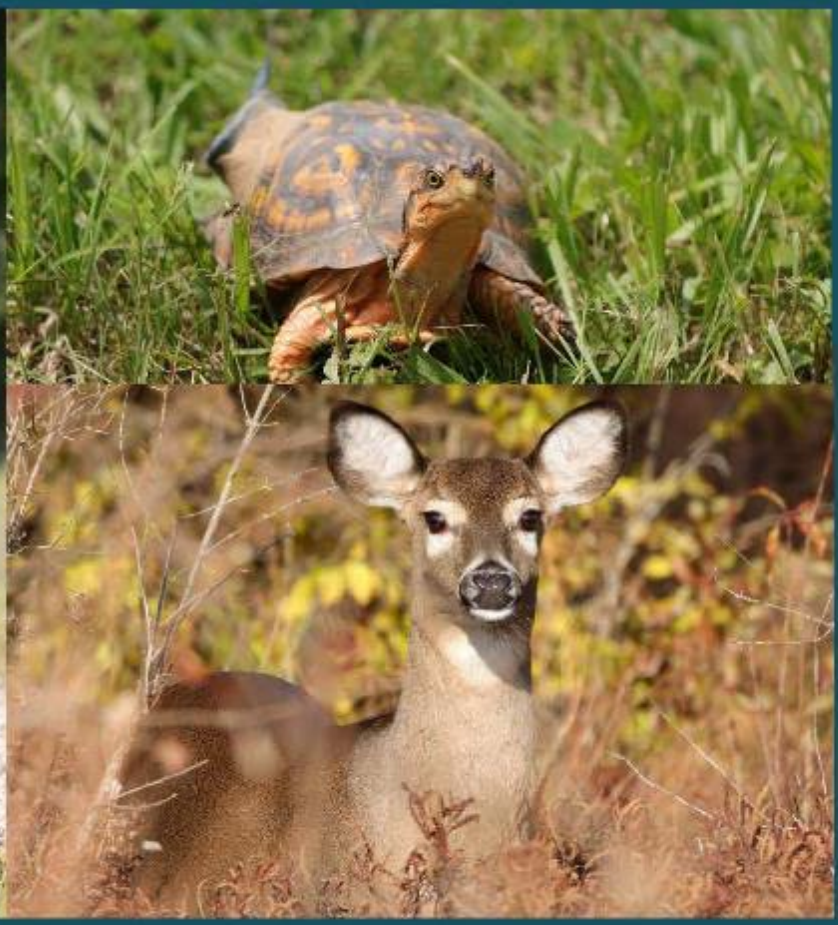
STATE OF THE RESERVATION REPORT

TRAINING YEAR 2021• CAMP EDWARDS
FINAL



Final Annual State of the Reservation Report, Camp Edwards, Training Year 2021
April 2022

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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 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 2021, which ran from October 1, 2020 to September 30, 2021; 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. Cape Cod Air Force Station and the US Coast Guard Communications Station are both located within the boundary of the Upper Cape Water Supply Reserve; however, they are not subject to Chapter 47 of the Acts of 2002 and the Environmental Performance Standards (Chapter 47 of the Acts of 2002, Section 15).

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 2021. 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 2021 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. Cape Cod Air Force Station and US Coast Guard Communications Station Boston are both located within the boundary of the Upper Cape Water Supply Reserve; however, they are not subject to the Environmental Performance Standards.

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. Although Cape Cod Air Force Station and the US Coast Guard Communications Station are located within the boundary of the Upper Cape Water Supply Reserve, the Environmental Performance Standards do not apply to them as they were excluded by Chapter 47 of the Acts of 2002.

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 2021 (October 1, 2020 – September 30, 2021).

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.

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 operationally 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 2021. 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.

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ACRONYMS

AFCEC	Air Force Civil Engineer Center
AFS	Air Force Station
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
BMP	Best Management Practice
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
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
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
MCP	Massachusetts Contingency Plan
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
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
SGCN	Species of Greatest Conservation Need
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
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. Excluded from the Upper Cape Water Supply Reserve are areas outside of the operational control of the Massachusetts National Guard (See Section 1.1 and Figure 1-1).

1.1 JOINT BASE CAPE COD STRUCTURE

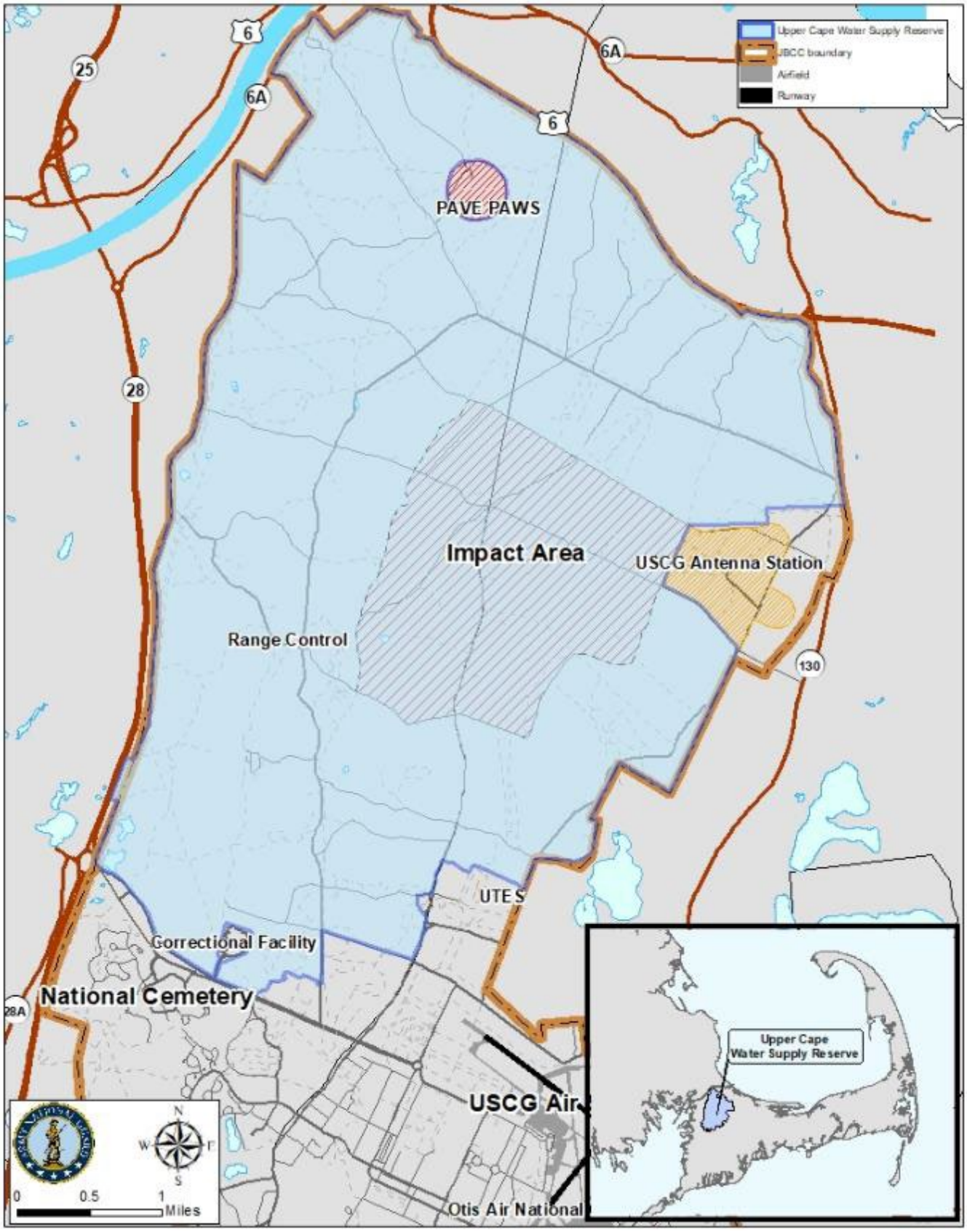
Joint Base Cape Cod is a multi-service military installation and is home to the Massachusetts Army National Guard's (MAARNG) Camp Edwards, the Massachusetts Air National Guard's (MAANG) Otis Air National Guard Base (ANGB), the United States Coast Guard's (USCG) Base Cape Cod, the U.S. Air Force's Cape Cod Air Force Station (AFS), 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 AFS, 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. Because these facilities are located on land not under the control of the Massachusetts National Guard, and because the Environmental Performance Standards (EPSs) (see Appendix A) established through Chapter 47 of the Acts of 2002 do not apply to these organizations and facilities, detailed information concerning activities at these facilities is not included in the Annual Report. Questions pertaining to activities at Cape Cod AFS, the Coast Guard Communications Station, and the Barnstable County Correctional Facility should be addressed to the persons listed in Appendix B of this report.

Figure 1-1 Map of Joint Base Cape Cod



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

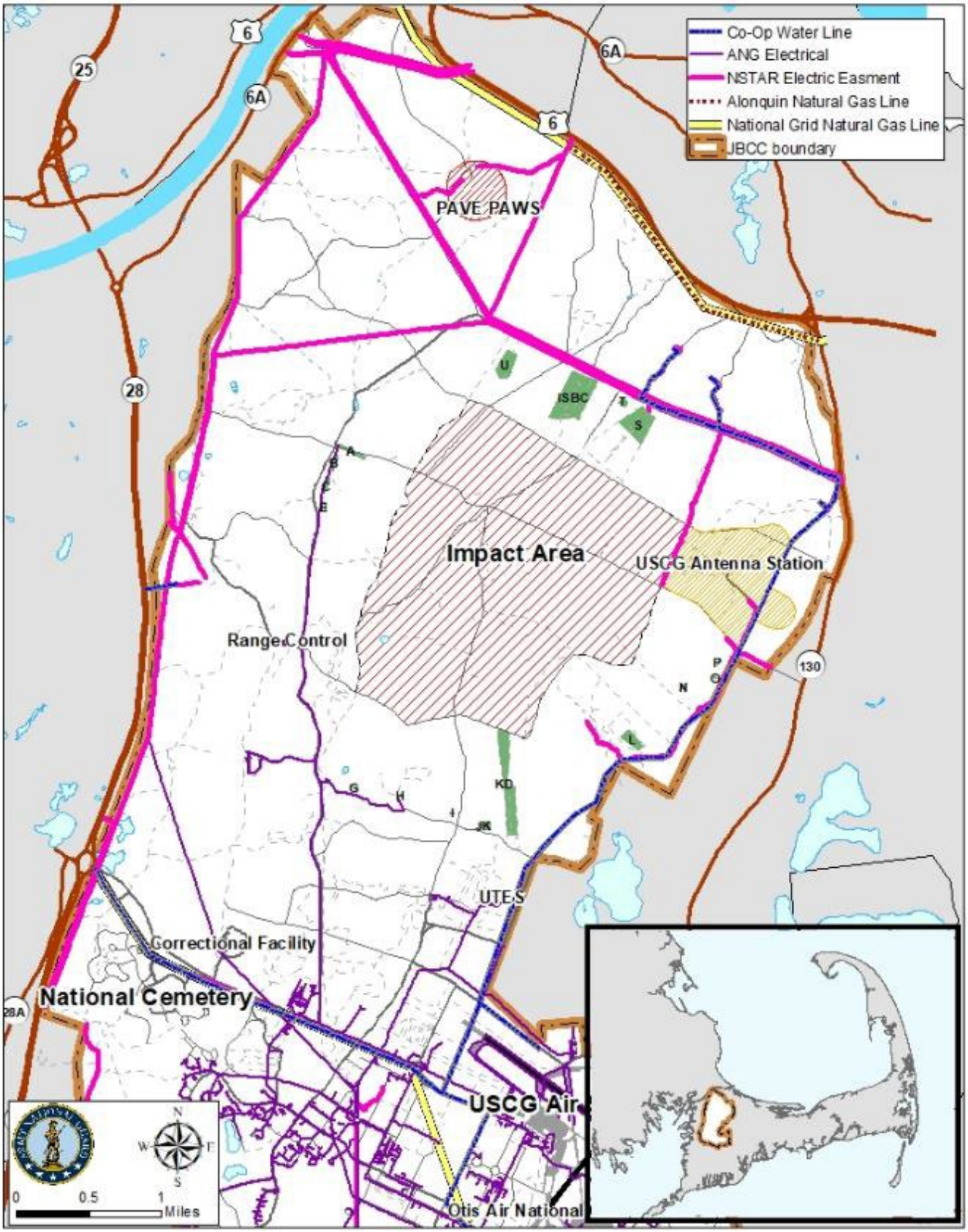
Chapter 47 of the Acts of 2002 also directed that the EMC be assisted by two advisory councils, appointed by the Governor of Massachusetts. The Community Advisory Council (CAC), consisting of 15 members, assists the EMC by providing advice on issues related to the protection of the water supply and wildlife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

The SAC and CAC met jointly in October 2020 and the SAC met in June 2021. The EMC did not meet during TY 2021. 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. Please see Section 2.3 for further discussion. Minutes from the meetings may be found at https://www.massnationalguard.org/ERC/advisory_groups_minutes.htm

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 operationally 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 2021.

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 6,068 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 Department of Defense (DoD) and law enforcement agencies (i.e.: Marines, US Coast Guard, Barnstable County Sheriff's Department, and local police departments). 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 2020) to the year of execution (TY 2021) 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 2021, while Table 2-2 shows their utilization for each of the past ten training years. For specific training area use for TY 2021 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 2021. 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 2021. 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 2021 and the average personnel use by training area for TY 2012 to TY 2021; Graph 2-2 shows days used by training area for TY 2021 and the average days used by training area for TY 2012 to TY 2021. 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 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/Impact Area Groundwater Study Program [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 the 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 2021. 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 2021

		PERSONNEL	
Area	**Training Days/Events**	**Military Personnel**	**Civilian Personnel**
Ranges	186	7,716	214
Training Areas	1,277	66,374	502
Training Support Areas	2,484	94,055	5,305
TOTAL	**3,947**	**168,145**	**6,021**

Figure 2-1 Camp Edwards Training Area and Ranges

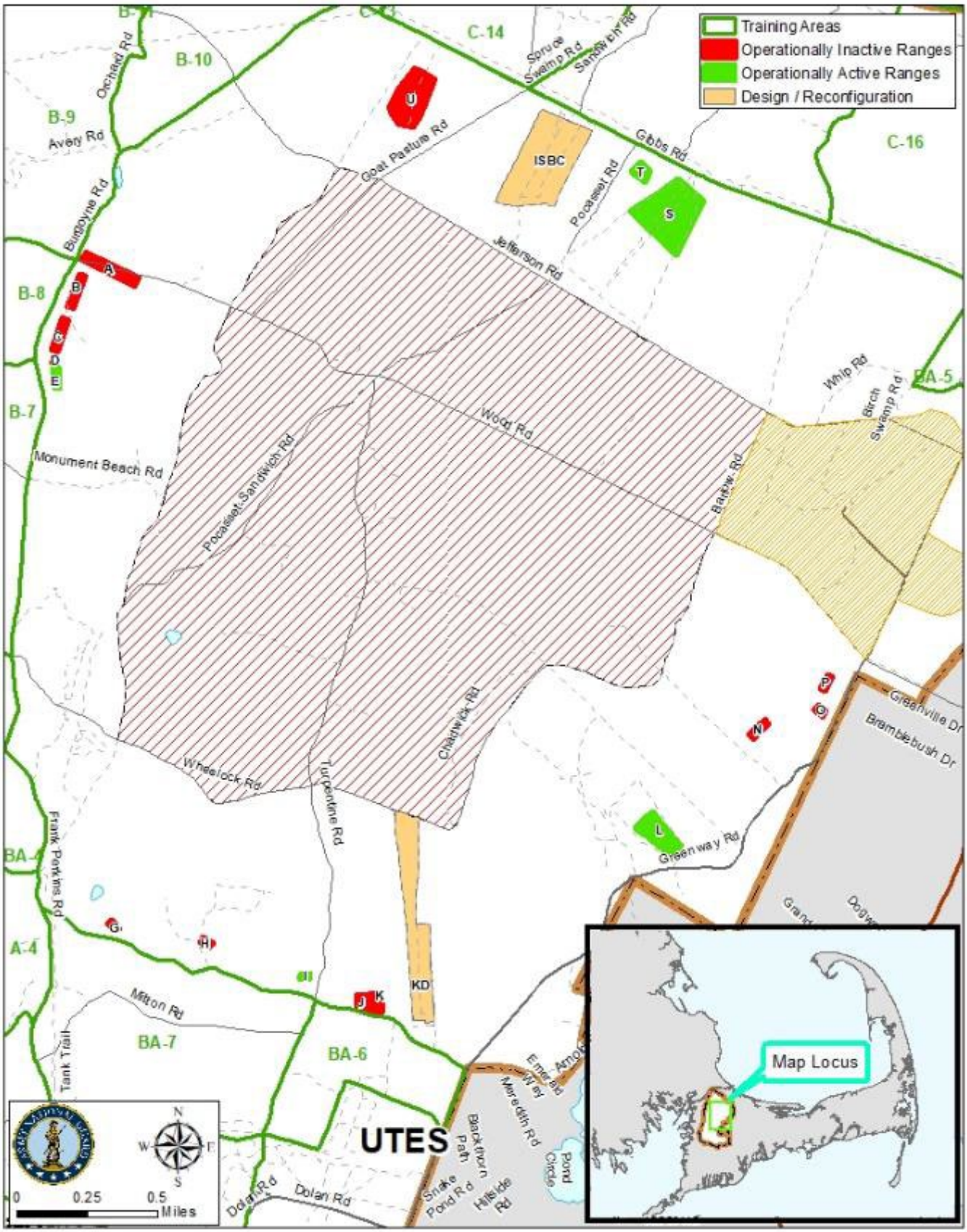


Figure 2-2 Personnel Usage by Training Area in the Training Area/Reserve, TY 2021

