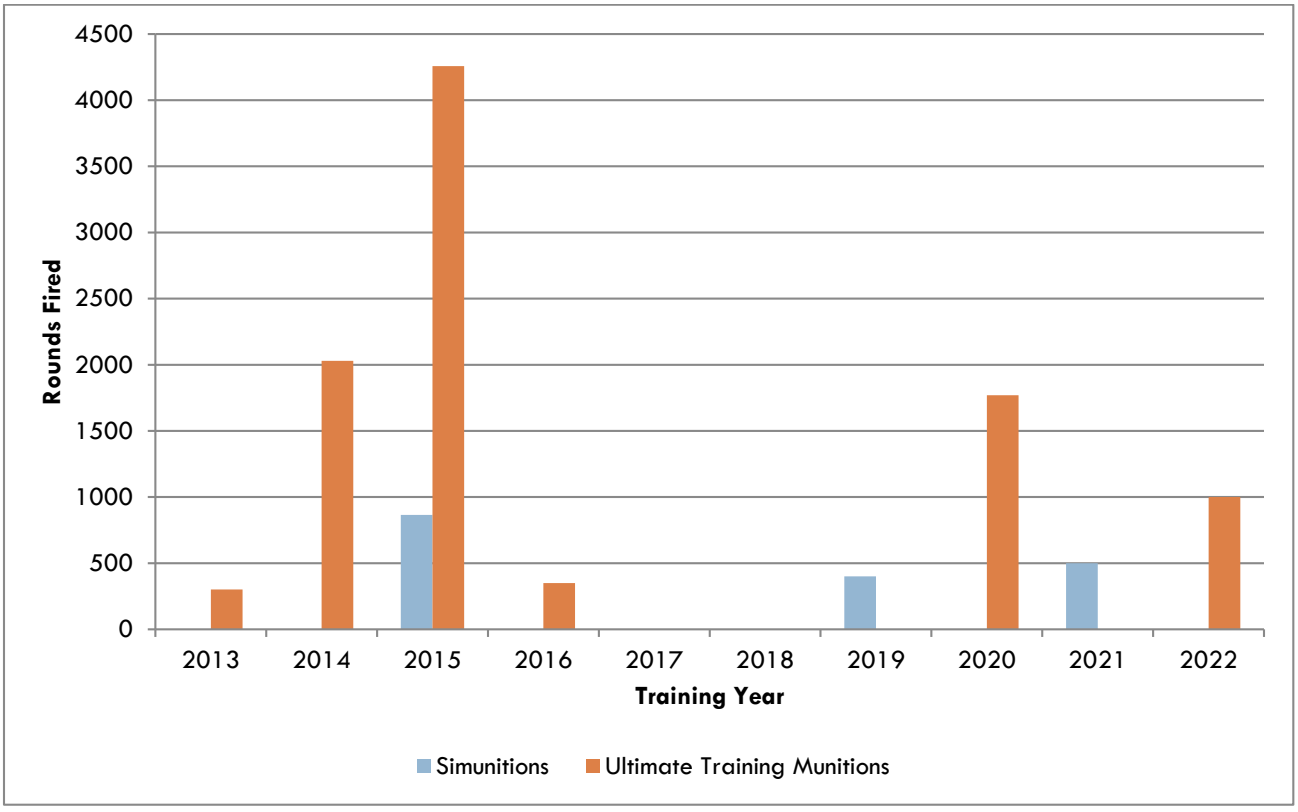
During TY 2022, the MAARNG had 79 units conduct their annual two-week training cycle. Of these, 61 units trained in Massachusetts, 32 of which trained solely at Camp Edwards (approximately 1,152 Soldiers). Six units trained in New York, four units trained in New Jersey, one unit trained in Iowa, one unit trained in Vermont, one unit trained in Michigan, one unit trained in Connecticut, one unit trained in California, and one unit 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 2022 was 3,460 out of 5,789. Twenty-one units conducted year-round annual training consisting of 502 Soldiers, while 306 served on Title 32 orders for the Covid-19, busing mission, or operational support in lieu of annual training. The number of MAARNG Soldiers that completed a two-week annual training cycle by general geographical locations is: 2587 in Massachusetts, 689 in other states, and 184 in Canada

## 2.12 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. 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. Simulated munitions are best used in concert with other simulators to be effective for most units; therefore, their effective training use is currently limited. The UTM Man Marker Round and the Simunitions FX Marking Round are on the Camp Edwards Approved Munitions List. Graph 2-6 provides the number of UTM and Simunitions FX Marking Rounds fired in the Training Area/Reserve since 2013.

Graph 2-6 Simulated Munitions Use



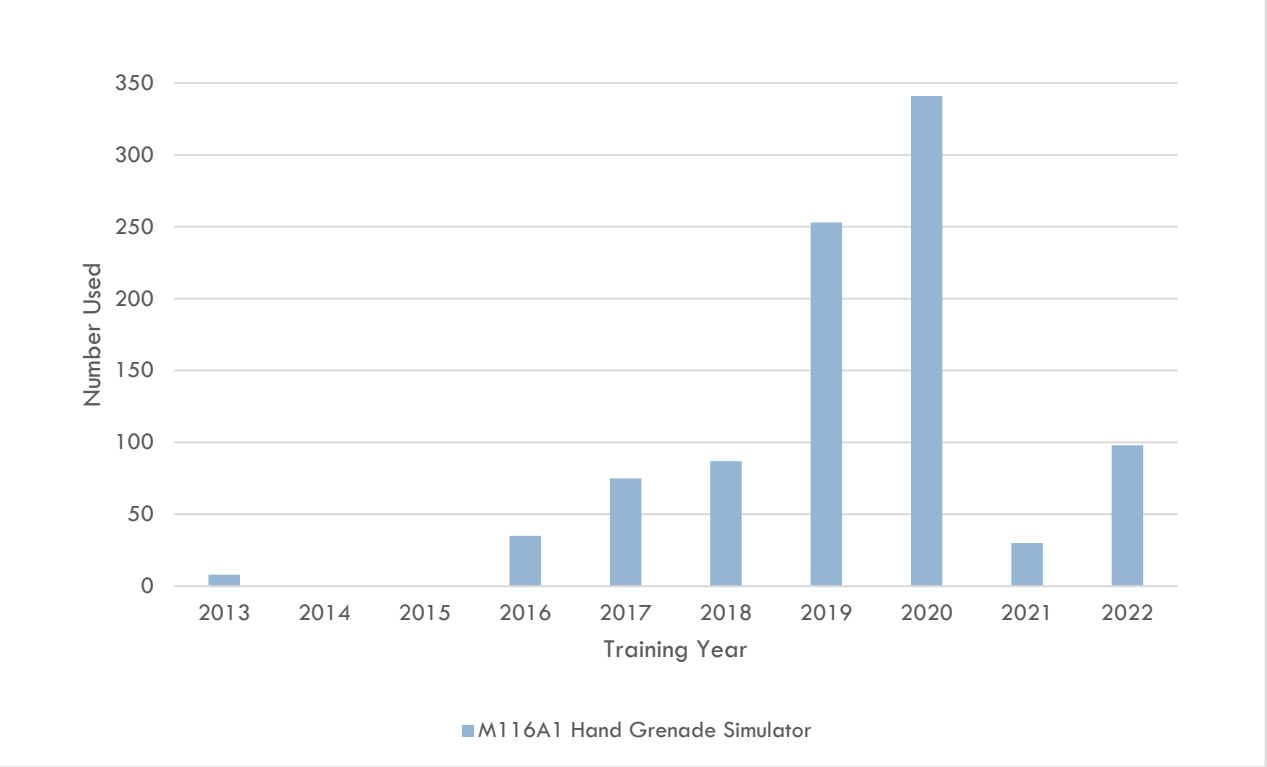
# 2.13 PYROTECHNICS

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.

## 2.13.1 M116A1 HAND GRENADE SIMULATOR

The M116A1 Hand Grenade Simulator was approved for use at Camp Edwards in March 2010. Ninety-eight were used in the Training Area/Reserve during TY 2022. Graph 2-7 shows the number used each training year since TY 2013. 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. M116A1 use was higher during TY 2022 than during TY 2021.

Graph 2-7 M116A1 Hand Grenade Simulator Use




## 2.13.2 M69 HAND GRENADE SIMULATOR

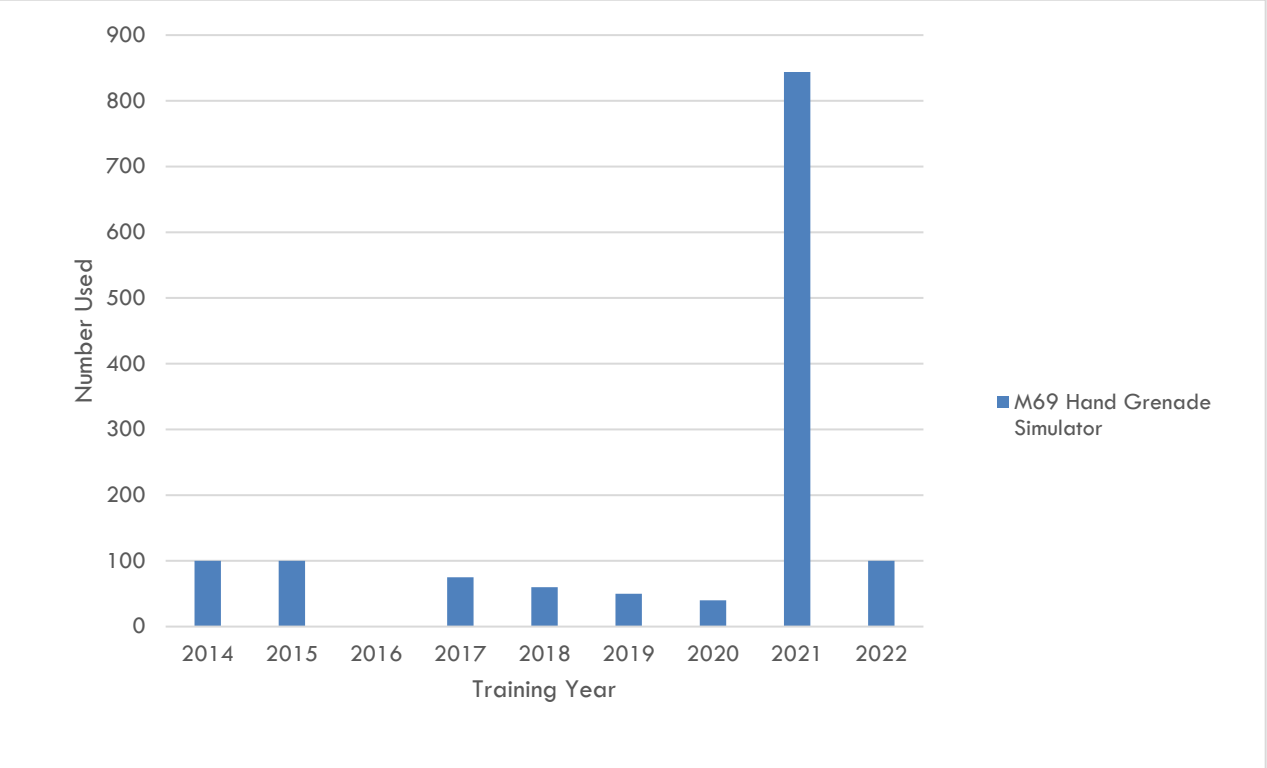
In 2013, EPA Region 1 and the EMC approved the use of the M69 Hand Grenade Simulator on Camp Edwards.

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. One hundred were used in the Training Area/Reserve in TY 2022. Graph 2-8 shows the number of M69 Hand Grenade Simulators used since TY 2014. M69 Hand Grenade Simulator use showed a decrease during TY 2022. The nature of required M69 grenade training is cyclical; however, if there is a collective training event, the usage numbers will go up.

Graph 2-8 M69 Hand Grenade Simulator Use



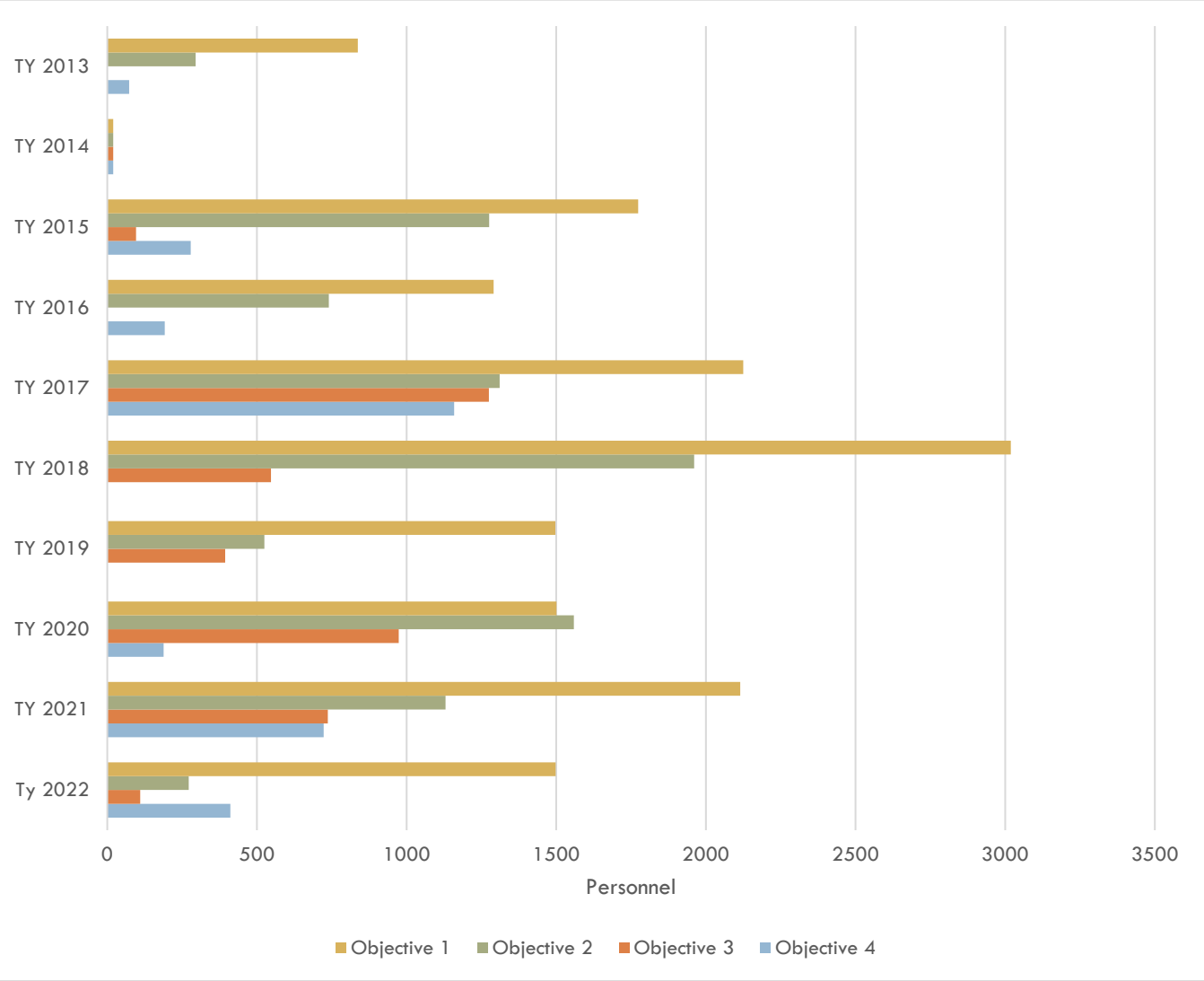

## 2.15 SOLDIER VALIDATION LANE

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.

Four SVL locations (called objectives) were used during TY 2022 to meet military training needs: Objective 1 in Training Area A-4; Objective 2 in Training Area BA 4; Objective 3 in Training Area B 11, and Objective 4 in Training Area C-14. Graph 2-9 shows the use of all four SVL Objectives since TY 2013. The locations of the SVL Objectives are shown in Figure 2-9.

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 2022 is available in Appendix C.

Graph 2-9 SVL Use



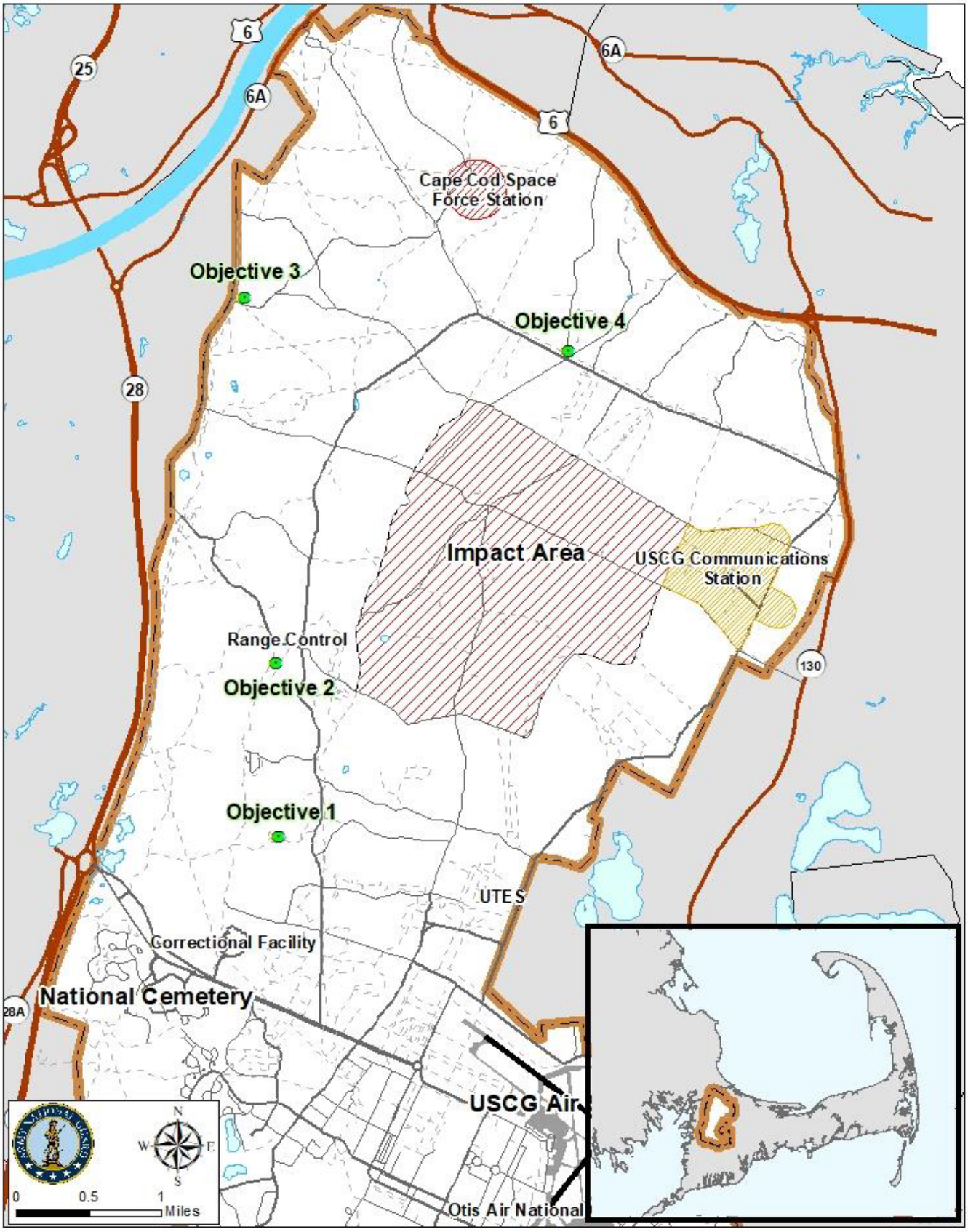

## 2.16 MULTI-PURPOSE MACHINE GUN RANGE

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

Figure 2-9 SVL Objective Locations



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 seven 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. EPA is evaluating information related to the project and plans to release a draft determination in early 2023 to include opportunity for public comment and a public hearing.

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.

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# SECTION 3
# ENVIRONMENTAL PROGRAM MANAGEMENT

## 3.0 INTRODUCTION

Chapter 47 of the Acts of 2002 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 3.16 include information for each EPS where there were associated activities. Section 3.17 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 of the Acts of 2002 also requires the Annual Report to describe long-term trends in the major areas of resource management and activities. Data is provided in this report back through TY 2013, 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 2022, seven Records of Environmental Consideration (RECs) were reviewed for natural and cultural resources for proposed actions in the Training Area/Reserve. RECs are an internal environmental review document based on NEPA. The RECs reviewed were for road repair, firebreak maintenance, and the Combined Arms Training Exercise training event.

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

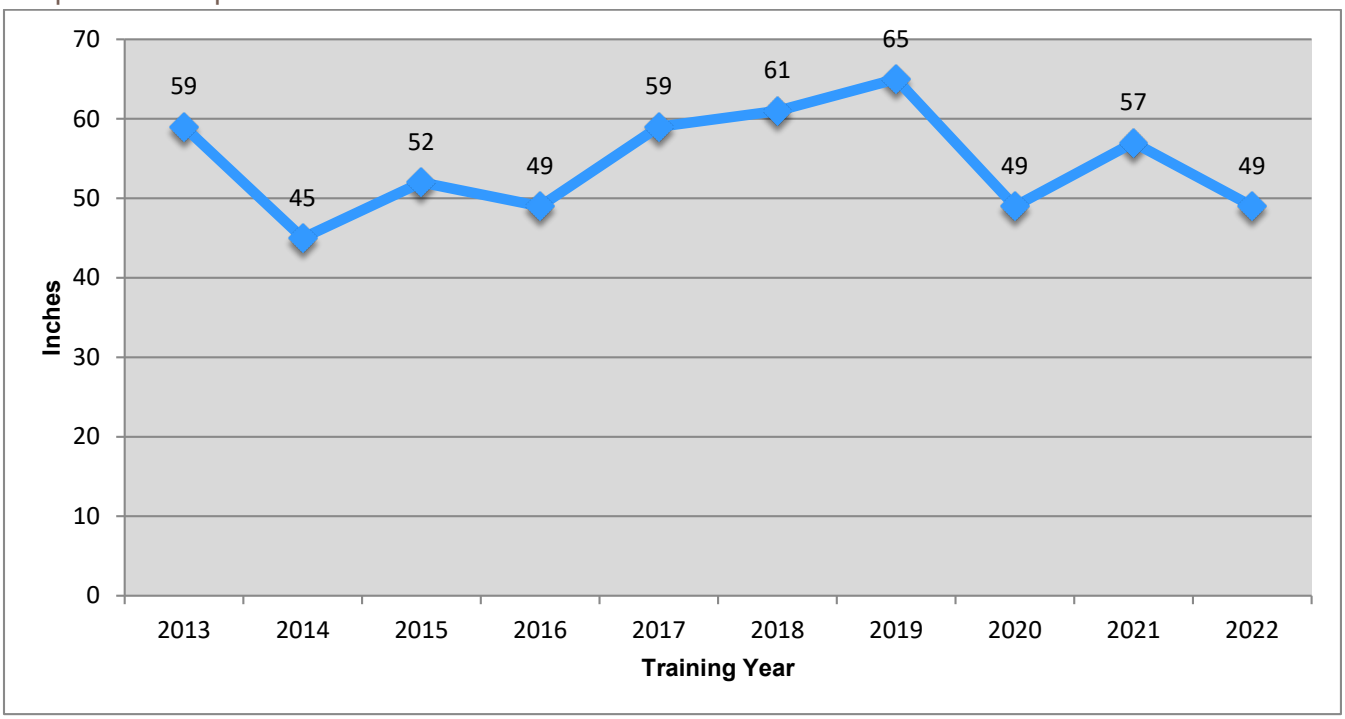
## 3.1 GROUNDWATER RESOURCES MANAGEMENT

The MAARNG complied with the Groundwater Environmental Performance Standard during TY 2022. 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 in Appendix E. 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 49.32 inches of precipitation for TY 2022 (Graph 3-1). Barnstable County experienced drought conditions in 2022.

Graph 3-1 Precipitation Recorded



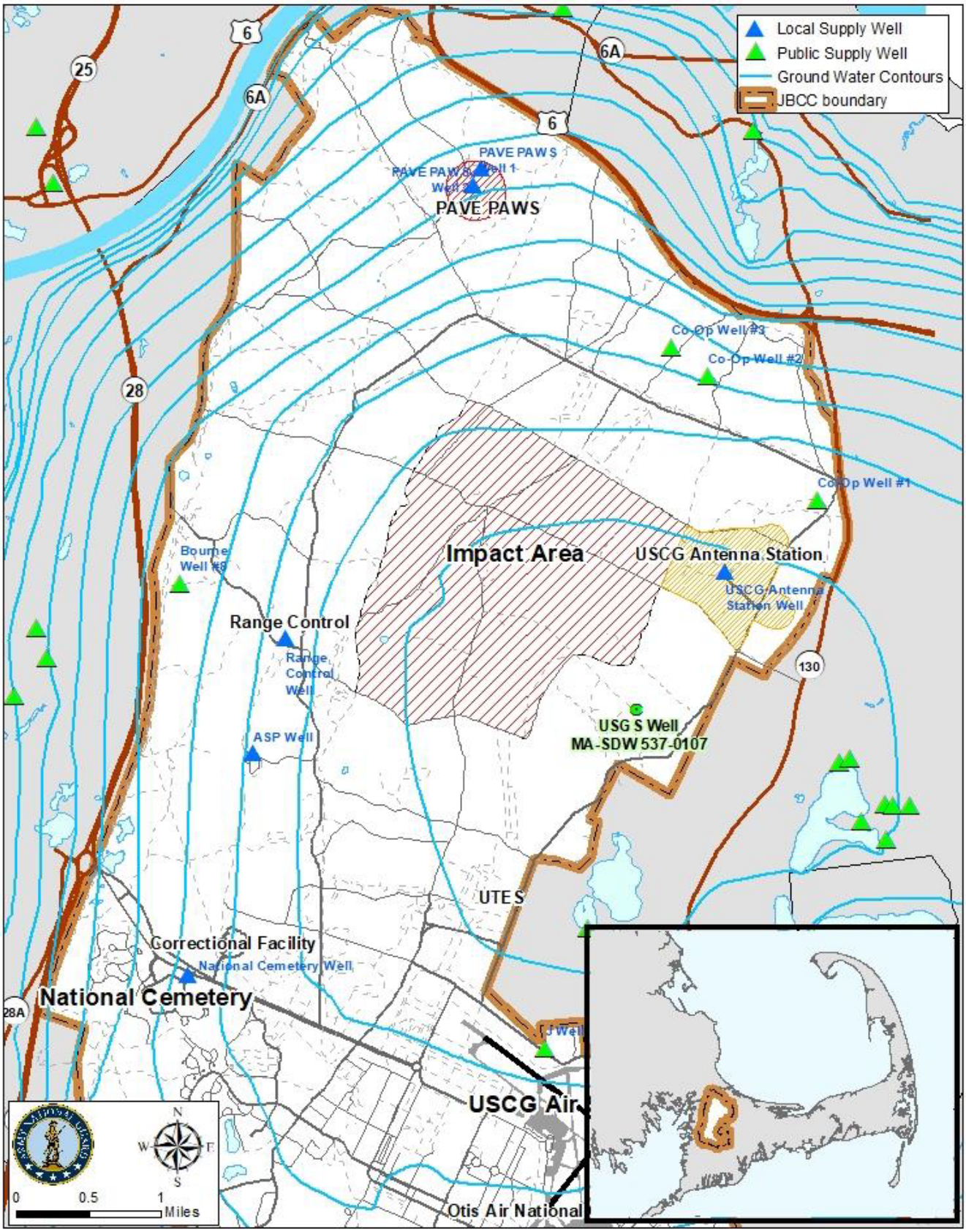

## 3.1.2 Groundwater Level

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.

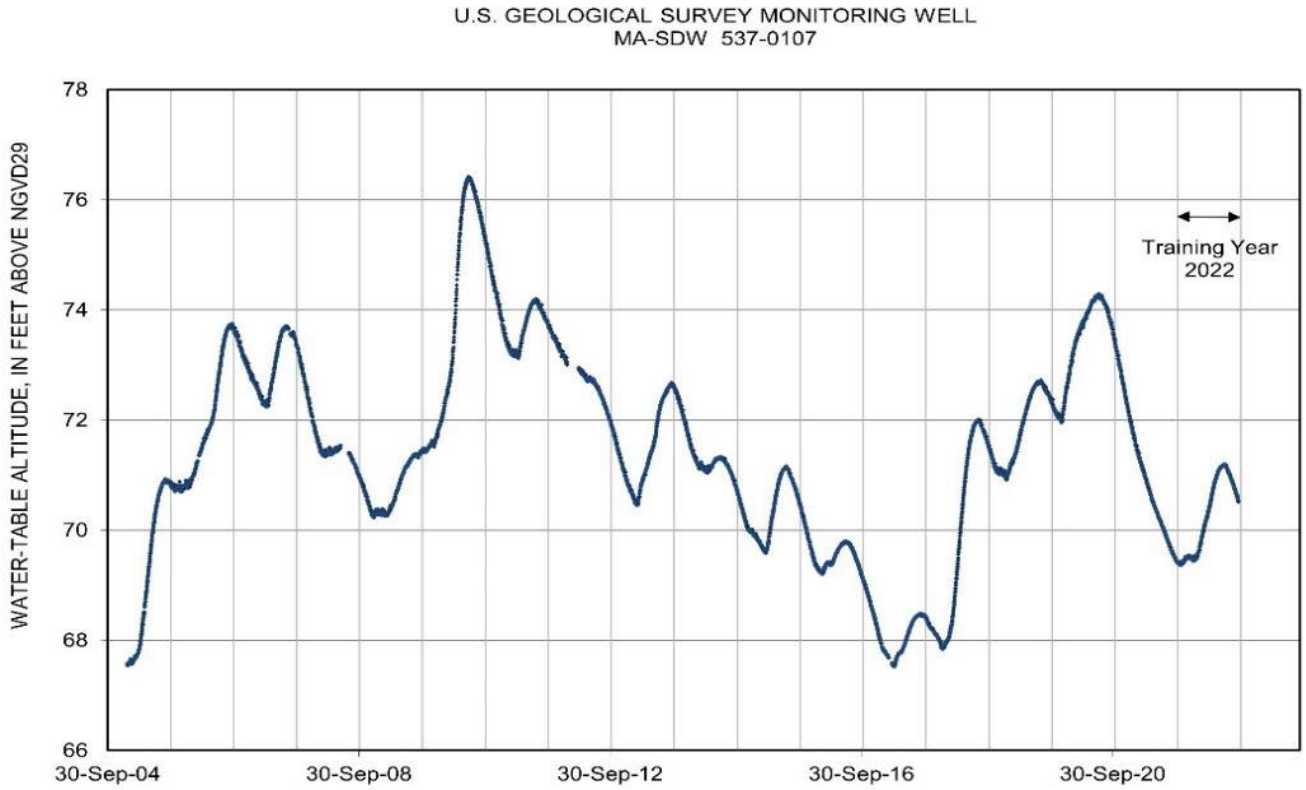
The pattern of water-level changes observed at the monitoring well is caused by natural seasonal and year-to-year variations in recharge from precipitation. Graph 3-2 shows the trend in the water-table altitude at the USGS monitoring well for the 2005-2022 training years. The water-table altitude rose about 1.7 feet between October 2021 and July 2022, then declined about 0.7 feet between July and October 2022. 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 393,633,000 gallons of water (a daily average of 1,078,447) from its three wells to the six public water supply systems it services during TY 2022: 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 2013. 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. No long-term monitoring sampling of the sentry wells was conducted by the Cooperative in Calendar Year 2022.

### Otis ANGB Public Water Supply System

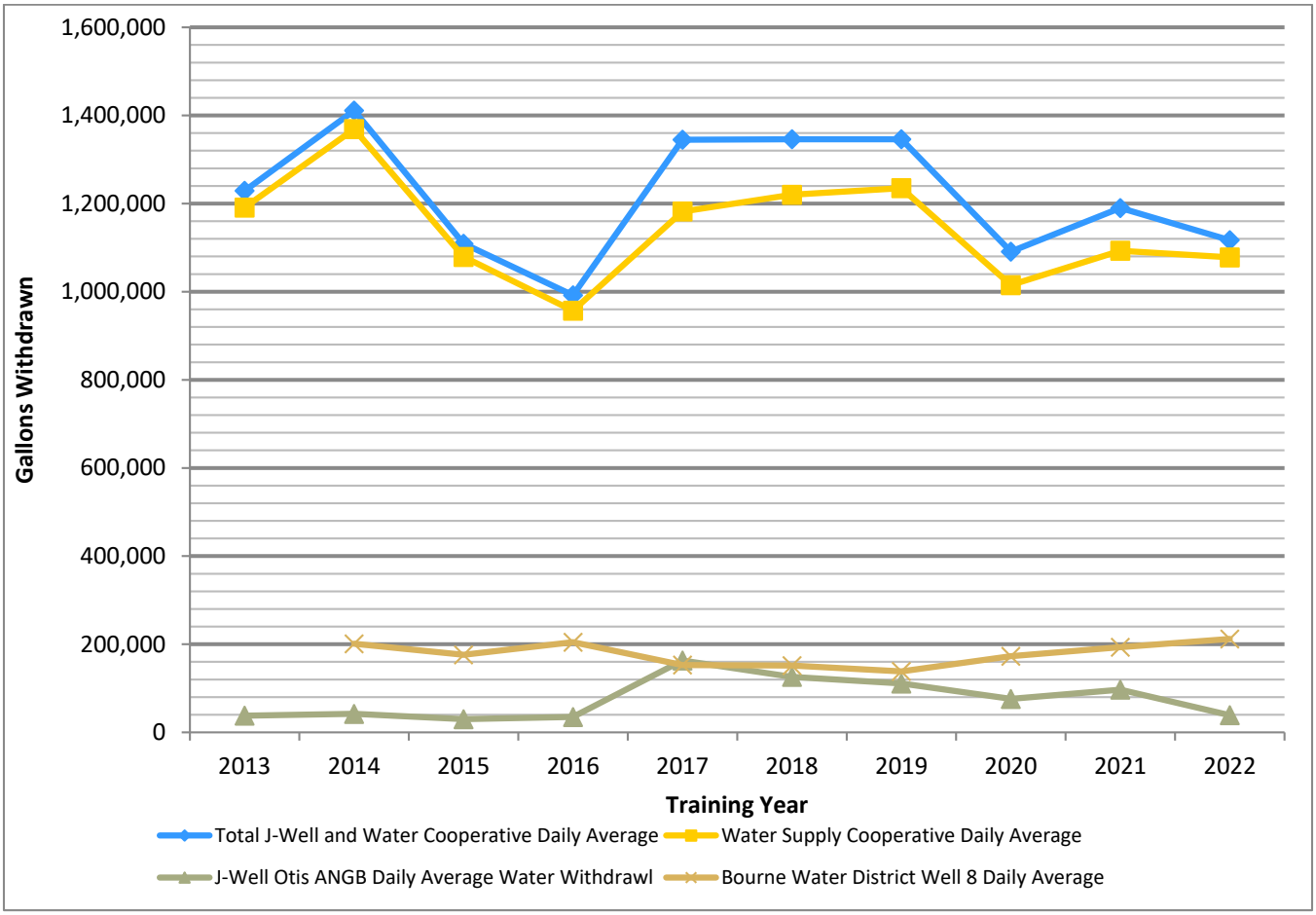
The Otis ANGB system pumped an average of 39,304 gallons of water per day and a total of 14,376,000 gallons of water from its well, known as J-Well (located in the Cantonment Area), during TY 2022. It also received 31,149,000 gallons from the Cooperative during TY 2022; a daily average of 85,340 gallons. Graph 3-3 shows the daily average pumping rate of the Otis system since TY 2013.

A copy of the calendar year 2021 Consumer Confidence Report for Otis ANGB is provided in Appendix E.

### Bourne Water District Water Supply Well

During TY 2022, Bourne Water District Well 8 pumped a total of 77,378,100 gallons, with a daily average of 211,995 gallons pumped. Graph 3-3 shows the daily average pumping rate of Well 8 for TY 2014 through TY 2022. The well's location is shown in Figure 3-1. A copy of the calendar year 2021 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 2022 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 2022 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 impacts were avoided or permitted.

In TY 2021, MAARNG amended the 2018-issued Conservation and Management Plan (CMP) for Agassiz's Clam Shrimp (*Eulimnadia agassizii*), a state listed endangered species that is documented primarily in roadway puddles. The amendment provides a long-term process that allows for necessary road maintenance and repair of road puddles in the training area while preserving suitable puddle habitat for clam shrimp populations. Details on the CMP amendment and mitigation and monitoring carried out during TY 2022 are in Section 3.3.4 and Appendix F.

### 3.2.1 Vernal Pools

In TY 2021, the Natural Resources Office contracted SWCA Environmental Consultants to locate sites in the training area, using GIS analysis and field verification, for vernal pool creation and to provide construction plans and specifications for a handful of locations. SWCA is full-service company experienced with creating vernal pools in Massachusetts. Key staff assigned to this project included a certified wildlife biologist with specialty in vernal pool amphibians, a landscape architect, GIS specialist, and wetland restoration expert who is also the company Principal and Senior Scientist. Budgeting for this project came from the funds set aside in the event the Town of Bourne Conservation Office had required mitigation in the form of vernal pool creation for the filling of three road puddles on Jefferson and Orchard Road that were attracting breeding vernal pool 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. This project is expected to be completed with a final report and design plans in the fall 2022. This contract does not include construction that would be carried out by MAARNG and would only be completed if the puddle locations are found not to interfere with the military mission.

## 3.3 RARE SPECIES MANAGEMENT

The Natural Resources Office and their contractors observed and reported on floral and faunal species listed under the Massachusetts Endangered Species Act (MESA) on Camp Edwards in TY 2022. The office and their contractors observed 17 species and is reporting the sightings to NHESP in early TY 2023 (Table 3-1). One field technician hired for TY 2022 and the Field Crew Leader were primarily involved in observing and reporting these rare floral and faunal species in the Training Area/Reserve with supplementary observations from others. The Natural Resources Office is also reporting observations of "Tracking List" species to NHESP as a standard condition of scientific collection permits for reptiles and amphibians. Perhaps most notably, one new listed species, Sandplain Heterocampa (*Heterocampa varia*) was collected in a light trap by GZA, a Natural Resources-ITAM contractor. This may be the first of this species collected on mainland Massachusetts (awaiting confirmation from specialists), with previous collections being on Martha's Vineyard and Nantucket.

The Natural Resources Office formally and informally reviewed proposed military and civilian activities in the Training Area/Reserve to ensure that adverse impacts to natural resources (including state-listed endangered species) were avoided or mitigated. No projects required informal or formal consultation with the US Fish and Wildlife Service under Section 7 of the Endangered Species Act. Under MESA, consultation and coordination was primarily limited to ongoing project planning and support under the existing Conservation and Management Permits discussed in more detail in Appendix F. This included implementation and completion of the Tango Range redevelopment and completion of the Eversource switching station soil stockpile. One natural resources and training lands habitat restoration project was reviewed through the Forest Cutting Act process and approved by NHESP, which is continuation of a kettle hole frost bottom restoration in Training Area E-3.

Multiple contracts were developed or continued in TY 2022 for surveying and managing rare species. See Section 3.3.2 and Section 3.3.5 for information on TY 2022 contracts and other in-house work regarding State and Federally Listed bats and Eastern Box Turtles, respectively. In FY 2022, technicians also checked snake cover

boards in the Training Area/Reserve to opportunistically document species on the site, particularly looking for the state listed Eastern hognose snake.

The Smithsonian Conservation Biology Institute received a DoD Legacy grant to conduct a status assessment of spotted turtles, a species under review for federal listing, at nine military installations. Camp Edwards, along with Camp Curtis Guild, was among the sites chosen for sampling in 2021. Results from Camp Edwards and other military installations were analyzed together to better inform best management practices for spotted turtles on military sites. The Natural Resources Office facilitated this effort through project coordination, technician help in the field, and the collection of blood samples by a veterinary student. The Natural Resources Office is awaiting the final report on this effort.

Photograph 3-1 Unexpected Cycnia Moth (*Cycnia collaris*) caterpillar feeding on Butterfly Milkweed (*Asclepias tuberosa*) in the northern training area. This state-listed species is a milkweed obligate found both in the grasslands and Training Area/Reserve.

In TY 2022, the Natural Resources Program initiated a contract with EA Engineering and Botanist Bryan Connolly to survey for potential-to-occur rare and special status plant species within the Camp Edwards managed grasslands. Field surveys are planned for the 2023 growing season. This project includes a limited survey in the central Impact Area, taking advantage of transects established by the IAGWSP in which vegetation cleared to find and remove source material has created conditions that may be suitable for certain rare plant species. Two high profile target plants, not recorded on Camp Edwards, are Sandplain Gerardia (*Agalinis acuta*) and American Chaffseed (*Schwalbea americana*). Both are State- and Federally-listed Endangered.

Results from the study, contracted in TY 2020, that investigates the taxonomic identity of the population of *Triosteum* on the base are being worked up into a publishable manuscript. This is an interesting study with significant findings. See Section 3.3.1 for more on the study's results of the state-listed plant *Triosteum perfoliatum*.

Although three field crew positions were funded for the summer, only one position was filled due to others declining based on a lack of housing. This lack of field staff meant that some efforts could not be implemented. It also meant less staff in the field opportunistically observing rare species. The Natural Resources-ITAM office compensated for some of this lack of staff by contracting Davey Resource Group to complete vegetation surveys for mitigation monitoring, contracting SWCA for clam shrimp monitoring, working with University of Massachusetts (UMass) interns to perform Monarch caterpillar surveys, and having a graduate researcher on site studying and documenting Eastern box turtles.

### 3.3.1 Rare Species Reporting

Table 3-1 identifies the rare species sightings reported to NHESP for the past five years (See Appendix G for sightings reported for the past 10 years). The fluctuation in numbers reported is attributed to a variety of factors, including but not limited to: the time and length of surveys, locations where surveys are conducted (the same locations are not necessarily visited each year), intensity of the surveys, the number and experience of summer field crew personnel, weather conditions during the times available for surveys, locations where soldiers may train during the training year, familiarity of individual soldiers and others utilizing the various training areas and training support areas on Camp Edwards with rare species, etc. With these limitations and the varied associated

counting procedures and efforts, the numbers contained in Table 3-1 do not reflect changes or trends in populations. These are raw number counts that are reported to NHESP based on sightings, including formal surveys and casual encounters.

TABLE 3-1 State-listed Species Reported to NHESP

Quantities shown[1] are not simply results of standardized surveys and do not represent population trends. Only observed species are listed[2].

| | | | Individuals Reported | | | | |
|---|---|---|---|---|---|---|---|
| **Common/Scientific Names** | **Fed Status[3]** | **State Status[4]** | **TY 2018** | **TY 2019** | **TY 2020** | **TY 2021** | **TY 2022** |
| | | | **BIRDS** | | | | |
| Grasshopper Sparrow[5] *(Ammodramus savannarum)* | - | T | 16 | 20 | 34 | 36 | 29 |
| Northern Harrier[6] *(Circus cyaneus)* | - | T | Wintering | Wintering | Wintering | Wintering | Wintering |
| Upland Sandpiper[5] *(Bartramia longicauda)* | - | E | 7 | 12 | 6 | 2 | 1 |
| Eastern Meadowlark[5,7] *(Sturnella magna)* | - | SC | 2 | 7 | 14 | 17 | 9 |
| Whip-poor-will *(Antrostomus vociferous)* | - | SC | 110 | 53 | 99 | 136 | 137 |
| | | | **REPTILES and AMPHIBIANS** | | | | |
| Eastern Box Turtle *(Terrapene carolina carolina)* | - | SC | 43 | 58 | 45 | 83 | 62 |
| Eastern Hog-nosed Snake *(Heterodon platirhinos)* | - | SC | 8 | 9 | 1 | 2 | 6 |
| | | | **PLANTS** | | | | |
| Adder's Tongue Fern[8] *(Ophioglossum pusillum)* | - | T | 0 | 25 | 646 | N/A | 225 |
| Spring Ladies Tresses *(Spiranthes vernalis)* | - | T | 0 | 0 | 0 | 3 | 0 |
| Broad Tinker's Weed[8] *(Triosteum perfoliatum)* | - | E | 0 | 200 | 6 | N/A | 1883 |
| | | | **BEES** | | | | |
| Walsh's Anthophora[9] *(Anthophora walshii)* | - | E | 0 | 32 (9) | 4 | N/A | 1 |
| | | | **BUTTERFLIES and MOTHS[10]** | | | | |
| Buck Moth (*Hemileuca maia*) | - | SC | 0 | 4 | 2 | 74 | 133 |
| Pine Barrens Speranza *(Speranza exonerata)* | - | SC | 0 | 0 | 0 | 0 | 4 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sandplain Euchlaena *(Euchlaena madusaria)* | - | SC | 0 | 0 | 1 | 0 | 0 |
| Melsheimer's Sack Bearer *(Cicinnus melsheimeri)* | - | T | 0 | 0 | 7 | 0 | 0 |
| Gerhard's Underwing *(Catocala herodias)* | - | SC | 0 | 0 | 2 | 0 | 35 |
| Sandplain Heterocampa *(Heterocampa varia)* | - | T | N/A | N/A | N/A | N/A | 1 |
| Chain-dotted Geometer *(Cingilia catenaria)* | - | SC | 0 | 1 | 0 | 0 | 0 |
| Pink Streak *(Dargida rubripennis)* | - | T | 0 | 0 | 3 | 1 | 1 |
| Collared Cycnia *(Cycnia collaris)* | - | T | 0 | 11 | 33 | 200 | 7 |
| Frosted Elfin *(Callophrys irus)* | - | SC | 5 | TBD[11] | 25 | 57 | 13 |
| Slender Clearwing Sphinx *(Hemaris gracilis)* | - | SC | 0 | 0 | 5 | 3 | 26 |
| **ODONATES** | | | | | | | |
| Scarlet Bluet *(Enallagma pictum)* | | | N/A | N/A | N/A | N/A | 6 |
| **CRUSTACEANS** | | | | | | | |
| Agassiz's Clam Shrimp[12] *(Eulimnadia agassizii)* | - | E | 38 | 9 | 3 | 5 | 12 |
| American Clam Shrimp[12] *(Limnadia lenticularis)* | - | SC | 0 | 0 | 0 | 3 | 0 |
| **MAMMALS** | | | | | | | |
| Northern Long-Eared Bat[13] *(Myotis septentionalis)* | T | E | 1 | 3 | 1 | TBD | N/A |
| Little Brown Bat[7] *(Myotis lucifugus)* | UR | E | 2 | 6 | 2 | TBD | N/A |
| Tricolored Bat[7] (Perimyotis subflavus) | UR | E | 2 | 3 | 1 | TBD | N/A |
| Eastern Small-Footed Bat[13] *(Myotis leibii)* | UR | E | 0 | 1 | 1 | TBD | N/A |

[1] Reported quantities are variable dependent upon survey effort, area/species of focus in a given year, opportunistic observations, and other influences. MAARNG reports all state-listed species observations consistent with the Environmental Performance Standards, with some caveats noted below.

[2] A full state-listed species list is included in the INRMP.

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

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

[5] 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.

[6] 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).

[7] 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.

[8] In 2018 only sites with historic records and no recent records were surveyed.

[9] 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.

[10] 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.

[11] 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.

[12] Numbers represent occupied locations with confirmed identification.