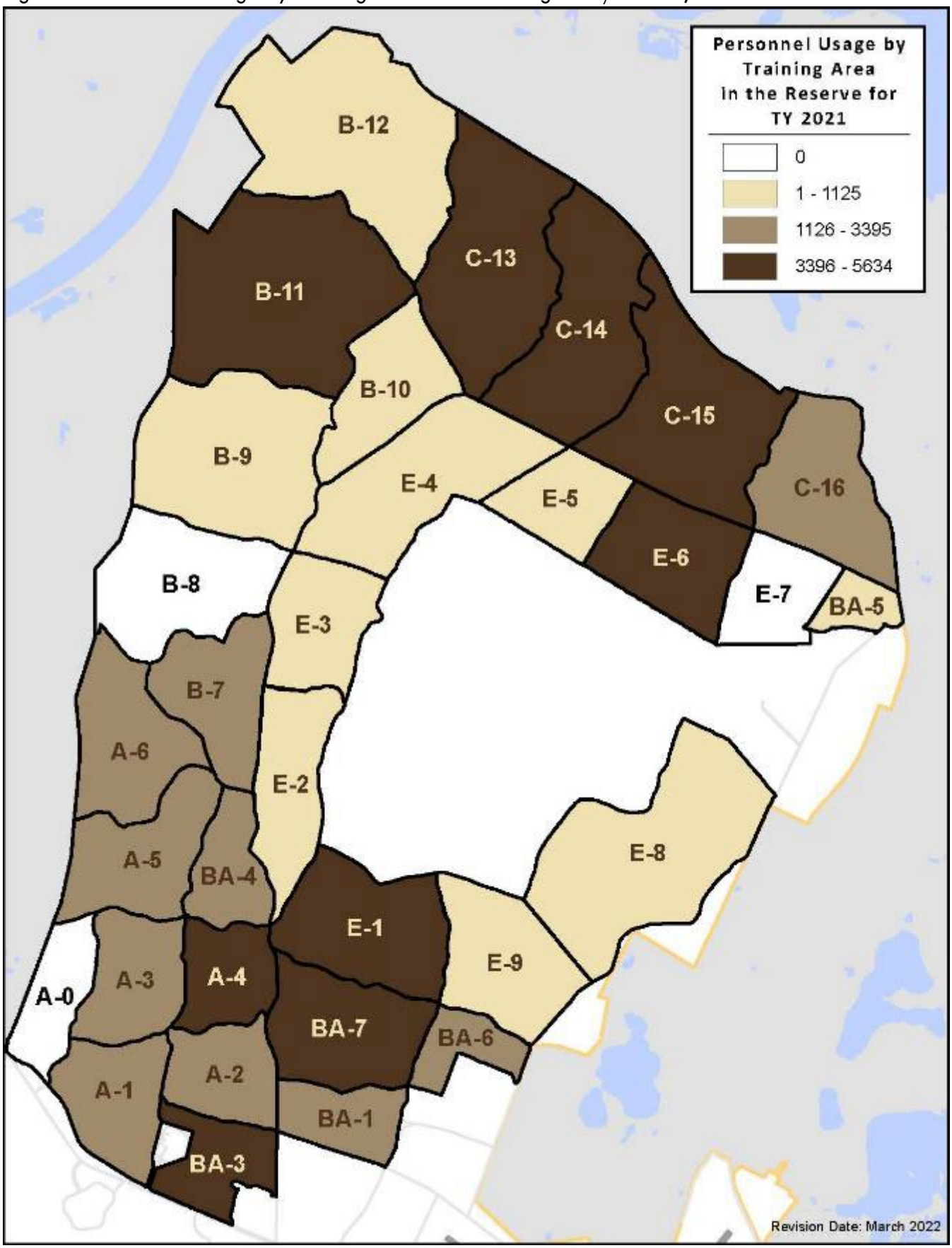
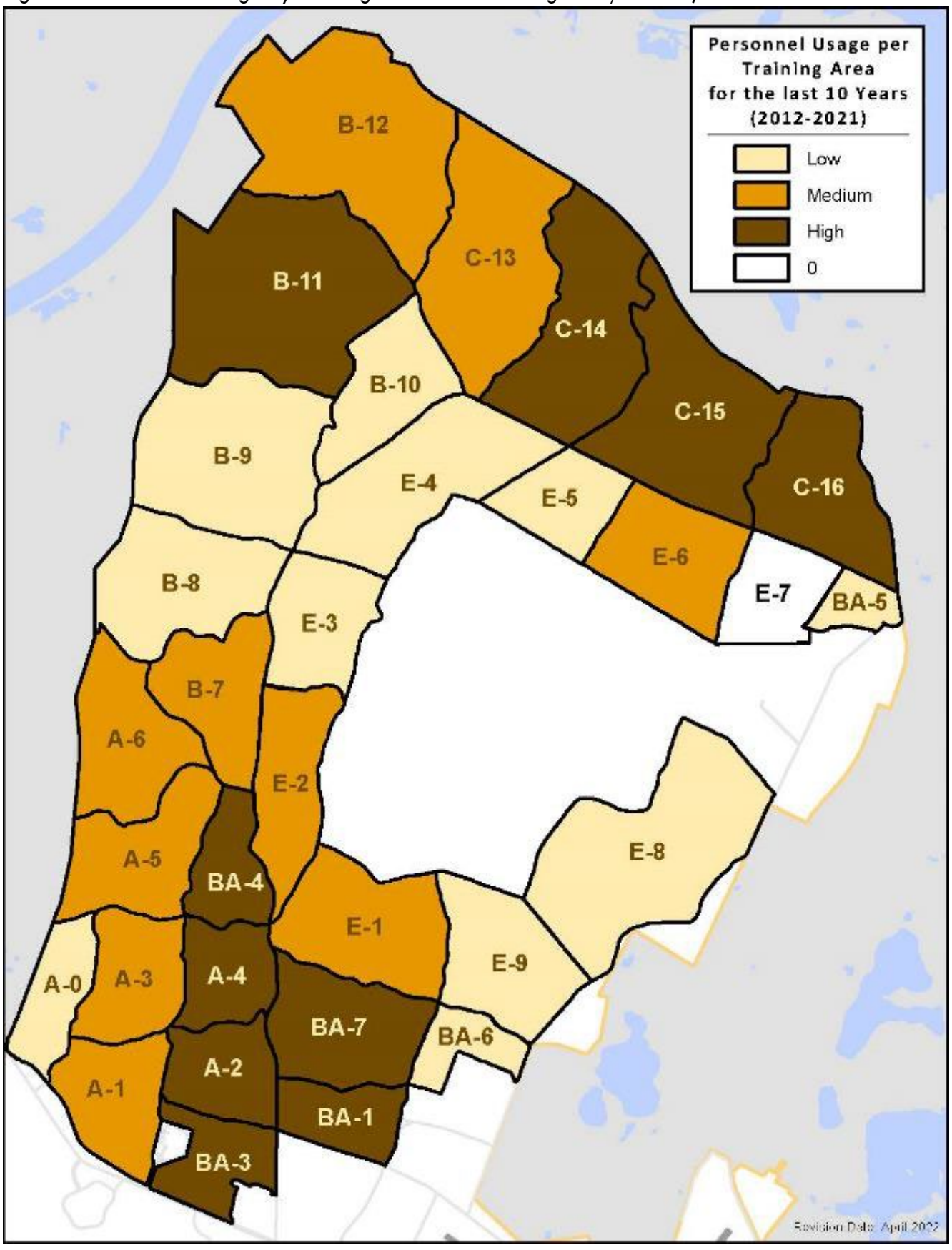
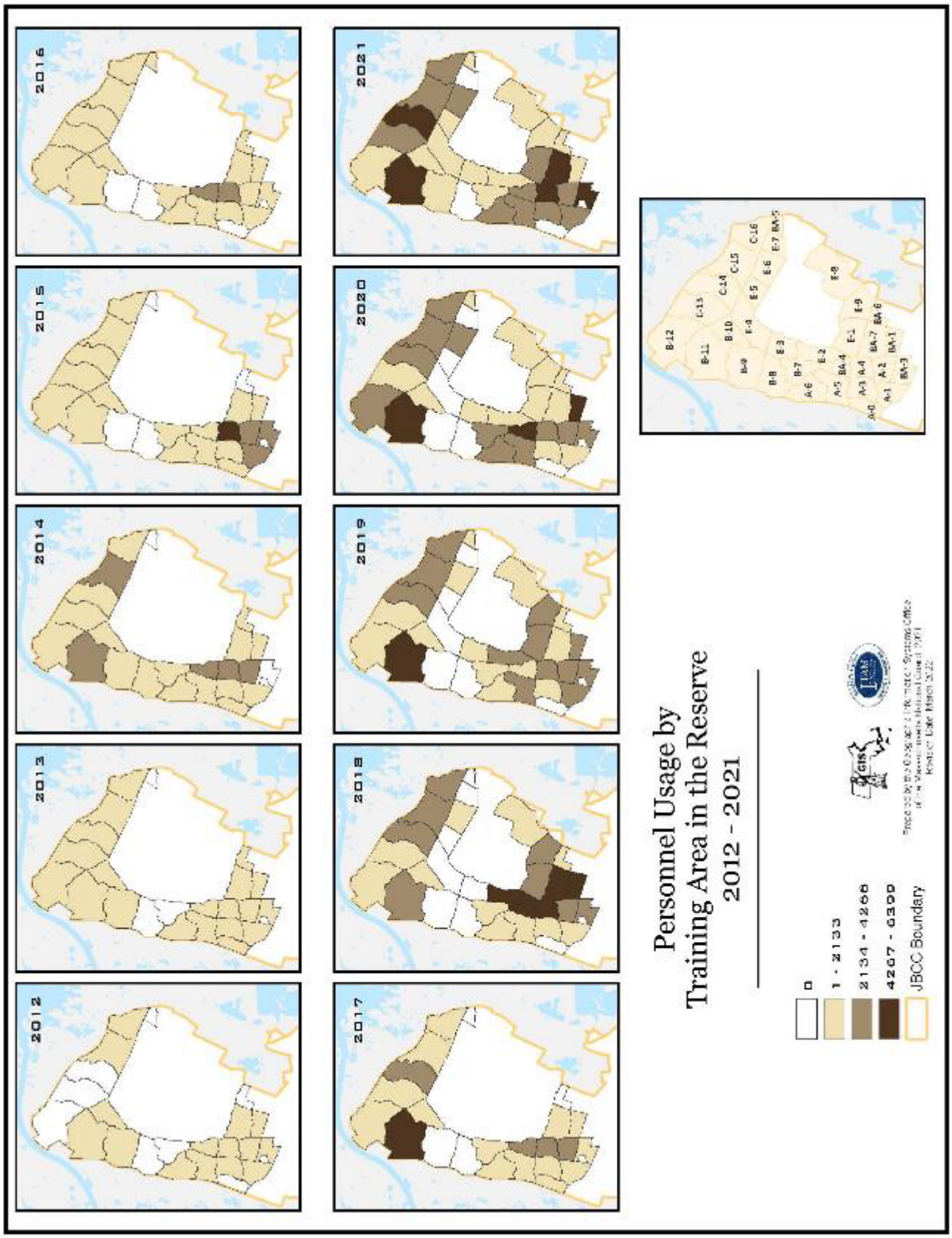


Figure 2-3 Personnel Usage by Training Area in the Training Area/Reserve, TY 2012 – TY 2021



Low=169-7,210 personnel; Medium=7,211-18,330 personnel; High=18,331-36,597 personnel

Figure 2-4 Ten Year Personnel Use by Training Area in the Training Area/Reserve, TY 2012 - TY 2021



Note: Prior to 2018, the E training areas were not available for use and are not delineated in the 2012 to 2017 graphics.

Figure 2-5 Daily Usage per Training Area in the Training Area/Reserve, TY 2021

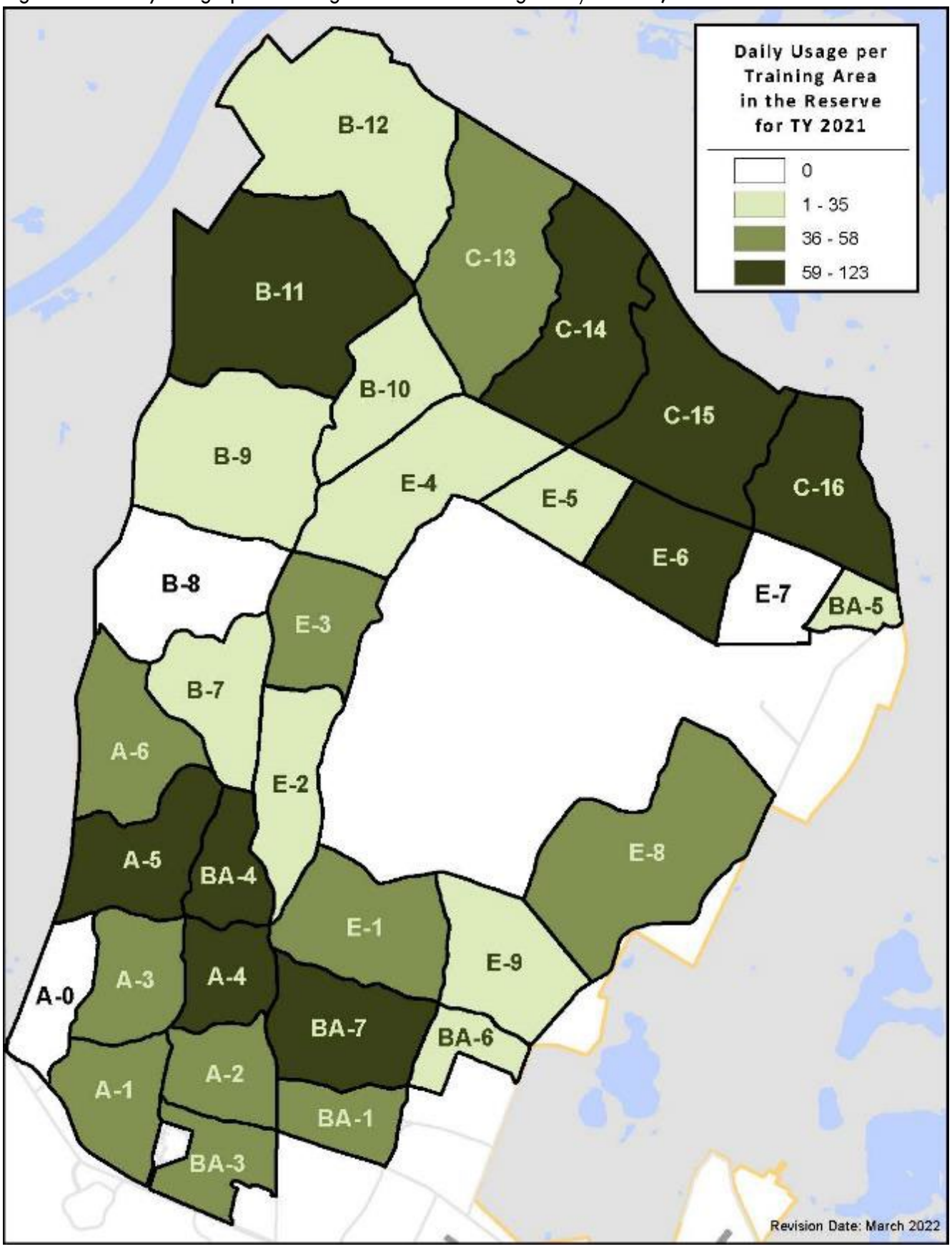
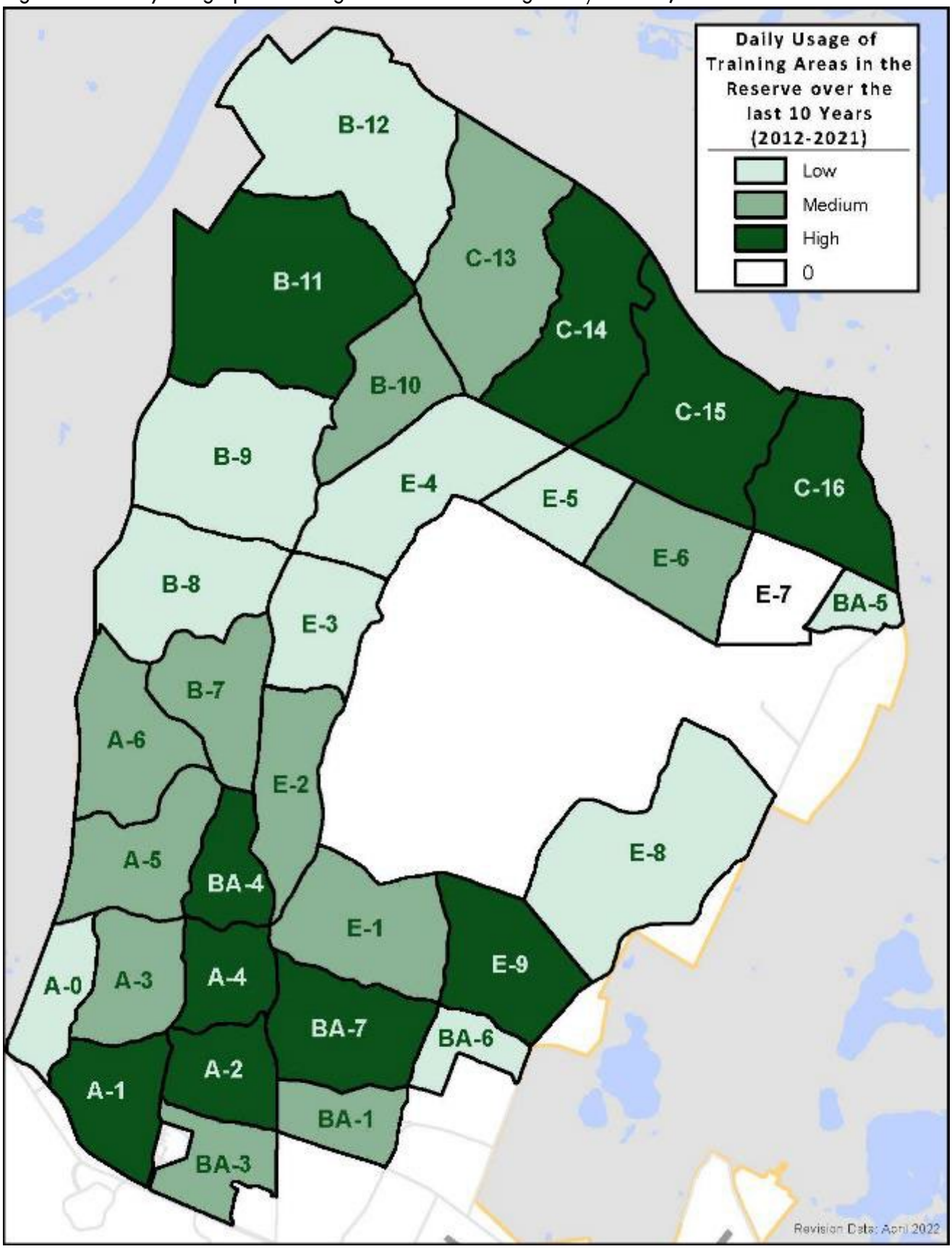
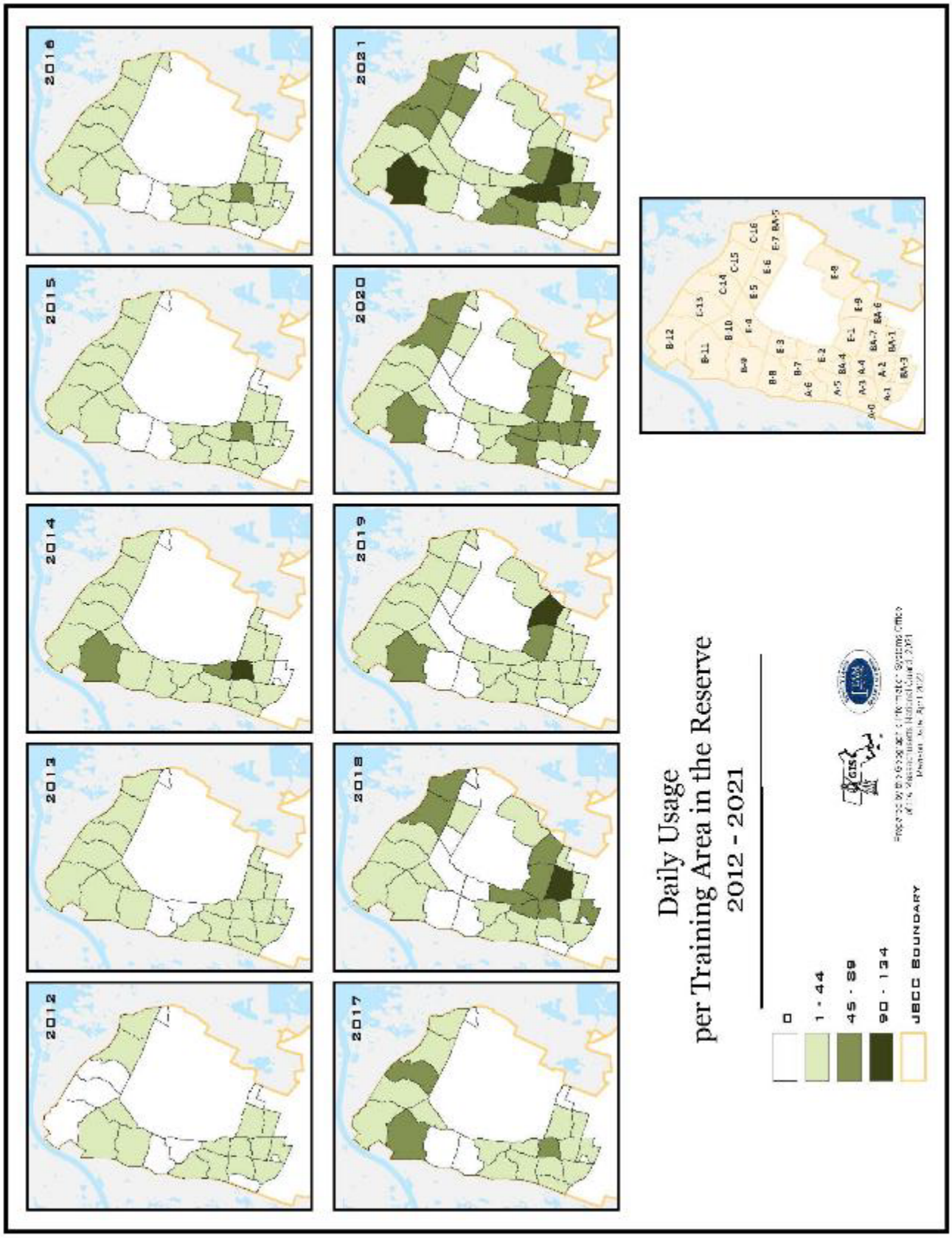


Figure 2-6 Daily Usage per Training Area in the Training Area/Reserve, TY 2012 – TY 2021



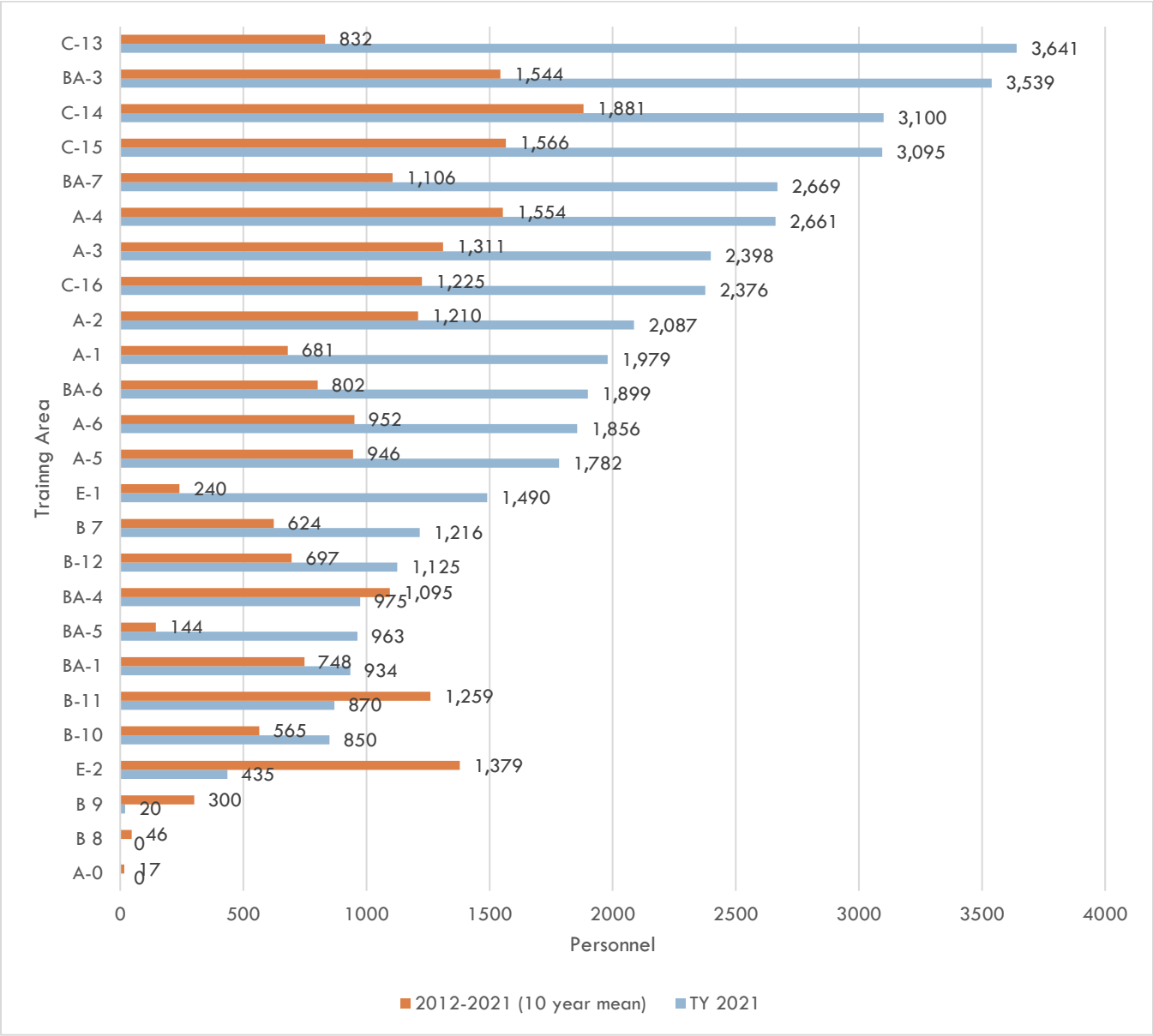
Low=4-85 days; Medium=86-267 days; High=269-616 days

Figure 2-7 Ten Year Daily Usage by Training Area in the Training Area/Reserve, TY 2012 – TY 2021



Note: Prior to 2018, the E training areas were not available for use and are not delineated in the 2012 to 2017 graphics.

Graph 2-1 Personnel Use by Training Area



Graph 2-2 Days Used by Training Area

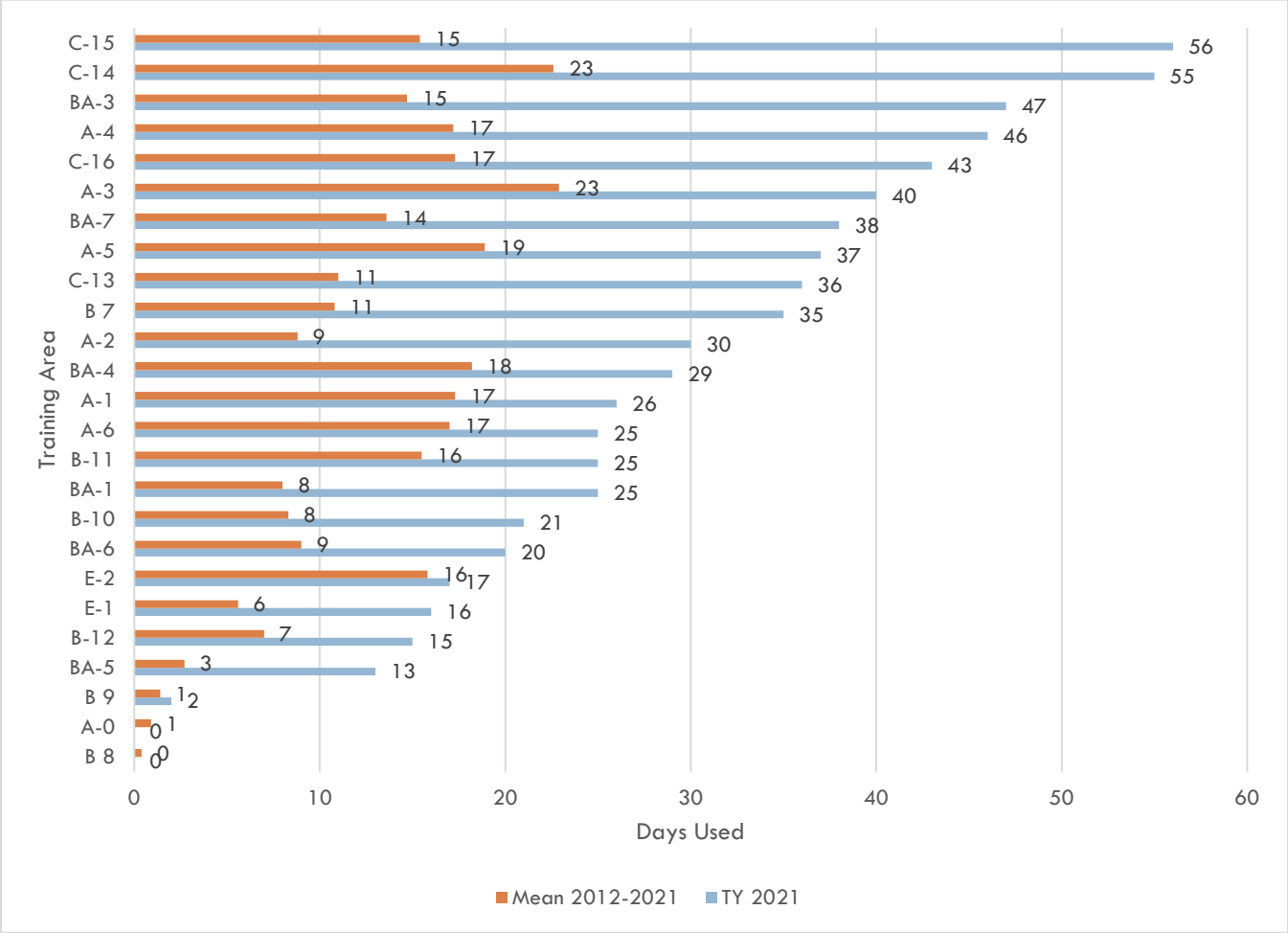


TABLE 2-2 TRAINING USE HISTORY

Training Year	Training Days/Events	Military Personnel	Civilian Personnel
TY 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
TY 2012	1,117	78,745	866
TOTAL	**22,039**	**1,111,602**	**39,924**

In the table above, civilian usage numbers in TY 2019-2021 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 three years as well as a Federal Emergency Management Agency training that took place in TY 2019.

2.2 RANGE UPDATE

The current operationally active small arms ranges on Camp Edwards are Sierra, India, Lima, and Echo ranges. Juliet and Kilo ranges are currently operationally inactive as their STAPP™ systems have been dismantled (see Section 2.4.2). The ISBC, KD and Tango ranges are undergoing rehabilitation. The locations of these ranges are shown in Figure 2-1.

2.3 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 members Phil Gschwend and Jack Duggan, both geochemists, 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 committee did not meet during TY 2021. When the committee last met in August 2020, members discussed the continuing work to research the movement of antimony in soil, which is being conducted by CRREL. The research was completed by CRREL with the results published February 2021 (Appendix C). 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. Amendment use no longer occurs at the direction of the EMC.

2.4 TANGO, JULIET AND KILO RANGES

Between 2007 and 2009, STAPP™ systems were installed on these Tango, Juliet and Kilo ranges to capture and contain lead ammunition. The system is a multi-layer rubber sandwich framed by synthetic lumber, which consists of a bottom rubber membrane, a matrix of rubber granules, and a cover that permits bullets to pass through and be captured in the rubber granule matrix but minimizes precipitation getting into the system.

The Tango Range STAPP™ system was dismantled in November 2017 and has been reconfigured for use as a copper ammunition only zeroing range in support of weapons qualification at Sierra Range. The Juliet Range and Kilo Range STAPP™ systems were dismantled in Fall 2020 (see Section 2.4.2). The Department of Defense has been moving away from lead ammunition for approximately 10 years. As such, 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 Kilo, and Tango ranges with their associated STAPP™ systems are no longer required.

2.4.1 Range Maintenance and Sampling

In September 2021, surface soil, porewater, and groundwater samples were collected from the ranges per the Operations, Maintenance and Monitoring Plan (OMMP) and guidance from the SAC Ad Hoc Committee. 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 surface soil and 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 parts per billion [ppb]) for antimony in several lysimeters on these ranges. Figures showing lysimeter locations and data are available in Appendix C. 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 in New Hampshire is that antimony is not threatening the groundwater. It has been determined that antimony mobility is influenced by pH and soil amendments. Soil amendments were halted several years ago at the direction of the SAC Ad Hoc committee until such time it could be determined what the effects of these amendments had on antimony mobility. It has also been determined through soil sampling that antimony mobility is limited to surface soils where amendments were applied.

Juliet and Kilo Ranges are now in operationally inactive status. Sampling of porewater on the ranges continued in 2021. Water removal from the STAPP™ systems is no longer required as the systems have been removed from the ranges. Water was last pumped from the ranges during the STAPP™ system removal process in October 2020. Throughout the month of October, 790 gallons were removed from the STAPP™ system on Kilo Range and 550 gallons were removed from the STAPP™ system on Juliet Range.

The Juliet Range and Kilo Range sampling results for TY 2021 are available in Appendix C. The Juliet Range and Kilo Range sampling results for TY 2021 are in Appendix C. Tango Range was redeveloped as an EPR (copper) zeroing range in 2021. All Tango Range sampling data for 2021 is for the reconfigured range and is the initial baseline sampling (see Appendix C). There were no action level exceedances for soil. For porewater there was one true action level exceedance on Juliet Range with several other numerical exceedances that the analyzing lab data flagged as non-detect for antimony. A non-detect is an analytical sample where the concentration is deemed to be lower than could be detected using the method employed by the laboratory. For groundwater there were numerical exceedances of the action levels for lead and antimony; however, the exceedances were data flagged as non-detect for both lead and antimony.

2.4.2 Tango, Juliet and Kilo Ranges STAPP™ Dismantling

Camp Edwards decommissioned and removed the STAPP™ system from Tango Range in November 2017. During TY 2021, the range was modernized to support a 32-lane zeroing range for copper ammunition. Soldiers will be able to zero their weapons at Tango Range and then move to the adjacent Sierra Range to conduct weapons qualification. The target and firing lines were moved 25 meters north, which moves them out of the SDZ of the adjoining Sierra Range, allowing both ranges to be used simultaneously. Construction began on Tango Range in Fall 2020 was complete in May 2021. In TY 2022, the MAARNG will request that the EMC authorize its Environmental Officer to approve the redesign and Operations, Maintenance and Monitoring Plan for the range. If approved, the range will then become operational.

Photograph 2-1 A view of the modernized Tango Range showing the target frames and backstop berm.

Work to dismantle the STAPP™ systems on Juliet and Kilo ranges began on October 13, 2020 and was completed by November 3, 2020. Approximately 4,192 lbs. of lead were removed from the Juliet and Kilo STAPP™ systems during the cleanout.

2.5 SIERRA AND INDIA RANGES

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.

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

2.5.1 Range Maintenance and Sampling

Maintenance activities during TY 2021 at Sierra Range included filling bullet pockets with screened loam. At India Range, maintenance activities included repairing and filling bullet pockets.

A list of Range Control's inspection and maintenance activities at Sierra and India ranges in TY 2021 is included in Appendix C.

In October 2021, groundwater, porewater, and surface soil samples were collected from Sierra Range and 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. The Sierra Range and India Range sampling results for TY 2021 are in Appendix C. There were no action level exceedances for soil. For porewater there was several numerical action level exceedances that the analyzing lab data flagged as non-detect for antimony. A non-detect is an analytical sample where the concentration is deemed to be lower than could be detected using the method employed by the laboratory. For groundwater there were numerical exceedances of the action levels for lead and antimony however the exceedances were data flagged as non-detect for both lead and antimony.

2.6 LIMA RANGE

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

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

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

2.6.1 Range Maintenance and Sampling

In October 2021 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. For porewater, there was several numerical action level exceedances that the analyzing lab data flagged as non-detect for antimony. A non-detect is an analytical sample where the concentration is deemed to be lower than could be detected using the method employed by the laboratory.

The Lima Range sampling results for TY 2021 are available in Appendix C.

Maintenance activities included installing supports to the posts holding the netting on the back of the range. A list of Range Control's inspection and maintenance activities Lima Range in TY 2021 is included 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

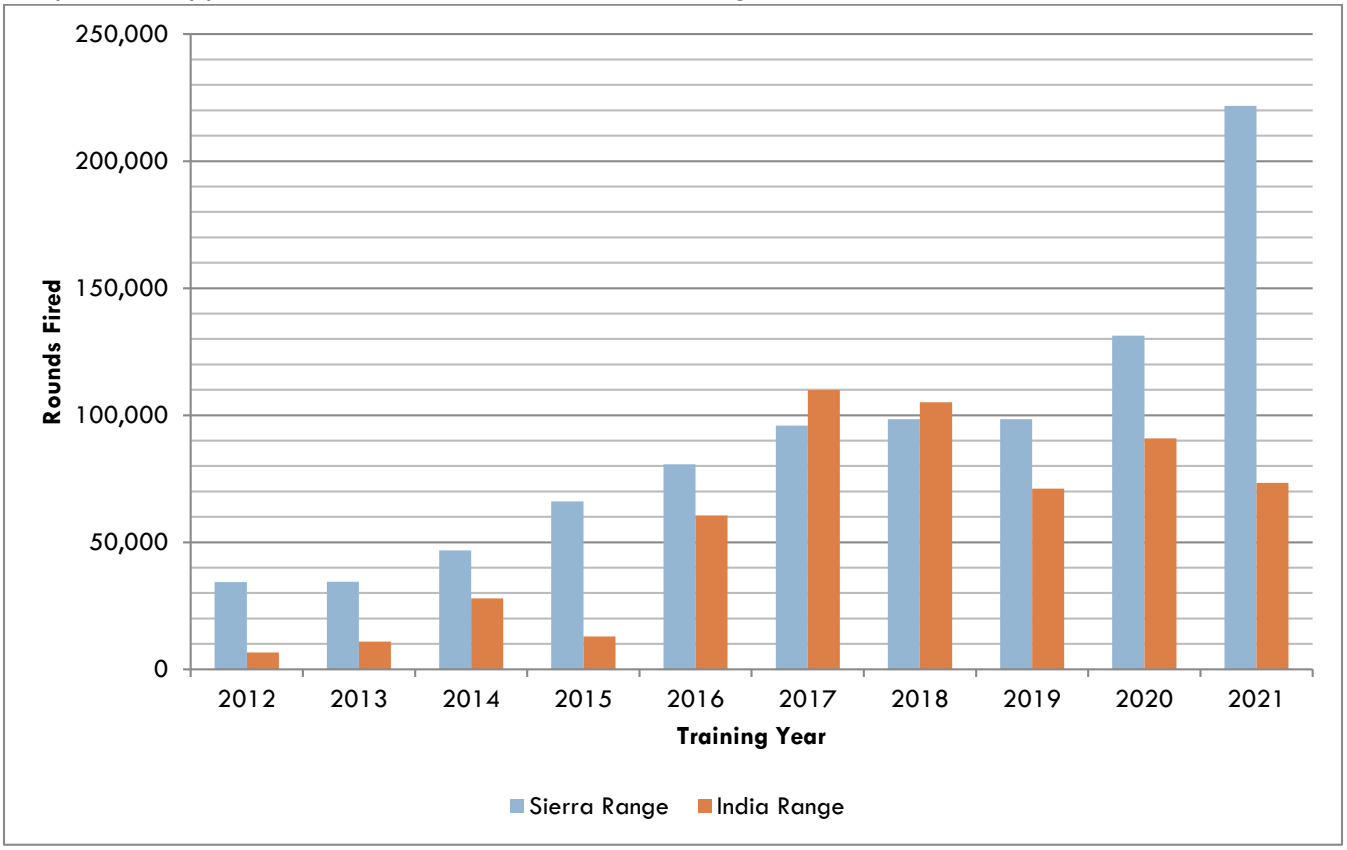
In October 2021, groundwater and surface soil samples were collected from Echo Range and analyzed for antimony, copper, lead, chloride, sulfate, calcium, magnesium, phosphate, potassium, sodium, pH, alkalinity, specific conductance, dissolved organic carbon and oxygen, where appropriate for the media being sampled. There were no action level exceedances for soil. For groundwater, there were numerical exceedances of the action levels for lead and antimony; however, the exceedances were data flagged as non-detect for both lead and antimony. A non-detect is an analytical sample where the concentration is deemed to be lower than could be detected using the method employed by the laboratory. The Echo Range sampling results for TY 2021 are in Appendix C.