[13] 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. TY 2020 data is still being processed, these numbers are to be determined at a later date (TBD).

The data currently reported in the table are gross observations only and not interpretable for trends. However, significant progress has been made to collect rare species and management data in a way that allows for trends analysis that will better inform management decisions and meet the intent of Chapter 47 of the Acts of 2002. 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 interannual 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.

State-listed plant surveys annually focus on *Ophioglossum pusillum* and *Triosteum perfoliatum* at Camp Edwards. Based on concerns for separation of the latter species from its congener, *T. aurantiacum*, the Natural Resources Office contracted a genetic and hybridization study, which started in TY 2020. The study was led by Dr. Bryan Connolly, Assistant Professor in the Department of Biology at Eastern Connecticut State University (ECSU) and who previously held the position of Massachusetts State Botanist. Mr. Connolly collaborated with colleagues from ECSU as well as the University of Tennessee and the Flanders Research Institute for Agriculture, Fisheries and Food in Belgium to process and analyze plant samples from Camp Edwards as well as two other Massachusetts sites for comparison and to develop a publishable manuscript. The manuscript is in a near final stage and will be submitted for publishing to a peer-reviewed scientific journal. Among other interesting results, the study shows that the *Triosteum* population at Camp Edwards is more closely related to *T. perfoliatum* than to *T. aurantiacum* and the authors conclude that the plants are likely *T. perfoliatum* and should be regulated in Massachusetts as a population of the rare species. Given the current evidence, annual plant surveys for *Triosteum* at the base will no longer separate *Triosteum* individuals based on morphological features. This means that the existing *T. perfoliatum* population covers a somewhat larger range (i.e., additional rare plant sites or kettle holes) with, in most cases, more individuals counted at known *T. perfoliatum* sites.

Six rare plant sites were surveyed for *T. perfoliatum* in TY 2022 following the protocol for previous years except that all *Triosteum* individuals, regardless of morphological features, are now counted as the rare species, T.

*perfoliatum*. As expected, *T. perfoliatum* counts were higher within rare plant sites than past years with a total of 1,883 stems counted across five of the six sites. Triosteum was not confirmed on one of the sites called RP06a. Triosteum had been observed at RP06a in small numbers in 2016 and 2019 but at the time, the plants were identified as T. *aurantiacum*. Four rare plant sites were surveyed for *O. pusillum* in TY 2022. Field technicians carrying out the surveys counted a total of 225 plants which were all observed from one rare plant site. *Ophioglossum pusillum* was not observed at three of the sites. Natural Resources biologists will continue communication with State Botanists regarding the population status and management of this small-statured and easily overlooked plant. In TY 2022, MAARNG staff installed a game camera for the second growing season at the rare plant site (RP05) that was experimentally fortified with buck fencing in TY 2021 to exclude previously observed deer browse on *T. perfoliatum* and *O. pusillum*. There were no observations of deer browse on rare plants at RP05 or observations of deer within the exclosure.

### 3.3.2 State and Federally Listed Bats

In TY 2022, both the Northern Long-eared Bat (currently federally listed as threatened) and the Tricolored bat (under status review) have been proposed by US Fish and Wildlife Service (USFWS) for listing as federally endangered species. The Northern Long-eared Bat (NLEB) was federally listed as threatened in May 2015 and proposed for listing as endangered in March 2022. The Tricolored bat (*Perimyotis subflavus*) was proposed for listing as endangered in September 2022. These listings are primarily due to the severe population crashes (estimated greater than 95% for NLEB and greater than 90% 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 will take 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, formal consultation will be required for these activities. The Army and National Guard levels are currently exploring formal consultation for regular training and habitat management activities on installations throughout the range of these species, which could apply to activities on Camp Edwards. The Natural Resources Office is monitoring progress of consultations closely and will proceed with a MAARNG consultation if necessary. Consultation at any of the levels will include mitigation and avoidance measures. The seven 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.

Survey efforts have suggested that NLEB are persisting better in coastal areas of the Northeast than any of the rest of their range. Because of this, there is a strong focus on surveys and conservation on Cape Cod and the Islands, Long Island, and coastal New Jersey. A NLEB was discovered on Martha's Vineyard in February 2016 with successively more found hibernating. Acoustic hits for NLEB on base in March and November suggest bats may be overwintering on Cape Cod, as well. If they are utilizing a different type of hibernacula than the caves utilized inland, it could have huge implications for the recovery of the species. Caves allow the spread and growth of white-nose, but a different type of hibernacula or less densely inhabited hibernacula may be allowing coastal bats to avoid white-nose syndrome leading to the greater numbers of bats in coastal areas.

In 2014, the Natural Resources Office began acoustic monitoring on base and continued into 2021. All acoustic data through 2020 were vetted for any Myotis (includes NLEB, Little brown bats, and Eastern small-footed bats) or Perimyotis (Tricolored bats) calls. In TY 2019-2020 and part of TY 2021, microphones were placed above the tree canopy at two sites to specifically target Perimyotis, which is a high-flying species. Perimyotis and NLEB were each recorded at 3 of the 19 acoustic sites monitored in TY 2019, including one site where they were both found, site 15_35, along the southeastern boundary of the Training Area/Reserve. Perimyotis was recorded at one of the two sites targeting the species in TY 2019, though equipment and insect noise issues were prevalent. In 2020, of the four sites monitored, site 15_35 had all the Myotis species and Perimyotis. One other site had little

brown bat and calls that could only be identified to the genus Myotis level. Both sites are along the eastern base boundary. The two sites targeting Perimyotis did not get any Myotis or Perimyotis calls and were more interior.

In TY 2022, acoustic monitoring was not conducted to prioritize analysis of past data. Tetra Tech has been organizing the TY 2021 acoustic data and beginning to vet data; the report on this data is expected in early TY 2023. Confirmed detections will be reported to NHESP. The results of the power analysis completed in TY 2021 was used this year to contract WEST Inc. to analyze the past data for spatial and temporal trends and occupancy analysis. This contract will also provide recommendations for future work that comes from looking at the whole data set. All vetted bat data from 2014-2020 was entered by Natural Resources staff into the federal database, NABat, to inform the USFWS status assessments of *Myotis lucifugus, M. septentrionalis,* and *Perimyotis subflavus*.

BRI was contracted to identify a bat roosting in a bunker on Knot Hollow Road in early February 2021. They identified the bat as a silver haired bat (*Lasionycteris noctivagans*), which is not a state or federally listed species. Federal biologists indicated that this is likely the first record of the species hibernating in New England. BRI also vetted past acoustic data and determined this species has been active on base and in Mashpee during the 2017-2018 winter season. Their report and a manuscript for publication, currently in draft, will be completed in early TY 2023.

The Army National Guard completed a programmatic informal consultation for NLEB addressing small projects implemented by MAARNG at all managed locations to include actions less than 5 acres and incorporating conservation measures. The USFWS concurred with the Army National Guard determination on October 8, 2015, and small projects are kept within the scope of that agreement. Larger projects are scoped to avoid impacts to bats to the extent possible while utilizing the 4(d) rule exemption under the Endangered Species Act as appropriate for habitat management actions. Investment in equipment, personnel training, and collaboration continued in TY 2022 to address concerns both over avoiding impacts to bats and minimizing bat impacts on ongoing actions such as pine barrens habitat management.

AFCEC and Cape Cod Space Force Station 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 2022. Equipment maintenance personnel are the primary observers and perform weekly operations and maintenance checks. Acoustic surveys conducted at Cape Cod Space Force Station, including turbine sites, found relatively low levels of activity, which was dominated by Big Brown Bat and consistent with results in surrounding areas.

### 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 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 2016, contracted wildlife detection dogs readily found pellets at off-base locations and at two on-base sites located along power lines. At several sites on base that had previously had rabbits, the dogs did not find rabbit sign or not in all repeated surveys at the site. This data could suggest a lower density of rabbits and/or a higher extinction rate at more interior sites. More interior sites tend to have more native habitat. To further explore the factors driving this, the Natural Resources Office sent fecal samples for diet analysis in TY 2017 and 2018. The low diversity of food resources at interior base sites with more native vegetation may be limiting the density of rabbits on base. In TY 2019, the Natural Resources Office assisted a Harvard graduate student correlating our diet analysis data with availability of vegetative resources through stem density counts. In TY 2020, the graduate student completed his thesis (available here: https://dash.harvard.edu/handle/1/37365622).

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 University of Rhode Island is wrapping up compiling and organizing data from both sites and will continue with data analysis and reporting in TY 2023.

The Natural Resources Office continued active participation on the 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 2022 in regional plots, in areas with previous management history, and along roads in the Impact Area. In TY 2022, the Natural Resources Office also began collaborating with the State University of New York College of Environmental Science and Forestry and USFWS for experimental management plots to be implemented this winter and subsequent 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 past 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.

Roadway puddles are most often heavily trafficked, unvegetated puddles created by roadway compaction. In TY 2018 when several puddles 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 plan included several components: habitat creation, experimental treatments, and monitoring. Requirements and activities specific to the CMP, including new puddle creation, *in-situ* modification to improve puddles, relocation of egg-bearing sediment, and three years of monitoring, 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, AgCS were still found in three of the 11 puddles monitored in 2020. Surveys in TY 2020 also documented for the first time AgCS and Mattox Clam Shrimp 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 creation and improvement and annual monitoring, brings in new elements, such as road category designations and their associated treatments, and provides for a net

Photograph 3-2 Conducting clam shrimp surveys at road puddle habitat along a powerline right-of-way in the Training Area/Reserve. Photo: Natural Resource Office/Erin Hilley

conservation benefit to AgCS. 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.

In TY 2022, as part of the CMP Amendment, annual clam shrimp monitoring resumed for the fifth consecutive year, however, to alleviate seasonal field technician shortages, SWCA Environmental Consultants was contracted to carry out clam shrimp monitoring and rare species reporting. SWCA is in the process of compiling the results from their eight monitoring visits spread out from mid-May to mid-October. The Natural Resources Office expects to receive the monitoring results from SWCA this fall and will update the Rare Species Table at that time. Clam shrimp samples collected by SWCA will be submitted to the MassWildlife Aquatic Ecologist and positive observations of state-listed clam shrimp will be submitted by SWCA to MassWildlife using their online reporting system, Heritage Hub, under their issued collection permit. The Natural Resources Office also received a collection permit, which has been renewed annually, to sample clam shrimp on MAARNG lands or any lawfully entered lands in Massachusetts.

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-ITAM, 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. The first Road Work Plan proposal was submitted for MassWildlife review concurrently with the CMP amendment request. The approved Road Work Plan was specifically for necessary repairs to severely degraded Impact Area perimeter roads. This included the boundary portion of Jefferson and Barlow Road and impacted 12 puddles with occupied status, meaning AgCS had been documented in previous years. Approved mitigation for this work was carried out in TY 2021 and included relocation of adult clam shrimp and/or transfer of egg-bearing sediment from the impacted puddles to existing surrounding puddles not known to contain clam shrimp. A report of Final Conditions for the impact area roadwork and clam shrimp mitigation was submitted and approved by NHESP in January 2022.

In December 2021, the Natural Resources Office submitted the second Road Work Plan. This plan was submitted to MassWildlife and approved by the end of TY 2021. This Plan includes projects that range from routine grading of Gibbs and Burgoyne Road, repairs to sloped rutted sections of Wheelock Road, and a puddle improvement project. FRED puddle, a large and nearly impassable puddle on Fredrickson Road, is habitat for AgCS. Using techniques approved and carried out as part of the original CMP, Natural Resources Program plans to raise the elevation and reduce the size of the puddle so that it still provides AgCS habitat but is also passable by vehicles. This plan was amended in July 2022 to include two additional projects, one, an IAGWSP grading project on a

section of Barlow Road and two, a necessary puddle improvement project on Pocasset Road. Neither project impact known clam shrimp puddles. Work approved under this plan is in various stages from complete, to underway, to not started. The Natural Resources Office will submit a Final Conditions Report to NHESP by the end of the calendar year. The Natural Resources-ITAM Office will coordinate with the IAGWSP, Camp Edwards troop labor officials, and Facilities and Engineering to develop a Road Work Plan for the coming year. The Natural Resources Office submitted a Final Conditions Report to NHESP on February 9, 2023 for projects completed.

## 3.3.5 Eastern Box Turtle

### 3.3.5.1 Turtle Protection

In support of the MPMG proposed project, AECOM was contracted to create an Eastern Box Turtle Construction Period Monitoring and Protection Plan (CPMPP) and to complete initial canine-assisted surveys around the MPMG range in fall 2019. Once NHESP approved the plan, the plan implementation was contracted to AECOM to provide canine-assisted pre-construction turtle surveys and construction period monitoring, including tracking turtles around the project area using radiotelemetry. The CPMPP included silt fence installation followed by the required hours of turtle surveys inside the wildlife barrier completed before October 31. The construction contract was not awarded in TY 2020, which meant the silt fence could not be installed. The agreed upon survey hours and turtle tracking was still completed. A report on all efforts was submitted to NHESP on February 2, 2021, and additional survey effort in 2021 was proposed to account for surveys inside the silt fence once installed. Due to permitting delays, the silt fence was not installed in 2021. In August 2021, the Natural Resources Office submitted "Addeundum: Turtle Protection Pre-surveys Camp Edwards Multipurpose Machine Gun Range" to NHESP to complete the agreed upon survey hours in an open system, to track turtles prior to hibernation, and to relocate turtles to a known hibernation location near the project area. This plan provided protection for turtles during winter silt fence installation and tree removal activities. However, the silt fence was not installed in the winter of 2021-2022 due to delays in project approvals. The Natural Resources Office and their contractor, AECOM, submitted a report and subsequent updates from the fall and spring activities in TY 2021. The report included plans for silt fence installation in the active or inactive season to accommodate work when approvals are obtained.

In TY 2022, the Natural Resources Office took over the turtle protection project started by Eversource at Dig Site 3. The Dig Site is being used as a stockpiling site for soil that will be used on future construction projects on base. The site was enclosed with silt fence until spring 2022 when it was taken down since major construction projects have been delayed. Approvals for this process and reporting on this process was completed with NHESP. Prior to the start of major construction projects requiring material removal, the silt fence will be installed again and maintained for turtle protection

Natural Resources Office staff provided education to equipment operators, monitoring of transmittered turtles, and sweeps prior to the start of work on a troop labor project completed at Tango Range. All this work was completed in collaboration and approval from NHESP.

Oxbow Associates, the contractor for Eversource, coordinated with the Natural Resources Office on their activities on base including at the substation and along the powerline paralleling Gibbs Road. The Natural Resources Office shared transmitter frequencies for turtles along the powerlines to facilitate turtle protection during pole replacement work this fall. Oxbow Associates has also provided information on the health of turtles they find on base.

### 3.3.5.2 Monitoring and Research

Photograph 3-3 Collaborative, interagency training on box turtle natural history, survey technique, conservation, and protection hosted at Camp Edwards. This event included MassWildlife, DCR, US Coast Guard, AECOM, Inc., and MAARNG.

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 MPMG range. Turtle searches will be completed in October 2022, and reporting on this project is expected in the spring of TY 2023.

In-house turtle telemetry efforts focused on tracking tagged turtles during spring emergence and in the fall. Turtles were assessed for the presence of fly larvae when found above ground. Tagged turtles are mostly in C-14, Sierra and Tango ranges and around the MPMG, 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 is planning to submit 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" and "Health assessment of spotted (*Clemmys guttata*) and painted (*Chrysemys picata*) turtles in Cape Cod, Massachusetts."

Dipteran larval infestations were again observed in TY 2022. The Natural Resources Office facilitated a UMass Amherst graduate student's research on dipteran larval infestations in Eastern box turtles on Camp Edwards. 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 will be supplemented with information gathered by Natural Resources staff in the spring and fall of this year. The graduate students will compare the movements of healthy and infected turtles to determine potential impacts on mobility from larval infestations. The graduate student also plans to identify the species of fly infesting box turtles and gather information from other researchers across the range on the distribution and prevalence. This project included inputs and collaboration from USFWS, USGS, and NHESP. 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.

Photograph 3-4 New signage at main entrances to the northern training area. Photo: Natural Resources Office/Nicole Madden

The Natural Resources Office is also collaborating with researchers from the University of Massachusetts Amherst, USGS, and the state Herpetologist to facilitate a PhD research project on Camp Edwards focused on prescribed fire and Eastern box turtle populations. In TY 2022, the Natural Resources Office collaborated with the researchers to define objectives and hosted the selected graduate student for two weeks to familiarize him with the base, the ecological context, and the study species. In 2023, the graduate student will begin the first of multiple years of research on base.

#### 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. In 2022, no road mortalities were documented. To minimize the potential for unintentional impacts to Eastern box turtles and snakes on base, Roads and Grounds installed permanent wildlife crossing signs displaying a turtle and snake on them at all the likely entrances to the training areas. In TY 2022, the Natural Resources Office conducted three trainings on box turtles. Two trainings were for personnel working on base: the Roads and Grounds crew and IAGWSP contractors. The third training was at the request of and in collaboration with NHESP and included attendance from DCR and US Coast Guard personnel. The Range Control Office also regularly briefs units on box turtles. Each year, Range Control personnel consistently report Eastern box turtle sightings to the Natural Resources Office, which are often tagged with transmitters.

USFWS and MassWildlife asked the Natural Resources-ITAM office to host and participate in an "Every Turtle Counts" PSA about keeping turtles in the wild due to increased collections for the pet trade. USFWS posted the video on their Facebook page in August 2022 (https://www.facebook.com/USFWS/videos/619037636620623). USFWS also plans to create a longer video with more details on Eastern box turtle research on base.

### 3.3.6 Lepidoptera

The creation of the MPMG, the associated fire control measures, and the required pine barrens management will increase the amount of fire on the landscape. Many of the Lepidoptera species on base are expected to greatly benefit from the reintroduction and increased frequency of fire. The monitoring component of the CMP requires long-term Lepidoptera surveys. The monitoring component needs to evaluate effects of the overall range development, the fire hazard reduction actions, and mitigation actions (short and long term) on the Lepidoptera

Photograph 3-5 Pink Streak Moth (Dargida rubripennis) photographed at Camp Edwards. This Switchgrass obligate was documented in both the grasslands and northern training area in TY 2022. Photo by Teá Montana.

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 Barrens buckmoth, a species believed to indicate improved conditions for state listed moths on base. The development of these protocols was completed in early TY 2022, and the vegetation sampling protocol was implemented at 20 sites in TY 2021.

In TY 2022, The Natural Resources Office contracted Davey Resource Group to implement the vegetation sampling at 30 sites and contracted GZA (two-year contract) to implement UV light trap sampling for night flying moths at 7 sites 4 times spaced out during the flight periods for target species. The first 3 sampling events captured 4 state listed species, including a new species for the site, Heterocampa varia. This may be the first individual documented on the mainland in Massachusetts, with previous findings of the species on Martha's Vineyard and Nantucket. This will be explored further in the report from all sampling events, expected in spring 2023.

In TY 2019-2022 the Natural Resources Office collaborated with a PhD student from the University of Massachusetts Boston Stevenson Lab in monitoring Lepidopteran diversity at Camp Edwards. The focus of the student's research is Lepidopteran diversity across urban/rural gradients, and the Training Area/Reserve fits the rural category. While a general moth expert, the student also specializes in the Sphingidae, a declining group. Her studies have expanded our knowledge of Sphingid moths at Camp Edwards and has added to our list of moth species found at Camp Edwards. She introduced staff to multiple surveys methods with notable results and renewed emphasis on moth documentation. Her work in TY 2022 continued to document Frosted Elfin, Slender Clearwing, and Pink Streak (*Dargida rubripennis*). 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 (*Hemileuca maia*), Unexpected cycnia (*Cycnia inopinatus*)) will be reported to NHESP.

The USFWS "Frosted Elfin Habitat and Butterfly Survey Protocol" was implemented at three locations on Camp Edwards with an abundance of their host plant (Wild Indigo, *Baptisia tinctoria*). Adults of this species were detected at each survey location and one location was followed by supplemental caterpillar surveys mentioned above. 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.

UMass interns completed Monarch surveys in two sites for larval Monarchs using the Monarch Larva Monitoring Project protocol developed through a partnership of the Monarch Joint Venture and the University of Wisconsin-Madison Arboretum. This data will be entered into their online database. Their effort was extremely helpful to supplement short staffing and continue monitoring this at-risk species.

### 3.3.7 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 over 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 decline throughout the region and close association with dense, but open woodland and shrubland habitat condition that is important to the vast majority of species of conservation concern in southeastern Massachusetts.

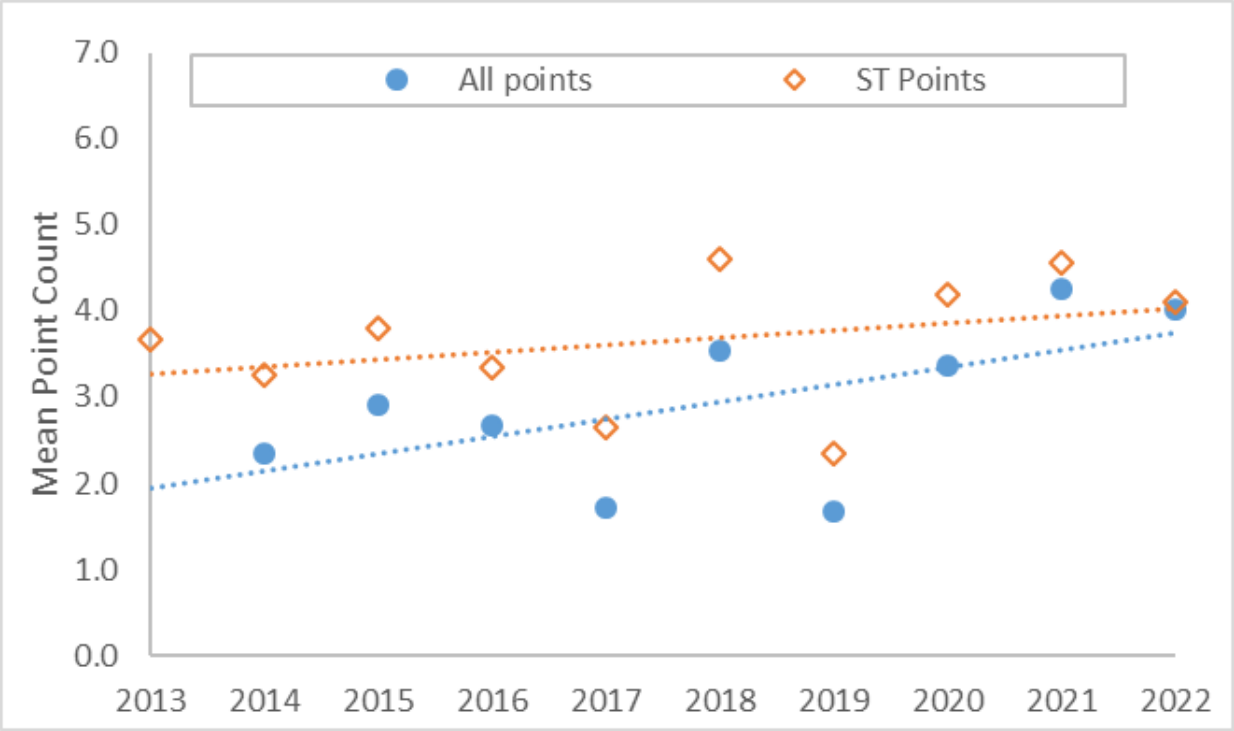
The TY 2022 Whip-poor-will surveys were completed on May 15, 2022 following two nights of shorter point-counts following the same protocol to provide background context and greater confidence in formal survey night results compared to prior years. The TY 2022 surveys documented Whip-poor-wills at all 32 survey locations for an occupancy rate of 100% and a mean count of 4.0 birds per point. This is compared to the long-term mean of 2.9 birds per point. Overall, Whip-poor-wills show an increasing trend for abundance, which is significant at a 90% confidence level ($p=0.09$ F-test for the slope coefficient). Trends in occupancy are stable due to near saturation and a long-term mean of 0.919 (91.9%) for occupancy. Graph 3-4 presents the summary annual mean counts and trend lines. Given that the state assigned points are placed at higher quality habitat than the more randomly assigned site-wide points, the state (ST) points have consistently higher mean count of birds per point, but the subset and overall set are highly consistent through time.

The lower count years in 2017 and 2019 are likely outliers based on survey conditions and attempting to find a quality survey night meeting the restrictive protocol while meeting other program priorities (e.g., prescribed fire, nocturnal research efforts, etc.). As mentioned above, the Natural Resources Office accounted for this in TY 2021 by implementing more opportunistic surveys prior to the formal survey night focusing on the very brief calling period displayed by Whip-poor-wills in lower lunar illumination. This first year's effort found very consistent results between the preliminary efforts and the formal survey as a quality night for combining lunar and weather conditions was available in TY 2021. In TY 2022, preliminary surveys revealed that surveys before the $10^{th}$ have lower detectability due to increased amphibian noise and decreased Whip-poor-will activity. The preliminary surveys still provides within year context, redundancy for instances of poor conditions on the formal surveys, and increased opportunities to record Chuck-will's-widow and Northern Saw-whet Owl. In successive years it is hoped that when staffing is available to complete these preliminary surveys they may help identify if low count results are consistent and indicate a representative result or an artifact of survey night conditions.

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.

Prior to TY 2016, Whip-poor-will numbers shown in Table 3-1 and in Appendix G have included multiple surveys, and likely repeated counts. From TY 2016 onward, the number reported reflects the lowest number (between two observers) heard per site during a single round of surveys to remain conservative in reporting, while keeping detections over negative site records (sites are only considered negative records if surveyors mark paired zeroes).

Graph 3-4 Camp Edwards Site-wide Eastern Whip-poor-will Monitoring




Graph 3-4: Annual results of Camp Edwards Whip-poor-will monitoring using the Northeastern Nightjar Survey protocol. The orange (ST) points are a subset of 10 points originally set by MassWildlife based on habitat associations and the blue points are the overall site-wide monitoring points (mean 34 count sites per year).

## 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. None of the existing unimproved roads in the Training Area/Reserve were made into improved roads as a result of IAGWSP remediation activities during the year. Additionally, any maintenance on unimproved roads during the year did not involve paving the roads. An Army National Guard Engineering unit graded and used gravel to repair 2,500 feet of Wheelock Road, stretching from Frank Perkins Road to Battle Position 24, and 1,400 feet of Fredrikson Road, extending south from Wheelock Road. The IAGWSP contracted work to gravel significantly degraded lengths of Wood, Jefferson, Crowell, and Turpentine Roads, with work completed in January 2022. Later in TY 2022, IAGWSP again coordinated with Natural Resources for a road improvement (grading and graveling) project on the section of Barlow Road between Wood Road and Jefferson Road. All repairs were coordinated with the EMC's Environmental Officer. All projects were also coordinated closely with Natural Resources to follow the Conservation and Management Permit for Agassiz's Clam Shrimp that ensures conservation of that species while supporting critical operations through road maintenance.

### 3.4.1 Erosion

During September, 2022, the base experienced two severe rain events that caused widespread erosion damage on roads in the training area. The ITAM program worked with Camp Edwards Facilities Engineering to identify the most severely impacted roads and set repair requirements. 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.

## 3.5 VEGETATION, HABITAT AND WILDLIFE MANAGEMENT

The Natural Resources Office manages for a diversity of natural communities, plants, and animals. This supports a sustainable military training site and high-quality habitat for rare species (Table 3-1) as well as common ones. Particular emphasis is on maintenance or expansion of earlier successional habitats (e.g., grasslands, shrublands, and young forests) due to the conservation value of these habitats and rapidity at which they are lost to trees or other influences. 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 habitats, including mature woodland. During TY 2022, two larger restoration projects were implemented along with several smaller, focal projects – all of which are discussed in much greater detail in Section 3.5.6. Table 3-2 provides an overview list of the projects. A project in training area BA-3 combined mastication (mechanically mowing/mulching) and whole tree harvesting to restore understory and create a large woodland opening that will support soldier training and a native grass/forb natural community. Another project used whole tree harvesting to restore functionality to a frost bottom depression in training area E-3. One training area and three helicopter landing zones received in-house mastication treatment to clear midstory vegetation and reestablish lines of sight and maneuverability while improving habitat conditions. Prescribed burns implemented for habitat and vegetation management are discussed in Section 3.6.1.

Table 3-2 Training Area Management Projects

| Training Area | Acres Treated | Primary Objective | Treatment Method |
|---|---|---|---|
| BA-3 | 68 | Training site rehabilitation | Mastication of vegetation ≤ 6" DBH |
| BA-3 | 18 | Training site rehabilitation/ habitat restoration | Whole tree harvest to thin understory and canopy coverage |
| E-3 | 27 | Frost bottom restoration | Whole tree harvest |

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 Conservation and Management Permit. 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 association with both small arms range areas and habitat management zones. Climate resilience planning and assessment is ongoing for Camp Edwards with the Woodwell Climate Research Center. A critical outreach element for TY 2021 and 2022 was communicating through public tours and other venues that the entirety of Camp Edwards, especially within the Upper Cape Water Supply 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

Primary effort for vegetation surveys in TY 2021 was focused on vegetation composition and structure pilot surveys linked to the long-term moth monitoring protocol. This long-term effort will provide valuable response and trend data for a variety of habitat to inform management activities and strengthen interpretation of faunal

survey results. In TY 2022, vegetation surveys for the long-term moth monitoring project were carried out for the second year. See Section 3.3.6 for more details.

### 3.5.2 Invasive and Nuisance Vegetation Management

Invasive plants are non-native species that have spread into natural, minimally managed, or disturbed plant systems in Massachusetts. They can cause economic or environmental harm by developing self-sustaining populations and becoming dominant and/or disruptive to those systems. As defined here, "species" includes all synonyms, subspecies, varieties, forms, and cultivars of that species unless proven otherwise by a process of scientific evaluation. Invasive species are primarily from the Massachusetts Invasive Plants Advisory Group (MIPAG) lists, but also include emerging invasive species as coordinated with partner agencies.

Nuisance species are more selectively or situationally defined and may include native plants under certain conditions. Several native species have displayed such aggressive establishment and regeneration that they require targeted management in order to preserve the training and preferred habitat value of some training venues. Although not exotic, these species, under certain conditions, can display the same dominant and disruptive characteristics normally associated with invasive species. Pitch pine in particular has historically taken advantage of neglected training sites to create impenetrably dense, overstocked monocultures that exclude nearly all other species of plants and animals, produce unhealthy trees, present significant fire hazard, and prevent training. Other native, desirable species that may situationally present a nuisance condition from a habitat perspective include bayberry and sweetfern due to tendencies towards monoculture through chemical defenses.

Exotic invasive plants are a management concern both in the Training Area and within the Cantonment area. Effective management of these species, primarily autumn olive (*Elaeagnus umbellata*), Oriental bittersweet (*Celastrus orbiculatus*), and shrub honeysuckles (*Lonicera spp.*), is both labor and cost intensive. Natural Resources-ITAM has two trained and licensed Massachusetts core pesticide applicators on staff. With this capability, Natural Resources-ITAM conducted in-house herbicide treatment to control the spread of *Calamagrostis epigejos*, an aggressive and exotic invasive grass. Crew used a backpack sprayer and a motorized UTV-mounted pump to spray a Glyphosate solution on clumps of the grass along Richardson Road, in Demo 2, on Sierra Range, and in Training Area BA-6. All spraying was precisely targeted with wands rather than boom or broadcast spraying. A total of 3.3 pounds of active ingredient were applied across these sites, over the course of the summer and a total area of less than one acre. ITAM also conducted hand pulling to remove spotted knapweed (*Centauria stoebe*) from restored training sites on BP-1, Demo-2, and Wheelock Overlook, covering 7 acres.

In TY 2017, the Natural Resources Office contracted Wilkinson Ecological Design to complete a Vegetation Management Plan for invasive species treatment in rare plant sites and complete the associated MESA permitting. In 2017, Wilkinson completed the site visits and prepared a Vegetation Management Plan, which was approved by NHESP. In TY 2018, Wilkinson performed chemical treatment of all invasive plants found at rare plant sites. Natural Resources Office staff performed follow-up treatments where necessary and monitored the sites from 2019-2021. Invasive plants do not appear to be a current threat at sites where rare plants exist, but several of the sites where rare plants have disappeared over the years and where they exist now still have some invasive plants and some of these sites have seen more and more encroachment of woody trees and shrubs which precludes suitable growing conditions for the rare plants. The Natural Resources-ITAM Office plans to remedy this through continued invasive plant monitoring and removal and targeted tree removal in TY 2023 and beyond in order to return frost bottom effects to these unique kettle hole depressions.

### 3.5.3 Bird Surveys

This is the tenth year that point counts were conducted along a bird survey route through the Training Area/Reserve to determine differences in bird activity in a variety of military training areas and habitat types. The routes consisted of 65 sites that were each visited three times to facilitate eventual analysis of detection probability and determination of effective indicator species. These analyses have yet to be completed, but with the completion of ten years of surveys with consistent protocol, the Natural Resources Office has been evaluating trend data, prioritizing species of significant conservation interest (e.g., Species of Greatest Conservation Need as defined in the State Wildlife Action Plan). The State Wildlife Action Plan is available at https://www.mass.gov/service-details/state-wildlife-action-plan-swap. The 2013-2022 survey efforts also follow the long-term effort from 1994-2013 with annual point count surveys at an average of about 30 points per year. The two combined provide a very robust data set for evaluating species and guild trends through time and in response to changes in habitat.

Photograph 3-6 American Woodcock, a Species of Greatest Conservation Need, found with nestlings near Sierra Range during an interagency box turtle training. While this species is not well monitored by typical daytime point counts, targeted surveys and opportunistic observations have found them thriving at Camp Edwards, especially in areas with a patchy barrens mosaic, including openings such as battle positions and ranges. Photo: Jake McCumber

Outside the primary scope of this report, but still relevant is that for the eighth year, a point-count methodology was implemented in continuation of a state-wide survey of grassland birds coordinated with the DFW and Mass Audubon, which has been incorporated into the overall bird survey effort. This method is intended to be continued to evaluate trends in grassland bird populations and response to management. State-listed species will be reported to NHESP (Table 3-1), including Grasshopper Sparrows (*Ammodramus savannarum*) and Upland Sandpipers (*Bartramia longicauda*). The Eastern Meadowlark (*Sturnella magna*) was also listed as a Species of Special Concern in TY 2020 and will now be reported in Table 3-1. The initial year of this effort focused only on target species, but all subsequent years have followed the standard point-count survey protocol for Camp Edwards.

Nineteen Species of Greatest Conservation Need (SGCN), as categorized by the State Wildlife Action Plan, were observed during breeding bird point counts in TY 2022 (See Table 3-3). Three species were not included due to the birds being flyovers not using habitat (Great Black-backed Gull, Common Loon, Herring Gull). Some SGCN are frequently observed at Camp Edwards, but are not readily detected through diurnal point counts, including American Woodcock (occasional focal surveys conducted) and Eastern Whip-poor-will (discussed above, annual targeted survey conducted). Many of the SGCN reported below are notable in their degree of occupancy (survey sites with detection) at Camp Edwards and several show significantly positive response to habitat management, including Brown Thrasher and Field Sparrow, but also species such as Scarlet Tanager. A total of 74 species were recorded during breeding bird point counts at Camp Edwards.

The overall proportion of occupied survey sites (occupancy) is shown in Table 3-3, but most of the species are distinctly associated with the habitat(s) of either the Training Area/Reserve or cantonment grasslands and are both shown and calculated separately within those subsets. A total of 65 training site points and 14 grassland sites were surveyed in TY 2022. More widespread species are shown as sitewide species with the full set of 79 points and many of these require a mosaic of habitats such as that provided in a variety of conditions at Camp Edwards.

Table 3-3 also presents the mean for 2022, mean for all survey years, and trends for abundance of the Species of Greatest Conservation Need breeding at Camp Edwards. Evaluation of both occupancy and abundance (average count at a survey point) helps better understand ecological and management response and evaluate the health of a population. Many of our SGCN are both increasing in occupancy and abundance demonstrating that the increases in distribution (occupied sites) is not at the loss of birds elsewhere, but due to increasing populations. Based on the species and both trends this is strongly suggestive as a positive response to the program of habitat restoration and maintenance focusing on providing a healthy pine barrens mosaic of habitat with diversity of habitat and species composition at multiple scales. The increases of species across a variety of habitats in response to fire and forestry is expected based on the condition of unmanaged stands that are often stunted and overcrowded based on long-term land use history. The restoration of a fire regime and conservation-minded forestry to restore diverse woodland conditions and openings supports an overall healthy ecosystem for which birds are a useful indicator of conditions based on detectability and variety of food and habitat needs.

It is notable that some species are demonstrating declines. The Upland Sandpiper and Horned Lark results are somewhat artificial and based on the survey area. Consistency in management regimes (mowing area and timing) at the Coast Guard airfield has proved to well support both of these species, which continue to be observed within the airfield. The declines shown below are based more on habitat selection between grassland conditions than the actual population at JBCC. Our program will work to collaborate with the Coast Guard on data analysis for these species to better evaluate populations for Joint Base Cape Cod as a whole. The Black-billed Cuckoo is consistently uncommon but has had somewhat stochastic counts through the years with moderate numbers in most years but very low counts in 2013, 2018, and 2022. This warrants investigation into literature of population dynamics for this species. Purple Finch has had a somewhat similar pattern.

TABLE 3-3 BREEDING BIRD POINT COUNTS – SPECIES OF GREATEST CONSERVATION NEED

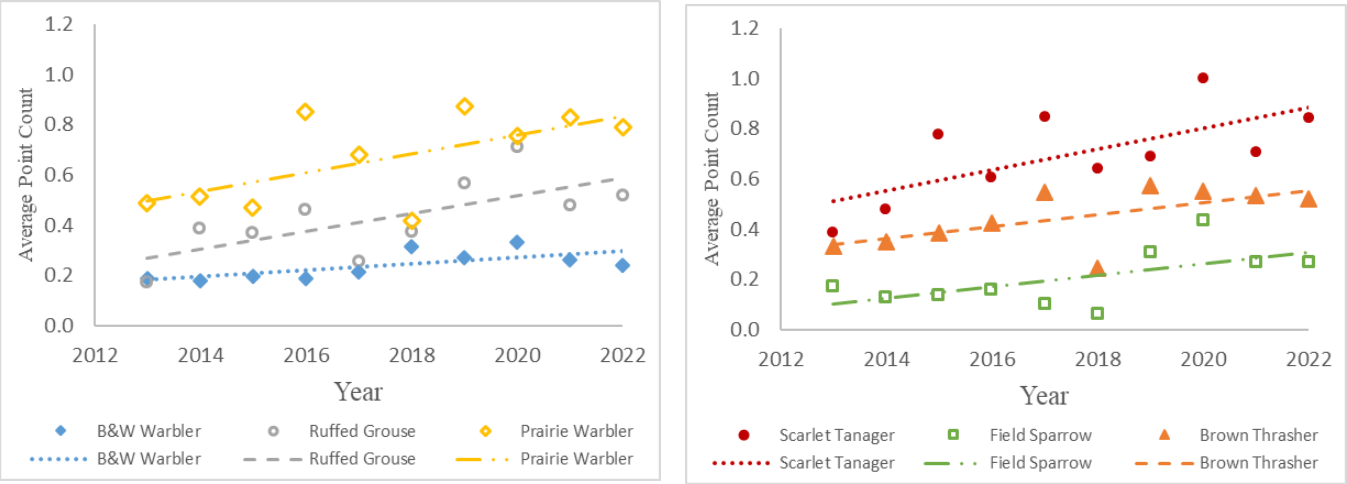
| | | Occupancy | | | Abundance | | |
|---|---|---|---|---|---|---|---|
| | | | 2013-2022 | | | 2013-2022 | |
| | Species | 2022 | Mean | Trend | 2022 | Mean | Trend |
| Grassland Subset (14 points) | American Kestrel | 0.286 | 0.332 | -0.010 | 0.095 | 0.174 | -0.014 |
| | Eastern Meadowlark | 0.643 | 0.506 | 0.090** | 1.262 | 0.393 | 0.189** |
| | Grasshopper Sparrow | 0.857 | 0.796 | 0.027 | 1.810 | 1.599 | 0.075 |
| | Horned Lark | 0.000 | 0.038 | -0.013 | 0.000 | 0.018 | -0.006 |
| | Upland Sandpiper | 0.071 | 0.394 | -0.042 | 0.024 | 0.397 | -0.054* |
| Sitewide Species (79 points) | Brown Thrasher | 0.671 | 0.594 | 0.019* | 0.519 | 0.426 | 0.024** |
| | Chimney Swift | 0.038 | 0.035 | 0.003 | 0.034 | 0.017 | 0.003 |
| | Eastern Towhee | 1.0 | 0.961 | 0.005 | 6.502 | 4.247 | 0.192 |
| | Field Sparrow | 0.367 | 0.285 | 0.020* | 0.270 | 0.188 | 0.023* |
| | Prairie Warbler | 0.633 | 0.510 | 0.022** | 0.789 | 0.631 | 0.037** |
| | Purple Finch | 0.114 | 0.163 | -0.010 | 0.042 | 0.075 | -0.005 |

TABLE 3-3 BREEDING BIRD POINT COUNTS – SPECIES OF GREATEST CONSERVATION NEED, cont'd

| | | Occupancy | | | Abundance | | |
|---|---|---|---|---|---|---|---|
| | | | 2013-2022 | | | 2013-2022 | |
| | Species | 2022 | Mean | Trend | 2022 | Mean | Trend |
| Training Area Subset (65 points) | Black-and-white Warbler | 0.400 | 0.394 | 0.013 | 0.241 | 0.239 | 0.013** |
| | Black-billed Cuckoo | 0.046 | 0.178 | -0.007 | 0.015 | 0.077 | -0.001 |
| | Eastern Whip-poor-will[1] | 1.000 | 0.910 | 0.009 | 4.000 | 2.947 | 0.203* |
| | Ruffed Grouse | 0.846 | 0.706 | 0.031 | 0.518 | 0.428 | 0.036** |
| | Scarlet Tanager | 0.923 | 0.777 | 0.021 | 0.841 | 0.697 | 0.042** |

This table presents results from 2013-2022 annual bird surveys, though grassland points were not started until 2015. Occupancy is the proportion of sampled sites (point count locations) where a species was detected, which demonstrates overall distribution or how widespread a species is in the survey area measured from 0 (absent at all sites) to 1 (present at all sites). Abundance is the actual count of individual birds at a survey point, presented here as the average count per point for the reporting period (TY 2022) or annual average count per point for the survey period (2013 or 2015 through 2022). Trends were calculated in Microsoft Excel and the slope coefficient was evaluated with an F-test statistic. Trends reported with a single asterisk (*) are significantly different from zero with a p-value less than 0.10 and a double asterisk (**) has a p-value less than 0.05. [1]Note for Eastern Whip-poor-will that the sample set is 32 points as reported elsewhere, but they are included in this table for comparison with other trends.

Graph 3-5 Abundance Trends for Select Species of Greatest Conservation Need




The above plots (Graph 3-5) show the abundance trends for select Species of Greatest Conservation Need based on relevance within the Upper Cape Water Supply Reserve (e.g., excluding grassland obligate species). Fitted trendlines match the reported slope values provided in the table above. All six of these species have statistically significant abundance (i.e., count) increases despite a variety of habitat affinities from mature forest/woodland (Scarlet Tanager, Black-and-white Warbler), to open shrubland or shrub savannah (Field Sparrow, Brown Thrasher), and species with more complex mosaic habitat selection (Ruffed Grouse, Prairie Warbler).

The calculation of detection probabilities for species of survey concern were not completed in TY 2022 due to other priorities; although the data were provided to a graduate student at the University of Massachusetts for potential future analysis. Past annual reports have set targets for reporting detection probabilities. However,

presenting and evaluating populations trends, as done here and in previous years, are more relevant and informative, especially with the longevity of the current dataset. Detection probabilities will be informative if observers or survey protocol changes (e.g., number of visits to a survey site). Going forward bird population trend information will be updated every two to three years with annual discussion of any notable positive or negative results.

The population trends described above and for the greater species assemblage of birds provides excellent information for habitat management and well demonstrates both the wildlife habitat protection within the Upper Cape Water Supply Reserve and the compatibility of military training with supporting healthy populations of birds of significant conservation concern, which themselves are dependent on a healthy diversity of flora and fauna for feeding, nesting, etc. The trends reported for the 2013-2022 survey protocol well match and continue occupancy trends calculated for the 1994-2013 dataset and show a long-term success for growing and conserving the overall bird community and ecosystem.

### 3.5.4 Deer Hunt

There was a deer hunting season in the Training Area/Reserve during TY 2022 in which 58 deer were taken during 877 hunter days. 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. 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.

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 2022 included a three-day hunt by paraplegic sportsmen (October 28-30, 2021), a one-day youth hunt (October 2, 2021), a two-day opening for archery scouting (November 8-9, 2021), a three-day archery season (November 11-13, 2021), a one-day hunt for military sportsmen (December 4, 2021), a six-day shotgun season (December 6-11, 2021), and a two-day primitive (muzzleloader) season (December 16-17, 2021). Graph 3-6 shows the hunter days and deer harvest ratio since TY 2013.

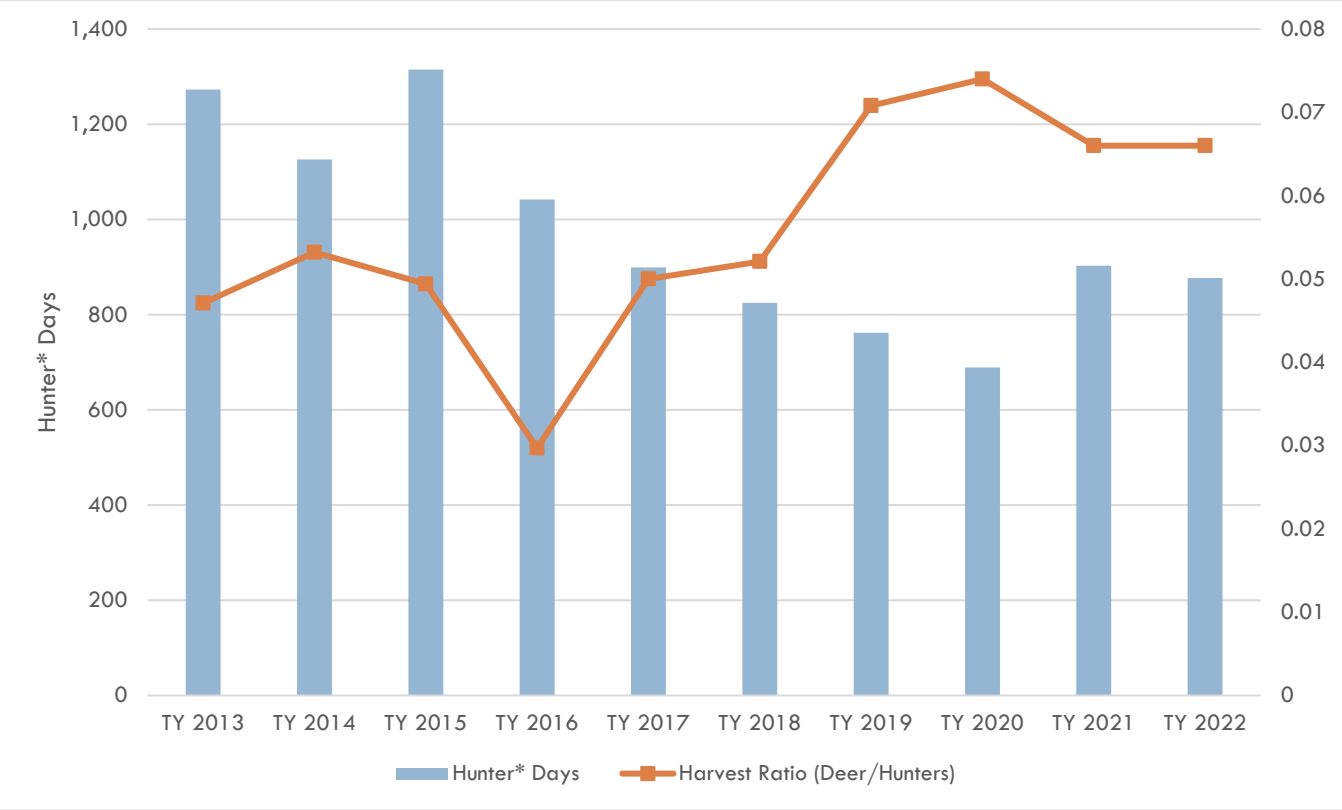
During TY 2020, the Natural Resources Office and the Division of Fisheries and Wildlife conducted hunter surveys to determine hunter preferences, to better respond to queries and requests from hunters, and to determine the success of our advertising efforts. The hunter surveys were not conducted in TY 2022 due to safety protocols to prevent the spread of Covid-19. The hunter surveys are planned to continue 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 goal. 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.