A list of Range Control's inspection activities at Echo Range in TY 2021 is included in Appendix C.

2.8 RANGE USAGE DATA

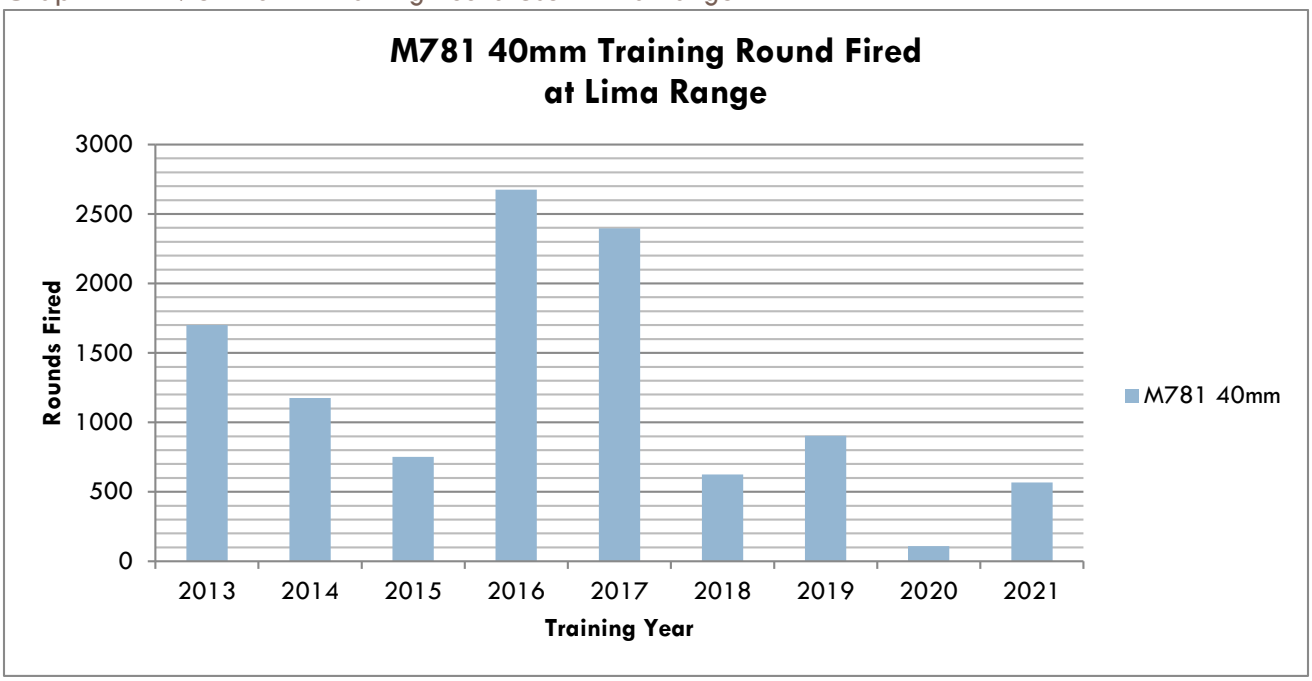
A total of 1,477,534 rounds of copper ammunition have been fired at Sierra and India ranges since its use was approved: 908,243 at Sierra Range and 569,291 at India Range. Graph 2-3 provides a summary of copper ammunition fired at Sierra and India ranges since use of copper ammunition was approved at 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 and India ranges each training year from 2012 through 2021 is provided in Appendix C.

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



A total of 10,905 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.

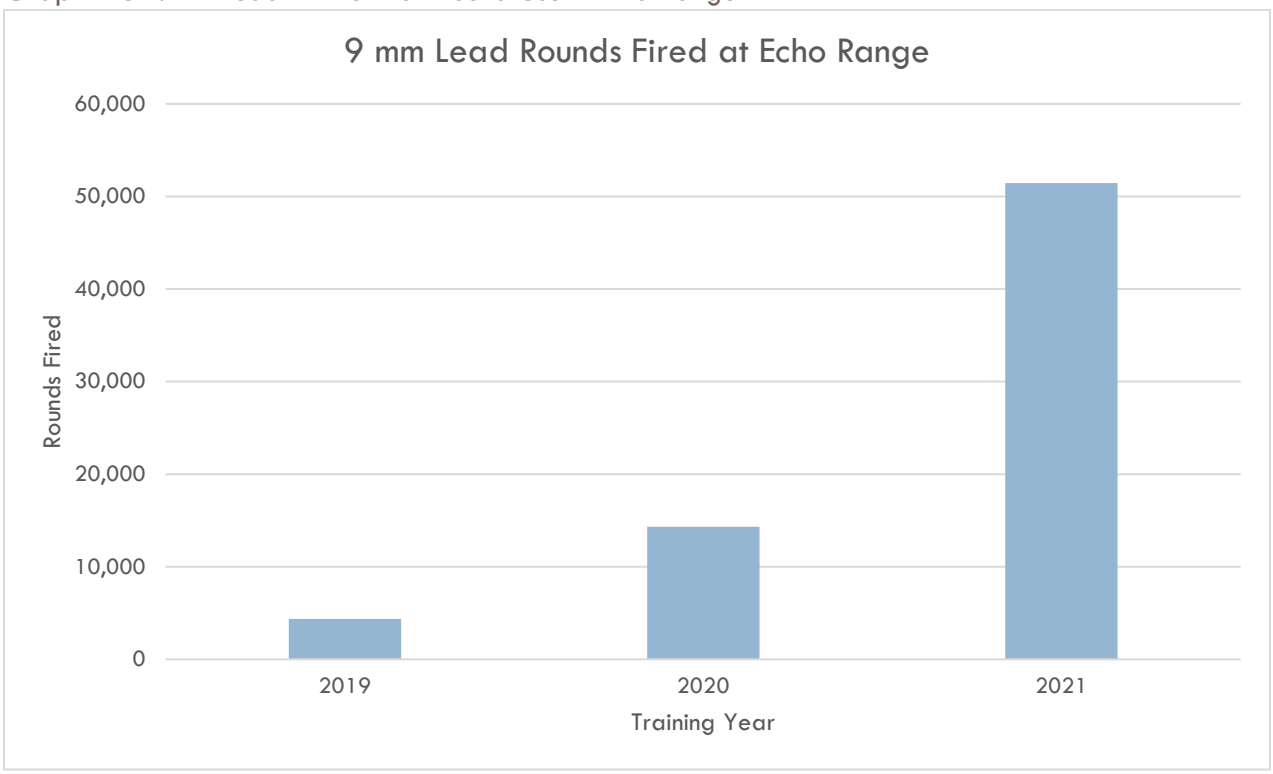
Graph 2-4 M781 40MM Training Round Use – Lima Range



Since TY 2019, a total of 70,543 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. During TY 2021, 19,975 rounds of 5.56mm copper-only ammunition were fired on Echo range during two non-standard training events.

Information on lead ammunition fired from TY 2007 through TY 2021, including amounts and types, is provided in Appendix C.

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



The only civilian use of the small arms ranges during TY 2021 was by the Falmouth Police. They fired 2,975 5.56mm rounds of ammunition and 3,476 .40 cal. rounds of ammunition.

During TY 2021, some type of weapons firing was conducted on at least one of the ranges on 113 calendar days.

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.

2.8.1 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.

Information on utilization of the training areas and major locations within them during TY 2021 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 2021, some type of training was conducted in at least one of the training areas on 218 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 2021, hunter days in the Training Area/Reserve accounted for around 1.36 percent of the usage, and approximately 75% 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 2021 included the US Army, the US Army Reserve, the US Coast Guard, the US Coast Guard Reserve, the US Navy, the US Marine Corps Reserve, New York ANG, and Army National Guard units from Rhode Island, New York, and Connecticut.

Civilian organizations using the training areas during TY 2021 included BAE Systems, the Falmouth Police Department, the Massachusetts Environmental Police, Massachusetts Institute of Technology-Lincoln Lab, Systems & Technology Research, the Department of Defense's Defense Innovation Unit, and environmental remediation and restoration contractors.

TABLE 2-3 TRAINING AREA USE - TY 2021

Location	Training Days	Personnel		Vehicles (Wheeled) #	Vehicles (Tracked) #
		Military	Civilian		
SVL-OBJ 1	60	2,059	56	0	0
SVL-OBJ 2	33	1,093	37	0	0
SVL-OBJ 3	14	737	0	0	0
SVL-OBJ 4	14	723	0	0	0
OP 1	17	435	0	0	0
OP 10	9	300	0	0	0
OP 11	8	285	0	0	0
BP 2	61	489	222	0	0
BP 6	14	357	0	0	0
BP 7	19	1,100	0	0	0
BP 8	21	408	24	0	0
BP 12	4	240	0	0	0
BP 14	27	390	0	0	0
BP 20	15	1,290	0	0	0
BP 24	26	1,539	0	0	0
BP 27	16	1,490	0	0	0
NBC 1	2	56	0	0	0
Training Roads	54	4,690	0	0	0
A 1	26	1,979	0	0	0
A 2	30	2,087	0	0	0
A 3	40	2,398	0	0	0
A 4	46	2,661	0	0	0
A 5	37	1,782	0	0	0
A 6	25	1,856	0	0	0
B 7	35	1,216	0	0	0
B 9	2	20	0	0	0
B 10	21	850	0	0	0
B 11	25	870	0	0	0

TABLE 2-3 TRAINING AREA USE - TY 2021, cont'd

Location	Training Days	Personnel		Vehicles (Wheeled) #	Vehicles (Tracked) #
		Military	Civilian		
B 12	15	1,125	0	0	0
BA 1	25	934	0	0	0
BA 3	47	3,539	0	0	0
BA 4	29	975	0	0	0
BA 5	13	963	0	0	0
BA 6	20	1,899	0	0	0
BA 7	38	2,669	0	36	0
C 13	36	3,641	0	0	0
C 14	55	3,100	0	0	0
C 15	56	3,095	0	0	0
C 16	43	2,376	0	0	0
Wheelock Hill	14	1,051	0	0	0
Land Nav 1	28	1,301	0	0	0
Land Nav 2	9	387	0	0	0
Land Nav 3	17	655	0	0	0
Land Nav 4 Alpha	9	344	27	0	0
Land Nav 4 Bravo	9	489	27	0	0
Land Nav 4 Charlie	11	381	27	0	0
Dig Site 1	13	1,007	0	0	0
Dig Site 2	20	1,810	0	0	0
Dig Site 3	14	850	0	0	0
Landing Zones	55	383	82	0	0
Total	**1,277**	**66,374**	**502**	**36**	**0**

TABLE 2-4 TRAINING AREA USE HISTORY

Training Year	Training Days/Events	Personnel		Vehicles (Wheeled)	Vehicles (Tracked)
		Military	Civilian		
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
TY 2012	232	13,532	122	2,037	5
TOTAL	**6,811**	**409,610**	**8,738**	**15,191**	**36**

2.8.2 Vehicle Use, Fueling and Maintenance

Vehicle use in the training areas during TY 2021 was 36 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. Several 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 successfully.

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.

2.8.3 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 2021. 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 2021 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, Falmouth Police Department, FBI Boston, Leominster High School, the Massachusetts Environmental Police, Massachusetts Maritime Academy, the Massachusetts State Police, the Red Cross-Southeastern Massachusetts, the Sea Cadets, the South Eastern Massachusetts Law Enforcement Council SWAT team, the United States Geological Survey, and the Massachusetts National Guard Family Support Group.

TABLE 2-5 TRAINING SUPPORT AREA USE - TY 2021

Training Support Area	Training Days/Events	Personnel	
		Military	Civilian
1000 Training Area	8	960	0
1100 Training Area (Drivers Tng)	45	6,625	0
3400 Training Area/Rail Load Ramp	8	960	0
3500 Training Area	16	1,485	0
ACFT Running Track	35	3,434	0
Asymmetric Threat Classroom	8	40	0

TABLE 2-5 TRAINING SUPPORT AREA USE - TY 2021, Cont'd

Training Support Area	Training Days/Events	Personnel	
		Military	Civilian
Battle Simulation Ctr - Bldg. 1206	108	6,013	935
Battle Simulation Ctr - Rear Offices	60	2,440	0
Battle Simulation - Bldg. 1213, 1st Floor	57	1,595	600
Battle Simulation - Bldg. 1213, 2nd Floor	66	2,090	600
Battle Simulation - TOC Pads	24	1,372	0
Bldg. 3499 - IWQ	31	1,387	20
Call for Fire Trainer II 1:30	108	2,353	0
VBS3 Classroom - Bldg. 3494	51	833	0
Connery Field	33	3,342	0
Counter IED Visual Indicator Lane	16	547	0
Counter IED Search House (HME)/Site Exploitation	15	500	0
Engagement Skill Trainer 2000 - A	180	2,588	64
Engagement Skill Trainer 2000 - B	244	7,884	24
Engagement Skill Trainer 2000 - C	202	7,380	0
1243-High Risk Entry Facility-Control	32	220	772
1244-High Risk Entry Facility	32	220	772
Lee Field	1	300	0
MRAP	43	1,193	0
ODS - Operator Driving System	4	9	0
Shaw Field	12	2,166	0
Unstabilized Gunnery	4	27	0
Vault 1 - TSC	122	716	0
Vault 2 - TSC	260	731	0
Vault 3 - TSC	158	1,016	0
Virtual Convoy Opns Trainer #98 (VCOT - TSC)	27	261	0
Weapons Cleaning - Bldg. 3498	76	1,739	0
Welcome Center	91	2,399	302
YD Memorial Park	8	805	300
3600LZ - TTB	44	2,802	0
Obstacle Course	29	1,057	365
Calero Mobile MOUT	31	442	326
Kelley TTB	83	14,559	0
Leadership Reaction Course	37	1,196	225
Rappel Tower 1	4	239	0
Rappel Tower 2	2	30	0
Structural Collapse Site	2	90	0
Mobile Distance Learning Classroom	67	8,010	0
TY 2021 Total	**2,484**	**94,055**	**5,305**

TABLE 2-6 TRAINING SUPPORT AREA USE HISTORY

Training Year	Training Days/Events	Personnel		
		Military	Civilian	Total
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
TY 2012	824	63,210	691	63,901
TOTAL	**13,564**	**649,452**	**31,341**	**683,606**

2.9 OFF-SITE TRAINING

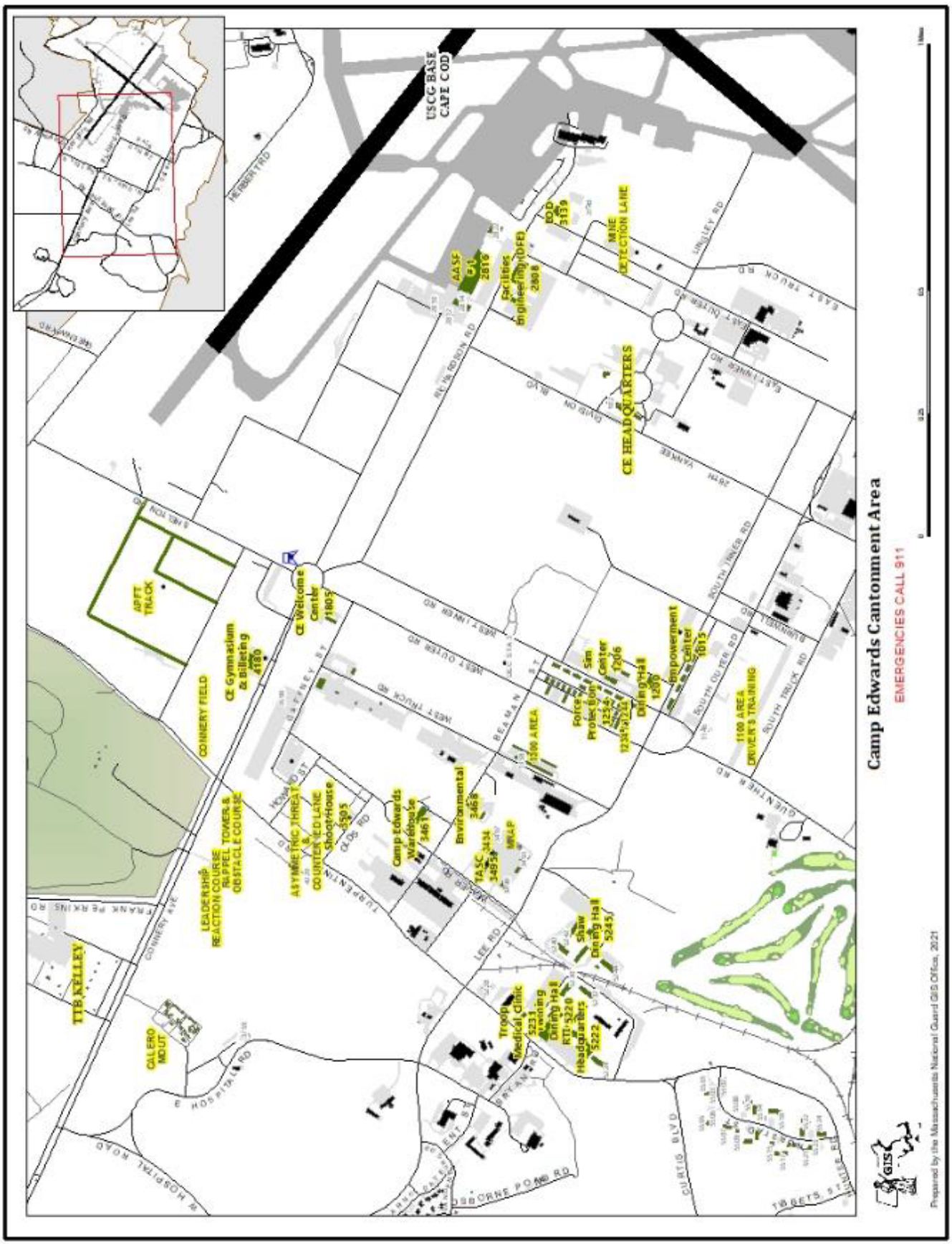
During TY 2021, the MAARNG had 77 units conduct their annual two-week training cycle. Of these, 73 units trained in Massachusetts, 47 of which trained solely at Camp Edwards (approximately 1,738 Soldiers). Two units trained in New Jersey, one unit trained in Montana, and one unit trained in Idaho. Eight units were mobilized and deployed in support of contingency operations; five units deployed overseas, and three units deployed to the continental United States.