### 3.5.5 Wild Turkey Hunt

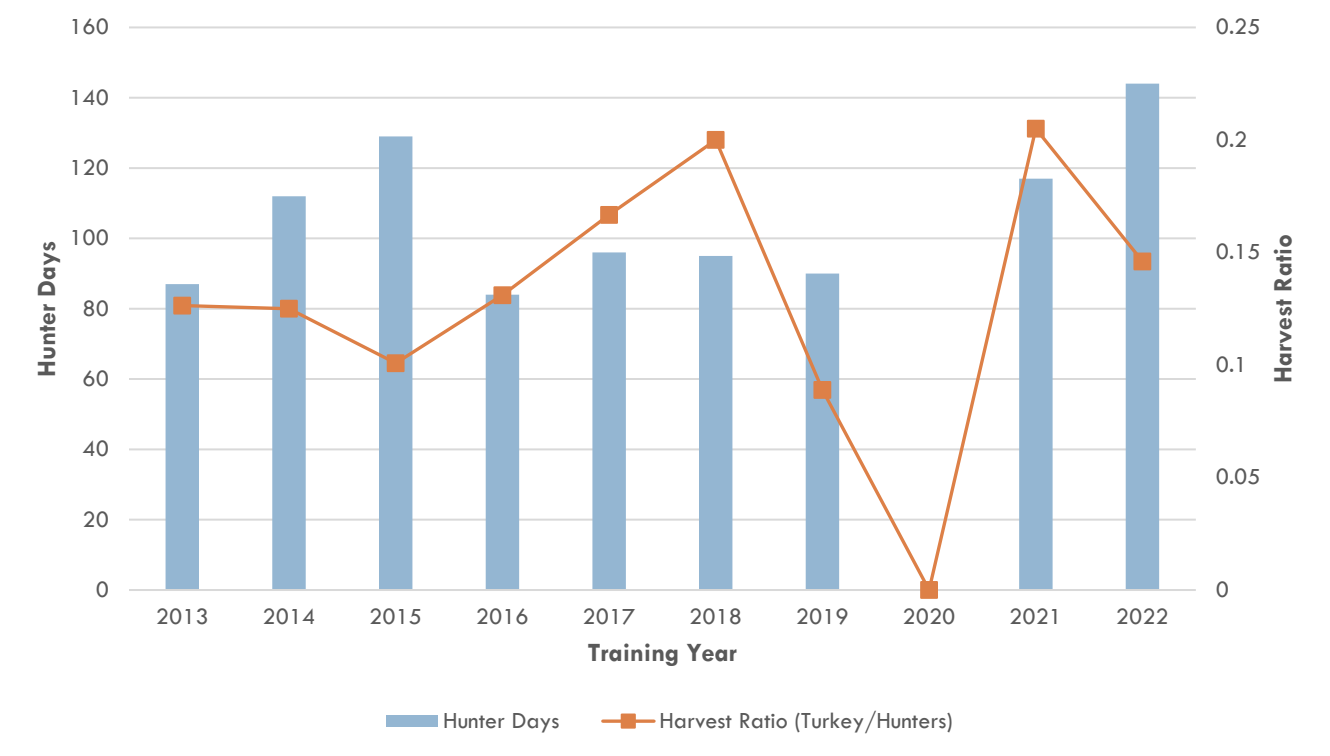
There was a five-day wild turkey hunting season in the Training Area/Reserve from May 2-7, 2022, during which 140 hunters took 19 turkeys. In addition, a one-day youth turkey hunt was held on April 23, 2021, in which four youths participated with two turkeys taken. Graph 3-7 provides information on the wild turkey hunts conducted in the spring since TY 2012.

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.

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.

## 3.5.6 Restoration Activities

The Natural Resources/ITAM 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 on Page 206, Appendix F).

### 3.5.6.1 – BA-3 Training Area Management

ITAM conducted a project devised in accordance with military requests for an accessible and level training area with sufficient space to conduct Table IV qualifications for an Artillery Battery, which has specific requirements for spacing between guns, orientation and sufficient area for trucks to maneuver towed guns. Before the project, there was no existing training site on Camp Edwards that provided the required conditions. In order to provide this required space, this project completely cleared seven acres of overgrown and impenetrable regenerated pitch pine and scrub oak. This portion of the project executed a 100% whole tree harvest and full stump removal, with the intent of removing all resulting debris from the base. In-house efforts cleaned any remaining debris to provide the best possible conditions for reseeding with a proprietary mix of native species of grasses and pollinator host plants. Once established, this site will provide grass/forb early successional habitat bounded by savannah-like conditions with newly reinvigorated understory.

In order to connect the artillery clearing to a suitable access road, this project cleared all trees and stumps on a path connecting to Howe Road to the north. The project included 11 acres of stand thinning on either side of this trail. This work was intended to increase solar exposure to stimulate the understory, to reduce the number of trees that could fall across the trail, and to increase lines of site and access to increase training opportunities (such as ambushes from the newly accessible ridgeline to the west). Per the project's prescription, the contractor removed 50% of all trees ≥ 10" diameter at breast height (DBH) and 50% of all vegetation 4-10" DBH.

For the final portion of the project, the contractor masticated all standing and dead vegetation ≤ 6" DBH (diameter at breast height) in 68 acres surrounding the current perimeter of the site. All material resulting from this project

Photograph 3-7 Northeastern corner of Training Area BA-3 before (July 2021) and after (October 2022) treatment by thinning of small trees and prescribed fire. Note remaining substantial woodland canopy with increased solar exposure to the dense regeneration of scrub oak, blueberry, and other

was left on the ground for future consumption by prescribed fire. The project did not impact mature trees and opened the midstory to permit vision into and out of the site for visibility and dismounted maneuver around the artillery training clearing (in part to facilitate perimeter defense training). This project area was also impenetrably

overgrown, with an alarming amount of ladder fuels and standing dead trees. This was determined to pose an unacceptable wildfire risk, especially with concerns about potential fire and smoke impacts on the Barnstable County Correctional Facility 1,000 feet to the west.

Following this treatment and future prescribed fire, this treatment will approach stand conditions more similar to 20 or 30 years ago, based on past forestry assessment, vegetation structure (e.g., very high density of small diameter trees in the understory and midstory), and anecdotal tree ring assessment. The structure of this stand and known fire history show more open, spaced overstory of comparatively robust trees heavily encroached by young trees moving into the midstory and shading out understory conditions for wildlife such as Eastern Whip-poor-will and plants such as Lowbush Blueberry. Understory mastication of brush and young trees facilitates further management with fire and restores previously more healthy ecosystem conditions and stand resilience.

Photograph 3-8 Barrens Buckmoth (*Hemileuca maia*) ovipositing (laying eggs) on a fresh scrub oak (*Queruc ilicifolia*) sprout in the BA-3 restoration area, October 2022. Understory mastication followed by prescribed fire led to the desired outcome of vigorous sprouting of scrub oak and heath (blueberry, huckleberry), actively supporting a diverse insect assemblage, including rare species, that in turn supports much of the rest of the natural community. Photo: Jake McCumber

### 3.5.6.2 – Range Area West 3 (RAW3) Frost Bottom Management

Natural Resources conducted a selective whole tree harvest in Training Area E-7 (also called RAW3 for fire planning purposes). The intent of the project was to restore functionality to a naturally occurring frost bottom. Vegetation within and surrounding the central depression was so overgrown that it was hindering air flow and venting, thus preventing frost from occurring during a wider range of the year, a mechanism that creates a pocket of rare early-successional habitat in this part of the base.

The project harvested all standing trees 4-22” DBH within the eight acres of the central depression. In addition, it harvested 100% of all trees ≥ 10” DBH and 40% of all trees 4-10” DBH in 14 acres around the depression. This thinning allows cold air to flow into the frost bottom, stimulates understory regeneration, significantly reduces wildland fire fuel loads next to the impact area, and ties into another harvest conducted in 2017, expanding a contiguous patch of savannah-like habitat conditions in the central training area.

### 3.5.6.3 – In-House Management

ITAM conducted limited in-house mastication of regenerating pitch pine in Battle Positions 9 and 10 as well as the following helicopter landing zones: Deep Bottom Pond, Ox Pond and Pinnacle. This landing zone maintenance work was chiefly driven by pilots’ concerns that encroaching vegetation was risking damage to the bellies of their aircraft as well as increasing the risk of rotor strikes. The work at BPs 9 and 10 was motivated by concern about densely stocked regenerating pitch pine and its potential for severe torching in case of fire. The total area affected was less than five acres. All material generated by these efforts was left on the ground for decomposition or future consumption by prescribed fire.

ITAM conducted some in-house tree thinning on Battle Position 1, in Training Area BA-3. This work continued a TY 2021 effort to thin an impenetrable wall of regen pine to reduce torching risk and create a more natural transition from the BP to the surrounding bivouac area. The total area affected was less than one acre. All material generated by this project was consumed in a pile burn.

### 3.5.6.4 – Pending Projects for Fiscal Year 2023

The following two projects were developed and funded in TY 2022 but are scheduled for execution in TY 2023.

#### C-14 Coppice Thinning

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 small in-house strategy to manage this regeneration and refines and applies it on a 30-acre scale. Contractors with hand-held equipment will cut the regenerating stems and, in some cases, apply herbicide directly to the resulting stumps. For 75% of the coppices in this unit, contractors will cut all stems and apply a triclopyr solution directly to the stems. For the remaining 25%, contractors will select the strongest stem for retention and cut all other stems. No herbicide will be applied to any stumps on coppices selected for retention. All cut stems will be left in place for future consumption by prescribed fire. The project also targets a widespread infestation of Black Locust (*Robinia pseudoacacia*) for 100% cut and spray.

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.

Photograph 3-9 Young, native Sundial Lupine (*Lupinus perennis*) that is part of a "headstart" and resilience program for early successional rare species at Camp Edwards that can be incorporated into managed woodland openings and other appropriate habitats. Photo: Jake McCumber

#### RAW3 Forest Thinning

This project will continue the work described in section 3.5.6.2. of this report. The goal of this project is to continue to thin the overstocked woods surrounding the newly restored frost bottom in Training Area E-7 (RAW3). This project will thin 49 acres of pitch pine/hardwood forest. The project has been divided into two stands, both of which bound previously harvested sites.

Stand 1: 31 acres. This treatment is meant 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 is 60 trees per acre, preferentially preserving hardwoods and mostly distributed in clumps of 5-15 trees with open spaces and scattered trees between. To achieve this, we will remove 40% of pine trees ≥ 10" DBH and 70% of pine trees 4-9" DBH.

Stand 2: 18 acres. This treatment is primarily intended to reduce fuel loads alongside the impact area. Our post-harvest goal for this unit is 80 trees per acre, mostly distributed in clumps of 5-15 trees with open spaces and

scattered trees between. To achieve this, we will remove 60% of all trees <12" DBH. All material is removed from the site by the contractor.

## 3.6 FIRE MANAGEMENT

### 3.6.1 Prescribed Fire

The Natural Resources Office utilizes prescribed fire to manage habitat, reduce fuel loads and help prevent wildfires. The prescribed burns are targeted to meet the multiple objectives of fuel reduction, habitat improvement, firefighter training, and soldier training support. The mix of those targets changes by operation, but each is met to varying degrees. The program is outlined in the Camp Edwards Fire Management Plan which is available on the E&RC's website: https://www.massnationalguard.org/ERC/publications.htm. The Camp Edwards smoke management permit (#4F02008) was renewed August 16, 2022 and is valid through December 31, 2024.

Photograph 3-10 Ignition team briefing before finishing a 42-acre prescribed burn in April, 2022. This woodland, dormant season burn was a second entry with prescribed fire in five years – a critical step in returning healthy function and a natural fire regime. Adjacent to Frank Perkins Road, this burn was an exceptional illustration during public tours of rapid, vigorous recovery in a fire adapted habitat. Photo: Joel Carlson

A goal of 25 operational burn days, with an average burn size of 25 acres, totaling 600 to 1,000 acres for TY 2022, was set. A total of 13 operational burn days that averaged 26 acres per burn day, for a total of 332 acres, was achieved in TY 2022. While the actual burn days, average acres burned per day, and total acres burned were less than what was targeted, the total burn days were almost double what has been accomplished in the past, in a twelve-month period. The short fall on the goals was primarily a result of weather and climatic conditions. Fall 2021 did not have any burn days due to weather. One of the worst drought periods on record occurred between June and August 2022, followed by extensive precipitation in late August and into September. The ten-year prescribed fire accomplishment within the Training Area/Reserve is shown in Graph 3-8.

Prescribed fire goals for TY 2023 are to again attempt to conduct 25 operational burn days, with an average burn size of 25 acres, totaling 600 to 1,000 of pine barrens (550+ acres) and grassland habitat (40-60 acres). This is a well-rounded balance of objectives that will meet primary habitat and training lands management objectives while building capacity, experience, and programmatic structure. Significant emphasis has been placed on burning units in the Impact Area buffer and immediately outside this buffer zone. This serves to maximize the mutual benefits and objectives of every operation – improving and maintaining pine barrens habitat, reducing hazardous fuel loading and wildfire potential, and improving training lands for soldiers. The primary limiting factor for wildland fire has recently been weather/climate with more extreme fluctuations in conditions (e.g., extended drought broken by extreme rain events). TY 2023 may be impacted by the pending listing of several bat species, with particular impact on June, which is a key month for pine barrens prescribed fire.

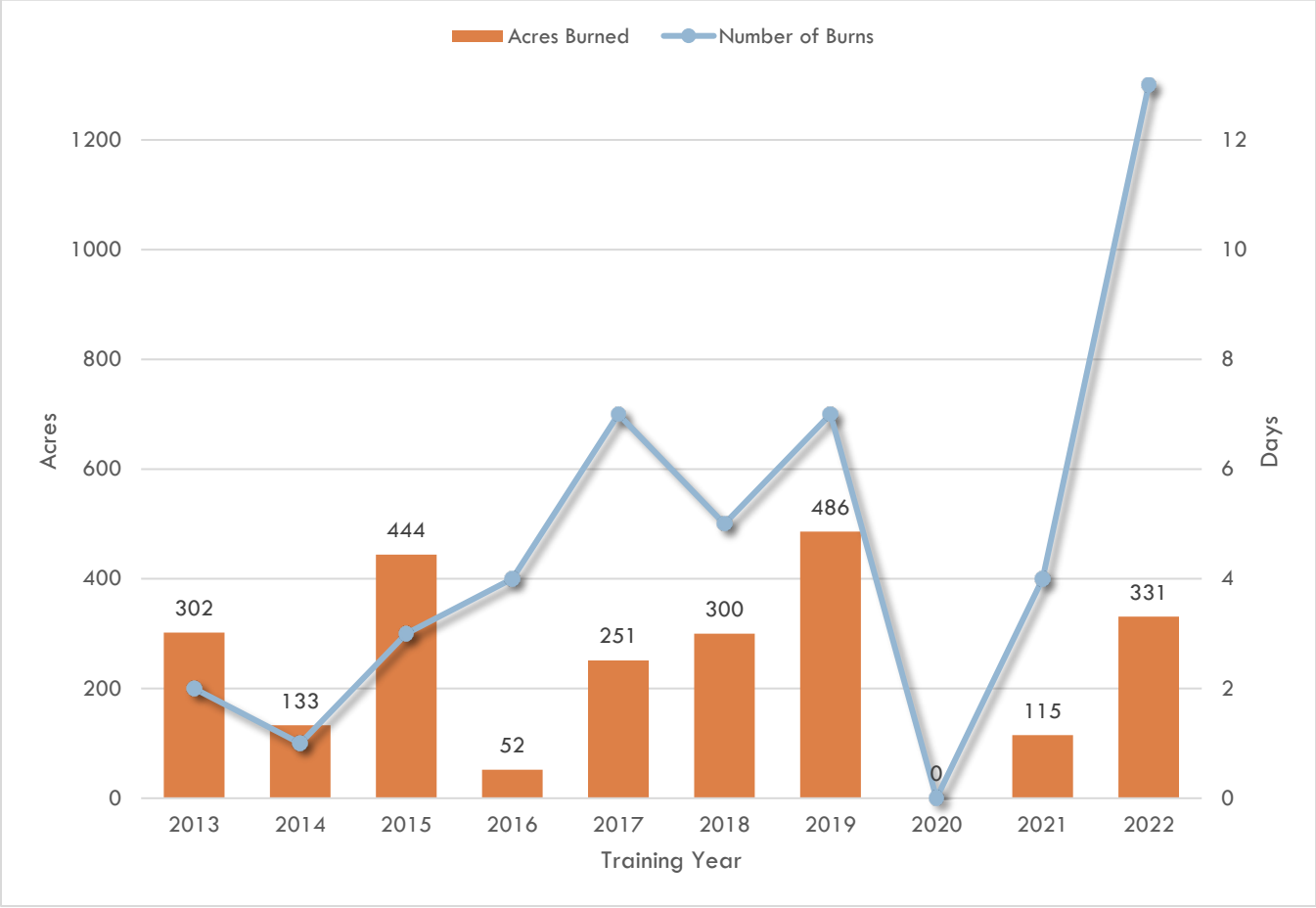
### 3.6.2 Fire Management Planning

The update of the 2007 Camp Edwards Integrated Wildland Fire Management Plan (IWFMP), which is under contract with Colorado State University, is in the final stages of being drafted for review. 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 complete in the spring of 2023.

### 3.6.3 Fire Management Training

Wildland fire training remains a critical component of natural resources management and interagency partnerships. During TY 2022 no formal training academy took place due to budget constraints. However, multiple trainings were held to maintain and improve qualifications of MAARNG and partner crews. TY 2022 trainings included RT-130 annual wildland fire safety refresher (classroom and field) and phase two situational exercises were conducted to complete an interagency Firefighter Type-1 training at Camp Edwards. Additionally, extensive informal, on the job, and performance-based National Wildfire Coordinating Group (NWCG) Position Task Book

Graph 3-8 Prescribed Fire Accomplishment within the Training Area/Reserve TY 2013-TY 2022




Note: Training Year acreage is graphed on the left and the number of burns is graphed on the right axis. In TY 2020, no prescribed burns were conducted due to weather conditions in the fall and the Covid-19 pandemic in the spring.

evaluation and trainings occurred in TY 2022. More than ten individuals from the Army National Guard and its partner agencies actively worked on or were certified on multiple Position Task Books that included Fire Effects

Monitor, Firefighter Type 1/Squad Boss, Incident Commander Type 5, Prescribed Fire Burn Boss Type 3, Engine Boss/Single Resource, and Firing Boss/Single Resource. Adhering to NWCG training and qualification standards ensures increased experience and uniformity of wildland fire credentials across agencies, all of which increases safety and MAARNG capacity to conduct wildland fire operations.

Classroom trainings and performance-based trainings will continue to be high priority in building internal and external partner agency wildland fire management capacity. Trainings will be critical in meeting the National Wildfire Coordinating Group training and qualification standards that the Department of the Army and the National Guard Bureau have recently adopted and are working on becoming compliant with. Planning has begun for a 2023 wildland fire training academy to be held at Camp Edwards.

## 3.7 PEST MANAGEMENT

During TY 2022, Natural Resources and ITAM conducted limited in-house herbicide applications, with an emphasis on the following species: spotted knapweed (*Centaurea stoebe*), oriental bittersweet (*Celastrus orbiculatus*), invasive phragmites (*Phragmites australis*), and *Calamagrostis epigejos*, an aggressive and exotic invasive grass. Crew used a backpack sprayer and a motorized UTV-mounted pump to spray a Glyphosate solution on clumps of the grass along Richardson Road, Howe Road, in Demo 2, on Sierra Range, and in Training Area BA-6. The crew also sprayed knapweed and bittersweet along the Hesco walls around the TTB Kelly Landing Zone, the old UTES staging area, and the Range Control Building. All Glyphosate spraying was precisely targeted with wands rather than boom or broadcast spraying. A total of 46.4 pounds of active ingredient were applied across these sites, over the course of the growing season.

ITAM also conducted a winter application of Krenite (active ingredient Fosamine) to determine its suitability for limiting pitch pine regeneration in training areas and potentially managed grasslands. This application was conducted in Battle Positions 1 and 8. Krenite is a selective herbicide that only affects conifers and leafed out broadleaf plants. Our application was conducted via boom sprayer but occurred in February when off-target impacts were minimal if any. A total of 10 pounds of active ingredient were used in this application.

ITAM also conducted hand pulling to remove spotted knapweed (*Centauria stoebe*) from restored training sites on BP-1, Demo-2, and Wheelock Overlook, covering 7 acres.

## 3.8 AIR QUALITY MANAGEMENT

### 3.8.1 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.

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

## 3.9 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.

## 3.10 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.

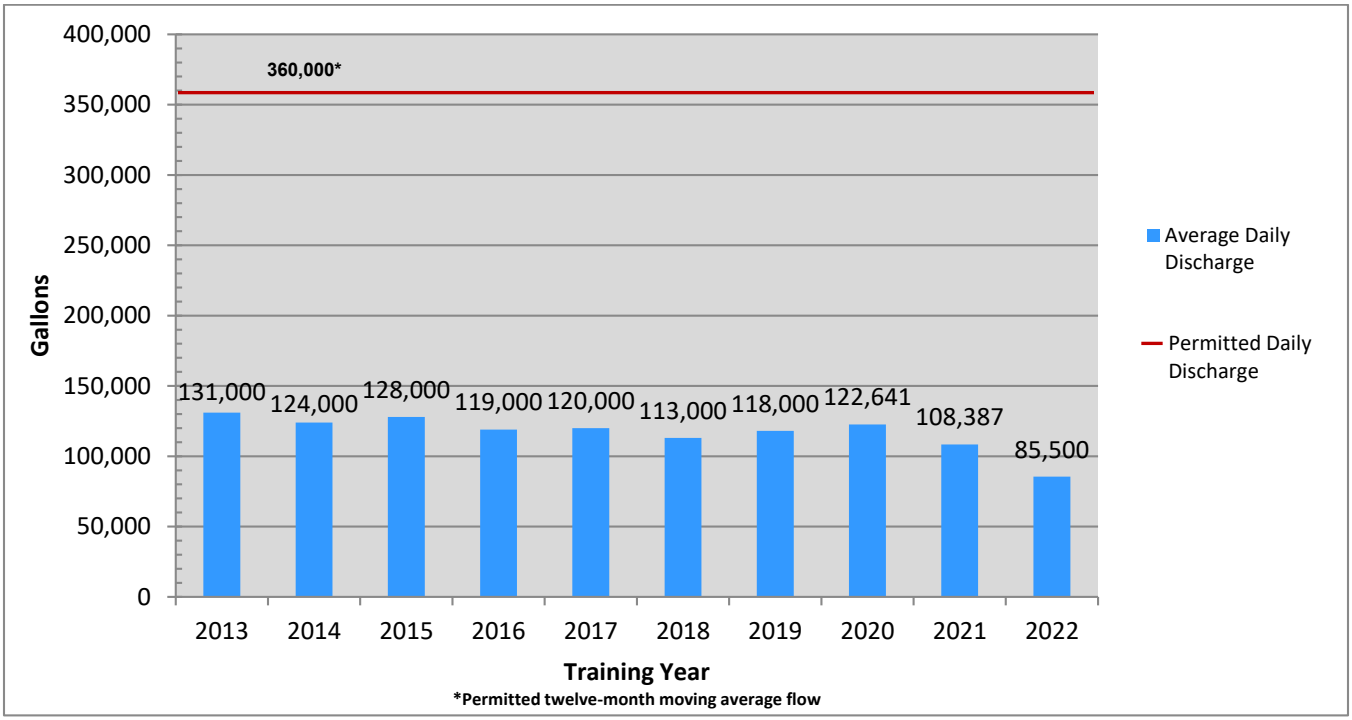
## 3.11 WASTEWATER MANAGEMENT

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 of the Acts of 2002 and the EPSs, but which are regulated by MassDEP.)

### 3.11.1 Wastewater Treatment Plant Discharge

The Otis ANGB wastewater treatment plant operated within the discharge volume limits of its wastewater discharge permit during TY 2022. The plant discharged 31,207,507 gallons of sewage into the sand filtration beds in the Training Area/Reserve; a daily average of 85,500 gallons versus its permitted twelve-month moving average flow of 360,000 gallons. Graph 3-9 shows the daily average pumping rate of the Otis system since TY 2013.

Graph 3-9 Wastewater Treatment Plant Discharge




## 3.12 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 2022. 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.

## 3.13 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 of the Acts of 2002. 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 was one small spill in the Training Area/Reserve during TY 2022 below the reporting levels established in the Massachusetts Contingency Plan. Approximately three gallons of Diesel fuel spilled when a backhoe loader rolled onto its side at Dig Site 3. The spill was cleaned up with any contaminated soil or cleanup materials disposed of in accordance with applicable federal and state environmental regulations.

# 3.14 HAZARDOUS WASTE MANAGEMENT

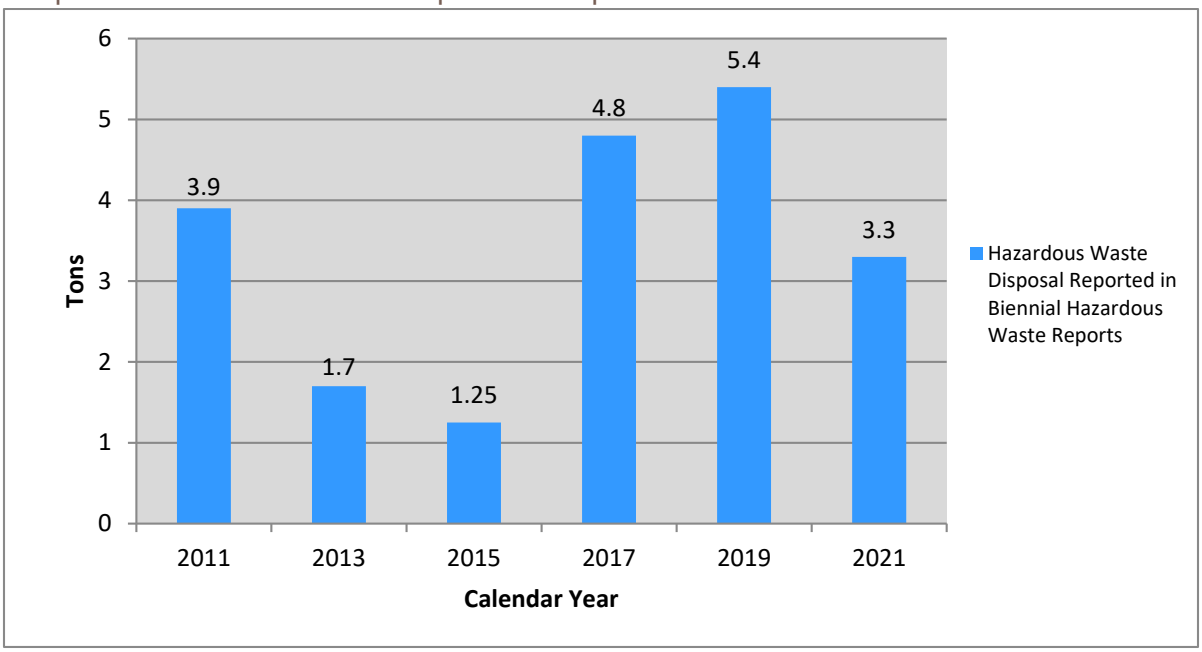
The MAARNG complied with its policy of not performing maintenance activities on military vehicles in the Training Area/Reserve throughout the year. Thus, hazardous wastes normally associated with vehicle maintenance and repair facilities were not generated or stored in the Training Area/Reserve. Vehicle 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.

## 3.14.1 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 3-10 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.

Graph 3-10 Hazardous Waste Disposal – Camp Edwards




# 3.15 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 2022. 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.

## 3.16 GENERAL USE AND ACCESS MANAGEMENT

Public access to Camp Edwards is limited; however, under certain circumstances 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).

## 3.17 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.

## 3.18 EPS VIOLATIONS

On March 31, 2022, the MAARNG reported to the EMC a noncompliance with the General Performance Standard, specifically "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." During the Best Warrior Competition on March 26, 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, and yellow smoke grenades were used in an unapproved location in the C15 training area.

Corrective actions included counseling the full-time Range Control and civilian staff on their failure to follow established processes for the consultation and approval for any non-standard training event through Camp Edwards's Plans and Training Officer. The staff were also directed that only written non-standard training plans signed by the EMC EO and the MAARNG will be executed; and no verbal authorizations will be authorized. Refresher training was conducted with part-time staff to ensure compliance.

In a letter dated May 16, 2022, the EMC determined the MAARNG was not in compliance "with one or more laws, regulations, orders, licenses, permits, or approvals enforced by the EMC" and that corrective actions were necessary for compliance with the requirements of Chapter 47 of the Acts of 2002, the EPSs and range specific standard operating procedures and/or OMMPs. In its letter, the EMC concurred that the corrective actions identified by Camp Edwards were appropriate and determined that no additional actions by the MAARNG were necessary.

Appendix H lists violations reported since TY 2013.

## 3.19 MITIGATION

Details of mitigation requirements and actions for TY 2022 are discussed in the *Conservation and Management Permit Compliance and Mitigation Actions,* which is available in Appendix F.

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# 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 2022.

## 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). The majority 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, former Mock Village, and former Otis Gun Club. The MMRP addresses potential threats to human health and the environment from munitions and munitions constituents in non-operational range areas.

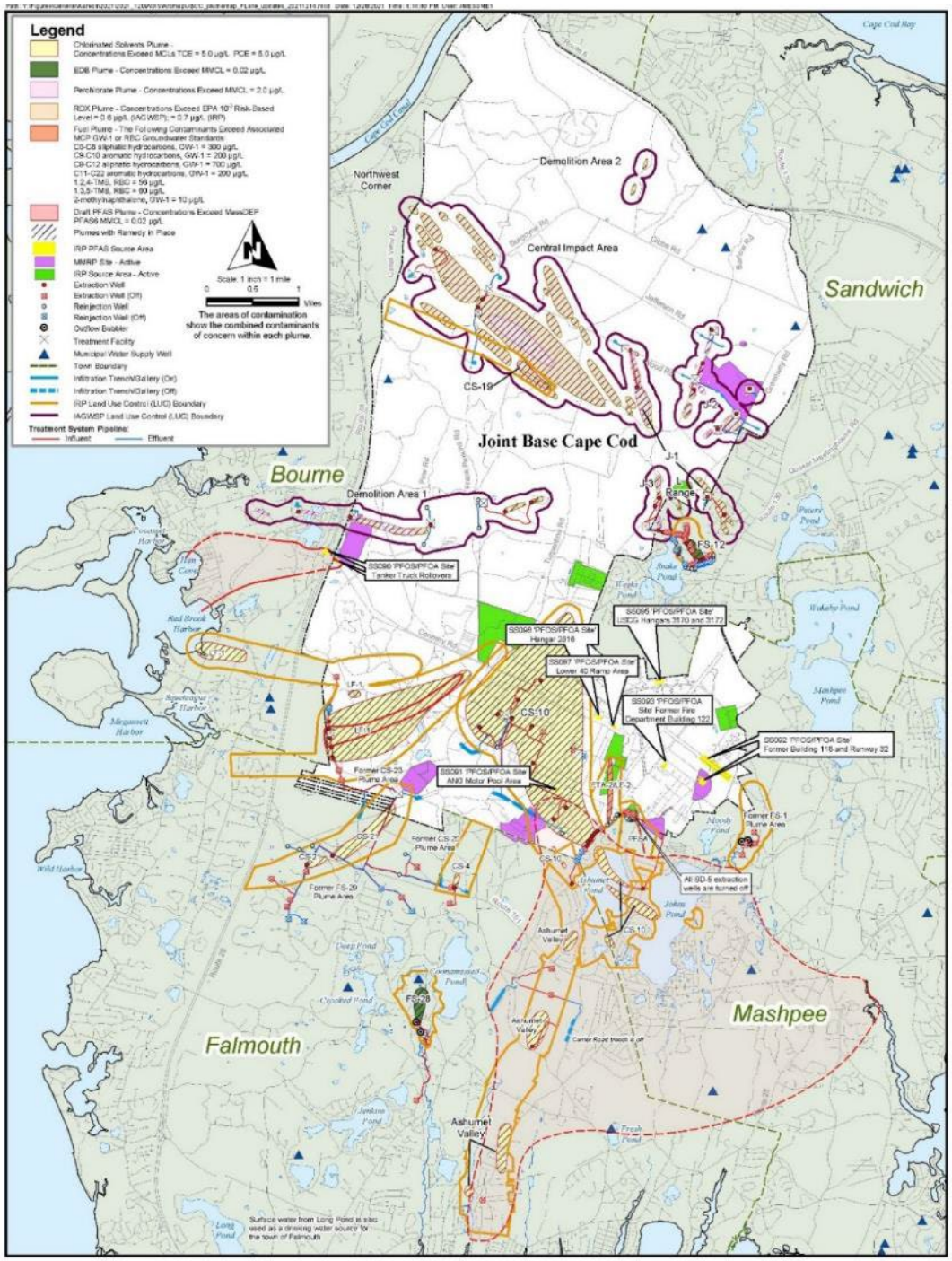
The IAGWSP is being managed by the Army National Guard. Investigation of the environmental impacts of legacy training in the upper 14,886 acres of JBCC began in 1996 and cleanup of groundwater contamination began in 2004. Seventeen treatment systems are currently operating on seven groundwater plumes to clean more than 3.8 million gallons of groundwater per day. More than 17.7 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. 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. The map in Figure 4-1 is available at http://jbcc-iagwsp.org/community/facts/jbcc_plume_map_121421.pdf

Figure 4-1 JBCC Groundwater Plume Map




The map is available at http://jbcc-iagwsp.org/community/facts/jbcc_plume_map_121421.pdf

## 4.2 INSTALLATION RESTORATION PROGRAM ACTIVITIES IN THE TRAINING AREA/RESERVE

In TY 2021, AFCEC finalized the Comprehensive Site Evaluation (CSE) Phase II (similar to a Site Inspection) investigation at 10 MMRP sites, including the three sites that are located in the Training Area/Reserve. A Streamlined Remedial Investigation/Feasibility Study (RI/FS) was prepared for the former World War II-era Mock Village and has been finalized. A RI was completed in TY 2019 at the World War II-era Old K Range and an FS was drafted and submitted for review in TY 2021. 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 currently off limits and ordnance warning signage was placed around the perimeter of the site. A RI was also completed for the former Otis Gun Club and an FS was drafted but identified data gaps; therefore, a Supplemental RI is planned to collect additional data. In addition to the MMRP sites, AFCEC manages two groundwater plumes in the Training Area/Reserve: CS-19 and FS-12.

In TY 2022, 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 1.3 µg/L.

AFCEC also manages three 1.5 MW wind turbines at JBCC, two of which are located 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 2022.

## 4.3 IMPACT AREA GROUNDWATER STUDY PROGRAM ACTIVITIES

During TY 2022, 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.

Removal of munitions and explosives from the source of the CIA groundwater plume continued in TY 2022. Work on Phase IV Area 2 (ten acres) of the CIA long-term source area response continued throughout the year. In the Central Impact Area, 103 acres have been cleared of munitions and explosives of concern to 90%. 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.

The IAGWSP conducted sampling at the former J-2 and J-3 Ranges as follow-up to detections from previous sampling done to evaluate whether Per- and polyfluoroalkyl substances (PFAS) are present in the groundwater from sites where former open burning/open detonation is known to have occurred. Groundwater sampling conducted in TY 2022 was conducted as follow-up to detections from 2021 PFAS sampling. Review of the data is ongoing and recommendations for sampling of additional wells and further investigations has been developed for Agency 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. The program is also installing new monitoring wells to assist in the investigations.

Juliet and Kilo Ranges are now in operational inactive status. For 2023, monitoring of these ranges will be conducted by the IAGWSP and reported as required.

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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 April 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. The tours were advertised in the Enterprise newspapers and on the E&RC's website. Approximately 175 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 five grassland bird tours in the grasslands of Camp Edwards in 2022 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 serves on the Commonwealth of Massachusetts's Military Asset and Security Strategy Task Force helping to secure the military bases of the Commonwealth. Brigadier General (ret) Christopher Faux was appointed JBCC Executive Director in June 2018.

## 5.2 MISCELLANEOUS CIVILIAN ACTIVITIES

### 5.2.1 Eversource Projects

As part of the Mid Cape Reliability Project, Eversource is upgrading an existing Eversource switching station (Bourne Switching Station #917) located on an easement in the Training Area/Reserve (Figure 5-1). Eversource evaluated several sites for minimal loss of training land and impact to state priority habitat. Eversource has sited the switching station southwest of the current substation (Figure 5-1). The property transfers between Eversource and the state 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. For this project, all review and permitting is complete. Completion of the project is anticipated for 2023.

Figure 5-1 Eversource Switching Station Area


Over the last 10 years, the EMC and the MANG at Camp Edwards have been involved stakeholders in Eversource's proposal to replace the switching station. Other partner agencies include MEPA, NHESP and DFW, the Cape Cod Commission, and the four Upper Cape Cod towns surrounding JBCC.

In TY 2019, Eversource came to the MAARNG with a new reliability project for another utility line from the switching station running down Cape to the Town of Barnstable. This will create a redundant line that will help ensure the Cape has reliable power. Eversource will use its current easement for the project.

### 5.2.2 Cape Cod Canal Area Transportation Improvement Program and the Cape Cod Bridges Program

The Canal Area Transportation Improvement Program, led by the Massachusetts Department of Transportation (MassDOT), covers areas in Bourne and Sandwich and west along Route 25 into Wareham. According to presentations given by MassDOT, the program will include replacing the Bourne Bridge and Sagamore Bridge, improvements to the approach roadway network, multimodal improvements, and utility relocations. Some changes could have potential impacts to JBCC and specifically the Camp Edwards Training Site. Information regarding this effort can be found at: https://www.capecodcommission.org/our-work/cape-cod-canal-study-resources.

MassDOT is addressing the Bourne and Sagamore Bridges through the Cape Cod Bridges Program. In November 2022, several potential bridge types were presented to the public during MassDOT's public outreach meetings. Items presented during these meetings included the draft Program Purpose and Need, funding and grant applications being pursued by the US Army Corps of Engineers, and updates on data collection and analysis. MassDOT plans an additional round of public outreach in 2023. Information related to the program may be found at: https://www.mass.gov/info-details/the-cape-cod-bridges-program-details#your-opinion-matters-.

## 5.3 ENVIRONMENTAL PROGRAM PRIORITIES

### 5.3.1 TY 2022 Environmental Program Priorities

The following subsections provide a list of the environmental program priorities established for TY 2022 as published in the TY 2021 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. Annual and ongoing for TY 2022 with primary emphasis on prescribed burning and monitoring/research.
    - Completed effectively for TY 2022 with reporting above and in the supplemental mitigation report.
- Continue to address potential federal status changes to species at Camp Edwards through interagency consultation, planning, and partnership. Ongoing with particular emphasis on the proposed change of the Northern Long-eared Bat from Threatened to Endangered under the Federal Endangered Species Act.
    - Moderate action on this objective with continued interagency coordination but needed consultation. Army is developing programmatic consultation in support of installations, and the Natural Resources Program will see what supplemental consultation needs to occur to support training and conservation actions at Camp Edwards.
- Further develop supplemental plans for Natural Resources/ITAM long-term budgets and implementation, including invasive species, wildland fire, and land rehabilitation. Ongoing with particular emphasis on growing prescribed fire implementation.
    - Strong progress with ongoing development of the IWFMP, monthly wildland fire working group meetings, and a Camp Edwards Community Risk Assessment reviewing fire response preparedness.
- Continue implementation and refinement of management focused monitoring of rare species, habitat management, and training capabilities. Ongoing with TY 2022 emphasis on continuing long-term efforts and initiating the robust moth and vegetation long-term monitoring effort.
    - Development and refinement continues with fielding of long-term moth monitoring protocol, detailed data analysis of bird monitoring data, etc.
- Continue to update wildland fire planning and program opportunities after hiring dedicated Wildland Fire Program Coordinator, including updating Integrated Wildland Fire Management Plan and planning for increased range usage. Ongoing with Integrated Wildland Fire Management Plan completion planned for this year.

  - Ongoing planning update as described above combined with very intentional programmatic goals for TY 2022 provided for successful fire implementation and program development. The 25 burn days averaging 25 acres per burn goal was intentionally set to identify strength and growth areas for the program constructively. This provided for improved planning and operational preparedness, including communication.

- 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.
  - This objective was met through ecological focus on both forestry and fire implementation informed by resource monitoring; results of which continue to demonstrate population level benefits of a variety of taxa in response to woodland mosaic management and climate resilience implementation.
- 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 new vernal pools based on ongoing siting plan.
  - Plan still ongoing through contract with likely need for cultural resources coordination prior to finalization and implementation.
- Continue and further develop interagency partnerships with Massachusetts Division of Fisheries and Wildlife, NHESP, US Fish and Wildlife Service, EMC, DCR, MassDEP, and others through active engagement to seek mutual benefit. Ongoing.
  - Partnership continues to be a major focus and element of successful conservation planning and implementation.