The total number of Massachusetts soldiers trained during annual training for TY 2021 was 4,047 out of 6,068. Twenty-two units conducted year-round annual training consisting of 1,570 Soldiers, while 1,008 served on Title 32 orders for the Covid-19 and National Capitol Region response in lieu of annual training. The number of MAARNG soldiers that completed a two-week annual training cycle by general geographical locations is: 3,808 in Massachusetts and 239 in other states.

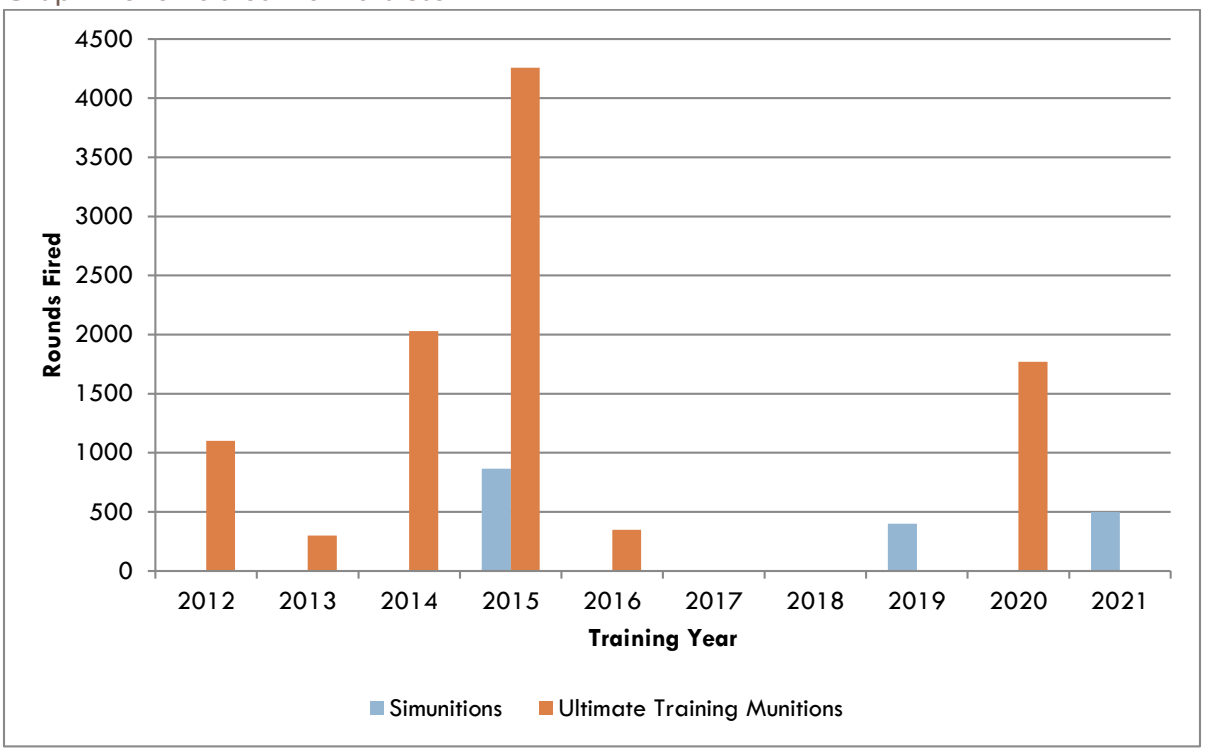
2.10 SIMULATED MUNITIONS

The MAARNG uses two types of simulated munitions at Camp Edwards: an Ultimate Training Munitions (UTM) Man Marker Round and a Simunitions FX Marking Round. 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 activities of the U.S. Army Environmental Command in its efforts working with private industry development 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. Graph 2-6 provides the number of UTM and Simunitions FX Marking Rounds fired in the Training Area/Reserve since 2012.

Figure 2-8 Training Support Areas



Graph 2-6 Simulated Munitions Use



2.11 PYROTECHNICS

The M116A1 Hand Grenade Simulator was approved for use at Camp Edwards in March 2010. Thirty were used in the Training Area/Reserve during TY 2021. Graph 2-7 shows the number used each training year since TY 2012. 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. Due to the MAARNG's deployment to Washington D.C. in January 2021, training was canceled in the month of August due to funding issues with the deployment. Pyrotechnic use was lower during TY 2021.

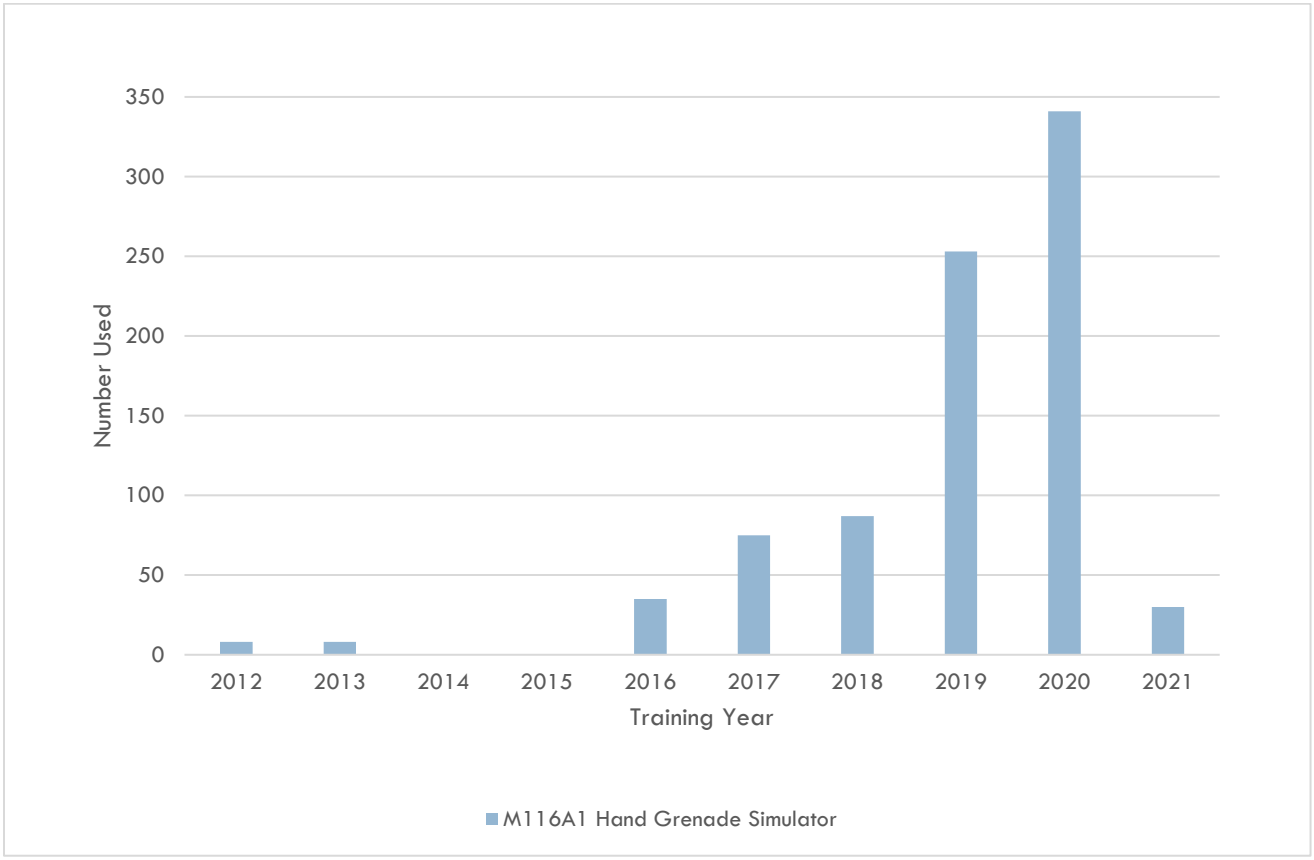
2.12 M69 HAND GRENADE SIMULATOR

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

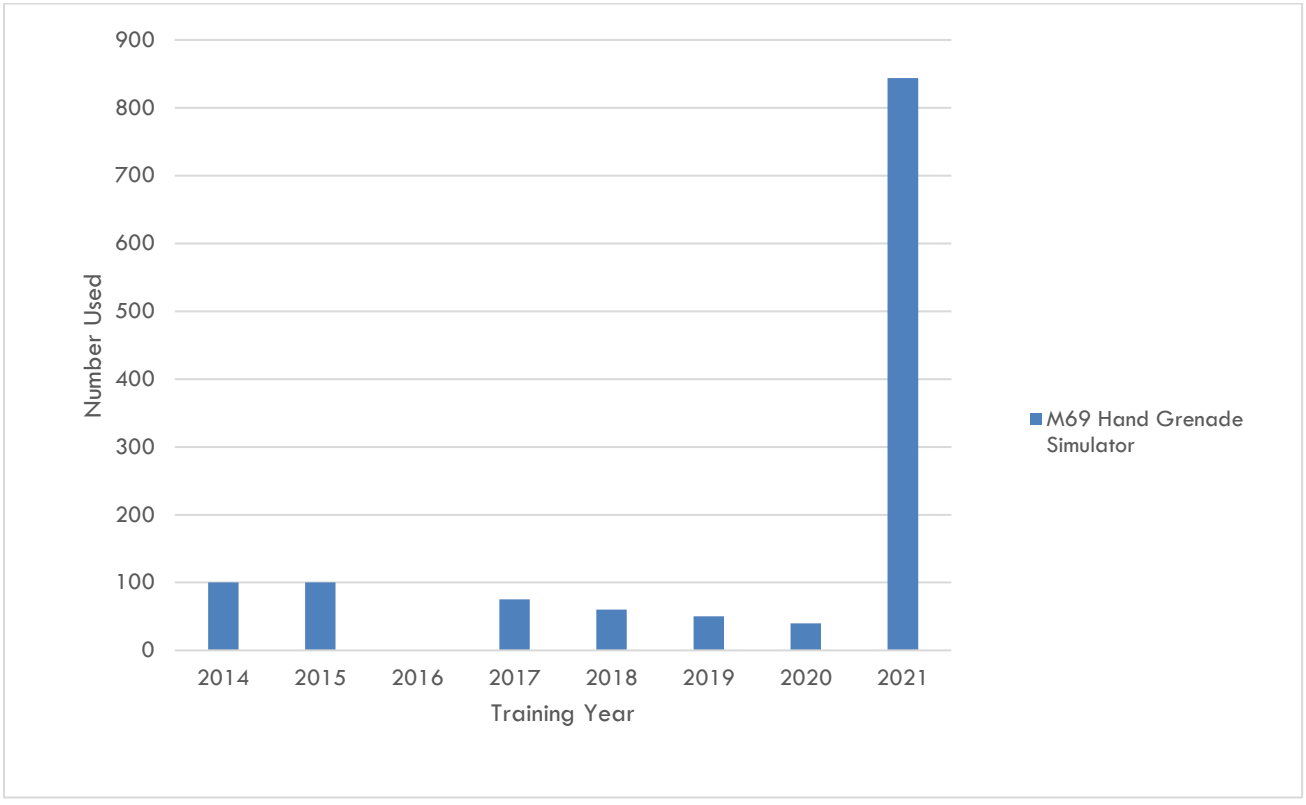
The M69 provides realistic training and familiarizes soldiers with the functioning of a fragmentation hand grenade. The average Soldier can throw the M69 approximately 40 meters (131 feet). After a delay of four to five seconds, the M69 emits a small puff of white smoke and makes a popping noise. The 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. Eight-hundred-forty-four were used in the Training Area/Reserve in TY 2021. Graph 2-8 shows the number of M69 Hand Grenade Simulators used since TY 2014. M69 Hand Grenade Simulator use shows an increase during TY 2021. The nature of required M69 grenade training is cyclical; however, if there is a collective training event, the usage numbers will go up.

Graph 2-7 M116A1 Hand Grenade Simulator Use



Graph 2-8 M69 Hand Grenade Simulator Use



2.13 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 training areas 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 2021 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 2012. 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 2021 is in Appendix C.

Graph 2-9 Soldier Validation Lane Use

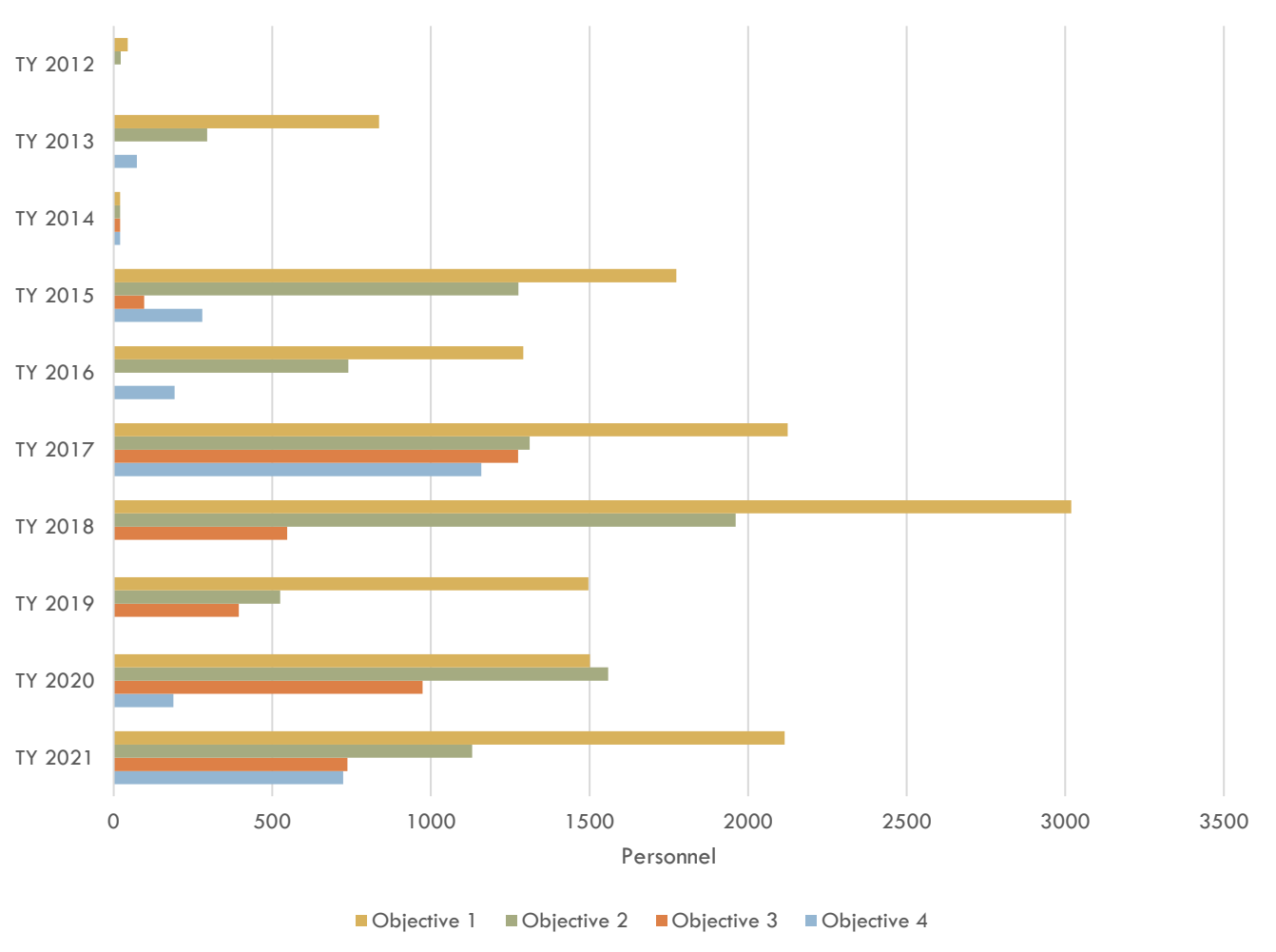
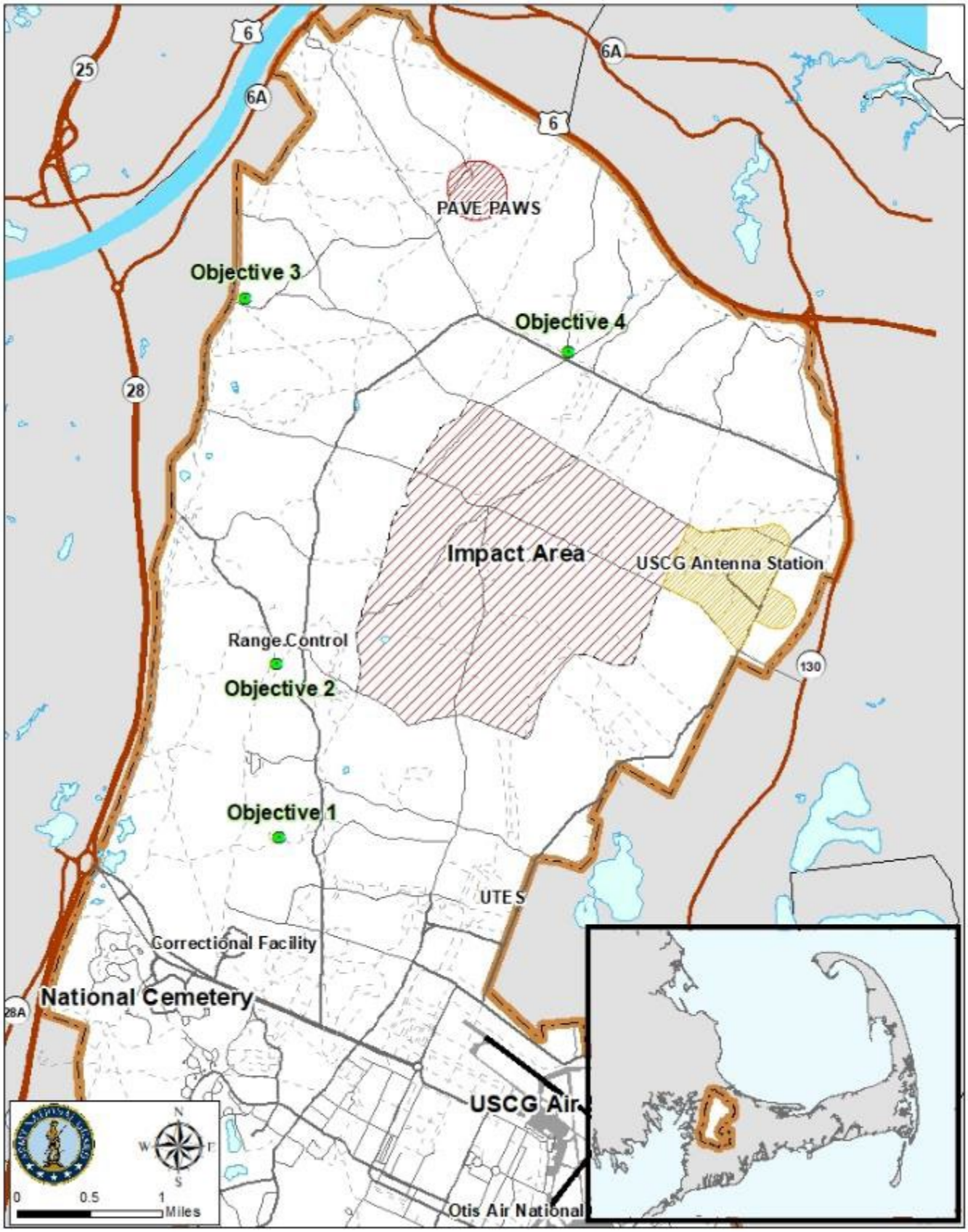


Figure 2-9 SVL Objective Locations



2.14 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 the current KD Range was funded by Congress. An MPMG is where soldiers train and qualify with automatic weapons. KD Range is a 600-yard Known Distance Range that is currently divided into two subparts with two distinct firing line/target configurations and training uses.