### 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 of the Acts of 2002. (Accomplished)
- Publish the final TY 2021 *State of the Reservation Report.* (Accomplished)

### 5.3.2 TY 2023 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 2023.

#### 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.
- 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.
- 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 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.
- 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 ESA) 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.
- 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.
- 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 new vernal pools based on ongoing siting plan.
- Continue and further develop interagency partnerships with Massachusetts Division of Fisheries and Wildlife, NHESP, US Fish and Wildlife Service, EMC, DCR, MassDEP, and others through active engagement to seek mutual benefit. 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.
- 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 of the Acts of 2002.
- Publish the final TY 2022 *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 2022

| Date | Activity |
|---|---|
| 25, 26 Mar 22 | EMC/E&RC inspection |
| 25, 26 Mar 22 | Pre/post-fire inspection |
| 09 Apr 22 | Pre/post-fire inspection |
| 07 May 22 | Pre/post-fire inspection |
| 13 May 22 | EMC/E&RC inspection |
| 13, 14 May 22 | Pre/post-fire inspection |
| 08, 09 Jun 22 | Pre/post-fire inspection |
| 09, 10 Jun 22 | Pre/post-fire inspection |
| 15 Jun 22 | Pre/post-fire inspection |
| 24 Jun 22 | Pre/post-fire inspection |
| 16 Jul 22 | Pre/post-fire inspection |
| 18 Jul 22 | Pre/post-fire inspection |
| 21, 24 Jul 22 | Pre/post-fire inspection |
| 11 Aug 22 | Pre/post-fire inspection |
| 06, 07 Aug 22 | Pre/post-fire inspection |
| 30 Aug 22 | EMC/E&RC inspection |
| 6 Sep 22 | EMC/E&RC inspection |
| 29 Sep 22 | Pre/post-fire inspection |
| 23, 24 Sep 22 | Pre/post-fire inspection |

# OPERATIONS, MAINTENANCE & MONITORING ACTIVITIES
# SIERRA RANGE
# TY 2022

| Date | Activity |
|---|---|
| 02 Oct 21 | Pre/post-fire inspection |
| 03 Oct 21 | Pre/post-fire inspection |
| 04 Oct 21 | Pre/post-fire inspection |
| 08, 09 Oct 21 | Pre/post-fire inspection |
| 15, 16 Oct 21 | Pre/post-fire inspection |
| 17, 18 Oct 21 | Pre/post-fire inspection |
| 23 Oct 21 | Pre/post-fire inspection |
| 05, 07 Nov 21 | Pre/post-fire inspection |
| 13, 14 Nov 21 | Pre/post-fire inspection |
| 19, 20 Nov 21 | Pre/post-fire inspection |
| 07 Dec 21 | Detailed Inspection |
| 11 Jan 22 | Detailed Inspection |
| 08 Feb 22 | Detailed Inspection |
| 15 Mar 22 | Detailed Inspection |
| 18 Mar 22 | Maintenance: hand filled minor erosion |
| 24 Mar 22 | Pre/post-fire inspection |
| 26 Mar 22 | Pre/post-fire inspection |
| 27 Mar 22 | Pre/post-fire inspection |
| 02 Apr 22 | Pre/post-fire inspection |
| 09 Apr 22 | Pre/post-fire inspection |
| 15 Apr 22 | Pre/post-fire inspection |
| 18 Apr 22 | Maintenance: filled minor bullet pocket and erosion |
| 07 May 22 | Pre/post-fire inspection |
| 11 May 22 | Pre/post-fire inspection |
| 13, 14 May 22 | Pre/post-fire inspection |
| 20, 21 May 22 | Pre/post-fire inspection |
| 03 Jun 22 | Pre/post-fire inspection |
| 03 Jun 22 | Pre/post-fire inspection |
| 04 Jun 22 | Pre/post-fire inspection |
| 08 Jun 22 | Pre/post-fire inspection |
| 09, 10 June 22 | Pre/post-fire inspection |
| 10 Jun 22 | Pre/post-fire inspection |
| 11, 12 Jun 22 | Pre/post-fire inspection |
| 15 Jun 22 | Pre/post-fire inspection |
| 24 Jun 22 | Pre/post-fire inspection |
| 16, 17 Jun 22 | Pre/post-fire inspection |
| 18 Jul 22 | Pre/post-fire inspection |
| 22 Jul 22 | EMC/E&RC inspection |
| 21, 22 Jul 22 | Pre/post-fire inspection |
| 24 Jul 22 | Pre/post-fire inspection |

# OPERATIONS, MAINTENANCE & MONITORING ACTIVITIES
# SIERRA RANGE
# TY 2022

| Date | Activity |
|---|---|
| 25 Jul 22 | EMC/E&RC inspection |
| 30, 31 Jul 22 | Pre/post-fire inspection |
| 05, 06 Aug 22 | Pre/post-fire inspection |
| 11 Aug 22 | Pre/post-fire inspection |
| 11 Aug 22 | Pre/post-fire inspection |
| 14 Aug 22 | Pre/post-fire inspection |
| 14 Aug 22 | Pre/post-fire inspection |
| 20 Aug 22 | Pre/post-fire inspection |
| 07 Sep 22 | Pre/post-fire inspection |
| 24, 25 Sep 22 | Pre/post-fire inspection |

# OPERATIONS, MAINTENANCE & MONITORING ACTIVITIES
# INDIA RANGE
# TY 2022

| Date | Activity |
|---|---|
| 04 Oct 21 | Pre/post-fire inspection |
| 08, 09 Oct 21 | Pre/post-fire inspection |
| 15, 16 Oct 21 | Pre/post-fire inspection |
| 16 Oct 21 | Pre/post-fire inspection |
| 22 Oct 21 | Pre/post-fire inspection |
| 23, 24 Oct 21 | Pre/post-fire inspection |
| 05, 06 Nov 21 | Pre/post-fire inspection |
| 13 Nov 21 | Pre/post-fire inspection |
| 07 Dec 21 | Monthly/Detailed Inspection |
| 11 Jan 22 | Monthly/Detailed Inspection |
| 08 Feb 22 | Monthly/Detailed Inspection |
| 15 Mar 22 | Monthly/Detailed Inspection |
| 21 Apr 22 | Monthly/Detailed Inspection/maintenance |
| 11 May 22 | Monthly/Detailed Inspection |
| 09 Jun 22 | Pre/post-fire inspection |
| 10 Jun 22 | Pre/post-fire inspection |
| 18 Jul 22 | Pre/post-fire inspection |
| 21 Jul 22 | Maintenance, berm maintenance |
| 22 Jul 22 | EMC/E&RC inspection |
| 23 Jul 22 | Pre/post-fire inspection |
| 30, 31 Jul 22 | Pre/post-fire inspection |
| 19, 20 Aug 22 | Pre/post-fire inspection |
| 24, 25 Sep 22 | Pre/post-fire inspection |

# OPERATIONS, MAINTENANCE & MONITORING ACTIVITIES
# ECHO RANGE
# TY 2022

| Date | Activity |
|---|---|
| 3 Oct 21 | Pre/post-fire inspection |
| 08, 09 Oct 21 | Pre/post-fire inspection |
| 16 Oct 21 | Pre/post-fire inspection |
| 23 Oct 21 | Pre/post-fire inspection |
| 05 Nov 21 | Pre/post-fire inspection |
| 14 Nov 21 | Pre/post-fire inspection |
| 07 Dec 21 | Detailed inspection |
| 11 Jan 22 | Detailed inspection |
| 10 Feb 22 | EMC/E&RC inspection |
| 08 Feb 22 | Detailed inspection |
| 15 Mar 22 | Detailed inspection |
| 26 Mar 22 | Pre/post-fire inspection |
| 31 Mar 22 | EMC/E&RC inspection |
| 31 Mar 22 | Pre/post-fire inspection |
| 05 Apr 22 | Pre/post-fire inspection |
| 16 Apr 22 | Pre/post-fire inspection |
| 21 Apr 22 | Maintenance, bullet pocket repair |
| 07 May 22 | Pre/post-fire inspection |
| 11 May 22 | Pre/post-fire inspection |
| 13 May 22 | Pre/post-fire inspection |
| 15 May 22 | Pre/post-fire inspection |
| 20 May 22 | Pre/post-fire inspection |
| 04 Jun 22 | Pre/post-fire inspection |
| 24 Jun 22 | Pre/post-fire inspection |
| 25 Jun 22 | Pre/post-fire inspection |
| 09 Jul 22 | Pre/post-fire inspection |
| 16 Jul 22 | Pre/post-fire inspection |
| 19 Jul 22 | Pre/post-fire inspection |
| 22 Jul 22 | EMC/E&RC inspection |
| 22, 23 July 22 | Pre/post-fire inspection |
| 24 Jul 22 | Pre/post-fire inspection |
| 6 Aug 22 | Pre/post-fire inspection |
| 10 Aug 22 | Pre/post-fire inspection |
| 14 Aug 22 | Pre/post-fire inspection |
| 09 Sep 22 | Pre/post-fire inspection |
| 10 Sep 22 | Pre/post-fire inspection |
| 24 Sep 22 | Pre/post-fire inspection |

# OPERATIONS, MAINTENANCE & MONITORING ACTIVITIES
# LIMA RANGE
# TY 2021

| Date | Activity |
|---|---|
| 05, 06 Nov 21 | Pre/post-fire inspection |
| 17 Dec 21 | Monthly inspection |
| 11 Jan 22 | Monthly inspection |
| 08 Feb 22 | Monthly inspection |
| 15 Mar 22 | Monthly inspection |
| 12 Apr 22 | Monthly inspection |
| 14 Apr 22 | Maintenance, putting up nets |
| 20 May 22 | Pre/post fire inspection |
| 10 Jun 22 | Pre/post fire inspection |
| 23 Jul 22 | Pre/post fire inspection |
| 06 Aug 22 | Maintenance, repaired bunkers |
| 8 Sep 22 | EMC/E&RC inspection |
| 20 Sep 22 | Monthly Inspection |

## Lead Ammunition Use

## Echo Range

| LEAD AMMUNITION USE HISTORY ECHO RANGE | | | |
|---|---|---|---|
| **Training Year** | **.40 Cal Lead** | **9 mm Lead** | **Total** |
| TY 2022 | 0 | 78,021 | 78,021 |
| TY 2021 | 3,476 | 51,438 | 54,914 |
| TY 2020 | 0 | 14,308 | 14,308 |
| TY 2019 | 0 | 4,350 | 4,350 |
| TY 2018 | 0 | 0 | 0 |
| TY 2017 | 0 | 0 | 0 |
| TY 2016 | 0 | 0 | 0 |
| TY 2015 | 0 | 347[1] | 347 |
| TY 2014 | 0 | 0 | 0 |
| TY 2013 | 0 | 0 | 0 |
| TY 2012 | 0 | 0 | 0 |
| TY 2011 | 0 | 0 | 0 |
| TY 2010 | 0 | 0 | 0 |
| TY 2009 | 0 | 0 | 0 |
| TY 2008 | 0 | 0 | 0 |
| TY 2007 | 0 | 100[1] | 100 |
| **TOTAL** | **3,476** | **148,564** | **152,040** |

Notes: Echo Range became operational in Fall 2019.
[1]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 Range** | **Kilo Range** | **Total** |
| 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[1] | 0 | 1,993[3] | 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[2] | 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[1] | 0 | 0 | 8,547 | 0 | 0 | 8,647 |
| **TOTAL** | **152,040** | **2,120** | **1,993** | **344,026** | **474,910** | **949,135** | 1,924,224 |

Notes: 1. Firing at Echo Range in TY 2007 and TY 2015 were part of tests for reintroducing lead ammunition.
2. Firing at Sierra Range in TY 2011 was part of a Line of Sight Analysis test.
3. 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 5.56 Copper | ISBC Range 5.56 Copper | Echo Range 5.56 Copper | Total |
|---|---|---|---|---|---|---|---|
| TY 2022 | 251,672 | 41,041 | 0 | 56,946 | 14,098 | 0 | 363,757 |
| TY 2021 | 221,756 | 73,400 | 0 | 0 | 0 | 19,975 | 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** | **1,159,915** | **605,539** | **4,793** | **56,946** | **14,098** | **19,975** | **1,861,266** |

Note: Firing of copper ammunition began at Sierra Range and India Range in TY 2012.
Tango Range became operationally active for copper ammunition in TY 2022.
Copper ammunition was used on the operationally inactive ISBC Range for two approved, non-standard training events during TY 2022.
Copper ammunition was used during two non-standard training event in TY 2021.

# Small Arms Range Sampling Reports

## Soil Sampling Results

Fall 2022

**CAMP EDWARDS SMALL ARMS RANGE ANNUAL SOIL MONITORING 2022**

*NOTE: Data entered does not include third-party data validation qualifiers per the 2018 QAPP, if required.*

| Site/SLX List | Location ID | Field Sample ID | Top Depth (feet bgs) | Bottom Depth (feet bgs) | Date Sampled | Test Method | Extraction Method | Analyte | Result Value (mg/kg) | Lab Report Qualifier | RL | MDL | OMMP Action Levels (mg/kg) | Sample Type | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E Range | SSERNG001 | SSERNG001_OCT22A | 0 | 0.25 | 10/13/2022 | EPA Moisture | -- | % moisture | 12.4 | | 1.0 | 1.0 | -- | N | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22A | 0 | 0.25 | 10/13/2022 | SW846 9045D | Soluble | pH (S.U.) | 5.6 | | 0.01 | 0.01 | -- | N | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22A | 0 | 0.25 | 10/13/2022 | EPA 300.0 | Soluble | Chloride | ND | U, F1 | 11 | 5.6 | -- | N | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22A | 0 | 0.25 | 10/13/2022 | EPA 300.0 | Soluble | Sulfate | ND | U, F1 | 17 | 5.6 | -- | N | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22A | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Antimony | ND | U, F1 | 4.5 | 1.5 | 300 | N | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22A | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Calcium | 380 | | 45 | 17 | -- | N | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22A | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Copper | ND | U | 18 | 6.9 | 10,000 | N | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22A | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Iron | 7,700 | | 18 | 5.6 | -- | N | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22A | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Lead | 11 | | 1.3 | 0.54 | 6,000 | N | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22A | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Magnesium | 660 | | 9.0 | 3.6 | -- | N | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22A | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Potassium | 430 | | 45 | 18 | -- | N | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22A | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Sodium | ND | U | 90 | 36 | -- | N | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22A | 0 | 0.25 | 10/13/2022 | EPA 365.1 | Total | Total Phosphate | 570 | | 67 | 34 | -- | N | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22B | 0 | 0.25 | 10/13/2022 | EPA Moisture | -- | % moisture | 12.3 | | 1.0 | 1.0 | -- | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22B | 0 | 0.25 | 10/13/2022 | SW846 9045D | Soluble | pH (S.U.) | 5.2 | | 0.01 | 0.01 | -- | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22B | 0 | 0.25 | 10/13/2022 | EPA 300.0 | Soluble | Chloride | 6.4 | J | 11 | 5.6 | -- | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22B | 0 | 0.25 | 10/13/2022 | EPA 300.0 | Soluble | Sulfate | ND | U | 17 | 5.6 | -- | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22B | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Antimony | ND | U | 5.4 | 1.5 | 300 | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22B | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Calcium | 390 | | 54 | 17 | -- | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22B | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Copper | ND | U | 22 | 6.9 | 10,000 | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22B | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Iron | 8,000 | | 22 | 5.6 | -- | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22B | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Lead | 12 | | 1.6 | 0.54 | 6,000 | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22B | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Magnesium | 630 | | 11.0 | 3.6 | -- | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22B | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Potassium | 400 | | 54 | 18 | -- | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22B | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Sodium | ND | U | 110 | 36 | -- | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22B | 0 | 0.25 | 10/13/2022 | EPA 365.1 | Total | Total Phosphate | 0.055 | | 0.0070 | 34 | -- | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22C | 0 | 0.25 | 10/13/2022 | EPA Moisture | -- | % moisture | 15.5 | | 1.0 | 1.0 | -- | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22C | 0 | 0.25 | 10/13/2022 | SW846 9045D | Soluble | pH (S.U.) | 5.1 | | 0.01 | 0.01 | -- | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22C | 0 | 0.25 | 10/13/2022 | EPA 300.0 | Soluble | Chloride | ND | U | 11 | 5.7 | -- | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22C | 0 | 0.25 | 10/13/2022 | EPA 300.0 | Soluble | Sulfate | 7.1 | J | 17 | 5.7 | -- | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22C | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Antimony | ND | U | 4.8 | 1.6 | 300 | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22C | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Calcium | 430 | | 48 | 18 | -- | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22C | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Copper | ND | U | 19 | 7.4 | 10,000 | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22C | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Iron | 8,600 | | 19 | 6.0 | -- | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22C | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Lead | 12 | | 1.4 | 0.58 | 6,000 | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22C | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Magnesium | 720 | | 9.6 | 3.8 | -- | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22C | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Potassium | 440 | | 48 | 20 | -- | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22C | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Sodium | ND | U | 96 | 38 | -- | FR | 100-pt MIS spl |
| E Range | SSERNG001 | SSERNG001_OCT22C | 0 | 0.25 | 10/13/2022 | EPA 365.1 | Total | Total Phosphate | 500 | | 72 | 36 | -- | FR | 100-pt MIS spl |
| E Range | SSERNG002 | SSERNG002_OCT22 | 0 | 0.25 | 10/13/2022 | EPA Moisture | -- | % moisture | 16.5 | | 1.0 | 1.0 | -- | N | 100-pt MIS spl |
| E Range | SSERNG002 | SSERNG002_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 9045D | Soluble | pH (S.U.) | 5.0 | | 0.01 | 0.01 | -- | N | 100-pt MIS spl |
| E Range | SSERNG002 | SSERNG002_OCT22 | 0 | 0.25 | 10/13/2022 | EPA 300.0 | Soluble | Chloride | 7.9 | J | 12 | 5.9 | -- | N | 100-pt MIS spl |
| E Range | SSERNG002 | SSERNG002_OCT22 | 0 | 0.25 | 10/13/2022 | EPA 300.0 | Soluble | Sulfate | 7.4 | J | 18 | 5.9 | -- | N | 100-pt MIS spl |
| E Range | SSERNG002 | SSERNG002_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Antimony | ND | U | 4.2 | 1.4 | 300 | N | 100-pt MIS spl |
| E Range | SSERNG002 | SSERNG002_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Calcium | 410 | | 42 | 16 | -- | N | 100-pt MIS spl |
| E Range | SSERNG002 | SSERNG002_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Copper | ND | U | 1.7 | 0.7 | 10,000 | N | 100-pt MIS spl |
| E Range | SSERNG002 | SSERNG002_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Iron | 6,900 | | 17 | 5.3 | -- | N | 100-pt MIS spl |
| E Range | SSERNG002 | SSERNG002_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Lead | 9 | | 1.3 | 0.51 | 6,000 | N | 100-pt MIS spl |
| E Range | SSERNG002 | SSERNG002_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Magnesium | 650 | | 8.5 | 3.4 | -- | N | 100-pt MIS spl |

| Site/SLX List | Location ID | Field Sample ID | Top Depth (feet bgs) | Bottom Depth (feet bgs) | Date Sampled | Test Method | Extraction Method | Analyte | Result Value (mg/kg) | Lab Report Qualifier | RL | MDL | OMMP Action Levels (mg/kg) | Sample Type | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E Range | SSERNG002 | SSERNG002_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Potassium | 380 | | 42 | 17 | -- | N | 100-pt MIS spl |
| E Range | SSERNG002 | SSERNG002_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Sodium | 37 | J | 85 | 34 | -- | N | 100-pt MIS spl |
| E Range | SSERNG002 | SSERNG002_OCT22 | 0 | 0.25 | 10/13/2022 | EPA 365.1 | Total | Total Phosphate | 500 | | 71 | 36 | -- | N | 100-pt MIS spl |
| E Range | SSERNG003 | SSERNG003_OCT22 | 0 | 0.25 | 10/13/2022 | EPA Moisture | -- | % moisture | 11.7 | | 1.0 | 1.0 | -- | N | 100-pt MIS spl |
| E Range | SSJRNG003 | SSERNG003_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 9045D | Soluble | pH (S.U.) | 5.2 | | 0.01 | 0.01 | -- | N | 100-pt MIS spl |
| E Range | SSERNG003 | SSERNG003_OCT22 | 0 | 0.25 | 10/13/2022 | EPA 300.0 | Soluble | Chloride | 7.9 | J | 11 | 5.7 | -- | N | 100-pt MIS spl |
| E Range | SSERNG003 | SSERNG003_OCT22 | 0 | 0.25 | 10/13/2022 | EPA 300.0 | Soluble | Sulfate | 6.7 | J | 17 | 5.7 | -- | N | 100-pt MIS spl |
| E Range | SSERNG003 | SSERNG003_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Antimony | ND | U | 4.0 | 1.3 | 300 | N | 100-pt MIS spl |
| E Range | SSERNG003 | SSERNG003_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Calcium | 330 | | 40 | 15 | -- | N | 100-pt MIS spl |
| E Range | SSERNG003 | SSERNG003_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Copper | ND | U | 16 | 6.1 | 10,000 | N | 100-pt MIS spl |
| E Range | SSERNG003 | SSERNG003_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Iron | 5,300 | | 16 | 4.9 | -- | N | 100-pt MIS spl |
| E Range | SSERNG003 | SSERNG003_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Lead | 9.0 | | 1.2 | 0.48 | 6,000 | N | 100-pt MIS spl |
| E Range | SSERNG003 | SSERNG003_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Magnesium | 520 | | 7.9 | 3.2 | -- | N | 100-pt MIS spl |
| E Range | SSERNG003 | SSERNG003_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Potassium | 350 | | 40 | 16 | -- | N | 100-pt MIS spl |
| E Range | SSERNG003 | SSERNG003_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Sodium | ND | U | 79 | 32 | -- | N | 100-pt MIS spl |
| E Range | SSERNG003 | SSERNG003_OCT22 | 0 | 0.25 | 10/13/2022 | EPA 365.1 | Total | Total Phosphate | 220 | | 14 | 14 | -- | N | 100-pt MIS spl |
| E Range | SSERNG004 | SSERNG004_OCT22 | 0 | 0.25 | 10/13/2022 | EPA Moisture | -- | % moisture | 11.5 | | 1.0 | 1.0 | -- | N | 100-pt MIS spl |
| E Range | SSERNG004 | SSERNG004_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 9045D | Soluble | pH (S.U.) | 5.0 | | 0.01 | 0.01 | -- | N | 100-pt MIS spl |
| E Range | SSERNG004 | SSERNG004_OCT22 | 0 | 0.25 | 10/13/2022 | EPA 300.0 | Soluble | Chloride | 9.2 | J | 11 | 5.7 | -- | N | 100-pt MIS spl |
| E Range | SSERNG004 | SSERNG004_OCT22 | 0 | 0.25 | 10/13/2022 | EPA 300.0 | Soluble | Sulfate | 6.4 | J | 17 | 5.7 | -- | N | 100-pt MIS spl |
| E Range | SSERNG004 | SSERNG004_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Antimony | ND | U | 5.3 | 1.8 | 300 | N | 100-pt MIS spl |
| E Range | SSERNG004 | SSERNG004_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Calcium | 480 | | 53 | 20 | -- | N | 100-pt MIS spl |
| E Range | SSERNG004 | SSERNG004_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Copper | ND | U | 21 | 8.1 | 10,000 | N | 100-pt MIS spl |
| E Range | SSERNG004 | SSERNG004_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Iron | 8,100 | | 21 | 6.5 | -- | N | 100-pt MIS spl |
| E Range | SSERNG004 | SSERNG004_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Lead | 13 | | 1.6 | 0.63 | 6,000 | N | 100-pt MIS spl |
| E Range | SSERNG004 | SSERNG004_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Magnesium | 680 | | 11.0 | 4.2 | -- | N | 100-pt MIS spl |
| E Range | SSERNG004 | SSERNG004_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Potassium | 460 | | 53 | 22 | -- | N | 100-pt MIS spl |
| E Range | SSERNG004 | SSERNG004_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Sodium | ND | U | 110 | 42 | -- | N | 100-pt MIS spl |
| E Range | SSERNG004 | SSERNG004_OCT22 | 0 | 0.25 | 10/13/2022 | EPA 365.1 | Total | Total Phosphate | 540 | | 68 | 34 | -- | N | 100-pt MIS spl |
| E Range | SSERNG005 | SSERNG005_OCT22 | 0 | 0.25 | 10/13/2022 | EPA Moisture | -- | % moisture | 13.7 | | 1.0 | 1.0 | -- | N | 100-pt MIS spl |
| E Range | SSERNG005 | SSERNG005_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 9045D | Soluble | pH (S.U.) | 4.9 | | 0.01 | 0.01 | -- | N | 100-pt MIS spl |
| E Range | SSERNG005 | SSERNG005_OCT22 | 0 | 0.25 | 10/13/2022 | EPA 300.0 | Soluble | Chloride | 8.9 | J | 11 | 5.5 | -- | N | 100-pt MIS spl |
| E Range | SSERNG005 | SSERNG005_OCT22 | 0 | 0.25 | 10/13/2022 | EPA 300.0 | Soluble | Sulfate | ND | U | 17 | 5.5 | -- | N | 100-pt MIS spl |
| E Range | SSERNG005 | SSERNG005_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Antimony | ND | U | 4.7 | 1.6 | 300 | N | 100-pt MIS spl |
| E Range | SSERNG005 | SSERNG005_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Calcium | 480 | | 47 | 18 | -- | N | 100-pt MIS spl |
| E Range | SSERNG005 | SSERNG005_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Copper | ND | U | 1.9 | 0.73 | 10,000 | N | 100-pt MIS spl |
| E Range | SSERNG005 | SSERNG005_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Iron | 8,300 | | 19 | 5.8 | -- | N | 100-pt MIS spl |
| E Range | SSERNG005 | SSERNG005_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Lead | 15 | | 1.4 | 0.57 | 6,000 | N | 100-pt MIS spl |
| E Range | SSERNG005 | SSERNG005_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Magnesium | 730 | | 9.4 | 3.8 | -- | N | 100-pt MIS spl |
| E Range | SSERNG005 | SSERNG005_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Potassium | 410 | | 47 | 19 | -- | N | 100-pt MIS spl |
| E Range | SSERNG005 | SSERNG005_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Sodium | 39 | J | 94 | 38 | -- | N | 100-pt MIS spl |
| E Range | SSERNG005 | SSERNG005_OCT22 | 0 | 0.25 | 10/13/2022 | EPA 365.1 | Total | Total Phosphate | 680 | | 69 | 35 | -- | N | 100-pt MIS spl |
| E Range | SSERNG006 | SSERNG006_OCT22 | 0 | 0.25 | 10/13/2022 | EPA Moisture | -- | % moisture | 14.4 | | 1.0 | 1.0 | -- | N | 100-pt MIS spl |
| E Range | SSERNG006 | SSERNG006_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 9045D | Soluble | pH (S.U.) | 5.4 | | 0.01 | 0.01 | -- | N | 100-pt MIS spl |
| E Range | SSERNG006 | SSERNG006_OCT22 | 0 | 0.25 | 10/13/2022 | EPA 300.0 | Soluble | Chloride | 7.4 | J | 11 | 5.6 | -- | N | 100-pt MIS spl |
| E Range | SSERNG006 | SSERNG006_OCT22 | 0 | 0.25 | 10/13/2022 | EPA 300.0 | Soluble | Sulfate | 6.0 | J | 17 | 5.6 | -- | N | 100-pt MIS spl |
| E Range | SSERNG006 | SSERNG006_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Antimony | ND | U | 4.1 | 1.4 | 300 | N | 100-pt MIS spl |
| E Range | SSERNG006 | SSERNG006_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Calcium | 510 | | 41 | 15 | -- | N | 100-pt MIS spl |
| E Range | SSERNG006 | SSERNG006_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Copper | 6.9 | | 1.6 | 0.62 | 10,000 | N | 100-pt MIS spl |
| E Range | SSERNG006 | SSERNG006_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Iron | 7,600 | | 16 | 5.0 | -- | N | 100-pt MIS spl |
| E Range | SSERNG006 | SSERNG006_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Lead | 21 | | 1.2 | 0.49 | 6,000 | N | 100-pt MIS spl |

| Site/SLX List | Location ID | Field Sample ID | Top Depth (feet bgs) | Bottom Depth (feet bgs) | Date Sampled | Test Method | Extraction Method | Analyte | Result Value (mg/kg) | Lab Report Qualifier | RL | MDL | OMMP Action Levels (mg/kg) | Sample Type | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E Range | SSERNG006 | SSERNG006_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Magnesium | 710 | | 8.1 | 3.2 | -- | N | 100-pt MIS spl |
| E Range | SSERNG006 | SSERNG006_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Potassium | 410 | | 41 | 17 | -- | N | 100-pt MIS spl |
| E Range | SSERNG006 | SSERNG006_OCT22 | 0 | 0.25 | 10/13/2022 | SW846 6010D | Total | Sodium | 36 | J | 81 | 32 | -- | N | 100-pt MIS spl |
| E Range | SSERNG006 | SSERNG006_OCT22 | 0 | 0.25 | 10/13/2022 | EPA 365.1 | Total | Total Phosphate | 590 | | 68 | 34 | -- | N | 100-pt MIS spl |
| I Range | SSIRNG001 | SSIRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | EPA Moisture | -- | % moisture | 28.1 | | 1.0 | 1.0 | -- | N | 100-pt MIS spl |
| I Range | SSIRNG001 | SSIRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | SW846 9045D | Soluble | pH (S.U.) | 4.9 | | 0.01 | 0.01 | -- | N | 100-pt MIS spl |
| I Range | SSIRNG001 | SSIRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | EPA 300.0 | Soluble | Chloride | 19 | | 14 | 6.9 | -- | N | 100-pt MIS spl |
| I Range | SSIRNG001 | SSIRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | EPA 300.0 | Soluble | Sulfate | ND | U | 21 | 6.9 | -- | N | 100-pt MIS spl |
| I Range | SSIRNG001 | SSIRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | SW846 6010D | Total | Antimony | ND | U | 6.9 | 2.3 | 300 | N | 100-pt MIS spl |
| I Range | SSIRNG001 | SSIRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | SW846 6010D | Total | Calcium | 930 | | 69 | 26 | -- | N | 100-pt MIS spl |
| I Range | SSIRNG001 | SSIRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | SW846 6010D | Total | Copper | 6.8 | | 2.8 | 1.1 | 10,000 | N | 100-pt MIS spl |
| I Range | SSIRNG001 | SSIRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | SW846 6010D | Total | Iron | 9,500 | | 28 | 8.5 | -- | N | 100-pt MIS spl |
| I Range | SSIRNG001 | SSIRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | SW846 6010D | Total | Lead | 48 | | 2.1 | 0.83 | 6,000 | N | 100-pt MIS spl |
| I Range | SSIRNG001 | SSIRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | SW846 6010D | Total | Magnesium | 1,200 | | 17 | 5.5 | -- | N | 100-pt MIS spl |
| I Range | SSIRNG001 | SSIRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | SW846 6010D | Total | Potassium | 900 | | 69 | 28 | -- | N | 100-pt MIS spl |
| I Range | SSIRNG001 | SSIRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | SW846 6010D | Total | Sodium | ND | U | 140 | 55 | -- | N | 100-pt MIS spl |
| I Range | SSIRNG001 | SSIRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | EPA 365.1 | Total | Total Phosphate | 790 | | 81 | 41 | -- | N | 100-pt MIS spl |
| L Range | SSLRNG001 | SSLRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | EPA Moisture | -- | % moisture | 30.5 | | 1.0 | 1.0 | -- | N | 100-pt MIS spl |
| L Range | SSLRNG001 | SSLRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | SW846 9045D | Soluble | pH (S.U.) | 5.0 | | 0.01 | 0.01 | -- | N | 100-pt MIS spl |
| L Range | SSLRNG001 | SSLRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | EPA 300.0 | Soluble | Chloride | 16 | | 14 | 6.9 | -- | N | 100-pt MIS spl |
| L Range | SSLRNG001 | SSLRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | EPA 300.0 | Soluble | Sulfate | ND | U | 21 | 6.9 | -- | N | 100-pt MIS spl |
| L Range | SSLRNG001 | SSLRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | SW846 6010D | Total | Antimony | ND | U | 5.5 | 1.9 | 300 | N | 100-pt MIS spl |
| L Range | SSLRNG001 | SSLRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | SW846 6010D | Total | Calcium | 1,100 | | 55 | 21 | -- | N | 100-pt MIS spl |
| L Range | SSLRNG001 | SSLRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | SW846 6010D | Total | Copper | 2.0 | J | 2 | 0.84 | 10,000 | N | 100-pt MIS spl |
| L Range | SSLRNG001 | SSLRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | SW846 6010D | Total | Iron | 10,000 | | 22 | 6.8 | -- | N | 100-pt MIS spl |
| L Range | SSLRNG001 | SSLRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | SW846 6010D | Total | Lead | 12 | | 1.6 | 0.65 | 6,000 | N | 100-pt MIS spl |
| L Range | SSLRNG001 | SSLRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | SW846 6010D | Total | Magnesium | 1,400 | | 11.0 | 4.4 | -- | N | 100-pt MIS spl |
| L Range | SSLRNG001 | SSLRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | SW846 6010D | Total | Potassium | 660 | | 55 | 22 | -- | N | 100-pt MIS spl |
| L Range | SSLRNG001 | SSLRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | SW846 6010D | Total | Sodium | 53 | J | 110 | 44 | -- | N | 100-pt MIS spl |
| L Range | SSLRNG001 | SSLRNG001_OCT22 | 0 | 0.25 | 10/14/2022 | EPA 365.1 | Total | Total Phosphate | 530 | | 85 | 43 | -- | N | 100-pt MIS spl |
| S Range | SSSRNG001 | SSSRNG001_OCT22 | 0 | 0.25 | 10/11/2022 | EPA Moisture | -- | % moisture | 13.9 | | 1.0 | 1.0 | -- | N | 100-pt MIS spl |
| S Range | SSSRNG001 | SSSRNG001_OCT22 | 0 | 0.25 | 10/11/2022 | SW846 9045D | Soluble | pH (S.U.) | 5.0 | | 0.01 | 0.01 | -- | N | 100-pt MIS spl |
| S Range | SSSRNG001 | SSSRNG001_OCT22 | 0 | 0.25 | 10/11/2022 | EPA 300.0 | Soluble | Chloride | ND | U | 12 | 5.8 | -- | N | 100-pt MIS spl |
| S Range | SSSRNG001 | SSSRNG001_OCT22 | 0 | 0.25 | 10/11/2022 | EPA 300.0 | Soluble | Sulfate | ND | U | 17 | 5.8 | -- | N | 100-pt MIS spl |
| S Range | SSSRNG001 | SSSRNG001_OCT22 | 0 | 0.25 | 10/11/2022 | SW846 6010D | Total | Antimony | ND | U | 4.1 | 1.4 | 300 | N | 100-pt MIS spl |
| S Range | SSSRNG001 | SSSRNG001_OCT22 | 0 | 0.25 | 10/11/2022 | SW846 6010D | Total | Calcium | 670 | F2 F1 | 41 | 15 | -- | N | 100-pt MIS spl |
| S Range | SSSRNG001 | SSSRNG001_OCT22 | 0 | 0.25 | 10/11/2022 | SW846 6010D | Total | Copper | 7.3 | | 2 | 0.63 | 10,000 | N | 100-pt MIS spl |
| S Range | SSSRNG001 | SSSRNG001_OCT22 | 0 | 0.25 | 10/11/2022 | SW846 6010D | Total | Iron | 8,200 | F2 | 16 | 5.0 | -- | N | 100-pt MIS spl |
| S Range | SSSRNG001 | SSSRNG001_OCT22 | 0 | 0.25 | 10/11/2022 | SW846 6010D | Total | Lead | 16 | F2 F1 | 1.2 | 0.49 | 6,000 | N | 100-pt MIS spl |
| S Range | SSSRNG001 | SSSRNG001_OCT22 | 0 | 0.25 | 10/11/2022 | SW846 6010D | Total | Magnesium | 910 | F2 F1 | 8.1 | 3.2 | -- | N | 100-pt MIS spl |
| S Range | SSSRNG001 | SSSRNG001_OCT22 | 0 | 0.25 | 10/11/2022 | SW846 6010D | Total | Potassium | 470 | F2 F1 | 41 | 17 | -- | N | 100-pt MIS spl |
| S Range | SSSRNG001 | SSSRNG001_OCT22 | 0 | 0.25 | 10/11/2022 | SW846 6010D | Total | Sodium | 39 | J | 81 | 32 | -- | N | 100-pt MIS spl |
| S Range | SSSRNG001 | SSSRNG001_OCT22 | 0 | 0.25 | 10/11/2022 | EPA 365.1 | Total | Total Phosphate | 630 | | 69 | 35 | -- | N | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22A | 0 | 0.25 | 10/12/2022 | EPA Moisture | -- | % moisture | 15.4 | | 1.0 | 1.0 | -- | N | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22A | 0 | 0.25 | 10/12/2022 | SW846 9045D | Soluble | pH (S.U.) | 6.1 | | 0.01 | 0.01 | -- | N | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22A | 0 | 0.25 | 10/12/2022 | EPA 300.0 | Soluble | Chloride | 9.6 | J | 12 | 5.9 | -- | N | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22A | 0 | 0.25 | 10/12/2022 | EPA 300.0 | Soluble | Sulfate | 41 | | 18 | 5.9 | -- | N | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22A | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Antimony | ND | U | 4.3 | 1.5 | 300 | N | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22A | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Calcium | 15,000 | | 43 | 16 | -- | N | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22A | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Copper | ND | U | 2 | 0.66 | 10,000 | N | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22A | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Iron | 15,000 | | 17 | 5.3 | -- | N | 100-pt MIS spl |

| Site/SLX List | Location ID | Field Sample ID | Top Depth (feet bgs) | Bottom Depth (feet bgs) | Date Sampled | Test Method | Extraction Method | Analyte | Result Value (mg/kg) | Lab Report Qualifier | RL | MDL | OMMP Action Levels (mg/kg) | Sample Type | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T Range | SSTRNG001 | SSTRNG001_OCT22A | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Lead | 15 | | 1.3 | 0.51 | 6,000 | N | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22A | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Magnesium | 2,700 | | 8.6 | 3.4 | -- | N | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22A | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Potassium | 1,100 | | 43 | 17 | -- | N | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22A | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Sodium | 38 | J | 86 | 34 | -- | N | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22A | 0 | 0.25 | 10/12/2022 | EPA 365.1 | Total | Total Phosphate | 520 | F1 | 73 | 37 | -- | N | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22B | 0 | 0.25 | 10/12/2022 | EPA Moisture | -- | % moisture | 14.1 | | 1.0 | 1.0 | -- | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22B | 0 | 0.25 | 10/12/2022 | SW846 9045D | Soluble | pH (S.U.) | 6.1 | | 0.01 | 0.01 | -- | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22B | 0 | 0.25 | 10/12/2022 | EPA 300.0 | Soluble | Chloride | 8.6 | J | 11 | 5.6 | -- | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22B | 0 | 0.25 | 10/12/2022 | EPA 300.0 | Soluble | Sulfate | 27 | | 17 | 5.6 | -- | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22B | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Antimony | ND | U | 5.1 | 1.7 | 300 | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22B | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Calcium | 3,600 | | 51 | 19 | -- | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22B | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Copper | ND | U | 2.0 | 0.78 | 10,000 | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22B | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Iron | 1,700 | | 20 | 6.3 | -- | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22B | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Lead | 18 | | 1.5 | 0.61 | 6,000 | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22B | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Magnesium | 2,700 | | 10.0 | 4.0 | -- | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22B | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Potassium | 1,200 | | 51 | 21 | -- | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22B | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Sodium | 45 | J | 100 | 40 | -- | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22B | 0 | 0.25 | 10/12/2022 | EPA 365.1 | Total | Total Phosphate | 1,500 | F1 | 340 | 170 | -- | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22C | 0 | 0.25 | 10/12/2022 | EPA Moisture | -- | % moisture | 17.1 | | 1.0 | 1.0 | -- | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22C | 0 | 0.25 | 10/12/2022 | SW846 9045D | Soluble | pH (S.U.) | 5.7 | | 0.01 | 0.01 | -- | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22C | 0 | 0.25 | 10/12/2022 | EPA 300.0 | Soluble | Chloride | 6.9 | J | 12 | 6.0 | -- | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22C | 0 | 0.25 | 10/12/2022 | EPA 300.0 | Soluble | Sulfate | 23 | | 18 | 6.0 | -- | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22C | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Antimony | ND | U | 5.1 | 1.7 | 300 | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22C | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Calcium | 2,000 | | 51 | 19 | -- | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22C | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Copper | ND | U | 2.0 | 0.78 | 10,000 | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22C | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Iron | 14,000 | | 20 | 6.3 | -- | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22C | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Lead | 24 | | 1.5 | 0.61 | 6,000 | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22C | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Magnesium | 1,900 | | 10.0 | 4.1 | -- | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22C | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Potassium | 890 | | 51 | 21 | -- | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22C | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Sodium | 45 | J | 100 | 41 | -- | FR | 100-pt MIS spl |
| T Range | SSTRNG001 | SSTRNG001_OCT22C | 0 | 0.25 | 10/12/2022 | EPA 365.1 | Total | Total Phosphate | 1,100 | | 71 | 36 | -- | FR | 100-pt MIS spl |
| T Range | SSTRNG002 | SSTRNG002_OCT22 | 0 | 0.25 | 10/12/2022 | EPA Moisture | -- | % moisture | 24.0 | | 1.0 | 1.0 | -- | N | 100-pt MIS spl |
| T Range | SSTRNG002 | SSTRNG002_OCT22 | 0 | 0.25 | 10/12/2022 | SW846 9045D | Soluble | pH (S.U.) | 5.6 | | 0.01 | 0.01 | -- | N | 100-pt MIS spl |
| T Range | SSTRNG002 | SSTRNG002_OCT22 | 0 | 0.25 | 10/12/2022 | EPA 300.0 | Soluble | Chloride | 14 | | 13 | 6.4 | -- | N | 100-pt MIS spl |
| T Range | SSTRNG002 | SSTRNG002_OCT22 | 0 | 0.25 | 10/12/2022 | EPA 300.0 | Soluble | Sulfate | 14 | J | 19 | 6.4 | -- | N | 100-pt MIS spl |
| T Range | SSTRNG002 | SSTRNG002_OCT22 | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Antimony | ND | U | 6.2 | 2.1 | 300 | N | 100-pt MIS spl |
| T Range | SSTRNG002 | SSTRNG002_OCT22 | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Calcium | 910 | | 62 | 23 | -- | N | 100-pt MIS spl |
| T Range | SSTRNG002 | SSTRNG002_OCT22 | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Copper | 9.1 | | 2.5 | 0.95 | 10,000 | N | 100-pt MIS spl |
| T Range | SSTRNG002 | SSTRNG002_OCT22 | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Iron | 10,000 | | 25 | 7.6 | -- | N | 100-pt MIS spl |
| T Range | SSTRNG002 | SSTRNG002_OCT22 | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Lead | 22 | | 1.8 | 0.74 | 6,000 | N | 100-pt MIS spl |
| T Range | SSTRNG002 | SSTRNG002_OCT22 | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Magnesium | 1,200 | | 12 | 4.9 | -- | N | 100-pt MIS spl |
| T Range | SSTRNG002 | SSTRNG002_OCT22 | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Potassium | 690 | | 62 | 25 | -- | N | 100-pt MIS spl |
| T Range | SSTRNG002 | SSTRNG002_OCT22 | 0 | 0.25 | 10/12/2022 | SW846 6010D | Total | Sodium | ND | U | 120 | 49 | -- | N | 100-pt MIS spl |
| T Range | SSTRNG002 | SSTRNG002_OCT22 | 0 | 0.25 | 10/12/2022 | EPA 365.1 | Total | Total Phosphate | 960 | | 80 | 40 | -- | N | 100-pt MIS spl |

**Notes:**

bgs = below ground surface
FR = field duplicate or replicate
ID = identifier
RL = reporting limit
**Bold Results Value = ABOVE OMMP ACTION LEVEL**
ND/U = non-detect UJ = non-detectable, estimated value
OMMP = Operation MDL = method detection limit
F1 = MS and/or MS mg/kg = milligram(s) per kilogram
Site/SLX List = Ra N = native sample
J1 = Estimated value is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

# Small Arms Range Sampling Reports

## Lysimeter Sampling Results

Fall 2022

## CAMP EDWARDS SMALL ARMS RANGE ANNUAL LYSIMETER 2022

***NOTE: Data entered does not include third-party data validation qualifiers per the 2018 QAPP, if required.***

| Site/SLX List | Location ID | Field Sample ID | Date Sampled | Test Method | Method | Analyte | Result Value (µg/L) | Lab Report Qualifier | RL | MDL | OMMP Action Levels (µg/L) | Sample Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I Range | LYIRNG001 | LYIRNG001_OCT22 | 10/12/2022 | EPA 300.0 | FLDFLT | Sulfate | ND | U | 7,500 | 2,500 | -- | N |
| I Range | LYIRNG001 | LYIRNG001_OCT22 | 10/12/2022 | EPA 300.0 | FLDFLT | Chloride | 3,300 | J | 7,500 | 3,000 | -- | N |
| I Range | LYIRNG001 | LYIRNG001_OCT22 | 10/12/2022 | SW846 6020B | FLDFLT | Antimony | 4.7 | | 1 | 0.21 | 6 | N |
| I Range | LYIRNG001 | LYIRNG001_OCT22 | 10/12/2022 | SW846 6020B | FLDFLT | Calcium | 3,100 | | 100 | 52 | -- | N |
| I Range | LYIRNG001 | LYIRNG001_OCT22 | 10/12/2022 | SW846 6020B | FLDFLT | Copper | 13 | | 1 | 0.37 | 1,300 | N |
| I Range | LYIRNG001 | LYIRNG001_OCT22 | 10/12/2022 | SW846 6020B | FLDFLT | Iron | ND | U | 52 | 21 | -- | N |
| I Range | LYIRNG001 | LYIRNG001_OCT22 | 10/12/2022 | SW846 6020B | FLDFLT | Lead | 3.0 | | 0.52 | 0.073 | 15 | N |
| I Range | LYIRNG001 | LYIRNG001_OCT22 | 10/12/2022 | SW846 6020B | FLDFLT | Magnesium | 900 | ^2 | 52 | 16 | -- | N |
| I Range | LYIRNG001 | LYIRNG001_OCT22 | 10/12/2022 | SW846 6020B | FLDFLT | Potassium | 1,400 | | 210 | 67 | -- | N |
| I Range | LYIRNG001 | LYIRNG001_OCT22 | 10/12/2022 | SW846 6020B | FLDFLT | Sodium | 1,800 | | 210 | 93 | -- | N |
| I Range | LYIRNG001 | LYIRNG001_OCT22 | 10/12/2022 | SM 2320B-2011 | FLDFLT | Alkalinity | 10,000 | | 8,000 | 2,600 | -- | N |
| I Range | LYIRNG001 | LYIRNG001_OCT22 | 10/12/2022 | EPA 365.1 | FLDFLT | Phosphate | ND | U | 310 | 250 | -- | N |
| I Range | LYIRNG001 | LYIRNG001_OCT22 | 10/12/2022 | SM 5310 C-2011 | FLDFLT | DOC | 3,400 | | 1,000 | 500 | -- | N |
| I Range | LYIRNG001 | LYIRNG001_OCT22D | 10/12/2022 | EPA 300.0 | FLDFLT | Sulfate | ND | U | 7,500 | 2,500 | -- | FR |
| I Range | LYIRNG001 | LYIRNG001_OCT22D | 10/12/2022 | EPA 300.0 | FLDFLT | Chloride | 3,100 | J | 7,500 | 3,000 | -- | FR |
| I Range | LYIRNG001 | LYIRNG001_OCT22D | 10/12/2022 | SW846 6020B | FLDFLT | Antimony | 4.6 | | 1 | 0.21 | 6 | FR |
| I Range | LYIRNG001 | LYIRNG001_OCT22D | 10/12/2022 | SW846 6020B | FLDFLT | Calcium | 3,600 | | 100 | 52 | -- | FR |
| I Range | LYIRNG001 | LYIRNG001_OCT22D | 10/12/2022 | SW846 6020B | FLDFLT | Copper | 13 | | 1 | 0.37 | 1,300 | FR |
| I Range | LYIRNG001 | LYIRNG001_OCT22D | 10/12/2022 | SW846 6020B | FLDFLT | Iron | ND | U | 52 | 21 | -- | FR |
| I Range | LYIRNG001 | LYIRNG001_OCT22D | 10/12/2022 | SW846 6020B | FLDFLT | Lead | 3.2 | | 0.52 | 0.073 | 15 | FR |
| I Range | LYIRNG001 | LYIRNG001_OCT22D | 10/12/2022 | SW846 6020B | FLDFLT | Magnesium | 960 | | 52 | 16 | -- | FR |
| I Range | LYIRNG001 | LYIRNG001_OCT22D | 10/12/2022 | SW846 6020B | FLDFLT | Potassium | 1,500 | | 210 | 67 | -- | FR |
| I Range | LYIRNG001 | LYIRNG001_OCT22D | 10/12/2022 | SW846 6020B | FLDFLT | Sodium | 1,900 | | 210 | 93 | -- | FR |
| I Range | LYIRNG001 | LYIRNG001_OCT22D | 10/12/2022 | SM 2320B-2011 | FLDFLT | Alkalinity | 10,000 | | 8,000 | 2,600 | -- | FR |
| I Range | LYIRNG001 | LYIRNG001_OCT22D | 10/12/2022 | EPA 365.1 | FLDFLT | Phosphate | ND | U | 310 | 250 | -- | FR |
| I Range | LYIRNG001 | LYIRNG001_OCT22D | 10/12/2022 | SM 5310 C-2011 | FLDFLT | DOC | 3,500 | | 1,000 | 500 | -- | FR |
| I Range | LYIRNG002 | LYIRNG002_OCT22 | 10/12/2022 | EPA 300.0 | FLDFLT | Sulfate | 16,000 | | 7,500 | 2,500 | -- | N |
| I Range | LYIRNG002 | LYIRNG002_OCT22 | 10/12/2022 | EPA 300.0 | FLDFLT | Chloride | 6,700 | J | 7,500 | 3,000 | -- | N |
| I Range | LYIRNG002 | LYIRNG002_OCT22 | 10/12/2022 | SW846 6020B | FLDFLT | Antimony | **7.8** | | 1 | 0.21 | 6 | N |
| I Range | LYIRNG002 | LYIRNG002_OCT22 | 10/12/2022 | SW846 6020B | FLDFLT | Calcium | 15,000 | | 100 | 52 | -- | N |
| I Range | LYIRNG002 | LYIRNG002_OCT22 | 10/12/2022 | SW846 6020B | FLDFLT | Copper | 330 | | 1 | 0.37 | 1,300 | N |

| Site/SLX List | Location ID | Field Sample ID | Date Sampled | Test Method | Method | Analyte | Result Value (µg/L) | Lab Report Qualifier | RL | MDL | OMMP Action Levels (µg/L) | Sample Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I Range | LYIRNG002 | LYIRNG002_OCT22 | 10/12/2022 | SW846 6020B | FLDFLT | Iron | 33 | J | 52 | 21 | -- | N |
| I Range | LYIRNG002 | LYIRNG002_OCT22 | 10/12/2022 | SW846 6020B | FLDFLT | Lead | 0.26 | J | 0.52 | 0.073 | 15 | N |
| I Range | LYIRNG002 | LYIRNG002_OCT22 | 10/12/2022 | SW846 6020B | FLDFLT | Magnesium | 4,000 | ^2 | 52 | 16 | -- | N |
| I Range | LYIRNG002 | LYIRNG002_OCT22 | 10/12/2022 | SW846 6020B | FLDFLT | Potassium | 2,200 | | 210 | 67 | -- | N |
| I Range | LYIRNG002 | LYIRNG002_OCT22 | 10/12/2022 | SW846 6020B | FLDFLT | Sodium | 5,200 | B ^2 | 210 | 93 | -- | N |
| I Range | LYIRNG002 | LYIRNG002_OCT22 | 10/12/2022 | SM 2320B-2011 | FLDFLT | Alkalinity | 14,000 | | 8,000 | 2,600 | -- | N |
| I Range | LYIRNG002 | LYIRNG002_OCT22 | 10/12/2022 | EPA 365.1 | FLDFLT | Phosphate | 39,000 | | 310 | 250 | -- | N |
| I Range | LYIRNG002 | LYIRNG002_OCT22 | 10/12/2022 | SM 5310 C-2011 | FLDFLT | DOC | 16,000 | | 1,000 | 500 | -- | N |
| I Range | LYIRNG002 | LYIRNG002_OCT22D | 10/12/2022 | EPA 300.0 | FLDFLT | Sulfate | 16,000 | | 7,500 | 2,500 | -- | FR |
| I Range | LYIRNG002 | LYIRNG002_OCT22D | 10/12/2022 | EPA 300.0 | FLDFLT | Chloride | 6,700 | J | 7,500 | 3,000 | -- | FR |
| I Range | LYIRNG002 | LYIRNG002_OCT22D | 10/12/2022 | SW846 6020B | FLDFLT | Antimony | **7.8** | | 1 | 0.21 | 6 | FR |
| I Range | LYIRNG002 | LYIRNG002_OCT22D | 10/12/2022 | SW846 6020B | FLDFLT | Calcium | 15,000 | | 100 | 52 | -- | FR |
| I Range | LYIRNG002 | LYIRNG002_OCT22D | 10/12/2022 | SW846 6020B | FLDFLT | Copper | 320 | | 1 | 0.37 | 1,300 | FR |
| I Range | LYIRNG002 | LYIRNG002_OCT22D | 10/12/2022 | SW846 6020B | FLDFLT | Iron | 28 | J | 52 | 21 | -- | FR |
| I Range | LYIRNG002 | LYIRNG002_OCT22D | 10/12/2022 | SW846 6020B | FLDFLT | Lead | 0.32 | J | 0.52 | 0.073 | 15 | FR |
| I Range | LYIRNG002 | LYIRNG002_OCT22D | 10/12/2022 | SW846 6020B | FLDFLT | Magnesium | 4,000 | ^2 | 52 | 16 | -- | FR |
| I Range | LYIRNG002 | LYIRNG002_OCT22D | 10/12/2022 | SW846 6020B | FLDFLT | Potassium | 2,200 | | 210 | 67 | -- | FR |
| I Range | LYIRNG002 | LYIRNG002_OCT22D | 10/12/2022 | SW846 6020B | FLDFLT | Sodium | 5,100 | B ^2 | 210 | 93 | -- | FR |
| I Range | LYIRNG002 | LYIRNG002_OCT22D | 10/12/2022 | SM 2320B-2011 | FLDFLT | Alkalinity | 14,000 | | 8,000 | 2,600 | -- | FR |
| I Range | LYIRNG002 | LYIRNG002_OCT22D | 10/12/2022 | EPA 365.1 | FLDFLT | Phosphate | 40,000 | | 3,100 | 2,500 | -- | FR |
| I Range | LYIRNG002 | LYIRNG002_OCT22D | 10/12/2022 | SM 5310 C-2011 | FLDFLT | DOC | 16,000 | | 1,000 | 500 | -- | FR |
| J Range | LYJRNG001 | LYJRNG001_OCT22 | 10/14/2022 | EPA 300.0 | FLDFLT | Sulfate | ND | U | 7,500 | 2,500 | -- | N |
| J Range | LYJRNG001 | LYJRNG001_OCT22 | 10/14/2022 | EPA 300.0 | FLDFLT | Chloride | ND | U | 7,500 | 3,000 | -- | N |
| J Range | LYJRNG001 | LYJRNG001_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Antimony | 0.9 | J | 1 | 0.21 | 6 | N |
| J Range | LYJRNG001 | LYJRNG001_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Calcium | 5,900 | | 100 | 52 | -- | N |
| J Range | LYJRNG001 | LYJRNG001_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Copper | 3.3 | | 1 | 0.37 | 1,300 | N |
| J Range | LYJRNG001 | LYJRNG001_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Iron | ND | U | 52 | 21 | -- | N |
| J Range | LYJRNG001 | LYJRNG001_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Lead | 0.25 | J | 0.52 | 0.073 | 15 | N |
| J Range | LYJRNG001 | LYJRNG001_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Magnesium | 2,800 | | 52.00 | 16 | -- | N |
| J Range | LYJRNG001 | LYJRNG001_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Potassium | 620 | | 210 | 67 | -- | N |
| J Range | LYJRNG001 | LYJRNG001_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Sodium | 2,100 | | 210 | 93 | -- | N |
| J Range | LYJRNG001 | LYJRNG001_OCT22 | 10/14/2022 | SM 2320B-2011 | FLDFLT | Alkalinity | ND | U | 8,000 | 2,600 | -- | N |
| J Range | LYJRNG001 | LYJRNG001_OCT22 | 10/14/2022 | EPA 365.1 | FLDFLT | Phosphate | ND | U | 310 | 250 | -- | N |

| Site/SLX List | Location ID | Field Sample ID | Date Sampled | Test Method | Method | Analyte | Result Value (µg/L) | Lab Report Qualifier | RL | MDL | OMMP Action Levels (µg/L) | Sample Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| J Range | LYJRNG001 | LYJRNG001_OCT22 | 10/14/2022 | SM 5310 C-2011 | FLDFLT | DOC | 5,500 | | 1,000 | 500 | -- | N |
| J Range | LYJRNG002 | LYJRNG002_OCT22 | 10/14/2022 | EPA 300.0 | FLDFLT | Sulfate | 5,500 | U | 7,500 | 2,500 | -- | N |
| J Range | LYJRNG002 | LYJRNG002_OCT22 | 10/14/2022 | EPA 300.0 | FLDFLT | Chloride | ND | U | 7,500 | 3,000 | -- | N |
| J Range | LYJRNG002 | LYJRNG002_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Antimony | 1.4 | | 1 | 0.21 | 6 | N |
| J Range | LYJRNG002 | LYJRNG002_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Calcium | 11,000 | | 100 | 52 | -- | N |
| J Range | LYJRNG002 | LYJRNG002_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Copper | 3.8 | | 1 | 0.37 | 1,300 | N |
| J Range | LYJRNG002 | LYJRNG002_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Iron | ND | U | 52 | 21 | -- | N |
| J Range | LYJRNG002 | LYJRNG002_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Lead | 0.17 | J | 0.52 | 0.073 | 15 | N |
| J Range | LYJRNG002 | LYJRNG002_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Magnesium | 6,500 | | 52.00 | 16 | -- | N |
| J Range | LYJRNG002 | LYJRNG002_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Potassium | 1,500 | | 210 | 67 | -- | N |
| J Range | LYJRNG002 | LYJRNG002_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Sodium | 2,500 | | 210 | 93 | -- | N |
| J Range | LYJRNG002 | LYJRNG002_OCT22 | 10/14/2022 | SM 2320B-2011 | FLDFLT | Alkalinity | 58,000 | | 8,000 | 2,600 | -- | N |
| J Range | LYJRNG002 | LYJRNG002_OCT22 | 10/14/2022 | EPA 365.1 | FLDFLT | Phosphate | ND | U | 310 | 250 | -- | N |
| J Range | LYJRNG002 | LYJRNG002_OCT22 | 10/14/2022 | SM 5310 C-2011 | FLDFLT | DOC | 4,700 | | 1,000 | 500 | -- | N |
| K Range | LYKRNG001 | LYKRNG001_OCT22 | 10/14/2022 | EPA 300.0 | FLDFLT | Sulfate | ND | U | 7,500 | 2,500 | -- | N |
| K Range | LYKRNG001 | LYKRNG001_OCT22 | 10/14/2022 | EPA 300.0 | FLDFLT | Chloride | 4,700 | J | 7,500 | 3,000 | -- | N |
| K Range | LYKRNG001 | LYKRNG001_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Antimony | 0.35 | J | 1 | 0.21 | 6 | N |
| K Range | LYKRNG001 | LYKRNG001_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Calcium | 8,800 | | 100 | 52 | -- | N |
| K Range | LYKRNG001 | LYKRNG001_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Copper | 1.1 | | 1 | 0.37 | 1,300 | N |
| K Range | LYKRNG001 | LYKRNG001_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Iron | 34 | J | 52 | 21 | -- | N |
| K Range | LYKRNG001 | LYKRNG001_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Lead | ND | U | 0.52 | 0.073 | 15 | N |
| K Range | LYKRNG001 | LYKRNG001_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Magnesium | 5,000 | ^2 | 52 | 16 | -- | N |
| K Range | LYKRNG001 | LYKRNG001_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Potassium | 1,100 | | 210 | 67 | -- | N |
| K Range | LYKRNG001 | LYKRNG001_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Sodium | 3,200 | | 210 | 93 | -- | N |
| K Range | LYKRNG001 | LYKRNG001_OCT22 | 10/14/2022 | SM 2320B-2011 | FLDFLT | Alkalinity | 4,300 | | 8,000 | 2,600 | -- | N |
| K Range | LYKRNG001 | LYKRNG001_OCT22 | 10/14/2022 | EPA 365.1 | FLDFLT | Phosphate | ND | U | 310 | 250 | -- | N |
| K Range | LYKRNG001 | LYKRNG001_OCT22 | 10/14/2022 | SM 5310 C-2011 | FLDFLT | DOC | 2,800 | | 1,000 | 500 | -- | N |
| K Range | LYKRNG002 | LYKRNG002_OCT22 | 10/14/2022 | EPA 300.0 | FLDFLT | Sulfate | ND | U | 7,500 | 2,500 | -- | N |
| K Range | LYKRNG002 | LYKRNG002_OCT22 | 10/14/2022 | EPA 300.0 | FLDFLT | Chloride | 3,600 | J | 7,500 | 3,000 | -- | N |
| K Range | LYKRNG002 | LYKRNG002_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Antimony | 0.28 | J | 1 | 0.21 | 6 | N |
| K Range | LYKRNG002 | LYKRNG002_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Calcium | 13,000 | | 100 | 52 | -- | N |
| K Range | LYKRNG002 | LYKRNG002_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Copper | 0.83 | J | 1 | 0.37 | 1,300 | N |
| K Range | LYKRNG002 | LYKRNG002_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Iron | ND | U | 52 | 21 | -- | N |

| Site/SLX List | Location ID | Field Sample ID | Date Sampled | Test Method | Method | Analyte | Result Value (µg/L) | Lab Report Qualifier | RL | MDL | OMMP Action Levels (µg/L) | Sample Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| K Range | LYKRNG002 | LYKRNG002_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Lead | ND | U | 0.52 | 0.073 | 15 | N |
| K Range | LYKRNG002 | LYKRNG002_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Magnesium | 10,000 | B | 52 | 16 | -- | N |
| K Range | LYKRNG002 | LYKRNG002_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Potassium | 1,000 | | 210 | 67 | -- | N |
| K Range | LYKRNG002 | LYKRNG002_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Sodium | 3,400 | | 210 | 93 | -- | N |
| K Range | LYKRNG002 | LYKRNG002_OCT22 | 10/14/2022 | SM 2320B-2011 | FLDFLT | Alkalinity | 71,000 | | 8,000 | 2,600 | -- | N |
| K Range | LYKRNG002 | LYKRNG002_OCT22 | 10/14/2022 | EPA 365.1 | FLDFLT | Phosphate | ND | U | 310 | 250 | -- | N |
| K Range | LYKRNG002 | LYKRNG002_OCT22 | 10/14/2022 | SM 5310 C-2011 | FLDFLT | DOC | 2,300 | | 1,000 | 500 | -- | N |
| K Range | LYKRNG003 | LYKRNG003_OCT22 | 10/14/2022 | EPA 300.0 | FLDFLT | Sulfate | ND | U | 7,500 | 2,500 | -- | N |
| K Range | LYKRNG003 | LYKRNG003_OCT22 | 10/14/2022 | EPA 300.0 | FLDFLT | Chloride | 4,800 | J | 7,500 | 3,000 | -- | N |
| K Range | LYKRNG003 | LYKRNG003_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Antimony | 0.67 | J | 1 | 0.21 | 6 | N |
| K Range | LYKRNG003 | LYKRNG003_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Calcium | 4,100 | | 100 | 52 | -- | N |
| K Range | LYKRNG003 | LYKRNG003_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Copper | 4.6 | | 1 | 0.37 | 1,300 | N |
| K Range | LYKRNG003 | LYKRNG003_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Iron | 2,300 | | 52 | 21 | -- | N |
| K Range | LYKRNG003 | LYKRNG003_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Lead | 6.2 | | 0.52 | 0.073 | 15 | N |
| K Range | LYKRNG003 | LYKRNG003_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Magnesium | 3,600 | | 52 | 16 | -- | N |
| K Range | LYKRNG003 | LYKRNG003_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Potassium | 1,900 | | 210 | 67 | -- | N |
| K Range | LYKRNG003 | LYKRNG003_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Sodium | 2,700 | | 210 | 93 | -- | N |
| K Range | LYKRNG003 | LYKRNG003_OCT22 | 10/14/2022 | SM 2320B-2011 | FLDFLT | Alkalinity | 10,000 | | 8,000 | 2,600 | -- | N |
| K Range | LYKRNG003 | LYKRNG003_OCT22 | 10/14/2022 | EPA 365.1 | FLDFLT | Phosphate | ND | U | 310 | 250 | -- | N |
| K Range | LYKRNG003 | LYKRNG003_OCT22 | 10/14/2022 | SM 5310 C-2011 | FLDFLT | DOC | 5,000 | | 1,000 | 500 | -- | N |
| K Range | LYKRNG004 | LYKRNG004_OCT22 | 10/14/2022 | EPA 300.0 | FLDFLT | Sulfate | ND | U | 7,500 | 2,500 | -- | N |
| K Range | LYKRNG004 | LYKRNG004_OCT22 | 10/14/2022 | EPA 300.0 | FLDFLT | Chloride | ND | U, F1 | 7,500 | 3,000 | -- | N |
| K Range | LYKRNG004 | LYKRNG004_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Antimony | **11** | | 1 | 0.21 | 6 | N |
| K Range | LYKRNG004 | LYKRNG004_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Calcium | 5,300 | | 100 | 52 | -- | N |
| K Range | LYKRNG004 | LYKRNG004_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Copper | 6.7 | | 1 | 0.37 | 1,300 | N |
| K Range | LYKRNG004 | LYKRNG004_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Iron | ND | U | 52 | 21 | -- | N |
| K Range | LYKRNG004 | LYKRNG004_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Lead | 2.6 | | 0.52 | 0.073 | 15 | N |
| K Range | LYKRNG004 | LYKRNG004_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Magnesium | 430 | | 52 | 16 | -- | N |
| K Range | LYKRNG004 | LYKRNG004_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Potassium | 360 | | 210 | 67 | -- | N |
| K Range | LYKRNG004 | LYKRNG004_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Sodium | 2,200 | | 210 | 93 | -- | N |
| K Range | LYKRNG004 | LYKRNG004_OCT22 | 10/14/2022 | SM 2320B-2011 | FLDFLT | Alkalinity | 13,000 | | 8,000 | 2,600 | -- | N |
| K Range | LYKRNG004 | LYKRNG004_OCT22 | 10/14/2022 | EPA 365.1 | FLDFLT | Phosphate | ND | U | 310 | 250 | -- | N |
| K Range | LYKRNG004 | LYKRNG004_OCT22 | 10/14/2022 | SM 5310 C-2011 | FLDFLT | DOC | 3,600 | | 1,000 | 500 | -- | N |

| Site/SLX List | Location ID | Field Sample ID | Date Sampled | Test Method | Method | Analyte | Result Value (µg/L) | Lab Report Qualifier | RL | MDL | OMMP Action Levels (µg/L) | Sample Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L Range | LYLRNG001 | LYLRNG001_OCT22 | 10/13/2022 | EPA 300.0 | FLDFLT | Sulfate | ND | U | 7,500 | 2,500 | -- | N |
| L Range | LYLRNG001 | LYLRNG001_OCT22 | 10/13/2022 | EPA 300.0 | FLDFLT | Chloride | 3,500 | J | 7,500 | 3,000 | -- | N |
| L Range | LYLRNG001 | LYLRNG001_OCT22 | 10/13/2022 | SW846 6020B | FLDFLT | Antimony | ND | U | 1 | 0.21 | 6 | N |
| L Range | LYLRNG001 | LYLRNG001_OCT22 | 10/13/2022 | SW846 6020B | FLDFLT | Calcium | 2,200 | | 100 | 52 | -- | N |
| L Range | LYLRNG001 | LYLRNG001_OCT22 | 10/13/2022 | SW846 6020B | FLDFLT | Copper | 5.4 | | 1 | 0.37 | 1,300 | N |
| L Range | LYLRNG001 | LYLRNG001_OCT22 | 10/13/2022 | SW846 6020B | FLDFLT | Iron | ND | U | 52 | 21 | -- | N |
| L Range | LYLRNG001 | LYLRNG001_OCT22 | 10/13/2022 | SW846 6020B | FLDFLT | Lead | 0.61 | | 0.52 | 0.073 | 15 | N |
| L Range | LYLRNG001 | LYLRNG001_OCT22 | 10/13/2022 | SW846 6020B | FLDFLT | Magnesium | 420 | | 52 | 16 | -- | N |
| L Range | LYLRNG001 | LYLRNG001_OCT22 | 10/13/2022 | SW846 6020B | FLDFLT | Potassium | 780 | | 210 | 67 | -- | N |
| L Range | LYLRNG001 | LYLRNG001_OCT22 | 10/13/2022 | SW846 6020B | FLDFLT | Sodium | 2,300 | | 210 | 93 | -- | N |
| L Range | LYLRNG001 | LYLRNG001_OCT22 | 10/13/2022 | SM 2320B-2011 | FLDFLT | Alkalinity | 3,500 | J | 8,000 | 2,600 | -- | N |
| L Range | LYLRNG001 | LYLRNG001_OCT22 | 10/13/2022 | EPA 365.1 | FLDFLT | Phosphate | ND | U | 310 | 250 | -- | N |
| L Range | LYLRNG001 | LYLRNG001_OCT22 | 10/13/2022 | SM 5310 C-2011 | FLDFLT | DOC | 6,900 | | 1,000 | 500 | -- | N |
| L Range | LYLRNG002 | LYLRNG002_OCT22 | 10/13/2022 | EPA 300.0 | FLDFLT | Sulfate | ND | U | 7,500 | 2,500 | -- | N |
| L Range | LYLRNG002 | LYLRNG002_OCT22 | 10/13/2022 | EPA 300.0 | FLDFLT | Chloride | ND | U | 7,500 | 3,000 | -- | N |
| L Range | LYLRNG002 | LYLRNG002_OCT22 | 10/13/2022 | SW846 6020B | FLDFLT | Antimony | ND | U | 1 | 0.21 | 6 | N |
| L Range | LYLRNG002 | LYLRNG002_OCT22 | 10/13/2022 | SW846 6020B | FLDFLT | Calcium | 26,000 | | 100 | 52 | -- | N |
| L Range | LYLRNG002 | LYLRNG002_OCT22 | 10/13/2022 | SW846 6020B | FLDFLT | Copper | 0.76 | J | 1 | 0.37 | 1,300 | N |
| L Range | LYLRNG002 | LYLRNG002_OCT22 | 10/13/2022 | SW846 6020B | FLDFLT | Iron | 33 | J | 52 | 21 | -- | N |
| L Range | LYLRNG002 | LYLRNG002_OCT22 | 10/13/2022 | SW846 6020B | FLDFLT | Lead | ND | U | 0.52 | 0.073 | 15 | N |
| L Range | LYLRNG002 | LYLRNG002_OCT22 | 10/13/2022 | SW846 6020B | FLDFLT | Magnesium | 560 | ^2 | 52 | 16 | -- | N |
| L Range | LYLRNG002 | LYLRNG002_OCT22 | 10/13/2022 | SW846 6020B | FLDFLT | Potassium | 91 | J | 210 | 67 | -- | N |
| L Range | LYLRNG002 | LYLRNG002_OCT22 | 10/13/2022 | SW846 6020B | FLDFLT | Sodium | 3,000 | | 210 | 93 | -- | N |
| L Range | LYLRNG002 | LYLRNG002_OCT22 | 10/13/2022 | SM 2320B-2011 | FLDFLT | Alkalinity | 72,000 | | 8,000 | 2,600 | -- | N |
| L Range | LYLRNG002 | LYLRNG002_OCT22 | 10/13/2022 | EPA 365.1 | FLDFLT | Phosphate | ND | U | 310 | 250 | -- | N |
| L Range | LYLRNG002 | LYLRNG002_OCT22 | 10/13/2022 | SM 5310 C-2011 | FLDFLT | DOC | 2,800 | | 1,000 | 500 | -- | N |
| S Range | LYSRNG001 | LYSRNG001_OCT22 | 10/11/2022 | EPA 300.0 | FLDFLT | Sulfate | ND | U | 7,500 | 2,500 | -- | N |
| S Range | LYSRNG001 | LYSRNG001_OCT22 | 10/11/2022 | EPA 300.0 | FLDFLT | Chloride | 6,200 | J | 7,500 | 3,000 | -- | N |
| S Range | LYSRNG001 | LYSRNG001_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Antimony | 1.5 | | 1 | 0.21 | 6 | N |
| S Range | LYSRNG001 | LYSRNG001_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Calcium | 21,000 | | 100 | 52 | -- | N |
| S Range | LYSRNG001 | LYSRNG001_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Copper | 4.4 | | 1 | 0.37 | 1,300 | N |
| S Range | LYSRNG001 | LYSRNG001_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Iron | 180 | | 52 | 21 | -- | N |
| S Range | LYSRNG001 | LYSRNG001_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Lead | 0.55 | | 0.52 | 0.073 | 15 | N |

| Site/SLX List | Location ID | Field Sample ID | Date Sampled | Test Method | Method | Analyte | Result Value (µg/L) | Lab Report Qualifier | RL | MDL | OMMP Action Levels (µg/L) | Sample Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S Range | LYSRNG001 | LYSRNG001_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Magnesium | 2,000 | | 52 | 16 | -- | N |
| S Range | LYSRNG001 | LYSRNG001_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Potassium | 190 | J | 210 | 67 | -- | N |
| S Range | LYSRNG001 | LYSRNG001_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Sodium | 5,300 | | 210 | 93 | -- | N |
| S Range | LYSRNG001 | LYSRNG001_OCT22 | 10/11/2022 | SM 2320B-2011 | FLDFLT | Alkalinity | 58,000 | | 8,000 | 2,600 | -- | N |
| S Range | LYSRNG001 | LYSRNG001_OCT22 | 10/11/2022 | EPA 365.1 | FLDFLT | Phosphate | ND | U | 310 | 250 | -- | N |
| S Range | LYSRNG001 | LYSRNG001_OCT22 | 10/11/2022 | SM 5310 C-2011 | FLDFLT | DOC | 8,100 | | 1,000 | 500 | -- | N |
| S Range | LYSRNG002 | LYSRNG002_OCT22 | 10/11/2022 | EPA 300.0 | FLDFLT | Sulfate | ND | U | 7,500 | 2,500 | -- | N |
| S Range | LYSRNG002 | LYSRNG002_OCT22 | 10/11/2022 | EPA 300.0 | FLDFLT | Chloride | 11,000 | | 7,500 | 3,000 | -- | N |
| S Range | LYSRNG002 | LYSRNG002_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Antimony | ND | U | 1 | 0.21 | 6 | N |
| S Range | LYSRNG002 | LYSRNG002_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Calcium | 1,700 | | 100 | 52 | -- | N |
| S Range | LYSRNG002 | LYSRNG002_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Copper | 1.8 | | 1 | 0.37 | 1,300 | N |
| S Range | LYSRNG002 | LYSRNG002_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Iron | 24 | J | 52 | 21 | -- | N |
| S Range | LYSRNG002 | LYSRNG002_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Lead | 0.14 | J | 0.52 | 0.073 | 15 | N |
| S Range | LYSRNG002 | LYSRNG002_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Magnesium | 510 | ^2 | 52 | 16 | -- | N |
| S Range | LYSRNG002 | LYSRNG002_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Potassium | 2,700 | | 210 | 67 | -- | N |
| S Range | LYSRNG002 | LYSRNG002_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Sodium | 5,300 | B ^2 | 210 | 93 | -- | N |
| S Range | LYSRNG002 | LYSRNG002_OCT22 | 10/11/2022 | SM 2320B-2011 | FLDFLT | Alkalinity | 3,500 | J | 8,000 | 2,600 | -- | N |
| S Range | LYSRNG002 | LYSRNG002_OCT22 | 10/11/2022 | EPA 365.1 | FLDFLT | Phosphate | ND | U | 310 | 250 | -- | N |
| S Range | LYSRNG002 | LYSRNG002_OCT22 | 10/11/2022 | SM 5310 C-2011 | FLDFLT | DOC | 3,000 | | 1,000 | 500 | -- | N |

Notes:

µg/L = microgram(s) per liter
bgs = below ground surface
FLDFLT = field filtered
FR = field duplicate or replicate
ID = identifier
SLX = location
MDL = method detection limit
N = native sample
ND/U = non-detectable value
OMMP = Operations, Maintenance and Monitoring Plan
RL = reporting limit
J = Estimated value, result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value

# Small Arms Range Sampling Reports

## Groundwater Sampling Results

Fall 2022

## CAMP EDWARDS SMALL ARMS RANGE ANNUAL GROUNDWATER MONITORING 2022

***NOTE: Data entered does not include third-party data validation qualifiers per the 2018 QAPP, if required.***

| Site/SLX List | Location ID | Field Sample ID | Date Sampled | Test Method | Method | Analyte | Result Value (µg/L) | Lab Report Qualifier | RL (µg/L) | MDL (µg/L) | OMMP Action Levels (µg/L) | Sample Type | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E Range | MW-468S | MW-468S_OCT22 | 10/14/2022 | EPA 300.0 | FLDFLT | Sulfate | NS | -- | -- | -- | -- | -- | Not enough water to collect additoional jars |
| E Range | MW-468S | MW-468S_OCT22 | 10/14/2022 | EPA 300.0 | FLDFLT | Chloride | NS | -- | -- | -- | -- | -- | Not enough water to collect additoional jars |
| E Range | MW-468S | MW-468S_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Antimony | ND | U | 1 | 0.21 | 3 | N | Grab Sample, not enough water to sample |
| E Range | MW-468S | MW-468S_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Calcium | 4,500 | | 100 | 52 | -- | N | Grab Sample, not enough water to sample |
| E Range | MW-468S | MW-468S_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Copper | 7.1 | | 1 | 0.37 | 650 | N | Grab Sample, not enough water to sample |
| E Range | MW-468S | MW-468S_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Iron | 1,200 | | 52 | 21 | -- | N | Grab Sample, not enough water to sample |
| E Range | MW-468S | MW-468S_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Lead | 4.6 | | 0.52 | 0.073 | 7.5 | N | Grab Sample, not enough water to sample |
| E Range | MW-468S | MW-468S_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Magnesium | 3,000 | | 52 | 16 | -- | N | Grab Sample, not enough water to sample |
| E Range | MW-468S | MW-468S_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Potassium | 1,100 | | 210 | 67 | -- | N | Grab Sample, not enough water to sample |
| E Range | MW-468S | MW-468S_OCT22 | 10/14/2022 | SW846 6020B | FLDFLT | Sodium | 7,500 | | 210 | 93 | -- | N | Grab Sample, not enough water to sample |
| E Range | MW-468S | MW-468S_OCT22 | 10/14/2022 | SM 2320B-2011 | FLDFLT | Alkalinity | NS | -- | -- | -- | -- | -- | Not enough water to collect additoional jars |
| E Range | MW-468S | MW-468S_OCT22 | 10/14/2022 | EPA 365.1 | FLDFLT | Phosphate | NS | -- | -- | -- | -- | -- | Not enough water to collect additoional jars |
| E Range | MW-468S | MW-468S_OCT22 | 10/14/2022 | SM 5310 C-2011 | FLDFLT | DOC | NS | -- | -- | -- | -- | -- | Not enough water to collect additoional jars |
| S Range | MW-465S | MW-465S_OCT22 | 10/11/2022 | EPA 300.0 | FLDFLT | Sulfate | 5,800 | J | 7,500 | 2,500 | -- | N | Grab Sample, not enough water to sample |
| S Range | MW-465S | MW-465S_OCT22 | 10/11/2022 | EPA 300.0 | FLDFLT | Chloride | 5,600 | J | 7,500 | 3,000 | -- | N | Grab Sample, not enough water to sample |

| Site/SLX List | Location ID | Field Sample ID | Date Sampled | Test Method | Method | Analyte | Result Value (µg/L) | Lab Report Qualifier | RL (µg/L) | MDL (µg/L) | OMMP Action Levels (µg/L) | Sample Type | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S Range | MW-465S | MW-465S_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Antimony | ND | U | 1 | 0.21 | 3 | N | Grab Sample, not enough water to sample |
| S Range | MW-465S | MW-465S_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Calcium | 4,300 | ^2 | 100 | 52 | -- | N | Grab Sample, not enough water to sample |
| S Range | MW-465S | MW-465S_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Copper | 0.67 | J | 1 | 0.37 | 650 | N | Grab Sample, not enough water to sample |
| S Range | MW-465S | MW-465S_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Iron | 22 | J | 52 | 21 | -- | N | Grab Sample, not enough water to sample |
| S Range | MW-465S | MW-465S_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Lead | 0.14 | J | 0.52 | 0.073 | 7.5 | N | Grab Sample, not enough water to sample |
| S Range | MW-465S | MW-465S_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Magnesium | 2,100 | ^2 | 52 | 16 | -- | N | Grab Sample, not enough water to sample |
| S Range | MW-465S | MW-465S_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Potassium | 630 | | 210 | 67 | -- | N | Grab Sample, not enough water to sample |
| S Range | MW-465S | MW-465S_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Sodium | 5,900 | | 210 | 93 | -- | N | Grab Sample, not enough water to sample |
| S Range | MW-465S | MW-465S_OCT22 | 10/11/2022 | SM 2320B-2011 | FLDFLT | Alkalinity | NS | -- | -- | -- | -- | -- | Not enough water to collect additoional jars |
| S Range | MW-465S | MW-465S_OCT22 | 10/11/2022 | EPA 365.1 | FLDFLT | Phosphate | NS | -- | -- | -- | -- | -- | Not enough water to collect additoional jars |
| S Range | MW-455S | MW-465S_OCT22 | 10/11/2022 | SM 5310 C-2011 | FLDFLT | DOC | NS | -- | -- | -- | -- | -- | Not enough water to collect additoional jars |
| S Range | MW-466S | MW-466S_OCT22 | 10/11/2022 | EPA 300.0 | FLDFLT | Sulfate | 7,400 | J | 7,500 | 2,500 | -- | N | Low Flow |
| S Range | MW-466S | MW-466S_OCT22 | 10/11/2022 | EPA 300.0 | FLDFLT | Chloride | 6,800 | J | 7,500 | 3,000 | -- | N | Low Flow |
| S Range | MW-466S | MW-466S_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Antimony | ND | U | 1 | 0.21 | 3 | N | Low Flow |
| S Range | MW-466S | MW-466S_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Calcium | 6,600 | | 100 | 52 | -- | N | Low Flow |
| S Range | MW-466S | MW-466S_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Copper | 0.47 | J | 1 | 0.37 | 650 | N | Low Flow |
| S Range | MW-466S | MW-466S_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Iron | ND | U | 52 | 21 | -- | N | Low Flow |
| S Range | MW-466S | MW-466S_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Lead | ND | U | 0.52 | 0.073 | 7.5 | N | Low Flow |
| S Range | MW-466S | MW-466S_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Magnesium | 3,000 | | 52 | 16 | -- | N | Low Flow |
| S Range | MW-466S | MW-466S_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Potassium | 730 | | 210 | 67 | -- | N | Low Flow |
| S Range | MW-466S | MW-466S_OCT22 | 10/11/2022 | SW846 6020B | FLDFLT | Sodium | 8,200 | | 210 | 93 | -- | N | Low Flow |
| S Range | MW-466S | MW-466S_OCT22 | 10/11/2022 | SM 2320B-2011 | FLDFLT | Alkalinity | 2,600 | | 8,000 | 2,600 | -- | N | Low Flow |

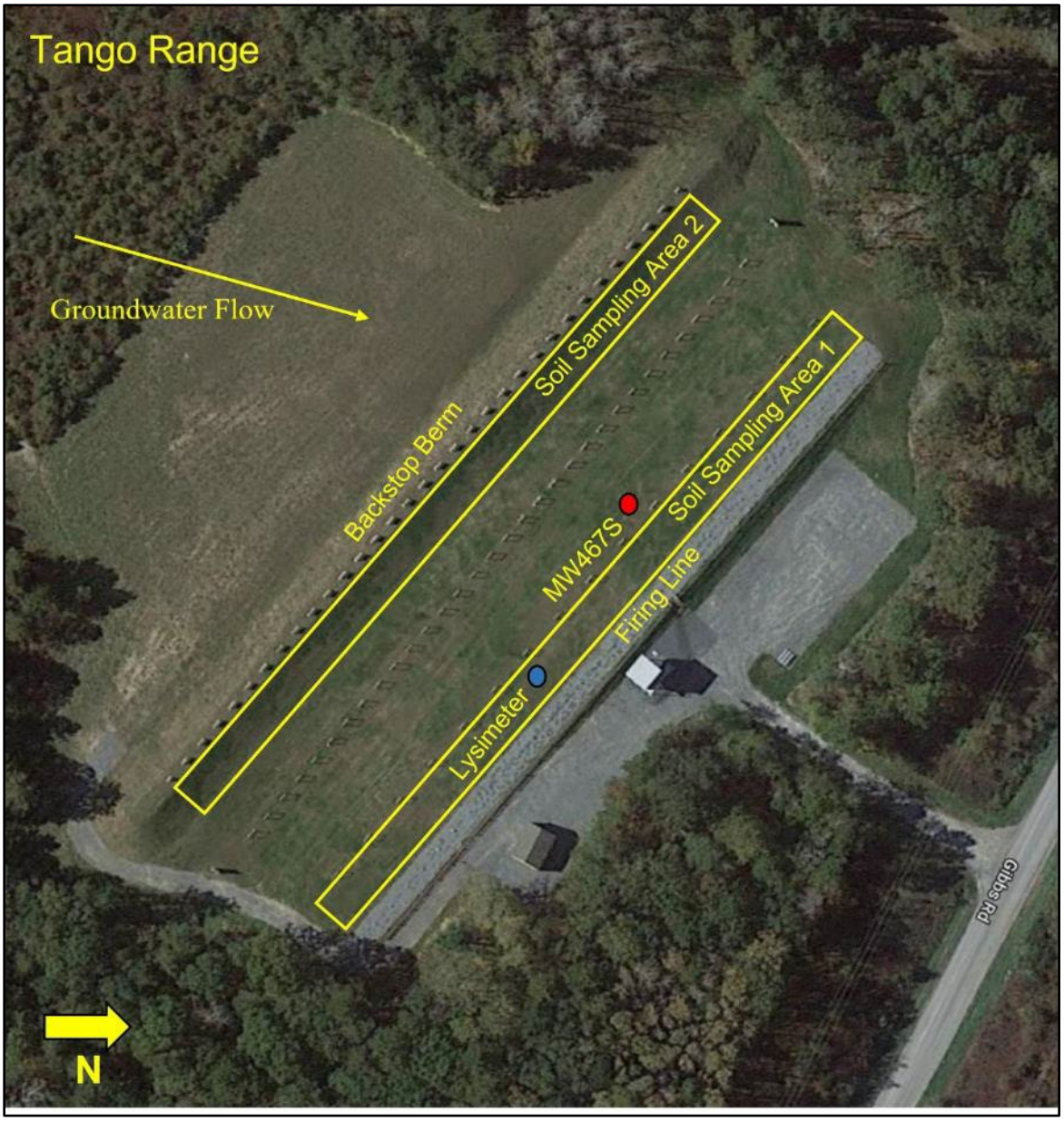
| Site/SLX List | Location ID | Field Sample ID | Date Sampled | Test Method | Method | Analyte | Result Value (µg/L) | Lab Report Qualifier | RL (µg/L) | MDL (µg/L) | OMMP Action Levels (µg/L) | Sample Type | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S Range | MW-466S | MW-466S_OCT22 | 10/11/2022 | EPA 365.1 | FLDFLT | Phosphate | ND | U | 310 | 250 | -- | N | Low Flow |
| S Range | MW-466S | MW-466S_OCT22 | 10/11/2022 | SM 5310 C-2011 | FLDFLT | DOC | ND | U | 1,000 | 500 | -- | N | Low Flow |

**Notes:**

µg/L = microgram(s) per liter
bgs = below ground surface
FLDFLT = field filtered
FR = field duplicate or replicate
ID = identifier
SLX = location

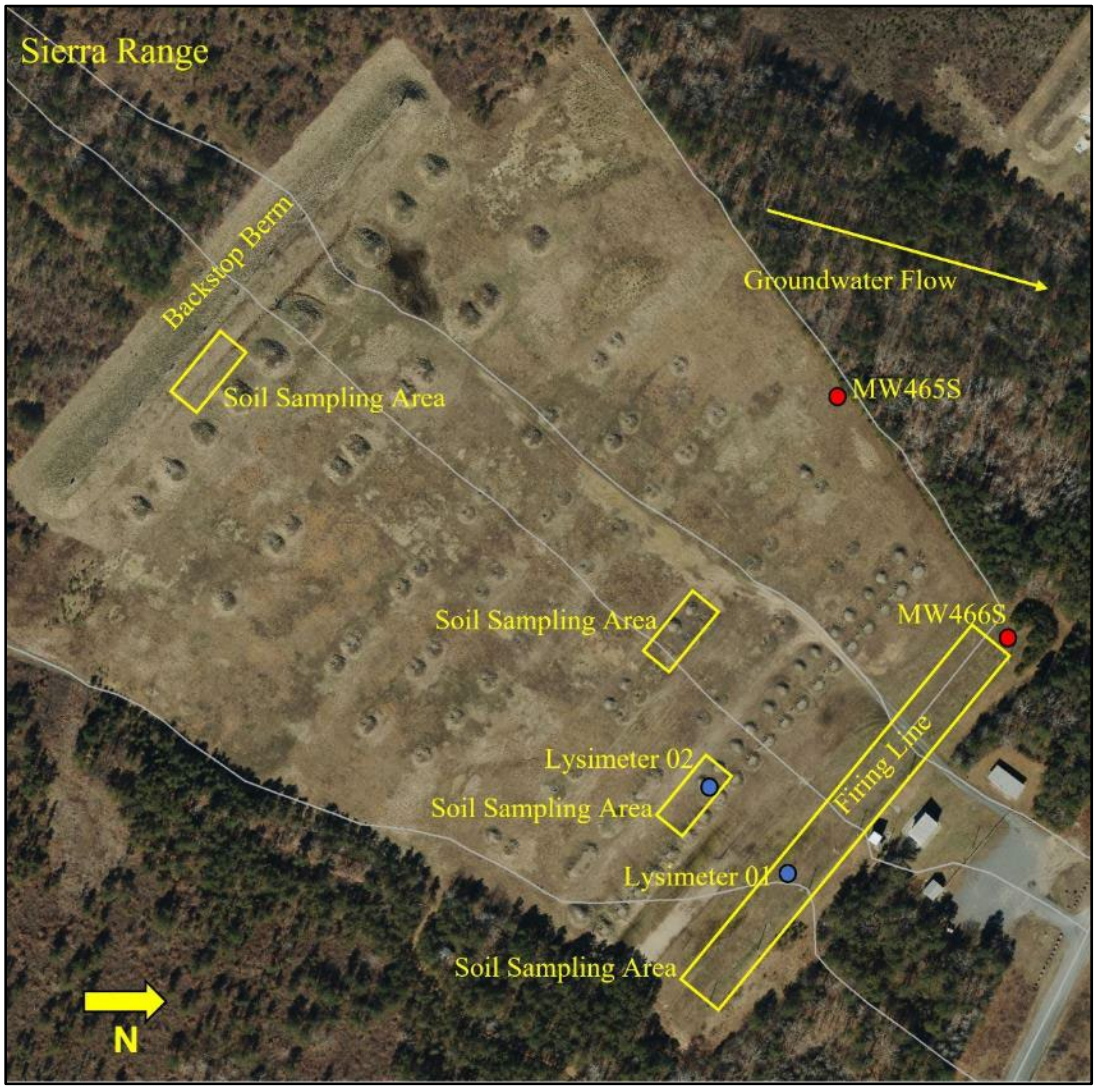
**Bold Results Value = ABOVE OMMP ACTION LEVEL**
DOC = Dissolved Organic Carbon
NS = No sample analyzed due to insufficient water
^2 = Calibration Blank (ICB andor CCB) is outside acceptance limits.

# Small Arms Range Sample Area Figures

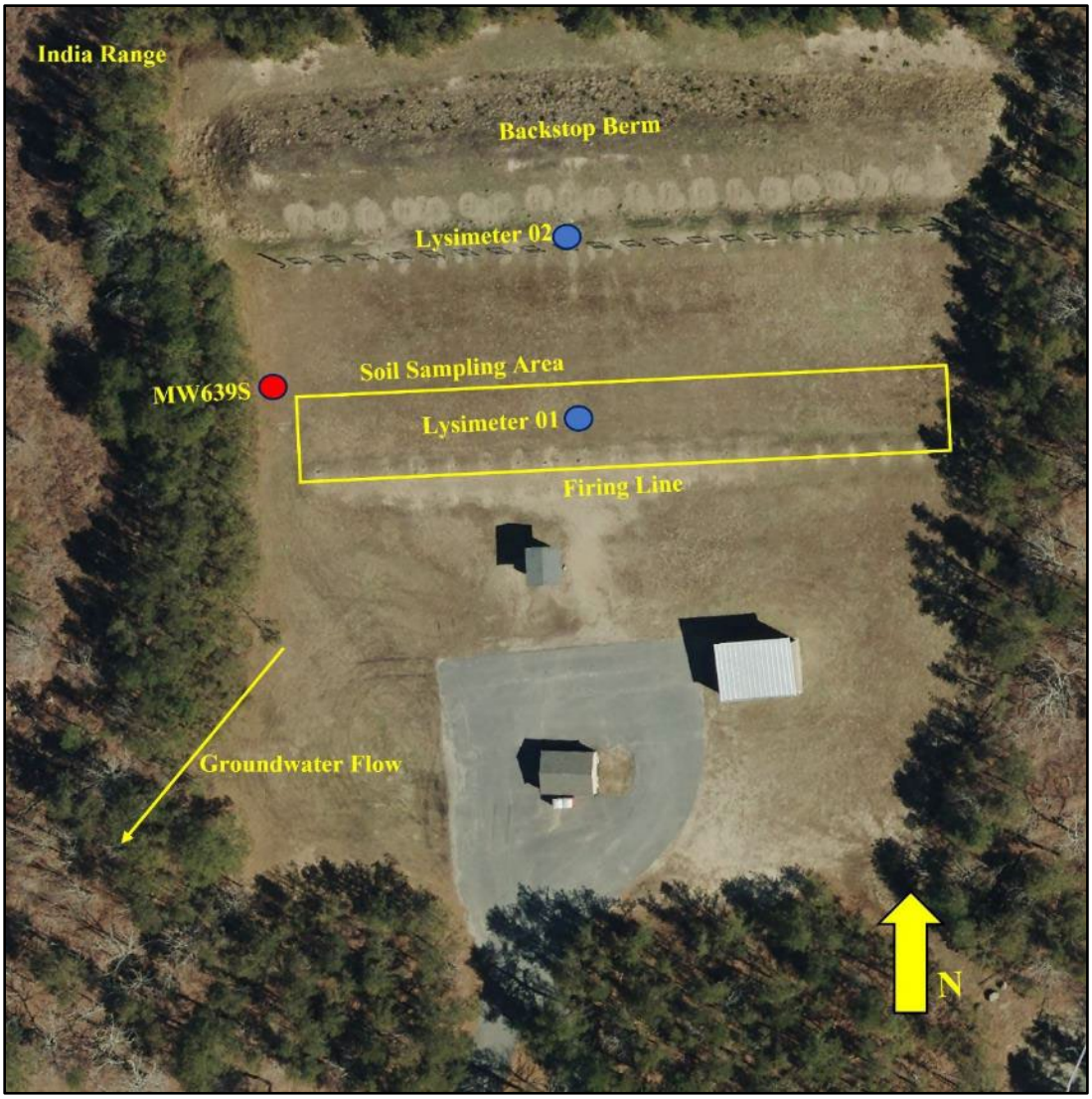



Tango Range (EPR copper only), Structures, and Sampling Areas
Camp Edwards, Massachusetts

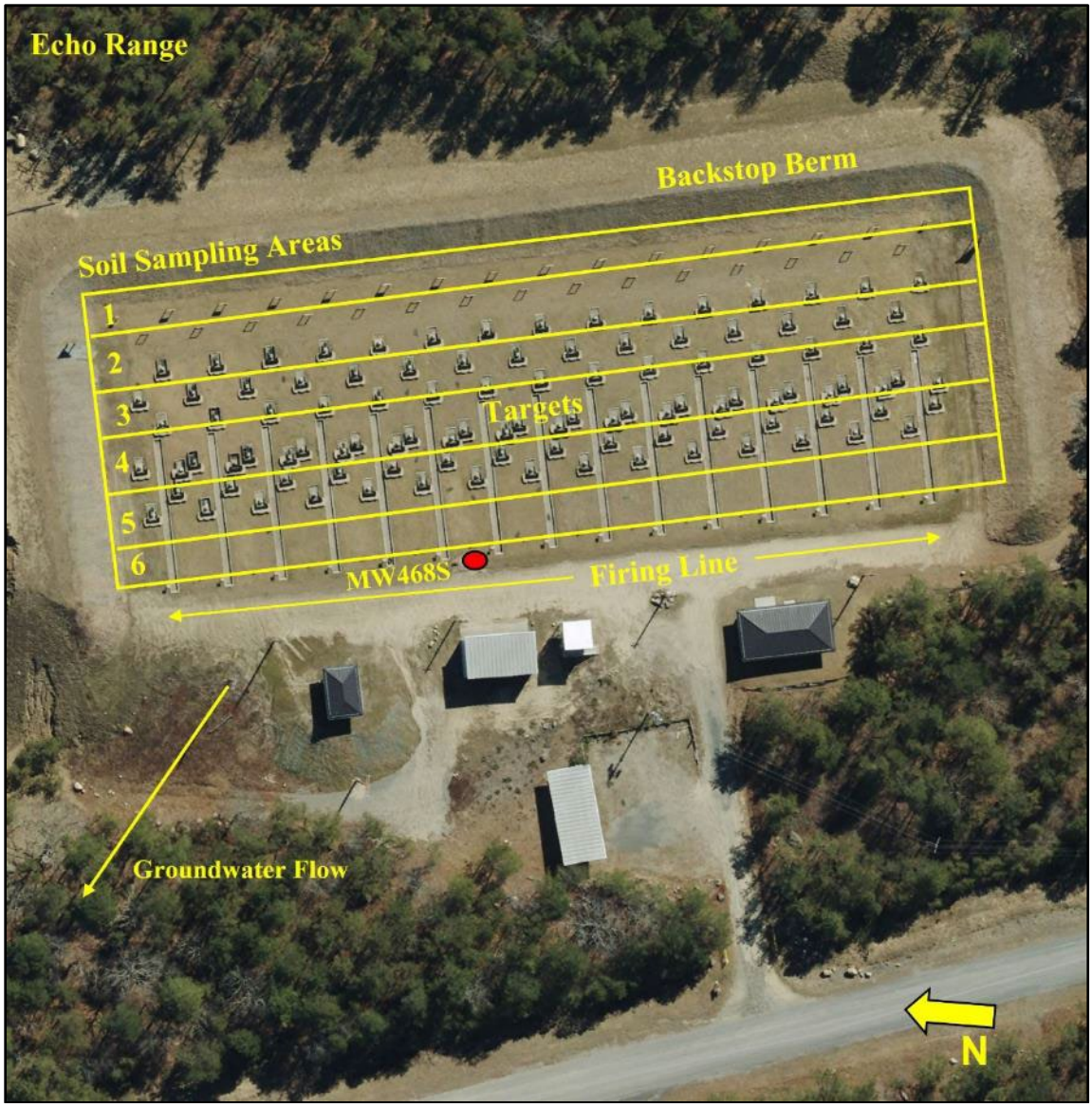
The lysimeter noted on the graphic above is planned to be installed in TY 2023.