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

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

Over the past six years, the MAARNG has coordinated with multiple state and Federal agencies including DFW's 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 (many same statements 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 Spring 2022 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 2012, 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 2021, 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 fence and gate repair projects, trail, firebreak and road maintenance, and habitat and training area restoration projects.

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

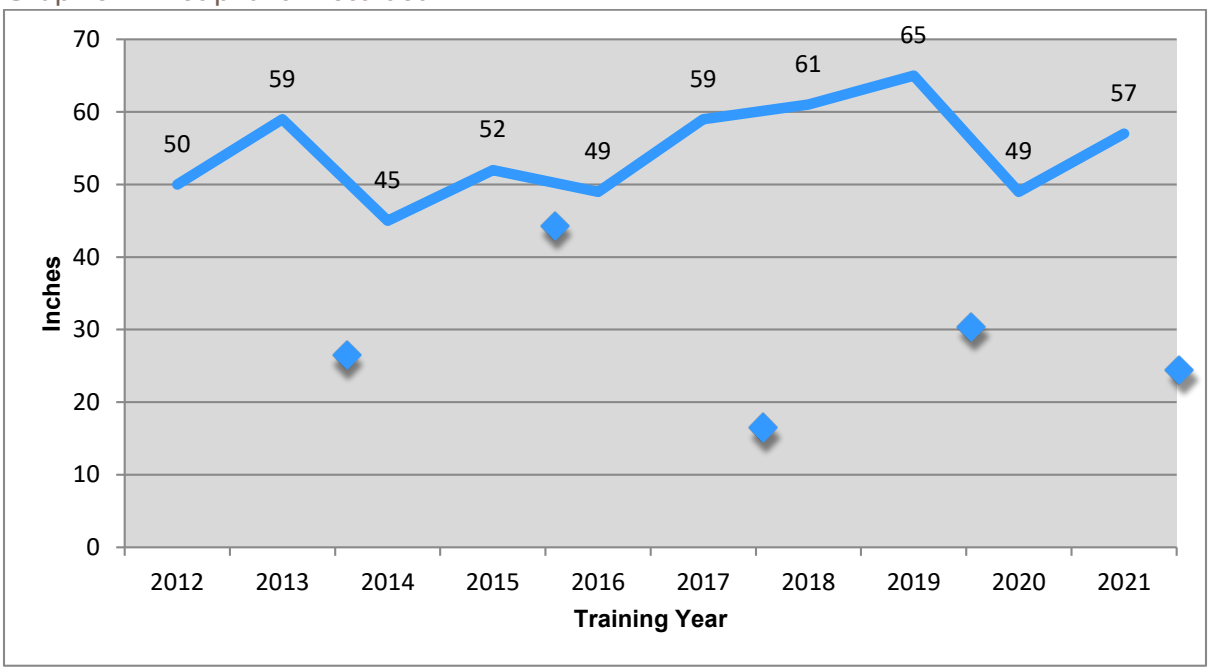
3.1 GROUNDWATER RESOURCES MANAGEMENT

The MAARNG complied with the Groundwater Environmental Performance Standard during TY 2021. 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 Water Supply Cooperative continues to have fencing around its three water supply wells and appropriate signage around the wells' 400-foot radius in the Training Area/Reserve. Both the Upper Cape 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 became operational in TY 2014 as part of its overall water supply system. Groundwater quality reports for the Upper Cape Water Supply Cooperative, the 102nd Intelligence Wing, and the Bourne Water District 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/.

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 56.79 inches of precipitation for TY 2021 (Graph 3-1).

Graph 3-1 Precipitation Recorded



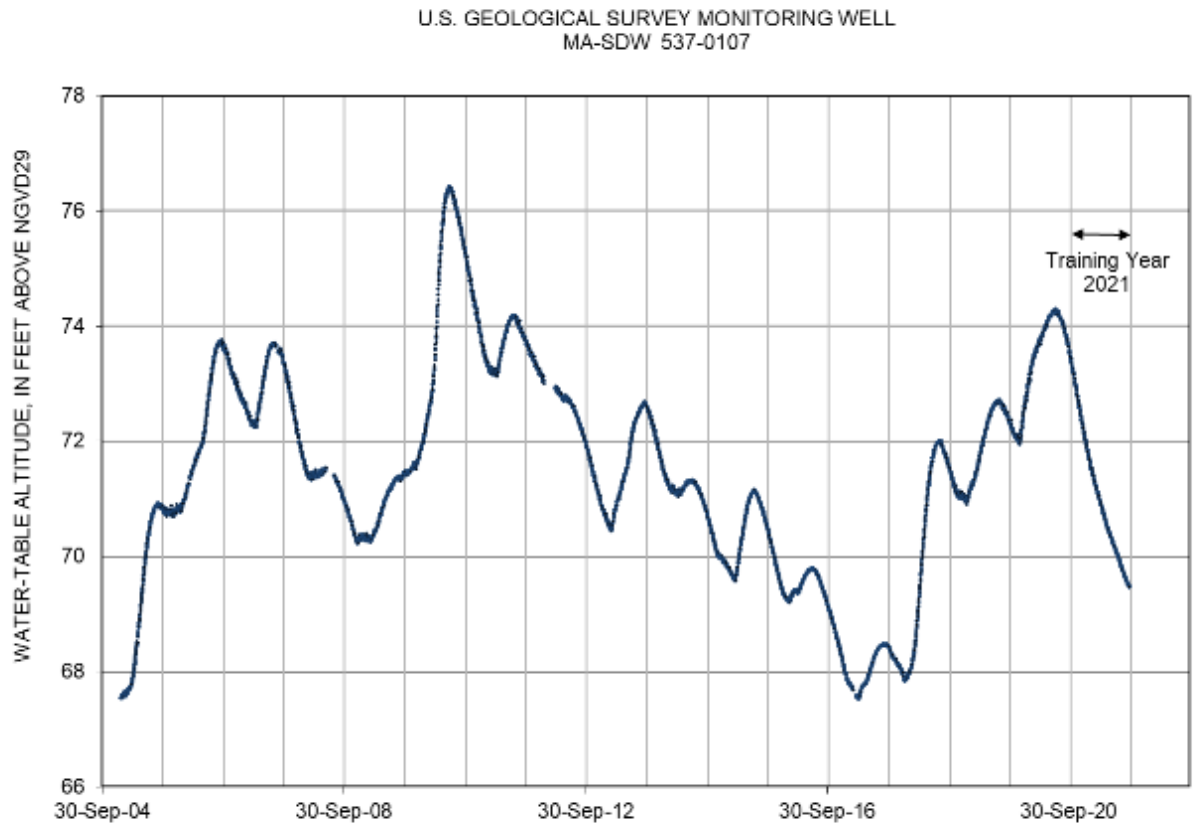
3.1.2 Groundwater Level

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

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 2005-2021 training years. The water-table altitude declined about 4.1 feet during TY 2021 (October 1, 2020, to September 30, 2021). Similar declining water 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 of the Army National Guard 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 is publicly available on the following USGS website: http://groundwaterwatch.usgs.gov/AWLSites.asp?S=414159070310501&ncd=

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 398,989,000 gallons of water (a daily average of 1,093,121) from its three wells to the six public water supply systems it services during TY 2021: 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 2012. The locations of the Cooperative's three water supply wells (WS-1, WS-2, WS-3) and its seven sentry monitoring wells (C-1 through C-7) are shown in Figure 1 in Appendix E. The Cooperative's 2021 Long Term Monitoring Sentry Well Sampling Results are available in Appendix E.

Otis ANGB Public Water Supply System

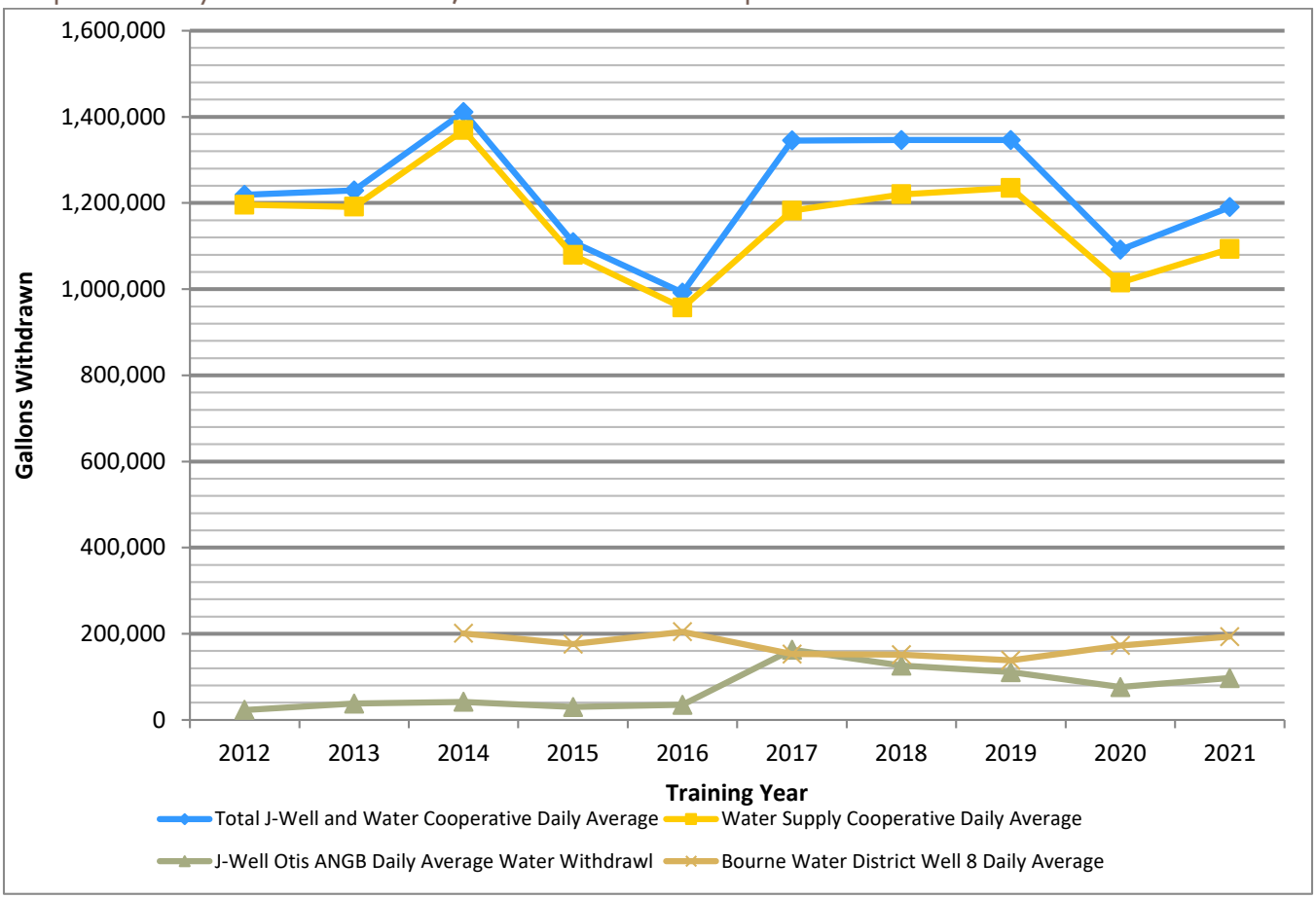
The Otis ANGB system pumped an average of 97,233 gallons of water per day and a total of 35,490,000 gallons of water from its well, known as J-Well (located in the Cantonment Area), during TY 2021. It also received 17,815,000 gallons from the Cooperative during TY 2021; a daily average of 48,808 gallons. Graph 3-3 shows the daily average pumping rate of the Otis system since TY 2012.

A copy of the calendar year 2020 Water Quality Report published by the 102nd Intelligence Wing in June 2021 is provided in Appendix E.

Bourne Water District Water Supply Well

Bourne Water District Well 8 became operational in May 2014. During TY 2021 a total of 70,538,600 gallons were pumped, with a daily average of 193,256 gallons pumped. Graph 3-3 shows the daily average pumping rate of Well 8 for TY 2014 through TY 2021. The well's location is shown in Figure 3-1. A copy of the calendar year 2020 Bourne Water District's Water Quality 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.

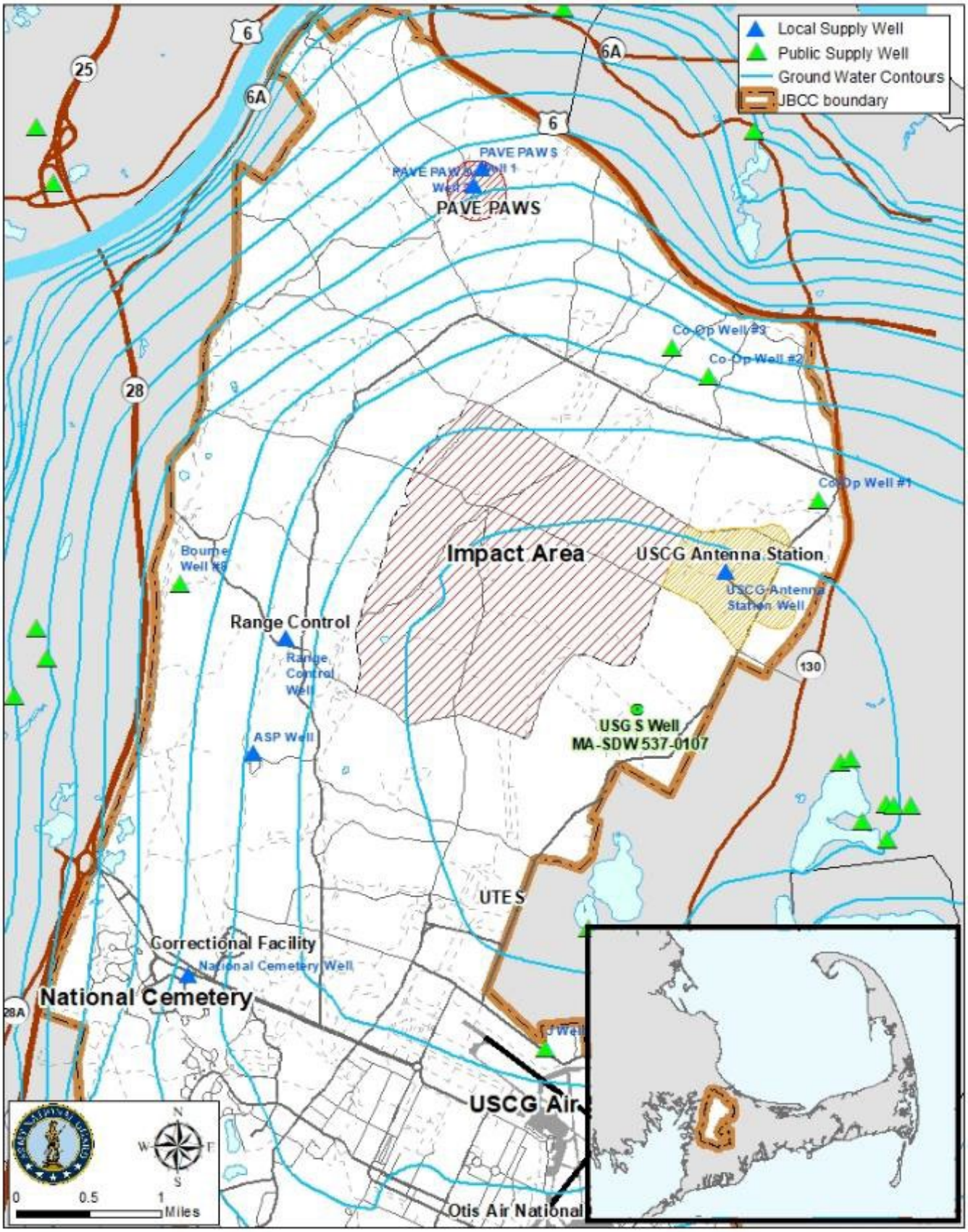
Other Water Wells

There are two water supply wells located within the boundary of the Training Area/Reserve, which are not subject to Chapter 47 of the Acts of 2002 and the EPSs. These are located at Cape Cod AFS (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 2021 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. Representatives of the E&RC routinely attended numerous 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.

Figure 3-1 Well Locations



Three dirt road puddles, in the northwest training area, one on Jefferson Road and two on Orchard Road, which had been creating conservation concerns by attracting breeding amphibians and box turtles, were filled in January 2021. Due to the vernal pool function that the puddles were providing, MAARNG submitted a letter to the Town of Bourne Conservation Agent to notify of the proposed work and request an opinion on wetland jurisdiction. The Conservation Agent responded that the Conservation Department would not apply wetland jurisdiction based on the training area road's "important governmental purpose" for a state agency. As described in previous reports and SAC/CAC/EMC meetings, the majority of roadway puddles present a population sink that is attractive to a variety of species but does not allow for successful amphibian reproduction and presents a direct mortality risk.

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 2021 are in Section 3.3.4 and Appendix F.

In TY 2020, two significant efforts were made to help further wetlands priorities on base. First, Conservation Agents from the towns of Bourne and Sandwich both participated in a Stakeholder Task Force meeting for the development of the Integrated Natural Resource Management Plan (INRMP) Update. This allowed for input from the town's wetland specialists on priorities for conservation projects on the base going forward. The INRMP was sent out for signatures in December 2020. The document is now final, with the final signature received on February 8, 2021. In addition, in TY 2020, the Natural Resources Office hired a Conservation Biologist to focus on wetlands and vegetation priorities. Both of these 2020 efforts facilitated increased planning and focus on wetland and vernal pool resources in TY 2021, including review and coordination with the EMC and Air Force Civil Engineering Center (AFCEC) regarding remediation and restoration planning for the Otis Rod and Gun Club site.

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. Budgeting for this project comes from the funds set aside in the event the Conservation Department had required mitigation in the form of vernal pool creation for the filling of the Jefferson and Orchard roads puddles. Mitigation was not needed, thus this project, in good faith, seeks to create habitat that is overall in short supply on the base. 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. This project is in progress. A developing vernal pool wetland feature, created accidentally as a result of training use and ITAM restoration in TY 2020 in TA C-14, is providing habitat for vernal pool breeding amphibians. This wetland feature was monitored for vernal pool function and clam shrimp presence during TY 2021 and reflective Siebert stakes were placed along the perimeter to mark this sensitive area off-limits. No vernal pools were officially surveyed during TY 2021. This is intended to function similarly to the planned vernal pool creation, opportunistically identifying a feature providing a habitat benefit that can coexist adjacent to military training and created by training and training lands rehabilitation.

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 2021. The office observed 16 species and is reporting the sightings to NHESP in early TY 2021 (Table 3-1). Three field technicians hired for TY 2021 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 two new listed species were identified by Natural Resources personnel with the documentation of Spring Ladies'-Tresses (*Spiranthes vernalis*) in the Cantonment grasslands and American Clam Shrimp (*Limnadia lenticularis*) documented in multiple road puddles in the Training Area/Reserve.

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, implementation and completion of the Eversource switching station soil stockpile, and review and species protection planning for the proposed track and field (outside the Training Area/Reserve). Two natural resources and training lands habitat restoration projects were reviewed through the Forest Cutting Act process and approved by NHESP including a kettle hole frost bottom restoration in Training Area E-3 and an understory maintenance and grassland opening project in Training Area BA-3.

Multiple contracts were developed or continued in TY 2021 for surveying and managing rare species. Tetra Tech, a contractor for the MAARNG, manually vetted bat acoustic data from TY 2020, uploaded past data into the MAARNG bat acoustic database, performed a power analysis on all the acoustic data, and created a scope of work to analyze trends in bat data on base over the last seven years. The results of the power analysis will be used in Fiscal Year 23 for a contract to analyze the past data for spatial and temporal trends and occupancy analysis. The power analysis specifically will be used to guide the recommendations for future work that come from looking at the whole data set. Biodiversity Research Institute (BRI) was contracted to confirm identification of 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-listed species. Federal biologists indicated that this is likely the first record of the species hibernating in New England. BRI is also going to vet past acoustic data calls to determine whether this species has been active on base or other nearby locations during the winter season. Their report will be completed in TY 2022.

See Section 3.3.5 for information on TY 2021 contracts and other in-house work regarding Eastern Box Turtles.

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. On Camp Edwards, the surveyors performed one demographic assessment, which entails trapping for 12 nights over three four-night (five day) survey periods, at a site spotted turtles have been found before. The surveyors also performed one rapid assessment (one four-night trapping event) at a site with unknown occupancy. Results from Camp Edwards and other military installations are being 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 results and recommendations from this effort will be received in TY 2022.

See Section 3.3.1 for details on a contract regarding the state-listed plant *Triosteum perfoliatum*.

In Fiscal Year 2021, the Natural Resources Office took samples for snake fungal disease surveys when snakes were opportunistically discovered.

Although two field crew members were hired for the summer, both left early in either early or late summer to attend graduate school. 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 extending a contract with Western EcoSystems Technology Inc. (WEST) to complete vegetation surveys for mitigation monitoring and by working with a volunteer to perform Monarch caterpillar surveys.

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.

TABLE 3-1 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 2017**	**TY 2018**	**TY 2019**	**TY 2020**	**TY 2021**
			BIRDS				
Grasshopper Sparrow[13] *(Ammodramus savannarum)*	-	T	15	16	20	34	36
Northern Harrier[1] *(Circus cyaneus)*	-	T	Wintering	Wintering	Wintering	Wintering	Wintering
Upland Sandpiper[13] *(Bartramia longicauda)*	-	E	8	7	12	6	2
Eastern Meadowlark[13,16] *(Sturnella magna)*	-	SC	3	2	7	14	17
Long-eared Owl[1] (*Asio otus*)	-	SC	0	0	0	0	0
Vesper Sparrow *(Pooecetes gramineus)*	-	T	0	0	0	0	0
Whip-poor-will[2] *(Antrostomus vociferous)*	-	SC	52	110	53	99	136
Bald Eagle[1] *(Haliaeetus leucocephalus)*	-	SC	0	0	0	0	0

TABLE 3-1 LIST OF RARE SPECIES REPORTED TO NHESP, cont'd

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 2017**	**TY 2018**	**TY 2019**	**TY 2020**	**TY 2021**
REPTILES and AMPHIBIANS							
Eastern Box Turtle *(Terrapene carolina carolina)*	-	SC	42	43	58	45	83
Eastern Hog-nosed Snake *(Heterodon platirhinos)*	-	SC	3	8	9	1	2
PLANTS							
Adder's Tongue Fern[4,6] *(Ophioglossum pusillum)*	-	T	247	0	25	646	N/A
Spring Ladies Tresses *(Spiranthes vernalis)*	-	T	0	0	0	0	3
Broad Tinker's Weed[5,6] *(Triosteum perfoliatum)*	-	E	127	0	200	6	N/A
American Arborvitae[9] (*Thuja occidentalis*)	-	E	N/A	N/A	N/A	N/A	N/A
BEES							
Walsh's Anthophora[15] *(Anthophora walshii)*	-	E	5 (1)	0	32 (9)	4	N/A
BUTTERFLIES and MOTHS[11]							
Buck Moth (*Hemileuca maia*)	-	SC	95	0	4	2	74
Pine Barrens Speranza *(Speranza exonerata)*	-	SC	13	0	0	0	0
Sandplain Euchlaena *(Euchlaena madusaria)*	-	SC	7	0	0	1	0
Heath Metarranthis *(Metarranthis pilosaria)*	-	SC	1	0	0	0	0
Melsheimer's Sack Bearer *(Cicinnus melsheimeri)*	-	T	0	0	0	7	0
Gerhard's Underwing *(Catocala herodias)*	-	SC	10	0	0	2	0
Pine Barrens Zale *(Zale lunifera)*	-	SC	8	0	0	0	0
Barrens Dagger Moth *(Acronicta albarufa)*	-	T	0	0	0	0	0

TABLE 3-1 LIST OF RARE SPECIES REPORTED TO NHESP, cont'd

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 2017**	**TY 2018**	**TY 2019**	**TY 2020**	**TY 2021**
BUTTERFLIES and MOTHS[11]							
Chain-dotted Geometer *(Cingilia catenaria)*	-	SC	0	0	1	0	0
Drunk Apamea *(Apamea inebriata)*	-	SC	0	0	0	0	0
Pink Sallow *(Psectraglaea carnosa)*	-	SC	5	0	0	0	0
Pink Streak *(Dargida rubripennis)*	-	T	0	0	0	3	1
Collared Cycnia *(Cycnia collaris)*	-	T	1	0	11	33	200
Coastal Heathland Cutworm *(Abagrotis benjamini)*	-	SC	1	0	0	0	0
Woolly Gray *(Lycia ypsilon)*	-	T	2	0	0	0	0
Water-willow Stem Borer *(Papaipema sulphurata)*	-	T	1	0	0	0	0
Waxed Sallow Moth *(Chaetaglaea cerata)*	-	SC	2	0	0	0	0
Frosted Elfin[12] *(Callophrys irus)*	-	SC	5	5	TBD	25	57
Slender Clearwing Sphinx *(Hemaris gracilis)*	-	SC	0	0	0	5	3
CRUSTACEANS							
Agassiz's Clam Shrimp[10] *(Eulimnadia agassizii)*	-	E	6	38	9	3	5
American Clam Shrimp ^ *(Limnadia lenticularis)*	-	SC	0	0	0	0	3
MAMMALS							
Northern Long-Eared Bat[7,8] *(Myotis septentionalis)*	T	E	2	1	3	1	TBD
Little Brown Bat[7] *(Myotis lucifugus)*	UR	E	4	2	6	2	TBD
Tricolored Bat[7] (Perimyotis subflavus)	UR	E	3	2	3	1	TBD

TABLE 3-1 LIST OF RARE SPECIES REPORTED TO NHESP, cont'd

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 2017**	**TY 2018**	**TY 2019**	**TY 2020**	**TY 2021**
			MAMMALS				
Eastern Small-Footed Bat[7] *(Myotis leibii)*	UR	E	0	0	1	1	TBD

[1] 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).

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

[3] Comet and Spatterdock Darner are no longer on NHESP's rare species list. Also, Odonate surveys were suspended after TY 2015.

[4] Several known *Ophioglossum* sites could not be surveyed in TY 2016 due to a lack of cease-fire agreement with the off-base Monument Beach Shooting Club. 2019 numbers are likely under representative, as surveys occurred late in the season. In 2020 *Ophioglossum* was surveyed earlier in the year in order to get an accurate count.

[5] Actual 2019 numbers may be as few as 82, MAARNG staff is now studying the genetics of *Triosteum perfoliatum* and *T. aurantiacum* due to difficulty in accurately differentiating the two species. Once the genetics project is completed, 2020 numbers will be reported.

[6] In 2018, only sites with historic records and no recent records were surveyed, and this should not be interpreted as a loss of rare plants between 2017 and 2018.

[7] 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).

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

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

[10] Numbers represent only locations where species was found and ID confirmed by either NHESP Aquatic Ecologist or trained MAARNG staff.

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

[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] 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.

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

[15] 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.

[16] 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.

Efforts are ongoing 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. The data currently reported in the table are gross observations only and not interpretable for trends. 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, grassland bird monitoring standardization will allow for long-term trends analysis and better integration with broader conservation initiatives. The Natural Resources Program staff are working with statewide and regional efforts to coordinate monitoring, including participating in the annual Northeastern Nightjar Survey.

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, *Triosteum aurantiacum*, the Natural Resources Office contracted a genetic and hybridization study, which started in TY 2020. A report was expected December 2021, however, findings, as conveyed preliminarily to MAARNG staff, suggest that, despite morphological features used to distinguish the two species, the dominant or sole Triosteum species encountered on Camp Edwards is *T. perfoliatum*. This will have implications for future monitoring which the Natural Resources Office plans to discuss with the state Botanist and botanist Bryan Connolly. This is an interesting study with potentially significant findings.

Photograph 3-1 A Natural Resources field technician with equipment used during acoustic monitoring for bats.

Rare plant sites were not formally surveyed in TY 2021 for a combination of reasons, but largely to await the results of the *Triosteum* genetics study, which is likely to inform future survey methods and to reduce the human impact at rare plant sites (e.g., soil compaction, trail formation, and possible trampling of plants), including those that continue to support *O. pusillum*. In TY 2021, MAARNG staff experimentally fortified one rare plant site (RP05), located in the southern training area with buck fencing to exclude previously observed deer browse on *T. perfoliatum* and *O. pusillum*. Observations of rare plants at RP05 verses other rare plant sites without buck fencing will continue through TY 2022.

In TY 2021, acoustic monitoring for bats continued. Tetra Tech was contracted to perform manual vetting and database upload, and results will be received in TY 2022. Confirmed detections will be reported to NHESP. All vetted bat data from 2014-2020 was entered by Natural Resources staff into the federal database, NABat, to inform the ongoing US Fish and Wildlife Service (USFWS) status assessment of *Myotis lucifugus, M. septentrionalis,* and *Perimyotis subflavus*. In TY 2021, Tetra Tech vetted data from 2020, produced a report on the findings, performed a power analysis of the larger dataset, and created a scope of work for the analysis of the long term data set. The results of the power analysis will be used in Fiscal Year 23 for a contract to analyze the past data for spatial and temporal trends and occupancy analysis. The power analysis specifically will be used to guide the recommendations for future work that come from looking at the whole data set.

Starting in TY 2019, grassland bird numbers represent individuals (not double counting the same bird) observed in a given year rather than the total number of birds observed throughout repeated surveys as was reported in past years. This will better represent the number of active territories in a given year.

Harrier sightings were not counted as the species is constant and conspicuous throughout the non-breeding season with much uncertainty to individuals, and NHESP no longer accepts non-nesting reports of this and other raptor species.

3.3.2 State and Federally Listed Bats

The Northern Long-eared Bat (NLEB) was federally listed as threatened in May 2015. The listing is primarily due to the severe population crashes (estimated greater than 95%) 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. Recent 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 TY 2021, five sites in the Training Area/Reserve were acoustically monitored for bats using programs targeting the foraging and echolocation characteristics of NLEB and *Perimyotis subflavus*. Two of these are considered long-term monitoring sites, having been recording at some of our highest-activity NLEB sites year-round since 2015. In TY 2019-2020 and part of TY 2021, program staff aimed to acoustically monitor the state-listed species *Perimyotis subflavus* (also being considered for federal listing), as it is a high-flying species that may require different methods than those used to monitor NLEB. Two of the acoustic sites were set up above the forest canopy to survey specifically for them. These sites were monitored through the winter of 2020-2021 and were then lowered for the rest of the year. *P. subflavus* 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. *P. subflavus* was recorded at one of the two sites targeting the species in TY 2019, though equipment and insect noise issues were prevalent. In TY 2021, the discovery of a silver haired bat (*Lasionycteris noctivagans*) in a bunker on base during the winter (details below), prompted the installation of the fifth station to monitor for winter activity.

In TY 2021, Tetra Tech, a contractor for the MAARNG, manually vetted bat acoustic data from TY 2020, performed a power analysis on the past data, and created a scope of work to analyze trends in bat data on base over the last seven years. Tetra Tech is currently working to manually vet bat acoustic data from TY 2021 and upload the data into the MAARNG bat acoustic database. The results of the power analysis will be used in Fiscal Year 23 for a contract to analyze the past data for spatial and temporal trends and occupancy analysis. The power analysis specifically will be used to guide the recommendations for future work that come from looking at the whole data set.

BRI was contracted to identify a bat roosting in a bunker on Knot Hollow Road in early February of 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 is also going to vet past acoustic data calls to determine whether this species has been active on base or other nearby locations during the winter season. Their report will be completed in TY 2022.

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 2021 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 four 1.5 megawatt (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 2021. 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.

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 throughout suitable scrub oak habitat across 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 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). His findings on preferred forage species and management techniques to encourage diverse forage species will be examined in TY 2022 along with the following effort and used in planning management activities for the species.

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 regional plots in TY 2021. In Fiscal Year 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.

3.3.4 Agassiz's Clam Shrimp

Clam shrimp were discovered in roadway puddles on base in TY 2015. Initial attempts at identification indicated the clam shrimp could be two state listed species, Agassiz's Clam Shrimp (*Eulimnadia agassizii,* [AgCS]) and American Clam Shrimp (*Limnadia lenticularis*, [AmCS]). In TY 2018, the NHESP Aquatic Ecologist confirmed Agassiz Clam Shrimp in multiple roadway puddles along with the non-listed Mattox Clam Shrimp (*Cyzicus gynecea*). In TY 2018, NHESP visited Camp Edwards, viewed some of the known clam shrimp locations, and trained MAARNG staff in proper identification of the species likely to be encountered in the Training Area/Reserve. 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.

Clam Shrimp occur in roadway puddles on the base. These sites are most often heavily trafficked, unvegetated puddles created by roadway compaction. Several puddles along Herbert and Cat roads had become large enough to impede use for training. In TY 2018, 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. A fourth year of monitoring was carried out because the 2020 drought conditions 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, precipitation was back to normal during the clam shrimp monitoring season. Natural Resources staff conducted repeated surveys from mid-May to October at a subset of 12 puddles. Pools were measured for area, depth, temperature and pH, and all aquatic life observed was recorded. In total, clam shrimp were observed in seven puddles, an increase from the previous two years. However, not all observations were identified to be AgCS. AmCS, a state-listed species of special concern, not previously confirmed on the base, were encountered in three puddles (two monitoring puddles contained both species but not necessarily at the same time). AmCS collected samples, along with AgCS have been submitted to MassWildlife for verification of ID. Clam shrimp collected from one puddle were unable to be identified to species due to poor condition of the sample. Details on the CMP monitoring carried out during TY 2021 are in Appendix F. Annual survey data and samples collected are submitted directly to the MassWildlife Aquatic Ecologist and positive observations of state-listed clam shrimp are submitted electronically using Heritage Hub, MassWildlife's reporting and filing system. 2021 monitoring clam shrimp samples and collected data have been submitted. 2021 positive observations are in the process of being uploaded to Heritage Hub.

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 (CSCRMP), 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 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.

A significant component of the CSCRMP is the submission of annual road work plans developed by MAARNG for NHESP review and approval. Road work plans include all road work planned to occur in the Training Area for the coming year. This involves planning meetings with participants from Natural Resources-ITAM, the 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 NHESP 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. Additional details on the CMP amendment are in Appendix F.

3.3.5 Eastern Box Turtle

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 the fall of 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 provides protection for turtles during winter silt fence installation and tree removal activities. This plan is being implemented in the fall of 2021. Eversource also completed a similar turtle protection project at Dig Site 3 to enclose the site, survey for turtles, and monitor. The Dig Site is being used as a stockpiling site for soil that will be used on future construction projects on base. The monitoring, maintenance and reporting for this site will be taken over by the Natural Resources Office and Facilities Engineering in Fiscal Year 2022. Eversource also completed surveys on the power line traversing east-west across the northern portion of the base. The contractor for Eversource coordinated with the Natural Resources Office on their activities on base.

Photograph 3-2 A Natural Resources Program field technician holds an Eastern Box Turtle.

In September and October 2020, AECOM completed a similar project for Tango Range including creating an approved CPMPP, completing surveys inside a wildlife barrier, obtaining approval from NHESP for construction to proceed, and completing construction monitoring during the turtle active season. The report for 2020 activities was submitted to NHESP on 12 January 2021. In TY 2021, surveys during construction continued and oversight during silt fence removal was completed at the end of the project. A final report will be submitted to NHESP in TY 2022.

In-house turtle searching and telemetry efforts focused on tracking turtles from C-14, Sierra and Tango Ranges and around the MPMG, which are areas with future construction projects or areas with previously tagged turtles. In addition, 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.

Fifty-four turtles were being tracked by the end of the fiscal year.

In response to the Dipteran larval infestations observed in past years, 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 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. Results and a report from this effort is expected in Fiscal Year 2022.

Dipteran larval infestations were again observed in TY 2021, but appeared less severe than the previous year. Two turtles were found dead and taken for necropsy at Tufts Wildlife Clinic. The two turtles that had overwintered at Tufts Wildlife Clinic were returned to their original locations. 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 threat to turtles on base.

In addition, the Natural Resources Office is collaborating with researchers from UMass Amherst, the US Geological Survey, NHESP, and USFWS to facilitate two graduate research projects on Camp Edwards focused on the threats to Eastern box turtles. An intern working for the Environmental Management Commission also used historical data on box turtle locations to create home ranges.