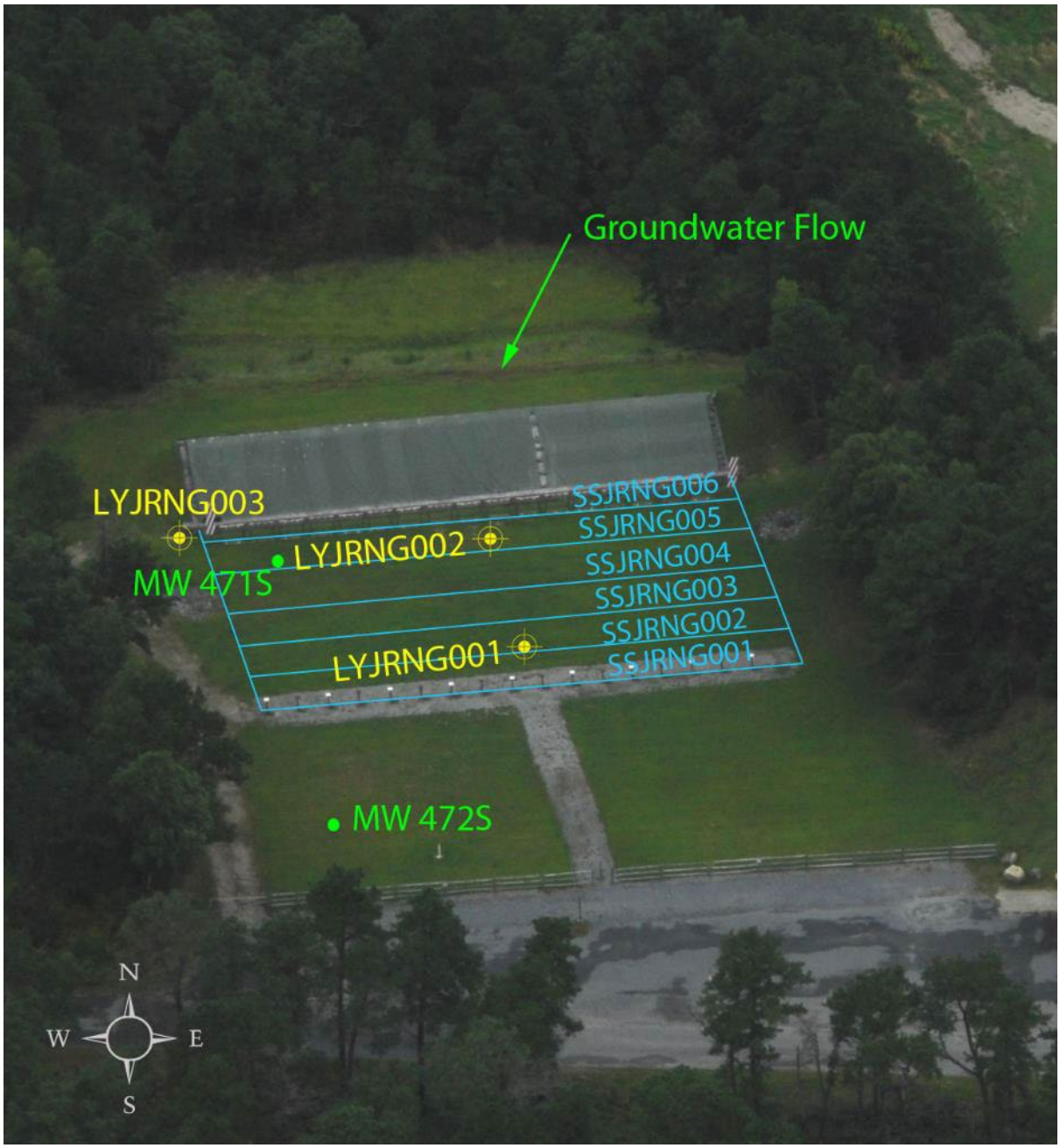

Sierra Range (EPR copper only) Sampling Areas
Camp Edwards, Massachusetts
MW=Monitoring Well



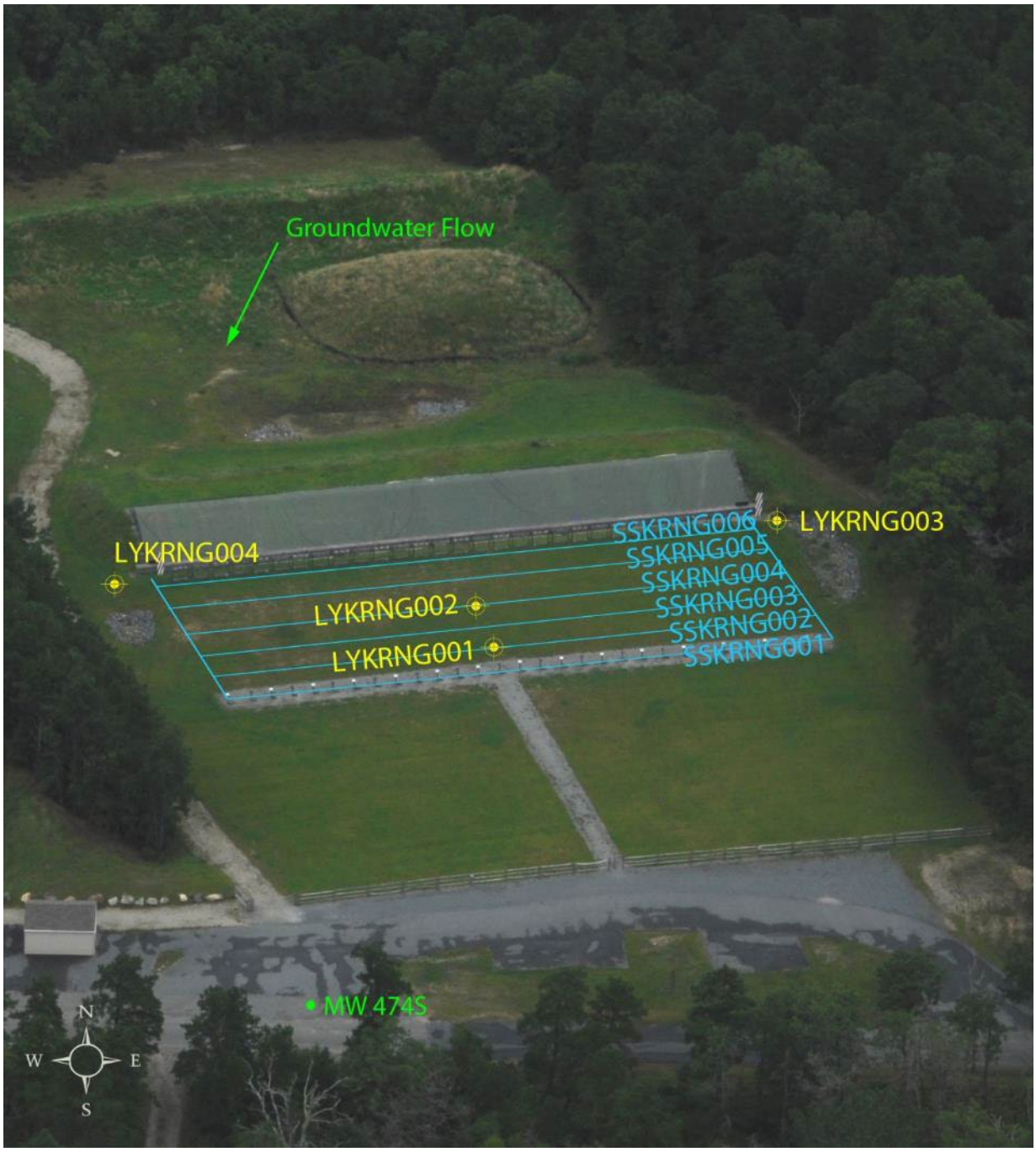

India Range (EPR copper only) Sampling Areas
Camp Edwards, Massachusetts
MW=Monitoring Well



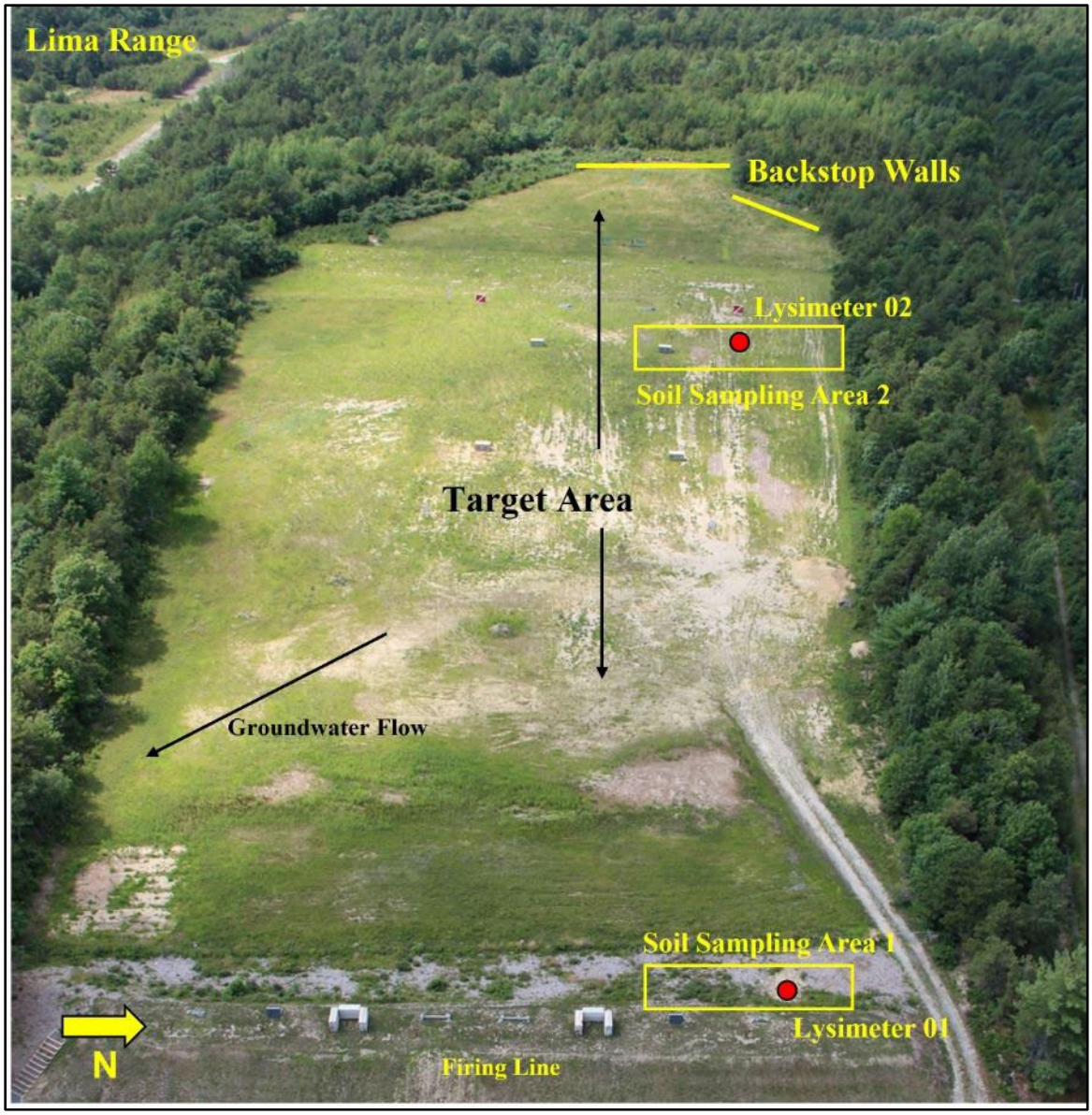

Echo Range Sampling Areas
Camp Edwards, Massachusetts
MW=Monitoring Well




Juliet Range
Camp Edwards, Massachusetts.
LY=Lysimeter, MW=Monitoring Well, SS=Soil Sample




Kilo Range
Camp Edwards, Massachusetts.
LY=Lysimeter, MW=Monitoring Well, SS=Soil Sample




Lima Range
Camp Edwards, Massachusetts.

# Mobility of Lead and Antimony in Shooting Range Soils:

# Column Leaching Study

Engineer Research and Development Center

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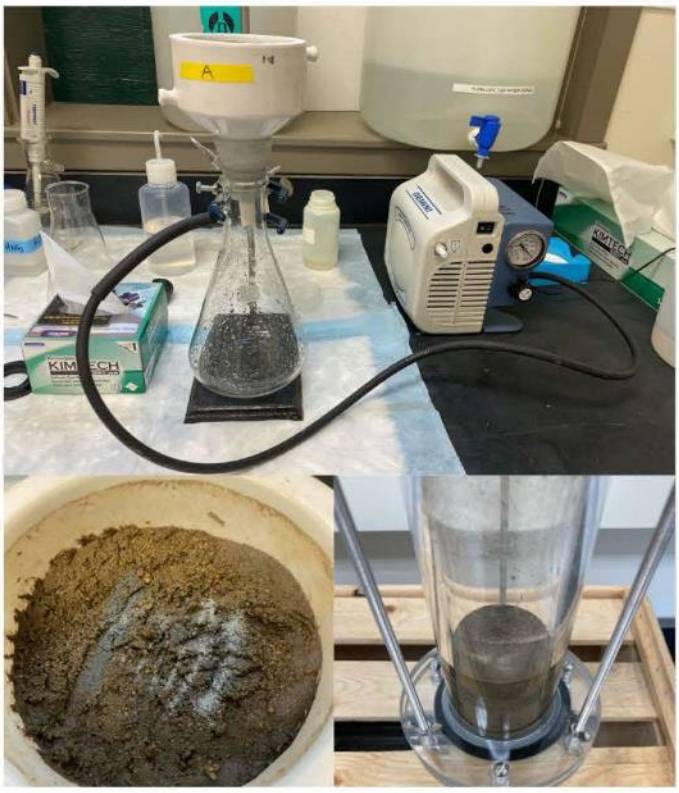
# Mobility of Lead and Antimony in Shooting Range Soils: Column Leaching Study

Amanda J. Barker and Jay L. Clausen

February 2021



# Mobility of Lead and Antimony in Shooting Range Soils: Column Leaching Study

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*U.S. Army Engineer Research and Development Center*
*72 Lyme Road*
*Hanover, NH 03755*

Final report

# Abstract

The mobility of lead (Pb) and antimony (Sb) in shooting range soils was investigated in this report. We found Sb significantly more mobile than Pb in the systems studied. Previous efforts concluded that the dominant Sb species in the system is likely Sb(V) and therefore has increased mobility at pHs above 7-8, in general. The results from this effort show that the amendment additions lime and phosphate caused an increase in Sb concentrations and had little effect on mobilizing Pb in the same systems.

# Contents

# Figures and Tables

## Figures



## Tables

# 1 Introduction

Mobility of lead (Pb) and antimony (Sb) in India Berm from Joint Base Cape Cod, MA soil were investigated in September, 2020 using leaching runoff procedures. Previous field efforts have shown an increase in Sb concentrations in pore water samples in select berms and ranges, while Pb concentrations remain relatively stable and low. Legacy reports describe the addition of amendments including lime and phosphate additions to the berms in an effort to stabilize metal,. The pH values for pore water samples after these additions increased to approximately 8 and 9 and then have since decreased to circumneutral values. The current effort simulated conditions at Joint Base Cape Cod, including acidic rain water and soil samples, to investigate concentrations of Pb and Sb in select soil samples. Native soil (India Berm) was used and spiked with Pb and Sb mesh powders and simulated rain was flushed through columns of soil for a total of 160 runoff samples. Two amendments were used to mirror field conditions, calcium hydroxide (lime) and calcium phosphate. The report presents Pb and Sb concentrations as a function of amendment additions over time.

# 2 Methods

## 2.1 Experimental Setup

There were two separate experiments within the scope of this work, A and B. Experiment A used lime (calcium hydroxide) as an addition and Experiment B used calcium phosphate tribasic as an addition to investigate how they individually impacted Pb and Sb mobility in soil solution. Simulated rainwater was prepared using ultrapure DI water with a resistivity of 18.2 mΩ·cm at 25 °C and using reagent grade chemicals as follows: 0.13 mg/L potassium nitrate, 0.0012 mg/L sodium bicarbonate, 1 mL of ultrapure 6 M nitric acid was added per every 10 L of ultrapure DI water and 0.5 mL of 5 M sodium hydroxide was added per 10 L of ultrapure DI water.

Acrylic soil columns were originally loaded with India Range Berm Face soil and packed uniformly for pressurized flow experiments. However, the flow through the soils was extremely slow and we experienced leaks when the pressure was increased to increase flow velocity. Therefore, we switched to a gravity flush system using a ceramic holder with a vacuum pump. Approximately, 200 grams of soil previously collected from the India Range berm face was loaded for each of the experiments, A and B. We used Pb and Sb mesh powder <200 mesh size for each of the spikes for both experiments and 0.1 grams were loaded. For each sample, 150 mLs of simulated rain water were flushed through the system and collected. Samples were all filtered to less than 1.6 microns using Whatman filters and acidified with ultrapure nitric acid. Samples were stored at 4°C until analysis.

## 2.2 Sample Analysis

Leaching runoff samples were analyzed using inductively coupled plasma-mass spectrometry (ICP-MS) at the Environmental Laboratory in Vicksburg, MS.

# 3 Results and Discussion

In general, Sb was mobilized to a much greater extent than Pb throughout the entirety of the experiment. Concentrations of Pb and Sb are shown plotted in Figures 1 and 2 and results are tabulated in Tables 1 and 2. The pH values of the simulated rain and the pH values for the effluent runoff samples are shown in Tables 1 and 2.

**Figure 1. Concentrations of Sb as a function of pH for experiment A.**

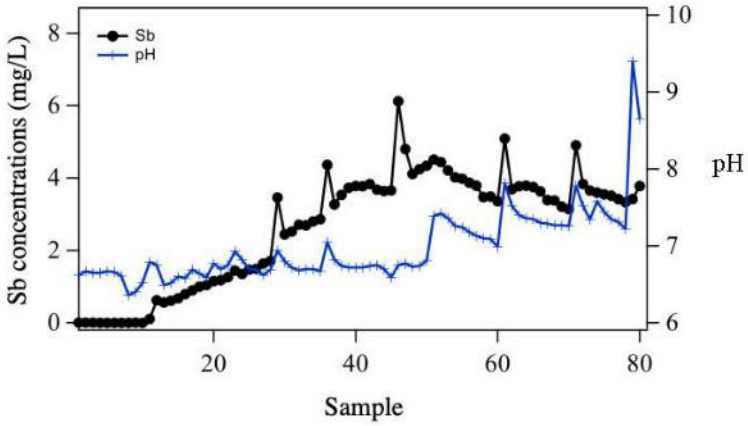
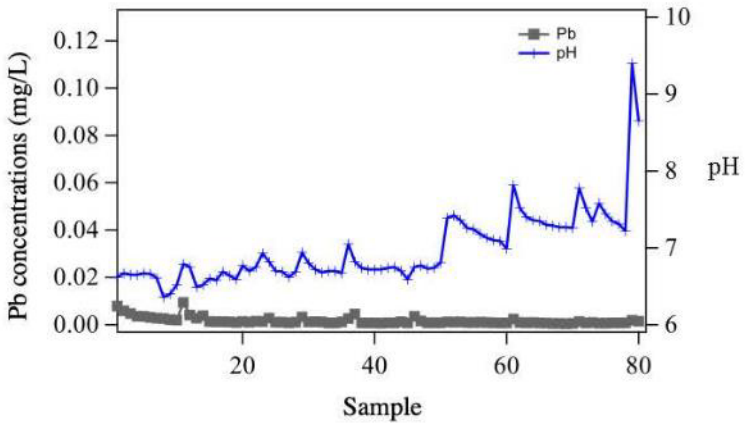



**Figure 2. Concentrations of Pb as a function of pH for experiment A.**




Once the soils in both experiments were spiked with Pb and Sb, concentrations of Sb were immediately mobilized to solution. Concentrations of Pb for the most part re-

mained relatively low and did not experience any mass release except at the end of Experiment B when concentrations increased significantly corresponding to a rise in pH above 9.

**Figure 3. Concentrations of Sb as a function of pH for experiment B.**

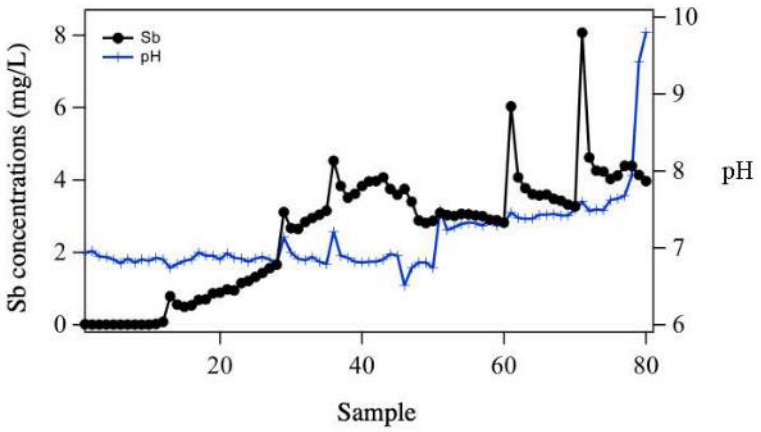
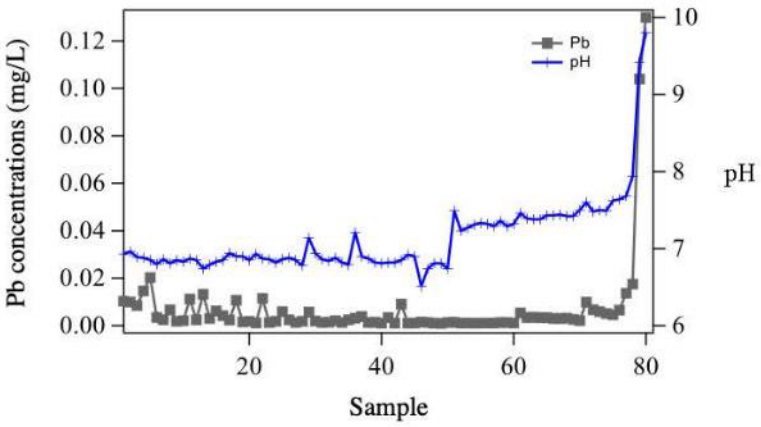



**Figure 4. Concentrations of Pb as a function of pH for experiment B.**




Antimony was particularly mobilized in soil solution after the addition of phosphate addition (Figure 4), reaching concentrations above 8 mg/L in solution. Based on previous efforts with the soils, it was determined that Sb was primarily present in the Sb(V) form (based on LC-MS/MS) therefore the slightly basic pH likely played a role in flushing Sb species into solution. Initial concentrations for Sb were low at the start with the simu-

lated acid rain flushes and began to rise upon addition of the spike. The phosphate addition mobilized Sb to a greater extent overall than the calcium hydroxide addition, indicating pH may not be the only factor in mobilizing Sb in these systems.

**Table 1. Results for experiment A (calcium hydroxide addition). 'Pb*' indicates values are qualitative.**

| Sample | | Date/Time | Simulated rain pH | Simulated rain ORP (mv) | Sample pH | Sample ORP (mV) | Sb (mg/L) | Pb (mg/L) | Estimate | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | a | 9/10/20 10:00 AM | 4.35 | 145 | 6.62 | 24 | 0.0069 | 0.0079 | | India soil packed and simulated rain |
| 2 | a | 9/10/20 10:10 AM | 4.35 | 145 | 6.67 | 22 | 0.0057 | 0.0059 | | |
| 3 | a | 9/10/20 10:20 AM | 4.35 | 145 | 6.65 | 23 | 0.0037 | 0.0048 | | |
| 4 | a | 9/10/20 10:30 AM | 4.35 | 145 | 6.65 | 23 | 0.0025 | 0.0037 | | |
| 5 | a | 9/10/20 10:40 AM | 4.35 | 145 | 6.67 | 22 | 0.0024 | 0.0035 | | |
| 6 | a | 9/10/20 10:50 AM | 4.35 | 145 | 6.66 | 23 | 0.0022 | 0.0032 | | |
| 7 | a | 9/10/20 11:00 AM | 4.35 | 145 | 6.61 | 25 | 0.0026 | 0.0028 | | |
| 8 | a | 9/10/20 11:10 AM | 4.35 | 145 | 6.36 | 39 | 0.0026 | 0.0026 | | |
| 9 | a | 9/10/20 11:20 AM | 4.35 | 145 | 6.40 | 37 | 0.0035 | 0.0022 | | |
| 10 | a | 9/10/20 11:30 AM | 4.35 | 145 | 6.52 | 30 | 0.0024 | 0.0020 | | |
| 11 | a | 9/10/20 12:30 AM | 4.35 | 145 | 6.79 | 15 | 0.103 | 0.0094 | | spiked with Pb/Sb powder |
| 12 | a | 9/10/20 12:40 PM | 4.35 | 145 | 6.75 | 18 | 0.625 | 0.0042 | | |
| 13 | a | 9/11/20 10:00 AM | 4.45 | 146 | 6.49 | 32 | 0.562 | 0.0028 | | |
| 14 | a | 9/11/20 10:10 AM | 4.45 | 146 | 6.52 | 31 | 0.609 | 0.0038 | | |
| 15 | a | 9/11/20 10:20 AM | 4.45 | 146 | 6.60 | 26 | 0.675 | 0.0014 | | |
| 16 | a | 9/11/20 10:30 AM | 4.45 | 146 | 6.58 | 27 | 0.791 | 0.0013 | | |
| 17 | a | 9/11/20 10:40 AM | 4.45 | 146 | 6.69 | 22 | 0.896 | 0.0013 | | |
| 18 | a | 9/11/20 10:50 AM | 4.45 | 146 | 6.64 | 24 | 1.00 | 0.0012 | | |
| 19 | a | 9/11/20 11:00 AM | 4.45 | 146 | 6.59 | 27 | 1.04 | 0.0010 | | |
| 20 | a | 9/11/20 11:10 AM | 4.45 | 146 | 6.77 | 17 | 1.15 | 0.0014 | | |
| 21 | a | 9/11/20 11:20 AM | 4.45 | 146 | 6.70 | 21 | 1.18 | 0.0011 | | |
| 22 | a | 9/11/20 11:30 AM | 4.45 | 146 | 6.75 | 18 | 1.26 | 0.0015 | | |
| 23 | a | 9/11/20 11:40 AM | 4.45 | 146 | 6.93 | 8 | 1.44 | 0.0014 | | |
| 24 | a | 9/11/20 11:50 AM | 4.45 | 146 | 6.82 | 14 | 1.35 | 0.0028 | | |
| 25 | a | 9/11/20 12:00 PM | 4.45 | 146 | 6.70 | 21 | 1.47 | 0.0011 | | |
| 26 | a | 9/11/20 12:10 PM | 4.45 | 146 | 6.69 | 21 | 1.49 | 0.0011 | | |
| 27 | a | 9/11/20 12:20 PM | 4.45 | 146 | 6.62 | 25 | 1.64 | 0.0009 | Pb* | |
| 28 | a | 9/11/20 12:30 PM | 4.45 | 146 | 6.69 | 22 | 1.71 | 0.0011 | | |
| 29 | a | 9/12/20 10:00 AM | 4.45 | 146 | 6.94 | 7 | 3.46 | 0.0033 | | |
| 30 | a | 9/12/20 10:10 AM | 4.45 | 146 | 6.80 | 16 | 2.44 | 0.0012 | | |
| 31 | a | 9/12/20 10:20 AM | 4.45 | 146 | 6.72 | 19 | 2.52 | 0.0013 | | |
| 32 | a | 9/12/20 10:30 AM | 4.45 | 146 | 6.68 | 22 | 2.71 | 0.0012 | | |
| 33 | a | 9/12/20 10:40 AM | 4.45 | 146 | 6.70 | 21 | 2.69 | 0.0008 | Pb* | |
| 34 | a | 9/12/20 10:50 AM | 4.45 | 146 | 6.70 | 21 | 2.80 | 0.0008 | Pb* | |
| 35 | a | 9/12/20 11:00 AM | 4.45 | 146 | 6.67 | 22 | 2.86 | 0.0012 | | |
| 36 | a | 9/13/20 10:00 AM | 4.45 | 146 | 7.05 | 2 | 4.36 | 0.0026 | | |
| 37 | a | 9/13/20 10:10 AM | 4.45 | 146 | 6.82 | 14 | 3.27 | 0.0045 | | |
| 38 | a | 9/13/20 10:20 AM | 4.45 | 146 | 6.74 | 19 | 3.53 | 0.0008 | Pb* | |
| 39 | a | 9/13/20 10:30 AM | 4.45 | 146 | 6.72 | 20 | 3.73 | 0.00077 | Pb* | |
| 40 | a | 9/13/20 10:40 AM | 4.45 | 146 | 6.72 | 20 | 3.78 | 0.0008 | Pb* | |
| 41 | a | 9/13/20 10:50 AM | 4.45 | 146 | 6.72 | 20 | 3.77 | 0.0007 | Pb* | |
| 42 | a | 9/13/20 11:00 AM | 4.45 | 146 | 6.74 | 19 | 3.83 | 0.0009 | Pb* | |
| 43 | a | 9/13/20 11:10 AM | 4.45 | 146 | 6.75 | 18 | 3.68 | 0.0008 | Pb* | |
| 44 | a | 9/13/20 11:20 AM | 4.45 | 146 | 6.70 | 20 | 3.64 | 0.0013 | | |
| 45 | a | 9/13/20 11:30 AM | 4.45 | 146 | 6.59 | 27 | 3.66 | 0.0008 | Pb* | |
| 46 | a | 9/17/20 10:00 AM | 4.48 | 147 | 6.75 | 18 | 6.12 | 0.0036 | | |
| 47 | a | 9/17/20 10:10 AM | 4.50 | 149 | 6.77 | 16 | 4.80 | 0.0016 | | |
| 48 | a | 9/17/20 10:20 AM | 4.50 | 149 | 6.73 | 19 | 4.11 | 0.0009 | Pb* | |
| 49 | a | 9/17/20 10:30 AM | 4.50 | 149 | 6.74 | 18 | 4.25 | 0.0009 | Pb* | |
| 50 | a | 9/17/20 10:40 AM | 4.50 | 149 | 6.81 | 15 | 4.34 | 0.0009 | Pb* | |
| 51 | a | 9/17/20 1:00 PM | 9.45 | -129 | 7.39 | -17 | 4.51 | 0.0012 | | Ca(OH)2 solution added |
| 52 | a | 9/17/20 1:10 PM | 9.45 | -129 | 7.42 | -19 | 4.44 | 0.0011 | | |
| 53 | a | 9/17/20 1:20 PM | 9.45 | -129 | 7.36 | -16 | 4.21 | 0.0012 | | |
| 54 | a | 9/17/20 1:30 PM | 9.45 | -129 | 7.26 | -11 | 4.02 | 0.0010 | | |
| 55 | a | 9/17/20 1:40 PM | 9.45 | -129 | 7.24 | -9 | 3.98 | 0.0010 | Pb* | |
| 56 | a | 9/17/20 1:50 PM | 9.45 | -129 | 7.18 | -6 | 3.87 | 0.0011 | | |
| 57 | a | 9/17/20 2:00 PM | 9.45 | -129 | 7.13 | -3 | 3.79 | 0.0010 | | |
| 58 | a | 9/17/20 2:10 PM | 9.45 | -129 | 7.10 | -1 | 3.47 | 0.0009 | Pb* | |
| 59 | a | 9/17/20 2:20 PM | 9.45 | -129 | 7.09 | -1 | 3.49 | 0.00079 | Pb* | |
| 60 | a | 9/17/20 2:30 PM | 9.45 | -129 | 6.99 | 5 | 3.36 | 0.0008 | Pb* | |
| 61 | a | 9/18/20 10:00 AM | 10.05 | -164 | 7.82 | -41 | 5.09 | 0.0024 | | |
| 62 | a | 9/18/20 10:10 AM | 10.05 | -164 | 7.52 | -25 | 3.69 | 0.0010 | | |
| 63 | a | 9/18/20 10:20 AM | 10.05 | -164 | 7.40 | -18 | 3.77 | 0.0009 | Pb* | |
| 64 | a | 9/18/20 10:30 AM | 10.05 | -164 | 7.36 | -16 | 3.79 | 0.0010 | Pb* | |
| 65 | a | 9/18/20 10:40 AM | 10.05 | -164 | 7.35 | -15 | 3.75 | 0.0008 | Pb* | |
| 66 | a | 9/18/20 10:50 AM | 10.05 | -164 | 7.30 | -12 | 3.63 | 0.0007 | Pb* | |
| 67 | a | 9/18/20 11:00 AM | 10.05 | -164 | 7.29 | -12 | 3.39 | 0.0006 | Pb* | |
| 68 | a | 9/18/20 11:10 AM | 10.05 | -164 | 7.27 | -11 | 3.38 | 0.0006 | Pb* | |
| 69 | a | 9/18/20 11:20 AM | 10.05 | -164 | 7.27 | -11 | 3.21 | 0.0005 | Pb* | |
| 70 | a | 9/18/20 11:30 AM | 10.05 | -164 | 7.26 | -10 | 3.14 | 0.00059 | Pb* | |
| 71 | a | 9/19/20 10:00 AM | 10.99 | -214 | 7.78 | -39 | 4.90 | 0.0014 | | |
| 72 | a | 9/19/20 10:10 AM | 10.99 | -214 | 7.52 | -25 | 3.83 | 0.0008 | Pb* | |
| 73 | a | 9/19/20 10:20 AM | 10.99 | -214 | 7.34 | -15 | 3.65 | 0.0010 | Pb* | |
| 74 | a | 9/19/20 10:30 AM | 10.99 | -214 | 7.58 | -28 | 3.60 | 0.0007 | Pb* | |
| 75 | a | 9/19/20 10:40 AM | 10.99 | -214 | 7.44 | -20 | 3.55 | 0.0007 | Pb* | |
| 76 | a | 9/19/20 10:50 AM | 11.55 | -245 | 7.35 | -15 | 3.51 | 0.0008 | Pb* | |
| 77 | a | 9/19/20 11:00 AM | 11.55 | -245 | 7.31 | -13 | 3.42 | 0.0008 | Pb* | |
| 78 | a | 9/19/20 11:10 AM | 11.55 | -245 | 7.22 | -8 | 3.33 | 0.00096 | Pb* | 0.15 g Ca(OH2) added directly to soil |
| 79 | a | 9/19/20 12:10 PM | 11.55 | -245 | 9.40 | -148 | 3.42 | 0.0019 | | 0.15 g Ca(OH2) added directly to soil |
| 80 | a | 9/19/20 1:10 PM | 11.55 | -245 | 8.65 | -87 | 3.78 | 0.0015 | | |

**Table 2. Results for experiment B (phosphate addition). 'Pb*' indicates values are qualitative.**

| Sample | | Date/Time | Simulated rain pH | Simulated rain ORP (mv) | Sample pH | Sample ORP (mV) | Sb (mg/L) | Pb (mg/L) | Estimate | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | b | 9/20/20 10:00 AM | 4.49 | 144 | 6.93 | 8 | 0.0177 | 0.0103 | | India soil packed and simulated rain |
| 2 | b | 9/20/20 10:10 AM | 4.49 | 144 | 6.96 | 6 | 0.0080 | 0.0100 | | |
| 3 | b | 9/20/20 10:20 AM | 4.49 | 144 | 6.89 | 10 | 0.0061 | 0.0084 | | |
| 4 | b | 9/20/20 10:30 AM | 4.49 | 144 | 6.88 | 10 | 0.0046 | 0.0147 | | |
| 5 | b | 9/20/20 10:40 AM | 4.49 | 144 | 6.85 | 12 | 0.0039 | 0.0203 | | |
| 6 | b | 9/20/20 10:50 AM | 4.49 | 144 | 6.80 | 15 | 0.0032 | 0.0035 | | |
| 7 | b | 9/20/20 11:00 AM | 4.49 | 144 | 6.86 | 12 | 0.0036 | 0.0025 | | |
| 8 | b | 9/20/20 11:10 AM | 4.49 | 144 | 6.81 | 15 | 0.0029 | 0.0067 | | |
| 9 | b | 9/20/20 11:20 AM | 4.49 | 144 | 6.85 | 12 | 0.0030 | 0.0018 | | |
| 10 | b | 9/20/20 11:30 AM | 4.49 | 144 | 6.83 | 13 | 0.0031 | 0.0022 | | |
| 11 | b | 9/20/20 12:30 AM | 4.49 | 144 | 6.87 | 11 | 0.0224 | 0.0112 | | spiked with Pb/Sb powder |
| 12 | b | 9/20/20 12:40 PM | 4.49 | 144 | 6.85 | 12 | 0.0806 | 0.0024 | | |
| 13 | b | 9/21/20 10:00 AM | 4.60 | 137 | 6.74 | 18 | 0.784 | 0.0133 | | |
| 14 | b | 9/21/20 10:10 AM | 4.60 | 137 | 6.79 | 15 | 0.559 | 0.0031 | | |
| 15 | b | 9/21/20 10:20 AM | 4.60 | 137 | 6.83 | 14 | 0.498 | 0.0063 | | |
| 16 | b | 9/21/20 10:30 AM | 4.60 | 137 | 6.85 | 12 | 0.536 | 0.0042 | | |
| 17 | b | 9/21/20 10:40 AM | 4.60 | 137 | 6.94 | 7 | 0.687 | 0.0023 | | |
| 18 | b | 9/21/20 10:50 AM | 4.60 | 137 | 6.90 | 10 | 0.706 | 0.0107 | | |
| 19 | b | 9/21/20 11:00 AM | 4.60 | 137 | 6.90 | 9 | 0.866 | 0.0016 | | |
| 20 | b | 9/21/20 11:10 AM | 4.60 | 137 | 6.85 | 12 | 0.891 | 0.0018 | | |
| 21 | b | 9/21/20 11:20 AM | 4.60 | 137 | 6.93 | 8 | 0.977 | 0.0012 | | |
| 22 | b | 9/21/20 11:30 AM | 4.60 | 137 | 6.87 | 11 | 0.949 | 0.0115 | | |
| 23 | b | 9/21/20 11:40 AM | 4.60 | 137 | 6.86 | 12 | 1.15 | 0.0013 | | |
| 24 | b | 9/21/20 11:50 AM | 4.60 | 137 | 6.82 | 14 | 1.21 | 0.0018 | | |
| 25 | b | 9/21/20 12:00 PM | 4.60 | 137 | 6.86 | 12 | 1.32 | 0.0059 | | |
| 26 | b | 9/21/20 12:10 PM | 4.60 | 137 | 6.88 | 11 | 1.43 | 0.0024 | | |
| 27 | b | 9/21/20 12:20 PM | 4.60 | 137 | 6.85 | 12 | 1.56 | 0.0013 | | |
| 28 | b | 9/21/20 12:30 PM | 4.60 | 137 | 6.78 | 16 | 1.66 | 0.0018 | | |
| 29 | b | 9/22/20 10:00 AM | 4.60 | 137 | 7.14 | -4 | 3.11 | 0.0057 | | |
| 30 | b | 9/22/20 10:10 AM | 4.60 | 137 | 6.94 | 8 | 2.67 | 0.0019 | | |
| 31 | b | 9/22/20 10:20 AM | 4.60 | 137 | 6.86 | 12 | 2.65 | 0.0013 | | |
| 32 | b | 9/22/20 10:30 AM | 4.60 | 137 | 6.84 | 13 | 2.84 | 0.0014 | | |
| 33 | b | 9/22/20 10:40 AM | 4.60 | 137 | 6.88 | 11 | 2.95 | 0.0022 | | |
| 34 | b | 9/22/20 10:50 AM | 4.60 | 137 | 6.82 | 14 | 3.04 | 0.0013 | | |
| 35 | b | 9/22/20 11:00 AM | 4.60 | 137 | 6.79 | 15 | 3.15 | 0.0024 | | |
| 36 | b | 9/23/20 10:00 AM | 4.60 | 137 | 7.21 | -7 | 4.53 | 0.0032 | | |
| 37 | b | 9/23/20 10:10 AM | 4.60 | 137 | 6.90 | 9 | 3.83 | 0.0038 | | |
| 38 | b | 9/23/20 10:20 AM | 4.60 | 137 | 6.87 | 11 | 3.51 | 0.0013 | | |
| 39 | b | 9/23/20 10:30 AM | 4.60 | 137 | 6.82 | 14 | 3.62 | 0.0014 | | |
| 40 | b | 9/23/20 10:40 AM | 4.60 | 137 | 6.81 | 15 | 3.83 | 0.0010 | Pb* | |
| 41 | b | 9/23/20 10:50 AM | 4.60 | 137 | 6.82 | 14 | 3.96 | 0.0034 | | |
| 42 | b | 9/23/20 11:00 AM | 4.60 | 137 | 6.82 | 14 | 3.97 | 0.0010 | | |
| 43 | b | 9/23/20 11:10 AM | 4.60 | 137 | 6.85 | 12 | 4.07 | 0.0091 | | |
| 44 | b | 9/23/20 11:20 AM | 4.60 | 137 | 6.92 | 9 | 3.75 | 0.0010 | | |
| 45 | b | 9/23/20 11:30 AM | 4.60 | 137 | 6.90 | 10 | 3.59 | 0.0011 | | |
| 46 | b | 9/27/20 10:00 AM | 4.47 | 144 | 6.51 | 31 | 3.75 | 0.0015 | | |
| 47 | b | 9/27/20 10:10 AM | 4.47 | 144 | 6.74 | 19 | 3.40 | 0.0013 | | |
| 48 | b | 9/27/20 10:20 AM | 4.47 | 144 | 6.81 | 15 | 2.88 | 0.0010 | Pb* | |
| 49 | b | 9/27/20 10:30 AM | 4.47 | 144 | 6.81 | 15 | 2.81 | 0.0009 | Pb* | |
| 50 | b | 9/27/20 10:40 AM | 4.47 | 144 | 6.74 | 18 | 2.87 | 0.0013 | | |
| 51 | b | 9/27/20 1:00 PM | 9.39 | -126 | 7.49 | -23 | 3.09 | 0.0014 | | Ca3(PO4)2 solution added |
| 52 | b | 9/27/20 1:10 PM | 9.39 | -126 | 7.23 | -9 | 3.03 | 0.0011 | | |
| 53 | b | 9/27/20 1:20 PM | 9.39 | -126 | 7.27 | -11 | 3.01 | 0.0011 | | |
| 54 | b | 9/27/20 1:30 PM | 9.39 | -126 | 7.31 | -13 | 3.06 | 0.0010 | | |
| 55 | b | 9/27/20 1:40 PM | 9.39 | -126 | 7.33 | -14 | 3.05 | 0.0011 | | |
| 56 | b | 9/27/20 1:50 PM | 9.39 | -126 | 7.32 | -14 | 3.02 | 0.0011 | | |
| 57 | b | 9/27/20 2:00 PM | 9.39 | -126 | 7.29 | -12 | 3.00 | 0.0011 | | |
| 58 | b | 9/27/20 2:10 PM | 9.39 | -126 | 7.36 | -16 | 2.90 | 0.0013 | | |
| 59 | b | 9/27/20 2:20 PM | 9.39 | -126 | 7.29 | -12 | 2.89 | 0.0013 | | |
| 60 | b | 9/27/20 2:30 PM | 9.39 | -126 | 7.32 | -13 | 2.82 | 0.0012 | | |
| 61 | b | 9/28/20 10:00 AM | 10.00 | -159 | 7.46 | -21 | 6.03 | 0.0054 | | |
| 62 | b | 9/28/20 10:10 AM | 10.00 | -159 | 7.39 | -17 | 4.07 | 0.0035 | | |
| 63 | b | 9/28/20 10:20 AM | 10.00 | -159 | 7.38 | -17 | 3.77 | 0.0036 | | |
| 64 | b | 9/28/20 10:30 AM | 10.00 | -159 | 7.38 | -17 | 3.61 | 0.0034 | | |
| 65 | b | 9/28/20 10:40 AM | 10.00 | -159 | 7.43 | -19 | 3.57 | 0.0033 | | |
| 66 | b | 9/28/20 10:50 AM | 10.00 | -159 | 7.43 | -19 | 3.60 | 0.0031 | | |
| 67 | b | 9/28/20 11:00 AM | 10.00 | -159 | 7.44 | -20 | 3.48 | 0.0031 | | |
| 68 | b | 9/28/20 11:10 AM | 10.00 | -159 | 7.42 | -19 | 3.43 | 0.0032 | | |
| 69 | b | 9/28/20 11:20 AM | 10.00 | -159 | 7.42 | -19 | 3.32 | 0.0027 | | |
| 70 | b | 9/28/20 11:30 AM | 10.00 | -159 | 7.50 | -20 | 3.27 | 0.0022 | | |
| 71 | b | 9/29/20 10:00 AM | 10.97 | -214 | 7.60 | -29 | 8.07 | 0.0099 | | |
| 72 | b | 9/29/20 10:10 AM | 10.97 | -214 | 7.48 | -22 | 4.62 | 0.0068 | | |
| 73 | b | 9/29/20 10:20 AM | 10.97 | -214 | 7.50 | -23 | 4.26 | 0.0059 | | |
| 74 | b | 9/29/20 10:30 AM | 10.97 | -214 | 7.49 | -23 | 4.23 | 0.0051 | | |
| 75 | b | 9/29/20 10:40 AM | 10.97 | -214 | 7.62 | -30 | 4.03 | 0.0046 | | |
| 76 | b | 9/29/20 10:50 AM | 11.55 | -246 | 7.64 | -31 | 4.12 | 0.0065 | | |
| 77 | b | 9/29/20 11:00 AM | 11.55 | -246 | 7.68 | -33 | 4.39 | 0.0137 | | |
| 78 | b | 9/29/20 11:10 AM | 11.55 | -246 | 7.94 | -47 | 4.39 | 0.0175 | | |
| 79 | b | 9/29/20 12:10 PM | 12.32 | -280 | 9.42 | -129 | 4.14 | 0.104 | | 0.01 mL 5 M NaOH added |
| 80 | b | 9/29/20 1:10 PM | 12.32 | -280 | 9.80 | -151 | 3.97 | 0.130 | | |

# 4 Conclusions

Overall, the experiment showed that Sb becomes significantly more mobilized than Pb in the systems studied. The phosphate addition caused higher concentrations of Sb to become mobilized than the calcium hydroxide addition. Lead concentrations remained relatively low throughout the entirety of both experiments, indicating Pb has relatively low mobility in these systems, unless pH spikes to above 9.5. Previous efforts concluded that the dominant Sb species in the system is likely Sb(V) and therefore has increased mobility at pHs above 7-8, in general. We conclude that Sb(V) is also the dominant Sb species in the current experiments. Lead, on the other hand, tends to become mobilized in low pH systems (<4-5) and high pH systems (>10). The results from this effort show that amendment additions to the Joint Base Cape Cod berms for sequestering metals, like lime and phosphate, caused an increase in Sb concentrations. There was not the same increase in mobility for Pb as seen with Sb after the additions. Comparing the two amendments, the phosphate addition mobilized Sb to a greater extent than the lime addition, indicating there may be additional controls on Sb mobility than just pH, such as a more favorable complex formed between phosphate and Sb than the calcium hydroxide addition.

# 5 Recommendations

Current and previous work show that the aqueous Sb in the systems at Camp Edwards is fully oxidized $Sb(V)_{aq}$ and becomes mobilized to a greater extent than Pb in shooting range systems when calcium hydroxide or calcium phosphate are applied. Concentrations of Sb will likely decrease in aqueous systems (groundwater, soil pore water, etc.) when the source of Sb has been depleted. Further work on these samples would include (1) solid phase characterization of total Pb and Sb concentrations in the soils after the calcium hydroxide and calcium phosphate additions, and (2) synchrotron characterization as next logical steps. Each step is outlined below in further detail.

(1) Solid phase characterization of the total Pb and Sb concentrations in the test soils collected after the leaching experiment. From this, we can determine Pb and Sb partition coefficients.

(2) Speciation characterization of the test soils collected after the leaching experiment. Characterizing the solid phase Sb product that was produced when either calcium phosphate or calcium hydroxide were added to the test soils would yield insight into stability of the product over time and potential pathways for weathering/degradation. Currently, we know the addition of these two amendments mobilized Sb to a greater extent than Pb and it is likely linked to the rise in pH and formation of secondary mineral phases or complexes in soil and soil solution.

These two recommendations are further steps to understand the detailed transformation pathways of Sb (particularly) in the Camp Edwards soil system. This type of detailed work may not be needed for regulatory purposes of managing the site, but may yield insight into weathering rates and assist with any future remediation plans.

# Soldier Validation Lane Annual Report

**Camp Edwards --- Massachusetts Army National Guard**

**Soldier Validation Lane Annual Monitoring Report**

**January, 2023**

**(NHESP Tracking No.: 08-24210)**

**Soldier Validation Lane Use**

No site composition changes occurred in FY22.

**SVL Assessments after 2022 Training Season**

All sites with containers were visited on January 20th, 2023 to evaluate training impacts during the 2022 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, 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 2022 and management activity was limited to Roads and Grounds personnel mowing around existing infrastructure. At BP-12 ITAM personnel mowed pitch-pine regen in the spring of 2023 to open the site for training (pictures included from 2020 and 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 (continued on next page)**

Figure 1; SVL1 rutting and puddles on road leading to SVL3.

Figure 2: Erosion and rutting occurring on entry road 2 for BP24.

Figure 3: Rutting and erosion at SVL6.

Figure 4: Puddles formed at SVL6.

Figure 5: Rutting and puddling at BP20 (picture location 1).

Figure 6 and 7: Rutting and erosion at BP20 (picture location 2).

Figure 8: BP12 with limited pitch pine regen and mostly grasses.

Figure 9: BP12 in 2020 with limited growth of grass and pitch-pine regen.

# 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<br>Safe Drinking Water Act | Drinking Water Quality Standards (310 CMR 22.00)<br>State Wellhead Protection (310 CMR 22.21)<br>Water Management Act (310 CMR 36.00) | AR 200-1<br>AR 200-2<br>Camp Edwards Regulation (CER) 385-63 |
| Wetlands and Surface Water | Clean Water Act<br>Coastal Zone Management Act<br>Floodplains Management (EO 11988)<br>Protection of Wetlands (EO 11990)<br>Rivers and Harbors Act of 1899<br>Sikes Act<br>Wetlands Management (EO 11990) | Massachusetts Wetlands Protection Act (M.G.L. c. 131, s40; 310 CMR 100.00 ) | AR 200-2<br>CER 385-63 |
| Rare Species | Federal Endangered Species Act<br>Sikes Act | Massachusetts Endangered Species Act (M.G.L. c. 131A, 321 CMR 10.00) | AR 200-1<br>AR 200-2<br>AR 200-3<br>CER 385-63 |
| Soil Conservation | Sikes Act<br>Soils and Water Conservation Act<br>Use of Off-Road Vehicles on Public Lands (EO 11989) | | AR 200-1<br>AR 200-2<br>AR 200-3<br>CER 385-63 |
| Vegetation Management | American Indian Religious Freedom Act<br>Environmental Justice (EO 12898)<br>Exotic Organisms (EO 11987)<br>Sikes Act | | AR 200-1<br>AR 200-2<br>AR 200-3<br>CER 385-63 |
| Habitat Management | Sikes Act | Massachusetts Endangered Species Act (M.G.L. c. 131A, 321 CMR 10.00) | AR 200-1<br>AR 200-2<br>AR 200-3<br>CER 385-63 |
| Wildlife Management | Fish and Wildlife Conservation Act<br>Migratory Bird Conservation Act<br>Migratory Bird Treaty Act<br>Sikes Act | | AR 200-1<br>AR 200-2<br>AR 200-3<br>CER 385-63 |
| Air Quality | Clean Air Act | State Air Quality Regulations (310 CMR 4.00) | AR 200-1<br>AR 200-2<br>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<br>Occupational Safety & Health Act<br>Use Planning Standards on Urban Noise, Guidelines for Considering Noise in Land Planning and Control (June 1990) | | AR 200-1<br>AR 200-2 |
| Pest Management | Animal Damage Control Act<br>Federal Insecticide, Fungicide, and Rodenticide Act<br>Noxious Weed Act<br>Resource Conservation and Recovery Act<br>Sikes Act<br>Toxic Substances Control Act | | DoD 4150.7<br>AR 200-1<br>AR 200-2<br>AR 200-5<br>AR 420-47 |
| Fire Management | Clean Air Act<br>Sikes Act<br>The National Fire Code<br>Uniform Fire Code | State Air Quality Regulations (310 CMR 4.00) | AR 200-1<br>AR 200-2<br>AR 200-3<br>AR 420-90<br>CER 385-63 |
| Storm Water Management | Clean Water Act<br>NPDES discharge permitting and limitations | Massachusetts Wetlands Protection Act (M.G.L. c. 131 s.40, 310 CMR 10.00.) | AR 200-1<br>AR 200-2 |
| Wastewater | Clean Water Act | Title V (310 CMR 15.00) | AR 200-1<br>CER 385-63 |
| Solid Waste | Resource Conservation and Recovery Act<br>Toxic Substances Control Act | State Solid Waste Handling and Disposal (310 CMR 16.00/19.00) | AR 200-1<br>AR 200-2<br>AR 420-47<br>CER 385-63 |
| Hazardous Materials | Asbestos Hazard Emergency Response (40 CFR 763)<br>Federal Insecticide, Fungicide and Rodenticide Act<br>Hazard Communication Standard Program (29 CFR 1910.1200)<br>Lead Contamination Control Act<br>OSHA (29 CFR 1910, 29 USC 91-596)<br>Poison Prevention Packaging Act<br>Toxic Substances Control Act | Hazardous Substances Labeling Law (105 CMR 650.00) | AR 200-1<br>AR 200-2<br>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<br>Clean Water Act<br>Emergency Preparedness and Community Right-To-Know Act<br>Federal Facilities Compliance Act<br>Hazardous Waste Operations and Emergency Response<br>Medical Waste Tracking<br>National Fire Code<br>Oil Pollution Act<br>Pollution Prevention Act<br>Resource Conservation and Recovery Act<br>The National Contingency Plan<br>Underground Storage Tank Program (RCRA, Title I)<br>Uniform Building and Fire Codes<br>Comprehensive Environmental Response, Compensation, and Liability Act | Department of Transportation regulations regarding shipping and transportation, Hazardous Waste Management and Transportation (310 CMR 30.000)<br>Management of Medical Waste (105 CMR 480)<br>Pesticide use (333 CMR 1.00 – 12.00)<br>Solid waste facilities management (310 CMR 16.00/19.00)<br>State right-to-know requirements (105 CMR 670.00)<br>Title V (310 CMR 15.00)<br>Toxic use reduction (310 CMR 5.00)<br>Underground storage tanks standards (527 CMR 4.00 and 9.0)<br>Massachusetts Contingency Plan (310 CMR 40.00) | AR 200-1<br>AR 200-2<br>AR 420-47<br>CER 385-63 |
| Vehicle | Use of Off-Road Vehicles on Public Lands (EO 11989) | | AR 200-2<br>CER 385-63 |
| General Use And Access | Use of Off-Road Vehicles on Public Lands (EO 11989) | | AR 200-1<br>AR 200-2<br>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<br><br>(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<br>Archeological and Historic Preservation Act of 1974<br>Archeological Resources Protection Act of 1979<br>Consultation and Coordination with Indian Tribal Governments (Executive Order 13175)<br>Curation of Federally Owned/Administered Archeological Collections<br>Executive Memorandum of April 19, 1994 – Government-to-Government Relations with American Tribal Governments<br>National Environmental Policy Act of 1966, as amended<br>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)<br><br>Massachusetts Environmental Policy Act (MEPA)<br>Massachusetts General Laws Chapter 30, sections 61 through 62H, inclusive (301 CMR 11.00)<br><br>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<br>AR 200-4<br>DA PAM 200-4<br>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

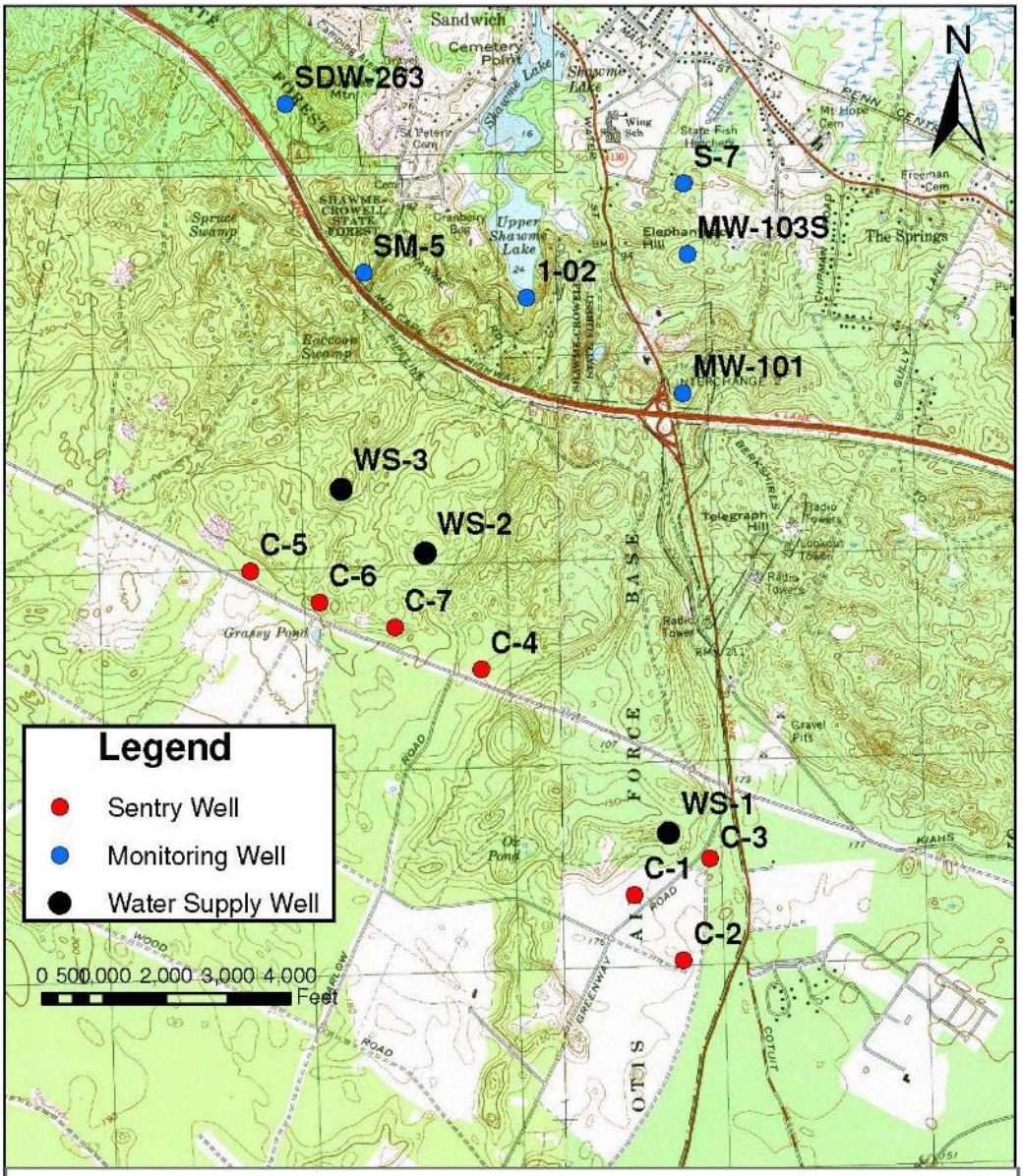



Figure 1
Long-term Monitoring Well Network
Upper Cape Regional Water Supply Cooperative
Cape Cod, Massachusetts

102nd Intelligence Wing
2021 Consumer Confidence Report

# *2021* 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: 156 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.

**Action Level (AL)** – The concentration of a contaminant which, if exceeded, triggers treatment or other requirements that a water system must follow.

**90th Percentile** – Out of every 10 homes sampled, 9 were at or below this level.

**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.

**Treatment Technique (TT)** – A required process intended to reduce the level of a contaminant in drinking water.

**Running Annual Average (RAA)** – The average of four consecutive quarter of data.

**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.

**Level 1 Assessment** - A Level 1 assessment is a study of the water system to identify potential problems and determine (if possible) why total coliform bacteria have been found in our water system.

**Level 2 Assessment** - A Level 2 assessment is a very detailed study of the water system to identify potential problems and determine (if possible) why an *E. coli* MCL violation has occurred and/or why total coliform bacteria have been found in our water system on multiple occasions.

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 = millimrems 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).

| | 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 Result or Highest Running Average Detected | Range Detected | MCL or MRDL | MCLG or MRDLG | Violation (Y/N) | Possible Source(s) of Contamination |
|---|---|---|---|---|---|---|---|
| **Inorganic Contaminants** | | | | | | | |
| 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) ■ | 2021 | 0.15 | 0.00-0.15 | 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) | 2021 | 1.90 | 0.00-1.90 | 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) | 2021 | ND | N/A | 2 | N/A | N | Rocket propellants, fireworks, munitions, flares, blasting agents |

| Regulated Contaminant | Date(s) Collected | Highest Result or Highest Running Average Detected | Range Detected | MCL or MRDL | MCLG or MRDLG | Violation (Y/N) | Possible Source(s) of Contamination |
|---|---|---|---|---|---|---|---|
| PFAS6 (ppt) | 2020 | 2.1 | 0.00-2.1 | 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) | QTR 3 (2021) | 12.1 | 6.86-12.1 | 80 | N/A | N | Byproduct of drinking water chlorination |
| Haloacetic Acids (HAA5) (ppb) | QTR 3 (2021) | ND | N/A | 60 | N/A | N | Byproduct of drinking water disinfection |
| Chlorine (ppm) (free, total or combined) | Monthly in (2021) | 2.2 | 0.01-2.2 | 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) | 2021 | 1.13-3.38 | 2.25 | N/A | N/A | Trihalomethane; by-product of drinking water chlorination |
| Bromoform (ppb) | 2021 | 0.00-1.20 | 0.60 | N/A | N/A | Trihalomethane; by- product of drinking water chlorination |
| Chloroform (ppb) | 2021 | 3.39-4.77 | 4.08 | N/A | 70 | By-product of drinking water chlorination (In non-chlorinated sources it may be naturally occurring) |
| Dibromodichloromethane (ppb) | 2021 | 0.96-4.16 | 2.56 | N/A | N/A | Trihalomethane; By-product of drinking water chlorination |
| Manganese* (ppb) | 2020 | <0.005 | <0.005 | 50 | 300 | Erosion of natural deposits |

| Unregulated Contaminants | Date(s) Collected | Result or Range Detected | Average Detected | SMCL | ORSG | Possible Source |
|---|---|---|---|---|---|---|
| * 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. | | | | | | |
| 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. However some contaminants that were tested last year did not meet all applicable health standards regulated by the state and federal government. Due to contaminant violations of Total Coliform and *E. coli* during the period(s) of 14-16 September 2021, our system took the following corrective actions.

- *We collected additional samples.*
- *We announced public notification 17 September 2021 by e-mail, posting notices etc.*
- *We disinfected and flushed the distribution system to eliminate coliform bacteria.*
- *All repeat samples returned absent of coliform; boil water order was terminated on 24 September 2021.*

Our water system and MassDEP monitor and record the effectiveness of actions taken in response to contaminant violations. The health effect statement(s) for this contaminant are listed below.

**Drinking Water Violations**

We had an *E. coli*-positive repeat sample following a total coliform-positive routine sample.

**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 exists 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 assessments to identify any problems that were found during these assessments.

***E. coli*** are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Human pathogens in these wastes can cause short-term effects such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a greater health risk for infants, young children, the elderly, and people with severely compromised immune systems. We found *E. coli* bacteria, indicating the need to look for potential problems in water treatment or distribution. When this occurs, we are required to conduct assessments to identify problems and to correct any problems that were found during these assessments.

| Bacteria | MCL / TT | MCLG | Value | Date | Violation (Y/N) | Possible Sources |
|---|---|---|---|---|---|---|
| *E. coli* | MCL | 0 | Positive (*E. coli*) | 14-16 Sep 2021 | Y | Human and animal fecal waste |
| 9/14/2021 - Site 001/Bldg. 149 ANG Medical Group E. coli present<br>9/16/2021 - Site 001/Bldg. 149 ANG Medical Group E. coli present<br>9/16/2021 - Site UR/Bldg. 162 ANG PMEL/COM E. coli present | | | | | | |

During the past year, we were required to complete a Level 2 Assessment because we found E. coli in our water system. In addition, we were required to take all four previously listed corrective actions and we completed all of these actions.

| Bacteria | MCL / TT | MCLG | Value | Date | Violation (Y/N) | Possible Sources |
|---|---|---|---|---|---|---|
| Total Coliform Bacteria | MCL | 0 | Positive | 14-16 Sep 2021 | Y | Human and animal fecal waste |
| On Mon., Tues., Wed., (9/20, 9/21, 9/22), collect RW, PT, all RS sites, including tanks, and the UR/DR repeat location for Site 001. All repeat samples returned absent of coliform. | | | | | | |

**Health Effects Statements**

Total Coliform: Coliforms are bacteria that are naturally present in the environment and are used as an indicator that other potentially harmful bacteria may be present. Coliforms were found in more samples than allowed and this was a warning of potential problems.

Fecal coliforms and E.coli are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Microbes in these wastes can cause short-term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a special health risk for infants, young children, and people with severely-compromised immune systems.

Inadequately treated water may contain disease-causing organisms. These organisms include bacteria, viruses, and parasites, which can cause symptoms such as nausea, cramps, diarrhea, and associated headaches.

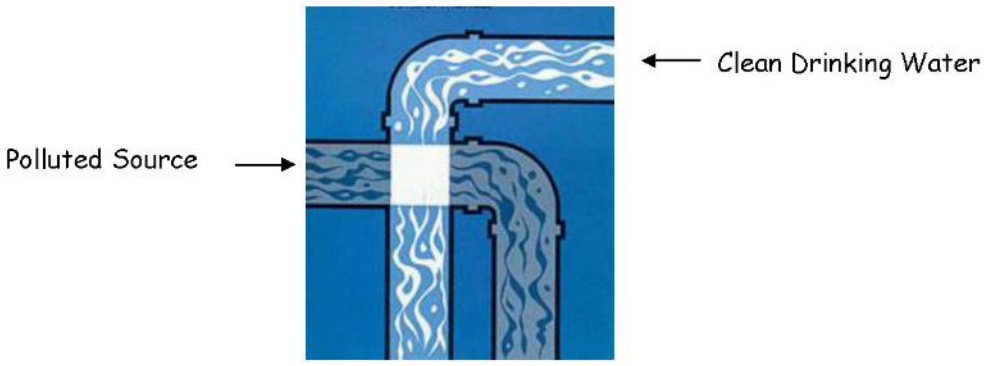
## EDUCATIONAL INFORMATON

**Do I Need To Be Concerned about Certain Contaminants Detected in My Water?**

Sodium sensitive individuals, such as those experiencing hypertension, kidney failure, or congestive heart failure, should be aware of the sodium levels where exposures are being carefully controlled.

**Cross-Connection Control and Backflow Prevention**

**What is a Cross Connection and what can I do about it?**




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. You hook up your hose to the sprayer that contains the fertilizer. If the water pressure drops at the same time you turn on the hose, the fertilizer may be sucked back into the drinking water pipes through the hose. This problem can be prevented by using an attachment on your hose called a backflow-prevention device.

The Water Superintendent recommends the installation of backflow prevention devices, such as a low cost hose bib vacuum breaker, for all inside and outside hose connections. You can purchase this at a hardware store or plumbing supply store. This is a great way for you to help protect the water in your home as well as the drinking water system on base! For additional information on cross connections and on the status of your water systems cross connection program, please contact your respective Environmental Management Office.

## 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:

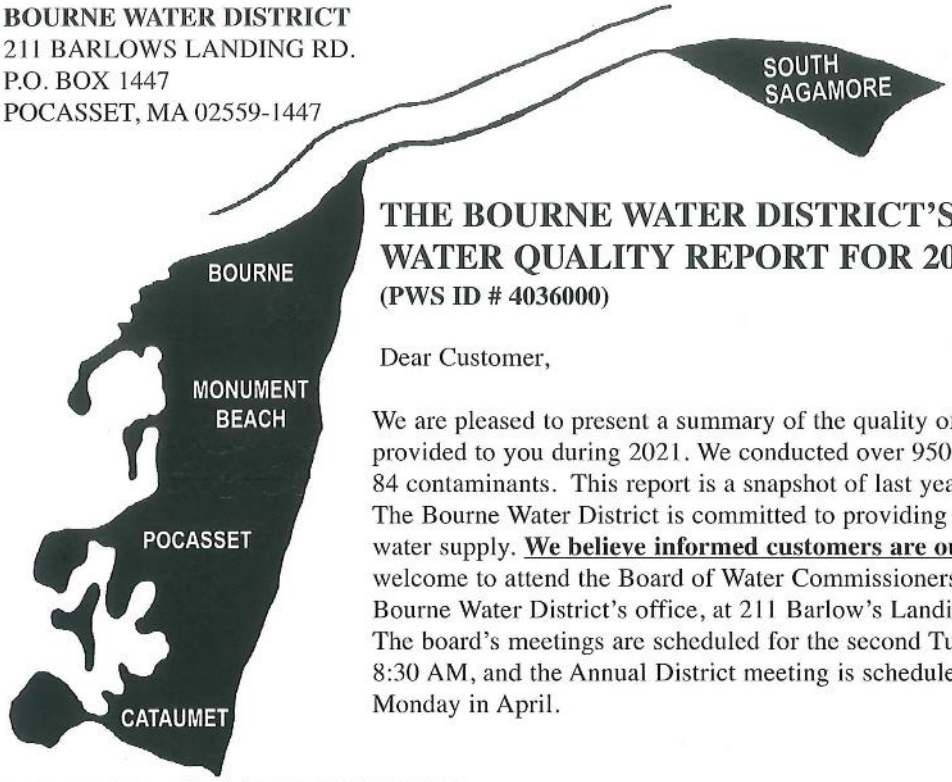
•The water mains, or
•The water pipes in your building

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
2021 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 2021

**(PWS ID # 4036000)**

Dear Customer,

We are pleased to present a summary of the quality of the drinking water provided to you during 2021. 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. The other two wells are in the Cataumet area of the Town of Bourne. One well is on Joint Base Cape Cod and we have one transfer station on Connery Ave. The Bourne Water District treats all supplies with lime slurry for corrosion control. The lime slurry 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 | yes | Naturally present in the environment |
| Fecal Coliform or E. Coli | 0 | 0 | 0 | 0 | No | Human andAnimal 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) | 9/1/2021 thru 12/31/2021 | 0.0018 | 15 | 0 | 30 | 0 | No | Corrosion of household plumbing systems: Erosio of natural deposits |
| Copper (ppm) | 9/1/2021 thru 12/31/2021 | 0.1 | 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 causse serious health problems,especially for pregnant women and young childern. 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 you water has been sitting for several hours,you can minimize the potental for lead exposure by flushing you 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: | | | | |
| Barium (ppm) | 2021 | 0.009 | 0-0.009 | 2 | 2 | No | Discharge of drilling waste; discharge from metal refineries;erosion of natural deposits |
| Nitrate * (ppm) | 2021 | 0.92 | 0.03-0.92 | 10 | 10 | No | Runoff from fertilizer use;leaching from septic tanks;sewage;erosion of natural deposits |
| Perchlorate ** (ppb) | 2021 | 0 | 0 | 2 | - | No | Rocket propellants,fireworks,munitions ,flares,blasting agents* (see note below) |
| | | | Radioactive contaminants | | | | |
| Gross Alpha Particle | 2021 | 1.01pci/L | 0.89-1.01pci/L | 15 pci/L | | No | |
| Radium 226 & 228 | 2021 | 1.22 pci/L | .42-1.22 pci/L | 5 pci/L combined | | No | |
| Organic Contaminants | | | | | | | |
| Tetrachloroethylene(PCE)(ppb) | 2021 | 1.27 | 0-1.27 | 5 | - | No | Discharge from factories and dry cleaners |
| Chloroform (ppb | 2021 | 1.68 | .66-1.68 | ORSG 70 | NA | No | By-product of drinking water chlorination |
| CIS-1,2 Dichloroethylene (ppb) | 2021 | 1.86 | 0-1.86 | 70 | NA | No | Runoff from fertilizer use;leaching from septic tanks;sewage;erosion of natural deposits |

| Secondary Contaminents | Date(s) collected | Highest Detect Value | Range Detected | SMCL | OSRG | Possible Source of Contamination |
|---|---|---|---|---|---|---|
| Magnesium (ppm) | 2021 | 3.1 | 1.0-3.1 | - | - | Natural Mineral and Organis Matter |
| Chloride (ppm) | 2021 | 46 | 7.3-46 | 250 | NA | Natural Mineral, Road Salt |
| Calcium (ppm) | 2021 | 25 | 6.1-25 | - | - | Natural Mineral and Organis Matter |
| Iron (ppb) | 2021 | 0 | 0 | 300 | NA | Erosion of Natural Deposits and oxidation of iron components |
| Manganese (ppb)* | 2021 | 0.008 | 0-.008 | 50 | NA | Erosion of Natural Deposits |
| Sodium(ppm)** | 2021 | 28** | 6.6-28 | - | 20 | Road Salting;erosion of natural deposits |
| Potassium (ppm) | 2021 | 0.9 | .4-.9 | - | - | Natural Mineral and Organis Matter |
| Sulfate (ppm) | 2021 | 8.2 | 5.1-8.2 | 250 | 250 | Natural Sources |
| Zinc (ppm) | 2021 | 0 | 0 | 5 | NA | Erosion of Natural Deposits,and industrial discharge |
| Aluminum | 2021 | 0.078 | .017-.078 | | 0.2 | |
| | | | | | | |
| | | | PER and POLYFLUOROALKYL | | | |
| PFOS total of 6 (ppt) | 2021 | 3.31 | 0-3.31 | 20 ppt | | |

**NATIONAL PRIMARY DRINKING WATER REGULATION COMPLIANCE**

The Total Coliform rule requires water systems to meet a stricter limit for Coliform bacteria. Coliform bacteria are harmless, but the presence in water can be an indication of disease-causing bacteria. When Coliform bacteria is found, special follow up tests are done to determine if harmful bacteria are present in the water supply. Over 500 Coliform samples were taken throughout the Bourne Water District in the year 2021. In September 2021 Bourne Water District had one detect of Total Coliform from a sample taken at the South Sagamore glass tank. Bourne Water District chlorinated the tank and rectified the issue. Bourne Water District completed the process with a Level 2 Assessment of the site and has not had any other Total Coliform hits anywhere in the system.

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.

**PER and POLYFLUOROALKYL SUBSTANCES (PFA's and PFOA's)**
Bourne Water District has been sampling for Per and Polyfluoroalkyl contaminants since the start of the Unregulated Contaminant Monitoring Rule (UCMR) in 2013 and reporting the detections in our yearly CCR. Bourne Water District has a small detect at 3.31 ppt at one of our well sites in Cataumet. As slight as it may be, Bourne Water has been and will continue to monitor and rectify the cause. Along with this CCR please find MASS Dep's Quick Reference Guide and feel free to contact Robert Prophett at 508-563-2294 with any questions and concerns.

**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
## 2021 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.

## 2021 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.

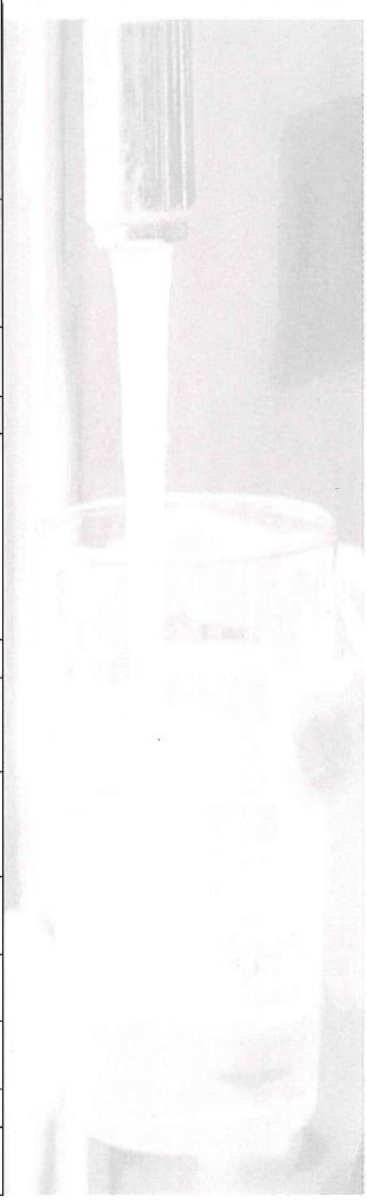
**2021 WATER QUALITY DATA**

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 | 0.002 ppm | 0.002 ppm | 2 ppm | 2 ppm | No | Discharge of drilling wastes; Discharge from metal refineries; Erosion of natural deposits |
| Nitrate | 2021 | 0.11 ppm | 0.07 ppm – 0.11 ppm | 10 ppm | 10 ppm | No | Runoff from fertilizer use; Leaching form 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 | -.210 (+- .331) pCi/l | -.210 (+- .331) 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** | **ORSG** | **Violation** | **Possible Sources** |
| Chloroform | 2021 | 1.81 ppb | 1.39 -1.81 ppb | NA | 70 ppb | No | Trihalomethane: by-product of drinking water chlorination. In non-chlorinated sources, chloroform may be naturally occurring |
| Chloride | 2021 | 9.3 ppm | 7.4 - 9.3 ppm | 250 ppm | – | NO | Runoff and leaching from natural deposits; seawater influence |
| Copper | 2021 | 0.041 ppm | 0.022-.041 ppm | 1 ppm | – | No | Internal corrosion of household plumbing; erosion of natural deposits |
| Sodium | 2020 | 5.4 ppm | 5.4 ppm | – | 20 ppm | No | Natural erosion, road salt |
| Sulfate | 2021 | 5.5 ppm | 4.7 – 5.5 ppm | 250 ppm | – | No | Runoff and leaching from natural deposits; industrial wastes |
| Zinc | 2021 | 0.017 ppm | ND – 0.017 ppm | 5ppm | – | No | Corrosion of household plumbing systems; erosion of natural deposits |

# Per- and Polyfluoroalkyl Substances (PFAS) Drinking Water Regulations Quick Reference Guide

MassDEP
Commonwealth of Massachusetts
Department of Environmental Protection



| Overview of the Rule | |
|---|---|
| **Title** | Per- and Polyfluoroalkyl Substances (PFAS) compliance requirements for Public Water Systems (PWS) - 310 CMR 22.07G |
| **Purpose** | Increase public health protection through the reduction of chemicals that have been linked to a variety of health risks, particularly for sensitive subgroups including pregnant women, nursing mothers and infants. |
| **General Description** | The amended Massachusetts Drinking Water Regulations establish a Maximum Contaminant Level (MCL) of 0.000020 milligrams per liter (mg/l) or 20 ng/l (also called parts per trillion or ppt) for the sum of six PFAS compounds (PFOS, PFOA, PFHxS, PFNA, PFHpA and PFDA), known as PFAS6. The regulations detail the sampling requirements and corrective actions that PWS must take when the MCL is exceeded, as well as the provisions for public education and notice of exceedances so that communities can be educated and proactive in protecting their drinking water quality. |
| **Utilities Covered** | The PFAS6 MCL applies to Community PWS and Non-transient, Non-community PWS. Transient Non-community PWS must collect a PFAS sample under the regulations and would be subject to a site-specific health assessment for elevated levels. |

- This document provides a summary of MassDEP drinking water requirements; to ensure full compliance, please consult the regulations at 310 CMR 22.07G.

## Public Health Benefits

Implementation of the PFAS regulations will result in:

- Monitoring for and identifying any elevated PFAS levels in public drinking water.
- Corrective actions that reduce drinking water exposures to PFAS6 to below the levels that may cause a variety of health effects to sensitive subgroups, including developmental effects in fetuses and infants, effects on the liver, blood, immune system, thyroid, and may elevate the risk of certain cancers..

## Critical Dates and Deadlines

| | |
|---|---|
| October 2, 2020 | MassDEP published its PFAS regulations establishing an MCL of 0.000020 milligrams per liter (mg/l) or 20 ng/l (also called parts per trillion or ppt) for the sum of PFAS6. |
| January 1, 2021 | Large Community (COM) and Non-transient Non-community PWS (NTNC) (schools, workplaces, etc.) serving more than 50,000 people will begin regulatory compliance monitoring. |
| April 1, 2021 | COM and NTNC PWS serving between 10,000 and 50,000 people will begin regulatory compliance monitoring. |
| October 1, 2021 | Small COM and NTNC PWS serving 10,000 or fewer people will begin regulatory compliance monitoring. |
| September 30, 2022 | Transient Non-community PWS (such as hotels and restaurants) must collect, analyze and report sampling results by this date. |

## Federal Drinking Water Standards

There are currently no federal PFAS drinking water standards. However, USEPA has a health advisory of 70 ppt for the sum of PFOA and PFOS.

## What are the Major Provisions?

### Sampling Locations

- PWS must sample at every entry point to the distribution system.
- PWS that draw water from more than one source, where the sources are combined before distribution, must collect samples that are representative of all such combined sources after treatment during periods of normal operating conditions.
- Consecutive PWS are exempt from conducting compliance monitoring for PFAS for the purchased portion of water when the PWS from which the water is obtained has conducted the required monitoring.

### Initial Monitoring (First Year)

- Four consecutive quarterly samples must be collected.
- Each sample shall be collected in the first month of every quarter during initial monitoring.
- The PWS may ask MassDEP to substitute previously conducted quarterly sampling.
- If no PFAS is detected in the first two quarters of monitoring, the PWS may request to have MassDEP waive the third and fourth quarters of monitoring.

### Routine Monitoring

- If initial monitoring does not identify any PFAS a PWS may monitor during one year of each subsequent three-year Compliance Period.
- PWS serving more than 3,300 individuals must collect two quarterly samples in that year.
- PWS serving fewer than or equal to 3,300 individuals must collect one sample in that year.

### Monitoring Waivers

- After January 1, 2023, a PWS on routine monitoring may request a monitoring waiver from MassDEP.
- Waivers cover a single three-year Compliance Period and must be renewed each Compliance Period.
- Sampling under an approved waiver shall occur at least once during the first Compliance Period of each successive nine-year Compliance Cycle.

### Confirmatory Sampling Requirements

- Initial Monitoring: The first detection of PFAS during initial monitoring, not just the detection of PFAS6, triggers confirmation sampling.
- Initial Monitoring: After first detection, subsequent PFAS6 detection greater than 10 ppt triggers confirmation sampling.
- Routine Monitoring: Confirmatory sampling is required when PFAS6 is detected greater than 10 ppt during routine monitoring unless MassDEP determines that the location is Reliably and Consistently below the MCL.
- The confirmatory sample must be collected as soon as possible after receipt of result requiring confirmation and no later than two weeks from receipt of such result (unless granted a MassDEP extension).
- A detection is defined as any PFAS contaminant level greater than the lab's minimum reporting level (MRL). All certified labs must achieve an MRL of 2 ppt or lower for the six PFAS covered by the MCL.

### Increased Monitoring if PFAS is detected

| | |
|---|---|
| Monthly monitoring | • If the average of a PFAS6 result and its associated confirmatory sample is greater than 10 ppt, the sampling location must be sampled monthly.<br>• Monthly sampling continues until the source is shown to be Reliably and Consistently Below the MCL. |

| | |
|---|---|
| Quarterly monitoring | • A PWS that has installed PFAS treatment and is thereby Reliably and Consistently Below the MCL will be put on quarterly monitoring. |
| Annual monitoring | • If the initial monitoring is complete and PFAS is detected but PFAS6 is confirmed less than 10 ppt, the location must be sampled annually.<br>• A PWS that is determined by MassDEP to be Reliably and Consistently Below the MCL without having to install PFAS treatment may be put on annual monitoring. |

## Public Education

- Any PWS where there has been a PFAS6 detection, and the average of such detection and an associated confirmatory sample exceeds the PFAS6 MCL, shall provide public education materials regarding the exceedance, as described by MassDEP. These should be provided as soon as possible, but within 30 days.
- Until the PWS obtains a monitoring result at or below the PFAS6 MCL at such locations, public education should be updated quarterly.

## Compliance and Violations

- MCL compliance is calculated using the average of the monthly samples over a quarter.
- If any one sampling point location is in violation, then the PWS shall be considered in violation.
- If any sample result would cause the quarterly average to exceed the PFAS6 MCL, the PWS is immediately in violation and begins compliance actions.

## Public Notice

- A violation of the MCL requires a Tier 2 Public Notice.
- Monitoring & testing procedure violations require Tier 3 Public Notice.

## Seasonal System Provisions

If a PWS reactivates an existing source or opens a seasonal system after the applicable commencement date of this regulation, it shall commence initial monitoring of such locations within the first month of delivering water to the public.

## MassDEP Technical Assistance and Grants

- Free testing is available until June 30, 2021 for PWS to sample drinking water for PFAS.
- The Commonwealth provided grant funding in October 2020 to assist PWS in the planning and design of treatment systems to remove PFAS Another round of grant funding is anticipated.
- MassDEP has made PFAS-reducing drinking water projects a priority in the 2021 State Revolving Fund (SRF) Loan Program. PFAS mitigation projects may be eligible to receive an additional subsidy in the form of a 0% interest rate loan. The additional subsidy is contingent on the availability of funds and approval of the Massachusetts Clean Water Trust Board of Trustees. For more information: https://www.mass.gov/doc/drinking-water-program-updates-2-13-2020/download

## Key Point for PWS to Remember

- All confirmed detections of PFAS6 > 20 ppt require public education.

For additional information on the PFAS6: Visit the MassDEP website at https://www.mass.gov/info-details/per-and-polyfluoroalkyl-substances-pfas; email the MassDEP Drinking Water Program at program.director-dwp@mass.gov; or call the MassDEP Drinking Water Program at 617-292-5770.

***THIS DOCUMENT CONTAINS IMPORTANT INFORMATION FOR YOUR SYSTEM. HAVE SOMEONE TRANSLATE IT FOR YOU OR SPEAK WITH SOMEONE WHO UNDERSTANDS IT.***

If you need this document translated, please contact MassDEP's Diversity Director, Michelle Waters-Ekanem, Diversity Director/Civil Rights: 617-292-5751 TTY# MassRelay Service 1-800-439-2370. You may also contact the Drinking Water Program at program.director-dwp@mass.gov.

# APPENDIX F
# CONSERVATION AND MANAGEMENT PERMIT COMPLIANCE AND MITIGATION ACTIONS

# Conservation and Management Permit Compliance and Mitigation Actions

## Camp Edwards: Fiscal Year 2022

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 the FY2022 period covering October, 2021, through September, 2022. 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): Hognose Snake (*Heterodon platyrhinos*) by *Evan Grimes (UMass Amherst)*; Unexpected Cycnia Moth (*Cycnia collaris*) at light sheet by *Jake McCumber*; Upland Sandpiper (*Bartramia longicauda*) by *Peter Trimble*. Bottom: Soldiers conducting approved training within the Wheelock Overlook restoration area during the 2022 Combined Arms Exercise by *Rob Crevey*.

**A note on photos:**

All photos in this report are by MAARNG Natural Resources and Training Lands staff in 2022 unless otherwise specified. Photographer credits are in italics following captions.

The Plain Prominent moth (*Coelodasys apicalis*; formerly genus *Schizura*) is closely tied to xeric barrens habitats. It is both rare and declining throughout the eastern United States. Though not state-listed, it is classified in NatureServe as a G3S1 (Global: Vulnerable; MA: Critically Imperiled). Populations are increasingly isolated, but maintenance of early and mid-successional habitats is helping preserve this species in southeastern Massachusetts. The Plain Prominent has been observed annually over the last few years in managed barrens habitats at Camp Edwards. *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, and five sites were repaired and the 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 drought conditions and the focal conservation interest of the species for MAARNG.

Surveying a puddle in a two-track road 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. FY22 highlights for both efforts are discussed below.

***Annual Monitoring.*** The fifth consecutive year of annual monitoring was completed in FY22. Due to a shortage of seasonal field technicians, SWCA Environmental Consultants was contracted to carry out the formal monitoring and report observations through MassWildlife's Heritage Hub. SWCA conducted repeated surveys following the standard approved protocol at a subset of 12 puddles. Three puddles

were 2021 CMP mitigation puddles, six were puddles not surveyed previously, and three were known to support AgCS in previous years. The 2021 mitigation puddles were not known to contain clam shrimp prior to intentional introduction of clam shrimp adults and puddle sediment thought to contain CS eggs. Adults and sediment were collected from puddles on the impact area perimeter roads (Jefferson, Barlow, Wheelock, and Crowell) that required repair. These roads had become severely degraded and occasionally impassable, in large part due to a prohibition on maintenance due to known AgCS presence.

From mid-May to October, puddles containing standing water were measured for area, depth, temperature and pH, and all aquatic life observed was recorded. AgCS were observed in seven of the twelve surveyed puddles or 67 percent of monitored puddles. This percentage is an increase from recent years (Chart 1). The seven positive observations were spatially distributed throughout Camp Edwards, occurring in all five training area zones. Zones are discussed below as part of the CMP amendment. Notably, three puddles are new locations for AgCS records. Also, it is significant that AgCS introductions to mitigation puddles continues to be successful. AgCS persisted and were observed in all three 2021 mitigation puddles that received adult AgCS and sediment. SWCA did not observe AmCS during their monitoring with all specimens identified as AgCS. All data and results are provided separately to MassWildlife and observation reporting through Heritage Hub will be completed in FY22 by SWCA (https://www.mass.gov/info-details/overview-of-the-heritage-hub).

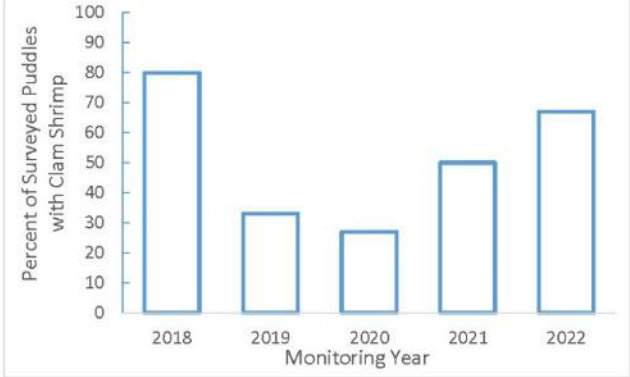



Chart 1. Percentage of puddles with confirmed presence of Agassiz's Clam Shrimp during formal annual monitoring. Each year a set of puddles is selected for iterative surveys following a mutually developed protocol that accounts for mitigation sites, novel sites, and return visits through long-term annual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

In addition to the 12 formal monitoring sites, MAARNG provided a list of additional puddles for SWCA to monitor in the event that formal sites were either consistently dry during monitoring visits or were confirmed to contain AgCS. SWCA visited 10 of these additional puddles throughout the monitoring period. Despite prolonged summer drought that left most sites dry, clam shrimp were observed at four of the puddles. Clam shrimp in three of the puddles were identified as AgCS but the clam shrimp from the fourth puddle were too small to positively identify to species, although AgCS is suspected. AgCS had been observed in two of the puddles previously, one in 2018 and the other in 2021, and two had not been monitored before. FY22 was a productive monitoring year resulting in eleven AgCS observations (1 site = 1 observation) with five of those being new clam shrimp puddles that will be marked with protective signage.

***Road Work Plans***. The overarching CS conservation strategy is to provide for both a sustainable road network and sustainable clam shrimp population throughout Camp Edwards. A well maintained road network is fundamental to supporting all operations on Camp Edwards, including groundwater monitoring, active remediation, natural resources management, and, critically, soldier training. A usable

and maintained road network appears to also support suitable clam shrimp habitat and their persistence throughout the Training Area. This can be seen in the annual monitoring efforts and results and the success of retaining clam shrimp on sites after road and puddle maintenance work.

In December 2021, MAARNG submitted Road Work Plan Proposal 2 to MassWildlife. The Plan was approved in January and included road work projects put forth by various Camp Edwards stakeholders such as Facilities Engineering, Impact Area Ground Water Supply Program (IAGWSP), and Natural Resources & Training Lands. Most road projects were standard road grading to repair rutting from storm water runoff. A few projects involved more hardened repairs to roads, such as re-paving and gravelling, these occurred on "Critical Roads", a CSCRMP designation. Critical Roads are technically outside the scope of the CSCRMP.

Agassiz's Clam Shrimp in various size classes in a sampling tray dipped from puddle SPSW1 during FY22 monitoring. Upper scale in millimeters. *Jonathan Schuster, SWCA*

One standout project put forth by Natural Resources & Training Lands includes in-place improvements to a known AgCS puddle on Fredrickson Road. This puddle, called FRED, triggers the CSCRMP Repair Threshold because it has caused road widening and is greater than 8-inches deep over most of its footprint. In-place improvements involve hardening the bottom of the puddle with rock and sand to raise the elevation and reduce the puddle size. The in-place improvements will improve the road condition and use while maintaining the clam shrimp habitat. A similar project was completed successfully during FY19 as part of the original CMP. While not completed during FY22, the FRED project is underway as of December 2022.

A second stand out project is the creation of three clam shrimp habitat sites to replace impacts to AgCS due to unauthorized road grading that resulted in the filling of three clam shrimp puddles. The road grading occurred in fall 2021 during road repairs permitted under the Road Work Plan #1 –July 2021, implemented by IAGWSP. However, the working contractor additionally graded a section of Wheelock Road to facilitate material hauling, which was outside the work scope and without prior approval. This section had received clam shrimp in three puddles as mitigation for the impact area boundary work and the puddles had been marked with rare species habitat signage. The graded over puddles are re-forming and will be observed by MAARNG during the FY23 clam shrimp active season.

The 2022 Work Plan was amended with MassWildlife in June to include two add-itional projects. One project, implemented by IAGWSP, was grading and gravelling a section of Barlow Road that accesses the Impact Area from Gibbs Road and is classified as a Critical Road. The second, proposed by Natural Resources & Training Lands is for repairs to a deep, wide, and often impassible puddle on Pocasset Road. This project is in the planning stage and may require more innovative solutions than other sites.

While the CSCRMP process has been successful, communication and process gaps, such as the grading described above, continue to come to light and are addressed as they do. Unforeseen situations are not surprising given the complex and multi-use needs of Camp Edwards and resilience to such complexity is

built in the conservation strategy. The only incident that occurred during FY22 was the unauthorized grading of two short road sections which resulted in the filling of two puddles. Fortunately, they were not known habitat to clam shrimp and the remaining number of puddles in the effected Zone remained above the established puddled density. It was later determined that a third party was improving access to two separate water supply wells and was not a known stakeholder for road repair.

Natural Resources staff preparing for in-situ modifications to FRED puddle. Work will improve conditions for both vehicles and clam shrimp. After draining, fine sediment will be scraped away and the bottom raised and hardened by compacting layers of sand over gravel. Finally, some scraped sediment containing clam shrimp eggs will be returned. *Erin Hilley*

***FY23 and Planned Activities.*** In December FY23, The Natural Resources & Training Lands Program met with representatives from Camp Edwards programs that plan and implement road work in the Training Area to identify roads and road sections in need of repair and planned for the fiscal year. These projects will be evaluated for potential impacts to available and known clam shrimp habitat, as well as other wildlife, and required and/or voluntary mitigation needs will be proposed. The culmination of the meeting and evaluation will be worked into the FY23 annual Road Work Plan and submitted to MassWildlife for review, coordination, and approval. Meanwhile, the Final Conditions report for completed projects approved in the Road Work Plan 2 is being developed for submission to MassWildlife.

**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

Frosted elfin larva feeding on Wild Indigo. This state-listed and federal At-risk Species thrives in fire maintained grassland, heath, and shrub habitats at Camp Edwards, including mitigation areas. *Jake McCumber*

***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.

White-tailed Deer caught licking its lips while at a frost bottom in a pine barrens mitigation zone. Deer exclusion fencing is an effective protection measure for listed plants.

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.

***Real Property Actions.*** Extensive land protection through real property actions was a fundamental component of the master CMP. One parcel (Special Military Reserve Commission [SMRC] Tract 5) that had already been transferred to MADFW was included in this agreement, as it had been transferred for a project that did not occur and the transfer was specified as mitigation. Additionally, SMRC Tracts 1 through 4 were transferred to MADFW as mitigation through this agreement in 2020. Tracts 1-5 total 260 acres and are directly adjacent to Crane Wildlife Management area; these tracts represent a significant expansion to this public conservation area. Another parcel previously identified for mitigation land transfer was Parcel H of Unit K, which is 150 acres within the cantonment area. This transfer was included within the master CMP agreement. The parcel was transferred to Military Division in 2020. MANG will receive a license to maintain overall access and use to meet habitat conversion and perpetual long-term management requirements under the mitigation agreement. There are no other updates for FY22 regarding real property actions. The MANG State Quartermaster has been in regular communication with the MA Department of Fish and Game General Counsel and Department of Capital Asset Maintenance and Management to develop Care, Custody, and Control agreements for the transferred parcels and to complete the transfer of Parcel H of Unit K with estimated completion now in 2023.

Butterfly Milkweed (fore), Common Milkweed (background), and Wild Indigo (center) responding vigorously in early summer following a spring 2022 grassland prescribed fire and fall 2021 invasive plant herbicide treatment. *Jake McCumber*

***Construction Projects.*** Approval and construction of the flagship project – the MPMG Range – remains delayed and is pending resumption of the Environmental Management Commission approval process. The redevelopment of Tango Range, approved in the CMP, was completed at the end of FY21 with minor troop labor improvements approved and completed in FY22. The final compliance report is in development for Tango Range. In early FY22 the management of the turtle protection for the staged soil at Dig Site 3 (source: Eversource's Bourne switching station) was transferred to MAARNG. In coordination with Natural Heritage, silt fence was removed from the site until major construction projects commence.

***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 (2021; https://www.massnationalguard.org/ERC/publications/Natural_Cultural/Final-INRMP-21.pdf) 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.

| Contract Cost | Fiscal Year | | | | |
|---|---|---|---|---|---|
| Mitigation Project Type | 2019 | 2020 | 2021 | 2022 | Grand Total |
| Administrative | $48,020 | $45,169 | $11,262 | $32,557 | $137,008 |
| Construction support | | $221,876 | | $540 | $222,416 |
| Monitoring | $62,810 | $103,248 | $123,739 | $146,600 | $436,396 |
| Other | | $9,700 | | | $9,700 |
| Initial treatment, fire | $64,480 | | | | $64,480 |
| Initial treatment, mechanical | $179,986 | $88,458 | $148,900 | | $417,344 |
| Maintenance treatment, other | | $55,950 | $8,000 | $118,840 | $182,790 |
| **Grand Total** | **$355,295** | **$524,401** | **$291,900** | **$298,537** | **$1,470,133** |

**Table 1.** Direct contract expenditure on mitigation projects per federal fiscal year implementing the Master Plan CMP. An estimated additional $80,000 per year is spent on internal staff time developing, overseeing, and implementing mitigation projects under this CMP.

| Mitigation Acreage | Fiscal Year | | | | | Grand |
|---|---|---|---|---|---|---|
| Project Type | 2019 | 2020 | 2021 | 2022 | 2023 | Total |
| Pine Barrens | 520 | 401 | 184 | 188.5 | 191 | 1,484.5 |
| Construction: Pine Barrens | | -6 | | -1 | -412 | -419 |
| 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 | 524 | 629 |
| Mitigation: Maintenance treatment, other | | 40 | | | 30 | 70 |
| Mitigation: Other | | | | | | |
| Mitigation: Real Property | | 261 | | | | 261 |
| Sandplain Grassland | 42 | 80 | 47 | 79 | 230 | 478 |
| Construction: Sandplain Grassland | | | | | -36 | -36 |
| Mitigation: Initial treatment, fire | 42 | | | 65 | | 107 |
| Mitigation: Initial treatment, mechanical | | 80 | | | | 80 |
| Mitigation: Maintenance treatment, fire | | | 47 | | 66 | 113 |
| Mitigation: Maintenance treatment, other | | | | 14 | 50 | 64 |
| Mitigation: Real Property | | | | | 150 | 150 |
| **Grand Total** | **562** | **481** | **231** | **267.5** | **421** | **1962.5** |

**Table 2.** 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 to account for mitigation ratios. Acres for mitigation projects are frequently counted the year after funding where a project is planned and funded from one FY, but implemented during the following winter due to conservation best management practices.

Wheelock Overlook harvest area in Pine Barrens Mitigation Focal Area West (Training Area A-5), August, 2022. The first CMP-funded mitigation project supports a robust natural community, including a variety of rare species. *Jake McCumber*

State-listed species conservation includes education and collaboration such as this interagency Eastern Box Turtle training hosted at Camp Edwards. *Jake McCumber*

Mitigation investment for specific CMP implementation contracts and projects totaled $298,537. An estimated additional $96,500 was invested in internal staff salary supporting mitigation projects within the CMP with primary emphasis on monitoring and overseeing monitoring contracts. All requested funds for FY22 were proposed mitigation projects. One project (RAW3 forestry, habitat restoration) was delayed in contracting and has become a FY23 project, but based on supplemental investment from other funds we were able to meet expected financial investment in mitigation for FY22. The breakdown by category of FY22 and prior years' CMP expenditures is outlined in Table 1. 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 FY22, addressing all the above-listed components of the master CMP. The mitigation actions implemented during FY22 totaled 268.5 acres of active habitat restoration. Prescribed fire implementation was significantly increased compared to the previous two years and accounted for 85% of mitigation acres for the year. Multiple trainings and thirteen burn days occurred at Camp Edwards in FY22. Seven prescribed burns were fully or partially within mitigation areas. An additional burn was within the Sierra Range barrens habitat that is associated with an earlier mitigation agreement, not the master development plan CMP and is not counted in this report. Extensive resource monitoring, including many in-house efforts, were completed or underway in FY22 in addition to the active habitat management. Projects undertaken in FY22 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.

- **Project Scoping, Design Minimization, and NHESP Review**
  - **MPMG Range** – NHESP review and approval was completed in September 2020, preceded by completion of the MA Environmental Policy Act (MEPA) process in July 2020; followed by finalization of the National Environmental Policy Act (NEPA) process in April 2021. Project implementation is pending final approval from the Environmental Management Commission. Turtle protection plans were amended in coordination with MADFW to address the delayed implementation and will continue to be amended as needed with coordination. Note there is no change in status relative to the permit on this project since the last annual report.
  - **Tango Range** – Construction and turtle protection actions were completed in September 2021. The preconstruction survey report was submitted in November 2020 and an interim, year-end

report was submitted to NHESP in January 2021. The closeout report for turtle protection was submitted on 10-DEC-2021 and approved by NHESP on 14-DEC-2021. The closeout and compliance report for the overall construction was delayed, but is anticipated for submittal in January 2023 with request for certificate of compliance.

- **Track and Field (1800 area)** – MADFW reviewed and approved final plans, turtle protection plan, and Net Benefit for the project design and consistency with the CMP January 12th, 2021. The project, including minimal land clearing and development of a track and field to support soldier fitness and training adjacent to the gymnasium, has been indefinitely put on hold pending funding. Notification will be made when funding is available to contract project implementation, including compliance with the CMP and turtle protection actions. Anticipated contracting is early FY23, but may include only the track and retain the grass field.
- **ISBC Range –** Design is still ongoing. Formal environmental review is anticipated in FY23.

- **Species Protection**
  - **MPMG Range** – Intensive year 4 of Eastern Box Turtle surveys implementing the approved turtle protection plan. The FY21 report was submitted on 7 April 2022. and an update was sent on 6 June 2022 detailing the spring work in FY22. In accordance with the Addendum to the CPMPP submitted and approved by NHESP on 6 August 2021, a movement barrier was installed in the fall of 2021 by in-house personnel to provide an area of good hibernation habitat (based on observed density of use) near the proposed project site. and turtles within the limits of work were relocated behind the barrier to allow for winter installation of the silt fence and tree removal. Given project delays, construction did not start in 2022 and is not anticipated in the winter of 2022-2023. Since no additional work was done in 2022 aside from continued turtle monitoring and transmitter attachments, no additional report will be sent in FY22.
  - **Tango Range** – On 12 July 2022, the Natural Resources Office submitted a project write-up for additional work at Tango Range, which included turtle protection measures. Consistent with the approved plan, the Natural Resources Office staff provided education to equipment operators, monitoring of transmittered turtles, and sweeps of the work area each morning for the troop labor project completed at Tango Range. One new turtle was discovered in the vicinity of the project, and another new turtle was added to the transmittered population when soldiers reported a turtle in the road on the way to the construction site.
  - **Track and Field (1800 area)** – The turtle protection plan was developed and approved by NHESP during project design and design submission. No action has been taken as the project was put on hold pending funding. If funding becomes available turtle protection implementation will be part of the construction contract and confirmation will be made with NHESP of compliance with turtle protection and all other permit requirements.
  - **Soil Stockpiling at Dig Site** - In TY 2022, the Natural Resources Office took over turtle protection from Eversource at Dig Site 3. The soil from the Bourne Switching Station will be used on future construction projects on base. Silt fence enclosure was removed in the spring of 2022 due to construction project delays. Approvals was obtained from NHESP and a report was submitted June 2022. Silt fence will be reinstalled and maintained for turtle protection prior to the start of major construction projects requiring material removal.

- **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. In FY22, 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 of 2022. In TY 2023, the Wildlife Epidemiology Lab is planning to submit a manuscript 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."

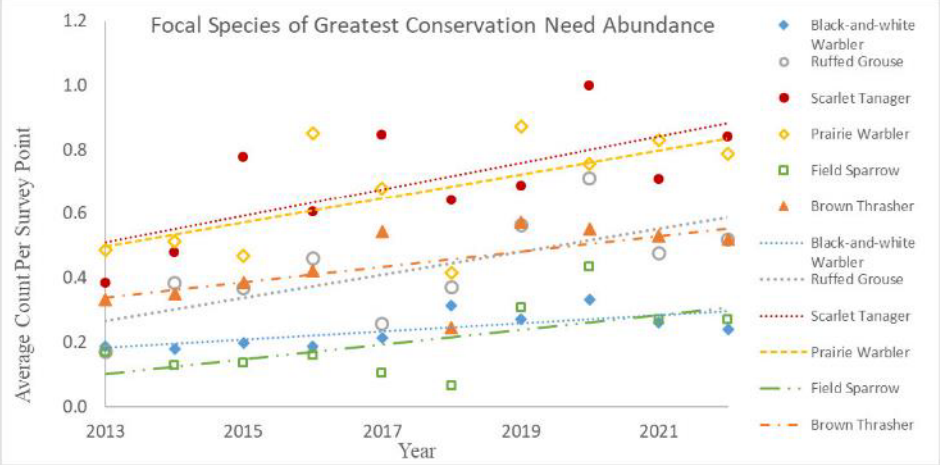
One of many Eastern Box Turtles tracked at Camp Edwards in 2022. *Nicole Madden*

    - MAARNG applied radio transmitters and monitored previously transmittered turtles for an end of year total of 63 EBT during FY22 as part of the long-term box turtle monitoring requirement. This includes opportunistic 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. The signals for two turtles cannot be located. Radio failure, damage to a radio or antenna, large turtle movements, turtle collection, or poor signal conditions can cause the loss of signal.
    - Although data is still being compiled from the several researchers doing EBT work on base, at least 16 mortalities (including 2 turtles without transmitters) were documented in FY22. Three of these were during a prescribed fire (two were not tagged turtles), two were road mortalities, and the remainder (11) are unknown. Two of the unknown mortalities were discovered by other researchers and the NR-ITAM Office is awaiting details on any apparent cause of death. Given multiple years of monitoring, the NR-ITAM Office is planning to compile the mortality rates and the proportion of mortalities attributable to typical causes (vehicle, prescribed fire) and unknown.
    - 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 training areas and habitat conditions distributed throughout Camp Edwards. Eight (8) EBT were detected in FY22 as part of this effort and seven (7) individuals were outfitted with radio transmitters for long-term tracking.
    - A graduate student at University of Massachusetts (UMass) Amherst's Massachusetts Cooperative Fish and Wildlife Research Unit (website), in coordination with MAARNG, MADFW, and USFWS, monitored the population of transmittered turtles at Camp Edwards for fly larva infestations and impacts.
    - A PhD student at the University of Massachusetts (UMass) Amherst's Massachusetts Cooperative Fish and Wildlife Research Unit was selected to begin studying EBT's influenced by prescribed fire on Camp Edwards.

- **Breeding Bird Point-counts**
  - Point-count surveys were conducted from 23 May through 28 June, 2022. 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. A total of 74 species were documented at point-count locations during the month of surveys.
  - Long-term trend analysis was completed for the newer point-count protocol covering data collected from 2013 through 2022. Trends in occupancy and abundance show positive or stable trends for nearly all Species of Greatest Conservation Need (SGCN) as identified by the State Wildlife Action Plan.

Field Sparrows rapidly establish within restored shrubland habitat at Camp Edwards leading to significant population increases. *Jake McCumber*

- Development of a full white-paper report has been delayed by inclusion of additional years of data (2021, 2022) to provide a full ten-year set, but such should be completed in 2023.
- The longer dataset provides much greater statistical significance with 10 of the 16 species of SGCN with regular breeding occurrence having significant trends for abundance. All but one of those are increasing trends and four also have statistically significant increases in occupancy.

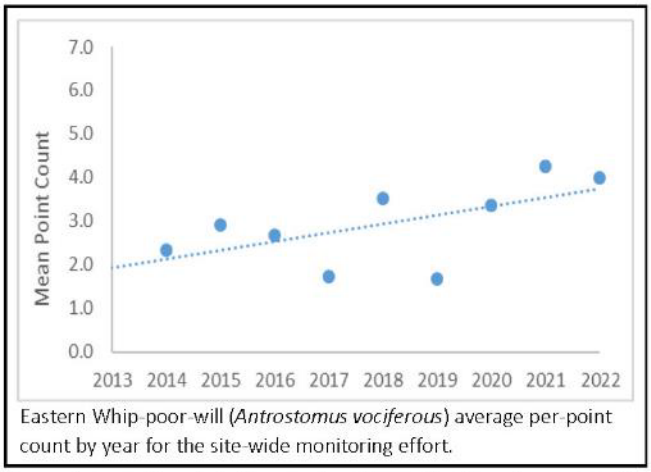



- The one species showing a declining trend with statistical significance at Camp Edwards is Upland Sandpiper, which is only declining when looking at the MAARNG managed grasslands alone. This species is showing significantly positive trends in both occupancy and abundance documented in the 2017-2022 point counts conducted on the airfield by the US Coast Guard. With this context the overall trends at JBCC are positive and reflect a selection for the current mowing regime at the airfield and scale

of available habitat. This additional data will be incorporated with the MAARNG analysis for reporting.

- The figure above presents species that all have statistical significance in abundance trends and represent a wide variety of habitat associations from mature forest to open shrub/savannah. Additionally, species such as the Eastern Meadowlark are showing strong and significant increases.
- How many of these trends are sustainable in the long-term given broader regional trends is uncertain, but these trends continue those seen with other long-term bird monitoring conducted annually from 1994 through 2013 at Camp Edwards. The scale of property combined with the extent and diversity of habitat restoration and maintenance provides a critical refugia and source population for a diverse assemblage of fauna. Such is only possible with the concentrated conservation effort of Department of Defense in support of the military mission.
- These broadly positive trends underscore the importance of restoration and stewardship even within forested habitats to address historic land use from hundreds of years. Forestry and prescribed fire are critical tools to provide diversity in structure, age, and species in all habitats, including working to develop older-growth forest characteristics in homogenous, dense regrowth woodlands. These bird population trends also indicate the alignment of goals and methods for addressing long-term climate targets and climate resilience with biodiversity and healthy ecosystems.

- **Eastern Whip-poor-will (EWPW)**
  - MAARNG NR-ITAM personnel conducted EWPW point-count transect surveys on 15 May, 2022. Three transects were conducted concurrently on one night covering 32 point-count locations throughout the northern training area. Whip-poor-wills were detected at all 32 locations for 100% occupancy. The mean per-point count was 4.0 birds, continuing a long-term stable to increasing trend from 2013 through 2021. Surveys are completed in coordination with MADFW and follow the North-eastern Nightjar Survey protocol. Additional, more opportunistic point-count surveys were conducted prior to the formal survey window and main survey night to provide greater confidence in results. A full report on the effort has been sent to MADFW. The first publication stemming from migration research conducted at Camp Edwards, in part, was published in 2022 by Bakermans, et al (https://ace-eco.org/vol17/iss2/art17/).



Eastern Whip-poor-will (*Antrostomus vociferous*) average per-point count by year for the site-wide monitoring effort.

- **Lepidoptera (Moths and Butterflies)**
  - Pine Barrens Moths: In early FY 2022, Western EcoSystems Technology, Inc. (WEST) completed a statistically robust and comprehensive moth monitoring protocol continued through a contract from MAARNG NR-ITAM. The overall protocol has a foundation of vegetation surveys that will evaluate change in structure and composition at a large number of sites. A subset of sites will be monitored with the protocols developed for nocturnal moth sampling and targeted diurnal sampling. Davey Resource Group was contracted to complete the second year of vegetation sampling in September of 2022. GZA completed the initial nocturnal UV trapping effort in the summer of 2022, and their contract includes a second year of sampling in 2023. The first sampling year included documentation of a new state-listed species for the site, *Heterocampa varia*. Diurnal sampling for Barrens Buckmoth (*Hemileuca maia*) caterpillars is anticipated to start in 2023.

Barrens Buckmoth had a strong year in FY22 for both larva and adult flight. The larva is well protected by elaborate spines that can deliver a painful sting. ***Jake McCumber***

  - Frosted Elfin Butterfly and Slender Clearwing Moth: The Frosted Elfin Butterfly (*Callophrys irus*) is state-listed and being considered for federal listing. MAARNG NR-ITAM completed three formal surveys in May through July following the range-wide protocol developed by USFWS including a multi-step protocol covering vegetation, adults, and larvae. One survey unit is within the Sandplain Grassland Mitigation Focal Area (Primary) while another is within the Sierra Range barrens habitat mitigation area (Training Area E-6, not part of the CMP mitigation). The third location is in the powerline right of way along the western edge of the base (Training Area B-9). Frosted Elfins were detected as adults at all three locations and appear to be expanding, including presence in a new portion of the Sierra Range area following 2021 prescribed fire. Larval surveys were completed with ultraviolet (UV) flashlights in the grasslands. This technique is particularly effective for Frosted Elfins, Slender Clearwing Moths (*Hemaris gracilis*), Barrens Buckmoth and other listed or otherwise rare Lepidoptera. Three nights of caterpillar surveys were completed in June and July 2022 covering two of the three sample sites with Frosted Elfins documented foraging on Wild Indigo (*Baptisia tinctoria*) at all three. Slender Clearwing Moth was again documented at both nocturnal survey locations (Tango Range and grasslands). Of particular note for both of these rare habitat specialists is their dramatic and quick response to a spring grassland prescribed burn. The June 16th and June 29th nocturnal surveys documented abundant larvae of both Frosted Elfin and Slender Clearwing Moth centrally within a 65 acre prescribed burn conducted on April 11th. Only brief surveys were conducted each night to avoid disturbance, but relatively high densities of both species demonstrates the success and importance of patch-burning to maintain habitat. Sufficient surrounding habitat produced adults to rapidly take advantage of widespread sprouting host plants.

- General Moths: More opportunistic moth survey and documentation has continued forward from 2019. During FY22 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. The most significant result of these efforts in 2022 was the observation and life history documentation of a new species for New England. *Anacampsis lupinella* is a micromoth that appears to be somewhat abundant, though patchily distributed, in the grasslands and similar habitats such as the Gibbs powerline right-of-way. It is typically associated with Sundial Lupine (Lupinus perennis), but, apparently like the Frosted Elfin, also uses Wild Indigo as a host plant. This species has likely existed here and throughout scattered barrens habitat in the region as a native species, but was overlooked due to secretive habits. Significant assistance was provided by the US Department of Agriculture Animal and Plant Health Inspection Service (Hannah Nadel and Steven Passoa) and a manuscript is in development with the life history information.

Bright late-summer fruit of Broad Tinker's-weed within a glacial frost bottom. *Sophia Roemer*

  - **State- listed Plants** – The CMP does not have specific state-listed plant monitoring requirements, but does reference monitoring and reporting will be done. How best to monitor these plants, particularly Adder's Tongue Fern (*Ophioglossum pusillum*) and Broad Tinker's-weed (*Triosteum perfoliatum*), while minimizing disturbance is still a topic of mutual interest and discussion with MassWildlife. Six rare plant sites (frost bottoms) were surveyed for Triosteum in 2022 with five having presence and one without continuing a decline at that site. Additional effort went to monitoring the effectiveness of the corral style fence at a frost bottom rare plant site. Game cameras and brows surveys show that browse and deer access are eliminated while the fence has the benefit of being wooden and temporary without soil impacts or digging that may present a safety hazard. The technique may be warranted elsewhere. Ophioglossum was only observed at one of four sites surveyed for that species showing a similar pattern as the state-wide population.

- **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 FY21 for winter (FY22) implementation in Training Area E-3 (Burn Unit RAW3, PBMFA-West). Due to increased costs of implementation the project was scaled down to the highest priority 27 acres,

which exposed an overgrown kettle hole depression and its "airshed" with intent of restoring frost bottom ecological function. This project is restoring scrub oak shrubland habitat transitioning into pitch pine – scrub oak habitat at the transition from glacial moraine to the impact area. This is the highest priority type of restoration effort as it restores impact area type habitat in areas where habitat maintenance actually can be implemented and this project was adjacent to the previously restored OP9/OP10 area. The harvest was completed December 29th, 2021 and initial results look promising for a functional frost bottom. The remainder of the originally planned harvest was contracted in November, 2022, and is ongoing.

- **Other Habitat Maintenance/Restoration**
  - An invasive shrub treatment was contracted for fall 2021 that included 14 acres of Grassland Unit (GLU) 04a, which is the southeastern portion of SGMFA-Primary. This treatment targeted Honeysuckle (*Lonicera japonica*), Autumn Olive (*Eleagnus umbellata*), Multiflora Rose (*Rosa multiflora*), and other priority invasive plants. It was successfully completed November 3rd, 2021. Herbicide application is a critical piece of habitat conservation and restoration and is implemented with numerous best management practices and use minimization.

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. Selective treatment of tree oak sprouts is critical to restoration of pitch pine – scrub oak natural communities. *Jake McCumber*

  - 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).
  - Hand-pulling of Spotted Knapweed (*Centauria stoebe*) was implemented across approximately 5 acres at Demo-2 (PBMFA-North) and Wheelock Overlook (PBMFA-West) to reduce encroachment into restored areas by this aggressive invasive plant.
  - Targeted spot-treatment with Glyphosate was used to control the invasive grass Calamagrostis epigejos within SGMFA-Primary (central grasslands), PBMFA-North (Training Area C-14), and PBMFA-South (Training Area B-6) to treat early detections and hopefully avoid broad habitat loss. This grass is a high priority for MassWildlife and MAARNG due to its tendency to create monocultures and expand rapidly – eliminating habitat value and use.
- **Prescribed Burning**
  - Seven prescribed burns were conducted within mitigation areas in FY2022. Programmatic rebuilding following the impacts of the pandemic on fire programs led to a very successful prescribed burning year that is planned to continue building. We well met annual targets

(100 acres of pine barrens, 40 acres of grassland) and successfully burned 227.5 acres in mitigation areas during FY2022.

- A spring grassland prescribed burn was conducted in SGMFA-Primary, GLU4C and GLU4D (northern 2/3 of the western half of the mitigation area). This 65 acre burn was conducted on April 11, 2022, and led to significant rare species observations including the above described influx of Frosted Elfin Butterflies and Slender Clearwing Moths. Continuing a relatively high return frequency (every 3 years) on rotation with the surrounding units will be important to maintain and improve the grassland/heathland habitat conditions of this unit. In balancing conditions for grassland birds and species like Frosted Elfin the scattered mature tree canopy should be maintained, but this leads to continual maintenance to reduce heavy encroachment from younger woody plants.
- A significant effort of planning and implementation went into a complex set of units on the moraine ridge in PBMFA-West (Training Area E-2). Four burn operations were conducted within quick succession (22, 24, 25, and 30 April, 2022) to set up the more complicated units by effective managing downwind fuels and other challenges with the burn scheduling. These four units totaled 99.5 acres of high priority habitat. One subunit was burned for the third time and is now likely in "maintenance mode" allowing for longer return intervals. The second subunit was burned for the second time as a critical stage in its restoration. The two northern subunits were each burned for their first time, which was greatly facilitated by the strategic scheduling and implementation.
- Two subunits were burned with growing season fire in PBMFA-South (Training Area B-6) to both allow for safe operations with the density and height of scrub oak in the unit and provide for habitat diversity through fire effects. The two operations (06 and 15 June, 2022) totaled 63 acres in high priority pitch pine – scrub oak habitat. Much like in grasslands, patchwork burning with diverse fire treatments (seasonality, intensity, etc.) is critical to meeting habitat and rare species conservation objectives.

Grassland Unit GLU04D in July, 2022, following an April prescribed burn. In 2022 the foreground of this image supported Walsh's Digger Bee (*Anthophora walshii*), Frosted Elfin Butterfly, and Slender Clearwing Moth among many other species. Transitions from open sandy blowout to lush grass/forb regeneration are essential to support species diversity in barrens habitats. Dynamic, early successional mosaics support a rich and resilient community of species, many of which are very uncommon regionally or globally and are highly localized within such habitat. *Jake McCumber*

## Fiscal Year 2023 Planning and Implementation

Army National Guard budgets have again been substantially reduced in FY23, impacting facilities and environmental programs throughout the country. However, $341,000 has been funded specifically for state-listed species conservation projects between dedicated mitigation under the master development plan CMP ($118,000; MA175180002), other state-listed species projects ($47,000; MA175150003), and an additional $176,000 that has been funded through supplemental sources to cover the primary mechanical restoration project for FY23 (RAW3 forest thinning). Other monitoring and habitat restoration funding supports the mitigation implementation requirements. 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. As the initial mitigation requirements are met for actions such as major monitoring plan development and primary MILCON acreage requirements, the perpetual requirements funding will predominantly shift to the state-listed species funding tied to the CMP similar to the FY22 funding. Annual expenses after the first five or so years will decrease significantly as MAARNG shifts to focus on annual maintenance and management targets, resource monitoring, and data analysis.

Eastern Box Turtles have been and remain a major investment of funds and time, including research collaborations. MAARNG has been working on several fronts to better understand their ecology, land use history effects on their response to management, parasite impacts, and fire ecology. *Jake McCumber*

Mechanical implementation of habitat mitigation is expected to be similar to FY22 with one primary, high priority restoration effort. Significant focus has gone into planning and facilitation to continue increasing prescribed fire implementation. As mapped and described below numerous prescribed burn priorities are planned throughout the training site in various mitigation focal areas to continue restoration and maintenance of pine barrens and sandplain grassland mosaic conditions.

Monitoring and research efforts will be focal for FY23 with the continued implementation of the long-term moth monitoring protocol and ongoing box turtle research in partnership with UMass Amherst, MassWildlife, and US Fish and Wildlife Service.

- **Project Scoping, Design Minimization, and NHESP Review**
  - **MPMG Range –** Completion of the Environmental Management Commission process will hopefully be in 2023 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.
  - **Tango Range –** Final reporting is in development and preparation for submission to NHESP to close out the construction phase of the project and move into long-term maintenance and use.

- **Track and Field (1800 area) –** Depending on funding the contracting of this project is anticipated during FY23. Contracting and implementation of the approved turtle protection plan and all other pre-Work requirements will be submitted for approval and completed as appropriate and able prior to construction.
- **ISBC Range –** Design consultation and internal review are ongoing with external reviews pending. It is anticipated that the CFMO will contract the turtle protection plan and other required support (e.g., permit compliance letter) given current funding if the project is slated to move forward in FY23. Submission and completion of all pre-Work required information and tasks will be completed as required prior to construction, to include approval and implementation of turtle protection, design review, etc.

- **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 and continued monitoring.
  - **Track and Field** – Initiation and compliance of turtle protection plan consistent with approval if construction project is funded and awarded.

The Acadian Hairstreak Butterfly is increasingly rare in MA, but appears to be faring well in barrens habitat at Camp Edwards. While not state-listed, listing has been proposed. A more dedicated survey for this species may be implemented in 2023 along with investigating the potential hosts. *Jake McCumber*

- **Species Monitoring**
  - **Eastern Box Turtles** – Ongoing in-house monitoring of box turtles found both opportunistically and during targeted surveys in 2019, 2020, and 2021 near future construction projects as well as those found during planning level surveys. Support for two graduate research projects focusing on efforts related to fly larval impacts and prescribed fire impacts. Review of health assessment results and continued coordination with university veterinarians.
  - **Bird Surveys** – 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, 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.

- **Habitat Management and Planning (see map below)**
  - **Prescribed Fire** – Priority prescribed burn areas for mitigation include:
    - PBMFA-West: Training Areas A-5, B-7, and BA-4 maintenance fires for pitch pine – scrub oak and pitch pine – heath habitat up to approximately 617 acres.
    - PBMFA-South: Training Areas B-6 and B-7 maintenance fires for pitch pine – scrub oak and pitch pine – heath habitat up to approximately 502 acres.

- SGMFA-Primary: Approximately 58 acres are prioritized for the more wooded northeastern portion of the mitigation area to facilitate slower conversion to savannah conditions suitable for frosted elfin and similar species while maintaining soil-disturbance sensitive plants. Approximately 16 acres are prioritized for the southwestern portion to maintain open grassland habitat.

- **Mechanical and Other Restoration** –
  - Phase two of the RAW3 (Training Area E-3, PBMFA-North) frost bottom restoration and surrounding forest thinning. This phase facilitates air-flow for frost bottom ecological function, which also will provide high quality pitch pine – scrub oak natural community outside the impact area. Phase two is 47 acres of thinning with a patchy distribution of treatment being implemented in the winter of 2022/2023.
  - 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 FY23.
  - A 30-acre coppice treatment of tree oak regeneration in the C-14 restoration area (PBMFA-North) was contracted in FY22 for completion in October and November 2022 (FY23). These coppice treatments are strongly recommened by MassWildlife and 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.
  - Completion of a 50-acre invasive shrub treatment (described above) within SGMFA-Primary that was contracted in FY22 for fall 2022 completion.

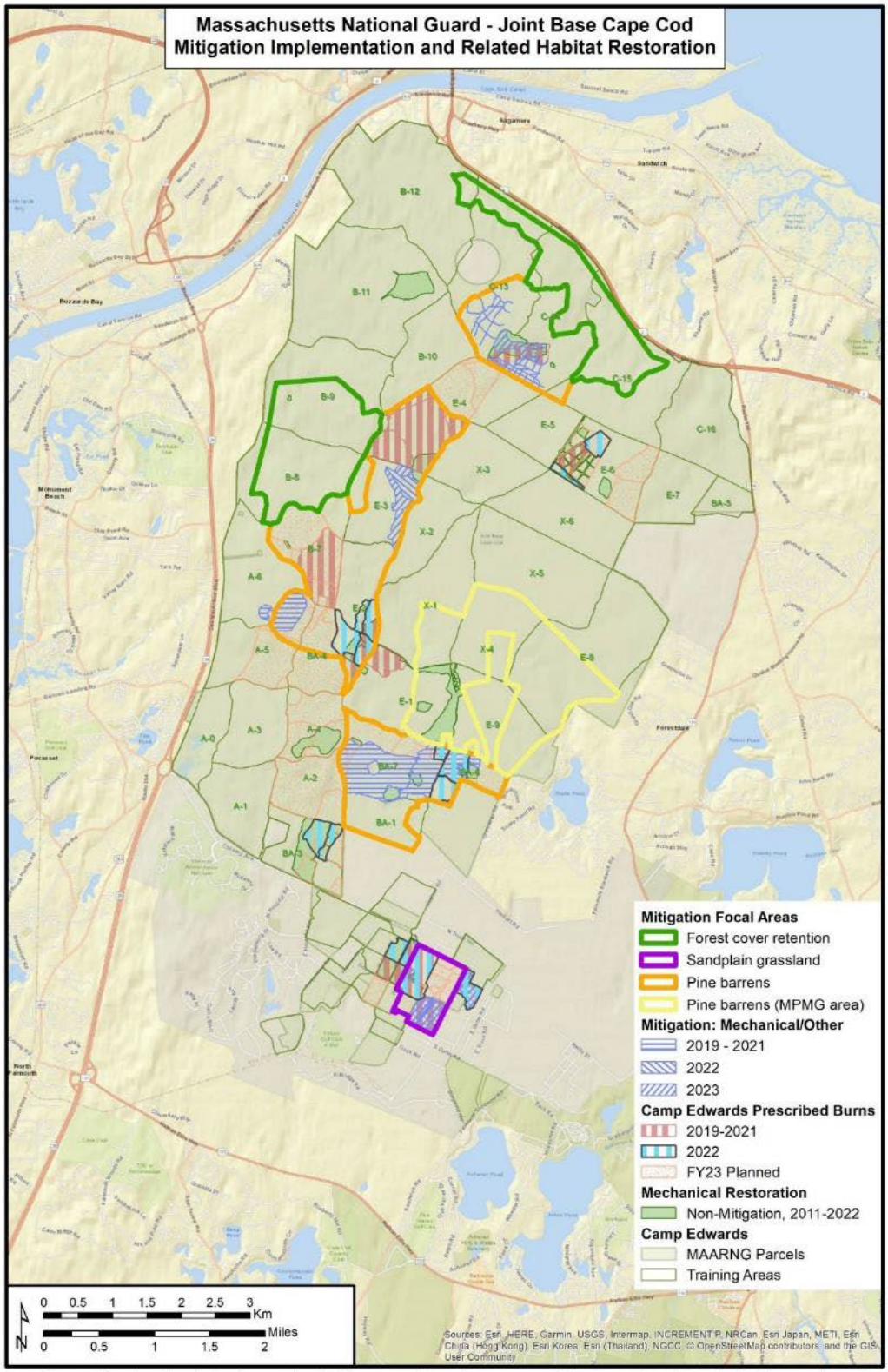
- **Rare species and mitigation outreach:** while outreach for rare species is not required or discussed in the CMP, other than contractor education, public outreach on rare species is important for long-term support of conservation efforts at Camp Edwards and elsewhere, including mitigation efforts.
  - **Camp Edwards Tours** – Base-wide tours of Camp Edwards have been well attended and popular with the public. 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

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. *Kathleen Kolva*

successional habitat. FY22 tours averaged two per month from October through December and April through September.

- **Grassland Bird Tours** – MAARNG hosted five public tours in May and June focusing on localized specialties of sandplain grassland habitat at Camp Edwards. These have long been productive out-reach with the public and bird enthusiasts for both grasslands habitat conservation and military conservation. Everyone was particularly enthusiastic for the return of the tours after two years off and they were all fully attended with 20 participants each.
- **Public presentations** – MAARNG personnel, particularly Jake McCumber, gave multiple other public or wide audience outreach presentations focused on state-listed species and rare habitat management during FY22. Multiple evening presentations were given to the Upper Cape Naturalist Club including ones on Barrens Buckmoth (with guided tour at Crane WMA), grassland birds of Camp Edwards (associated with tours), and a Camp Edwards overview. 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. We also presented an hour-long webinar to US Fish and Wildlife Service At-risk Species conservation stakeholders regarding state-listed and At-risk Species conservation efforts. Two community television interviews were aired that included discussions of rare species and habitat conservation at Camp Edwards, in addition to a variety of special group and public presentations including MA Maritime Academy, USDA-APHIS, Bourne Newcombers, Cape Cod Masons, Mashpee seniors, and others. 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.

Frosted Elfin Butterfly (left) and Eastern Box Turtle with radio transmitter (right). *Jake McCumber*




Map of Camp Edwards mitigation implementation (habitat restoration and management) from 2019 through 2022, including ongoing and planned 2023 efforts. Designated mitigation areas from the Conservation and Management Permit are also shown, as are Camp Edwards Training Areas for reference.

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

| Appendix G - LIST OF RARE SPECIES REPORTED TO NHESP | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Quantities shown[1] are not simply results of standardized surveys and do not represent population trends. Only observed species are listed[2]. | | | | | | | | | | | | |
| | | | Individuals Reported | | | | | | | | | |
| **Common/Scientific Names** | **Fed Status[3]** | **State Status[4]** | **TY 2013** | **TY 2014** | **TY 2015** | **TY 2016** | **TY 2017** | **TY 2018** | **TY 2019** | **TY 2020** | **TY 2021** | **TY 2022** |
| **BIRDS** | | | | | | | | | | | | |
| Grasshopper Sparrow[5] *(Ammodramus savannarum)* | - | T | 19 | 26 | 23 | 16 | 15 | 16 | 20 | 34 | 36 | 29 |
| Northern Harrier[6] *(Circus cyaneus)* | - | T | 8 | 12 | Wintering | Wintering | Wintering | Wintering | Wintering | Wintering | Wintering | Wintering |
| Upland Sandpiper[5] *(Bartramia longicauda)* | - | E | 5 | 2 | 4 | 9 | 8 | 7 | 12 | 6 | 2 | 1 |
| Eastern Meadowlark[5,7] *(Sturnella magna)* | - | SC | 3 | 1 | 0 | 8 | 3 | 2 | 7 | 14 | 17 | 9 |
| Long-eared Owl[6] *(Asio otus)* | - | SC | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vesper Sparrow *(Pooecetes gramineus)* | - | T | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Whip-poor-will *(Antrostomus vociferous)* | - | SC | 51 | 156 | 96 | 87 | 52 | 110 | 53 | 99 | 136 | 137 |
| Bald Eagle[6] *(Haliaeetus leucocephalus)* | - | SC | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **REPTILES and AMPHIBIANS** | | | | | | | | | | | | |
| Eastern Box Turtle *(Terrapene carolina carolina)* | - | SC | 1 | 15 | 13 | 38 | 42 | 43 | 58 | 45 | 83 | 62 |
| Eastern Hog-nosed Snake *(Heterodon platirhinos)* | - | SC | 0 | 0 | 0 | 2 | 3 | 8 | 9 | 1 | 2 | 6 |
| **PLANTS** | | | | | | | | | | | | |
| Adder's Tongue Fern[8] *(Ophioglossum pusillum)* | - | T | 542 | 1467 | 256 | 98 | 247 | 0 | 25 | 646 | N/A | 225 |

| Appendix G - LIST OF RARE SPECIES REPORTED TO NHESP | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Quantities shown[1] are not simply results of standardized surveys and do not represent population trends. Only observed species are listed[2]. | | | | | | | | | | | | |
| | | | Individuals Reported | | | | | | | | | |
| **Common/Scientific Names** | **Fed Status[3]** | **State Status[4]** | **TY 2013** | **TY 2014** | **TY 2015** | **TY 2016** | **TY 2017** | **TY 2018** | **TY 2019** | **TY 2020** | **TY 2021** | **TY 2022** |
| Spring Ladies Tresses *(Spiranthes vernalis)* | - | T | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 |
| Broad Tinker's Weed[8] *(Triosteum perfoliatum)* | - | E | 1230 | 297 | N/A | 113 | 127 | 0 | 200 | 6 | N/A | 1883 |
| American Arborvitae[9] (*Thuja occidentalis*) | - | E | 0 | 0 | 0 | 4 | N/A | N/A | N/A | N/A | N/A | N/A |
| **BEES** | | | | | | | | | | | | |
| Walsh's Anthophora[10] *(Anthophora walshii)* | - | E | 0 | 0 | 0 | 0 | 5 (1) | 0 | 32 (9) | 4 | N/A | 1 |
| **BUTTERFLIES and MOTHS[11]** | | | | | | | | | | | | |
| Buck Moth (*Hemileuca maia*) | - | SC | 0 | 4 | 13 | 90 | 95 | 0 | 4 | 2 | 74 | 133 |
| Pine Barrens Speranza *(Speranza exonerata)* | - | SC | 0 | 0 | 0 | 44 | 13 | 0 | 0 | 0 | 0 | 4 |
| Sandplain Euchlaena *(Euchlaena madusaria)* | - | SC | 0 | 0 | 0 | 3 | 7 | 0 | 0 | 1 | 0 | 0 |
| Heath Metarranthis *(Metarranthis pilosaria)* | - | SC | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| Melsheimer's Sack Bearer *(Cicinnus melsheimeri)* | - | T | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 7 | 0 | 0 |
| Gerhard's Underwing *(Catocala herodias)* | - | SC | 0 | 0 | 0 | 33 | 10 | 0 | 0 | 2 | 0 | 35 |
| Pine Barrens Zale *(Zale lunifera)* | - | SC | 0 | 0 | 0 | 13 | 8 | 0 | 0 | 0 | 0 | 0 |
| Barrens Dagger Moth *(Acronicta albarufa)* | - | T | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sandplain Heterocampa *(Heterocampa varia)* | - | T | | | | | 0 | N/A | N/A | N/A | N/A | 1 |

| Appendix G - LIST OF RARE SPECIES REPORTED TO NHESP | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Quantities shown[1] are not simply results of standardized surveys and do not represent population trends. Only observed species are listed[2]. | | | | | | | | | | | | |
| | | | Individuals Reported | | | | | | | | | |
| **Common/Scientific Names** | **Fed Status[14]** | **State Status** | **TY 2013** | **TY 2014** | **TY 2015** | **TY 2016** | **TY 2017** | **TY 2018** | **TY 2019** | **TY 2020** | **TY 2021** | **TY 2022** |
| **BUTTERFLIES and MOTHS[11]** | | | | | | | | | | | | |
| Chain-dotted Geometer *(Cingilia catenaria)* | - | SC | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Drunk Apamea *(Apamea inebriata)* | - | SC | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pink Sallow *(Psectraglaea carnosa)* | - | SC | 0 | 0 | 0 | 9 | 5 | 0 | 0 | 0 | 0 | 0 |
| Pink Streak *(Dargida rubripennis)* | - | T | 0 | 0 | 0 | 25 | 0 | 0 | 0 | 3 | 1 | 1 |
| Collared Cycnia *(Cycnia collaris)* | - | T | 0 | 0 | 0 | 0 | 1 | 0 | 11 | 33 | 200 | 7 |
| Coastal Heathland Cutworm *(Abagrotis benjamini)* | - | SC | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Woolly Gray *(Lycia ypsilon)* | - | T | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| Water-willow Stem Borer *(Papaipema sulphurata)* | - | T | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Waxed Sallow Moth *(Chaetaglaea cerata)* | - | SC | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| Frosted Elfin *(Callophrys irus)* | - | SC | 0 | 0 | 0 | 5 | 5 | 5 | TBD | 25 | 57 | 13 |
| Slender Clearwing Sphinx *(Hemaris gracilis)* | - | SC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 3 | 26 |
| **ODONATES** | | | | | | | | | | | | |
| Scarlet Bluet | | | | N/A | N/A | N/A | N/A | | | 6 | | |

| 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[14]** | **State Status** | **TY 2013** | **TY 2014** | **TY 2015** | **TY 2016** | **TY 2017** | **TY 2018** | **TY 2019** | **TY 2020** | **TY 2021** | **TY 2022** |
| **CRUSTACEANS** | | | | | | | | | | | | |
| Agassiz's Clam Shrimp[12] *(Eulimnadia agassizii)* | - | E | 0 | 0 | 1 | 0 | 6 | 38 | 9 | 3 | *5* | N/A |
| American Clam Shrimp[12] *(Limnadia lenticularis)* | - | SC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | N/A |
| **MAMMALS** | | | | | | | | | | | | |
| Northern Long-Eared Bat[13] *(Myotis septentionalis)* | T | E | 0 | 8 | 22 (2) | 15 (1) | 2 | 1 | 3 | 1 | TBD | N/A |
| Little Brown Bat[7] *(Myotis lucifugus)* | UR | E | 0 | 4 | 40 | 22 | 4 | 2 | 6 | 2 | TBD | N/A |
| Tricolored Bat[7] (Perimyotis subflavus) | UR | E | 0 | 11 | 11 | *7* | 3 | 2 | 3 | 1 | TBD | N/A |
| Eastern Small-Footed Bat[13] *(Myotis leibii)* | UR | E | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | TBD | N/A |

[1] Reported quantities are variable dependent upon survey effort, area/species of focus in a given year, opportunistic observations, and other influences. MAARNG reports all state-listed species observations consistent with the Environmental Performance Standards, with some caveats noted below.

[2] A full state-listed species list is included in the INRMP.

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

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

[5] 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.

[6] 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).

[7] 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.

[8] In 2018 only sites with historic records and no recent records were surveyed.

[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] Numbers represent occupied locations with confirmed identification.

[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. TY 2020 data is still being processed, these numbers are to be determined at a later date (TBD).

# APPENDIX H
# ENVIRONMENTAL PERFORMANCE STANDARDS VIOLATIONS HISTORY

| EPS VIOLATIONS HISTORY | | | |
|---|---|---|---|
| TRAINING YEAR | REPORTED VIOLATION | EXPLANATION OF VIOLATION | CORRECTIVE ACTION |
| 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<br><br>(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.<br>Camp Edwards staff conducted a Range Officer in Charge and Range Safety brief audit to validate content and effectiveness.<br>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<br><br>(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.<br>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 | ----- | |
| TY 2013 | None | ----- | ----- |