During the summer of 2020, a turtle mortality was discovered on Echo Range in one of the firing lanes. It is assumed that the turtle fell in the firing lane and was unable to escape. Given the heat in the summer and lack of shade, Range Control conducted twice daily checks of the lanes to prevent another mortality event. In TY 2021 Range Control completed the installation of ramps in each lane to provide a means of egress for turtles and preclude the need for monitoring during the turtle active season. The Natural Resources Office tested the ramps with a live turtle to ensure their suitability. Monitoring was completed until all ramps were installed.

In response to road mortalities, near misses, and increased sightings on roads this year, the Natural Resources Office has made efforts to increase awareness and education this year. To minimize the potential for unintentional impacts to Eastern box turtles and snakes on base, technicians placed wildlife crossing signs displaying a turtle and snake on them at all the likely entrances to the training areas. In the fall of TY 2022, the Natural Resources Office conducted a training on box turtles for the Roads and Grounds crew, some of the mowing crew from the Coast Guard, Coast Guard environmental personnel, and a project manager from the IAGWSP. The Range Control Office also regularly briefs units on box turtles.

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 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 has contracted WEST to provide a robust analysis of sampling designs to make the most use of the monitoring data. In TY 2021, the Natural Resources Office has been working 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 is expected to be complete in early TY 2022, but the vegetation sampling protocol was able to be implemented at 20 sites in TY 2021. The Natural Resources Office plans to implement the full sampling design in TY 2022.

In TY 2019, 2020, and 2021 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 at Camp Edwards will continue in TY 2022. Her work in TY 2021 continued to document frosted elfin and also documented another state-listed species, pink streak (*Dargida rubripennis*) which was known to occur in the grasslands. 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 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. Adults of this species were detected at each survey location and followed by supplemental caterpillar surveys mentioned above. Data from this survey will be submitted to USFWS to aid in their regional survey efforts.

A volunteer, Elise Leduc, completed Monarch surveys in the grasslands 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 and the volunteer effort was extremely helpful to supplement short staffing and continue monitoring this at-risk species.

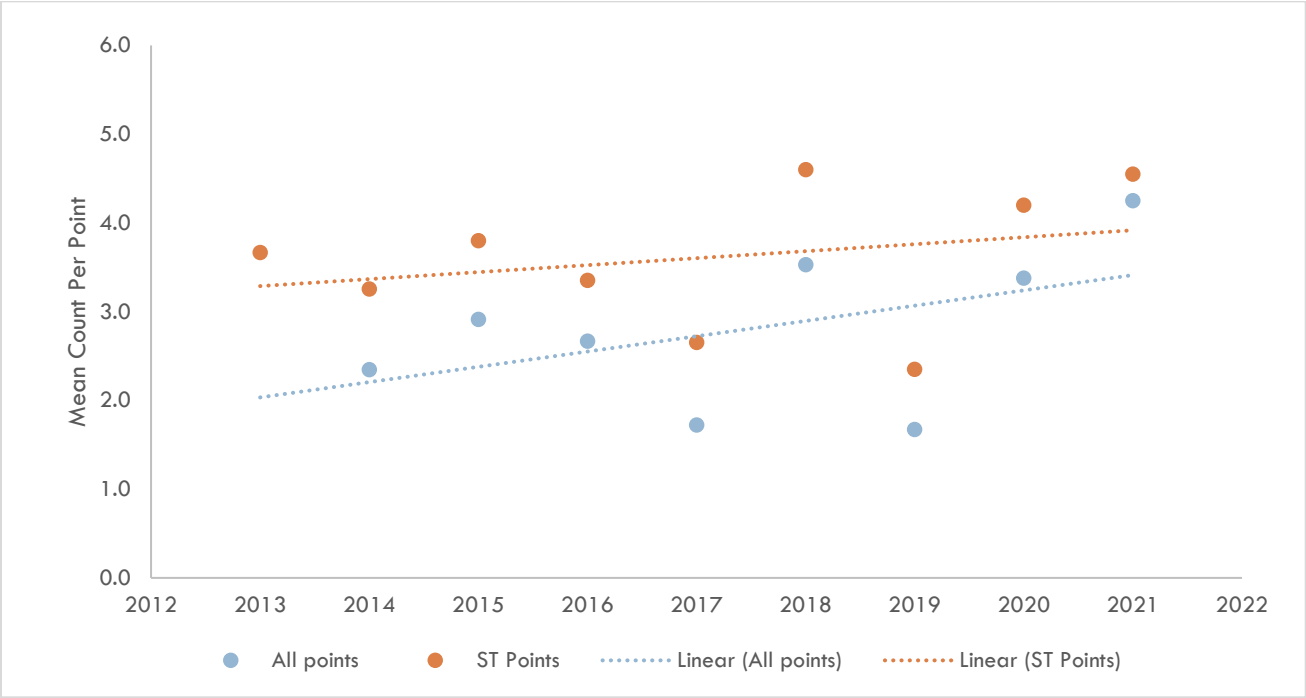
3.3.7 Eastern Whip-poor-will

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 2021 Whip-poor-will surveys were completed on May 19, 2021 following a week 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 2021 surveys documented Whip-poor-wills at all 32 survey locations for an occupancy rate of 100% and a mean count of 4.3 birds per point. This is compared to the long-term mean of 2.8 birds per point. Overall, Whip-poor-wills show an increasing, but not statistically significant, trend for abundance. Trends in occupancy are stable due to near saturation and a long-term mean of 0.9 (90%) 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 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.

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 per year).

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).

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, cut drainage ditches for, and used gravel to rebuild the westernmost portion of Estey Road, repairing the intersection with Fredrikson Road. Repairs consisting of graveling significantly degraded road segments were funded and initiated, although not completed, by the IAGWSP, coordinated with the EMC's Environmental Officer, on Jefferson Road, Wheelock Road, and Crowell Road. IAGWSP coordinated closely with Natural Resources to minimize impact on the Agassiz's clam shrimp, coordinate the project with NHESP through permit amendment, implement mitigation measures, and ensure provision of abundant clam shrimp habitat while maintaining an effective road network that supports training, remediation, natural resources management, and emergency response.

3.4.1 Erosion

The Integrated Training Area Management Program (ITAM) worked with Camp Edwards Facilities Engineering to conduct limited erosion maintenance on established maneuver trails. No significant projects were conducted.

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. Mechanical restoration, prescribed fire, resource monitoring, invasive plant management and others are important tools used here. During TY 2021, 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 mastication project restored the area surrounding the NBC Site to more open woodland conditions. One hardwood coppice management project was conducted in-house, experimenting with mechanical alternatives to chemical strategies. Two training areas 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
A-4 (NBC Site)	42	Training site rehabilitation	Mastication of vegetation ≤ 6" DBH
BA-7	157	Training site rehabilitation	Targeted mastication of standing dead trees
BA-6	4	Training site rehabilitation	Mastication of mid- and understory vegetation

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, having been contracted in TY 2021. A critical outreach element for TY 2021 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.

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.

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 provide little habitat value, produce unhealthy trees, present significant fire hazard, prevent training, and suppress all other vegetation. 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. 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.

Many rare plant sites are being encroached by invasive species or overshadowed by native species. 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 has since been 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. No major invasive species problems remain at sites where rare plants still exist, but several of the bowls where rare species have disappeared over the years still have high numbers of invasive shrubs and small trees. The Natural Resources-ITAM Office plans to remedy this through targeted tree removal in order to return frost bottom effects to these bowls.

3.5.3 Bird Surveys

This is the ninth 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 reduce the likelihood of species being undetected. The calculation of detection probabilities for species of survey concern were not completed in TY 2021 due to other priorities; although the data were provided to a graduate student at the University of Massachusetts for potential future analysis. Additionally, with the completion of nine years, the Natural Resources Office has been evaluating trend data as able, 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.

Eastern Whip-poor-wills (*Antrostomus vociferus*) are discussed in more detail in Section 3.3.7. The annual surveys in TY 2021 continued a gently increasing trend in Eastern Whip-poor-will abundance. Additionally, Whip-poor-wills were detected at all 32 survey locations with an average of 4.3 birds per point.

For the seventh 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 were 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.

Twenty-two Species of Greatest Conservation Need (SGCN), as categorized by the State Wildlife Action Plan, were observed during breeding bird point counts in TY 2021 (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). Additionally, the Blackpoll Warbler and Nashville Warbler are migrants here and not included in analysis or conservation planning. Additional 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). 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, especially including Brown Thrasher and Field Sparrow, but somewhat surprisingly also species such as Scarlet Tanager. The overall proportion of occupied survey sites is shown in Table 3-3, but most of the species are more distinctly associated with habitat of either the Training Area/Reserve or Cantonment grasslands and are reported separately. A total of 65 training site points and 14 grassland sites were surveyed in TY 2021.

Table 3-3 compares TY 2021 point count results to the 2015-2020 occupancy, which is the proportion of surveyed sites with recorded detections of a species. Occupancy is correlated with abundance and both measures are being analyzed and prepared for a more thorough reporting. Results that are more than 20% different from the period mean are shown in either green or red for increase or decrease, respectively. However, such differences should be evaluated along with overall trends, which will be contextualized in the overall report. While not strongly apparent in the simplified table, a notable trend is response of shrubland associated species (e.g., Prairie Warbler,

Field Sparrow, Brown Thrasher) to the combination of restoration management in both grassland and pine barrens habitats which is seen in decreasing trends in the smaller grasslands area offset by increases in occupancy and abundance in the training area. Another notable trend for grassland obligate species is those associated with low grass (e.g., Horned Lark) and very open field/prairie habitat (e.g., Upland Sandpiper) were much less detected in cantonment grasslands. However, those species were more densely populated in nearby JBCC habitats such as the capped landfill and airfield.

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

	Species	TY 2021 Sites	Proportion of Sites (total n=14)	2015-2020 Mean Proportion
Grassland Subset	American Kestrel	4	0.29	0.35
	Brown Thrasher	11	0.79	0.60
	Chimney Swift	7	0.50	0.12
	Eastern Meadowlark	11	0.79	0.42
	Eastern Towhee	11	0.79	0.90
	Field Sparrow	5	0.36	0.40
	Grasshopper Sparrow	13	0.93	0.76
	Horned Lark	0	0.00	0.05
	Prairie Warbler	12	0.86	0.75
	Purple Finch	2	0.14	0.19
	Upland Sandpiper	1	0.07	0.50
	Species	**TY 2021 Sites**	**Proportion of Sites (total n=65)**	**2015-2020 Mean Proportion**
Training Area Subset	Black-and-white Warbler	30	0.46	0.37
	Black-billed Cuckoo	13	0.20	0.19
	Brown Thrasher	36	0.55	0.6
	Eastern Towhee	65	1.00	1
	Field Sparrow	23	0.35	0.22
	Prairie Warbler	34	0.52	0.43
	Purple Finch	9	0.14	0.14
	Ruffed Grouse	50	0.77	0.71
	Scarlet Tanager	52	0.80	0.79

In the table above, results that are more than 20% different from the period mean are shown in either green or red for increase or decrease, respectively.

3.5.4 Deer Hunt

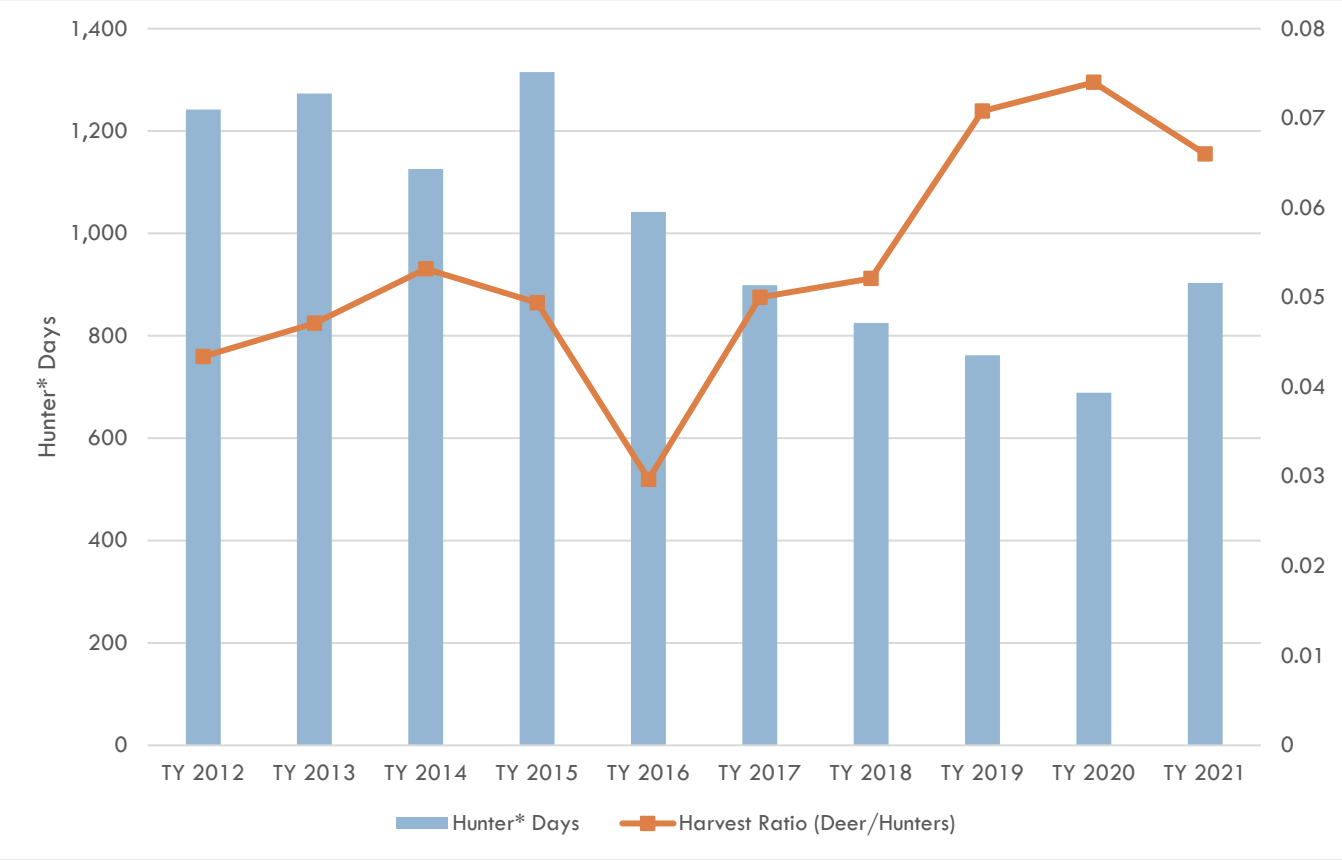
There was a deer hunting season in the Training Area/Reserve during TY 2021 in which 60 deer were taken during 903 hunter days. The Natural Resources Program supports a hunt sufficient to maintain a harvest level that is compatible with a healthy deer herd and healthy ecosystem. MAARNG and DFW generally 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 2021 included a three-day hunt for paraplegic sportsmen (October 29-31, 2021), a one-day youth hunt (October 3, 2021), a two-day opening for archery scouting (November 16-17, 2021), a three-day archery season (November 19-21), a one-day hunt for military sportsmen (December 5, 2021), a six-day shotgun season (December 7-12, 2021), and a two-day primitive (muzzleloader) season (December 17-18, 2021). Graph 3-5 shows the hunter days and deer harvest ratio since TY 2012.

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 2021 due to safety protocols to prevent the spread of Covid-19. The hunter surveys are planned to continue in TY 2023.

Graph 3-5 Camp Edwards Deer Harvest



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

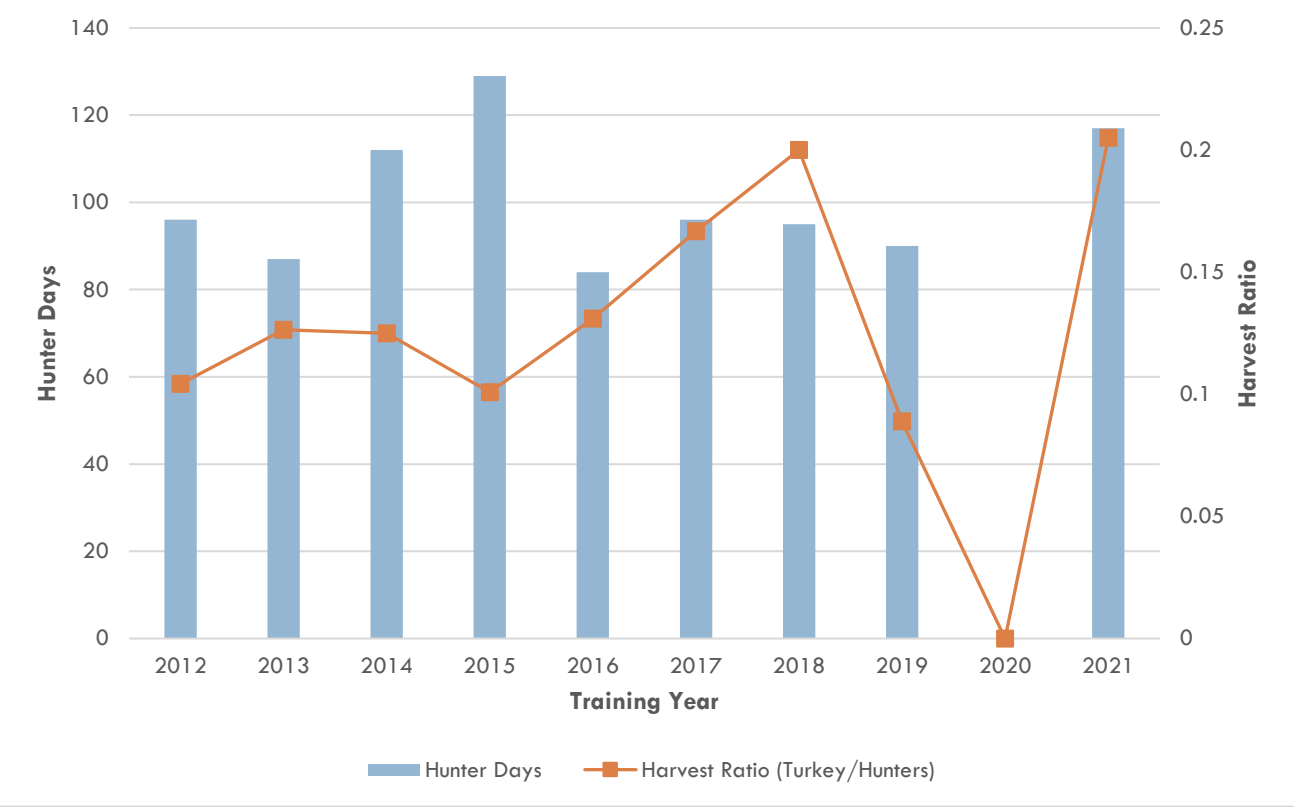
The goal of the hunt program is to provide recreational opportunities to the public and military and to harvest deer for the health of the herd and for ecosystem management. Deer harvests on base have been close to the 60 deer per year goal. Casual observations of browse on site do not indicate excessive 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 Southeast District of DFW 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 3-7, 2021 during which 115 hunters took 23 turkeys. In addition, a one-day youth turkey hunt was held on April 26, 2021 in which 2

youths participated with one turkey taken. Graph 3-6 provides information on the wild turkey hunts conducted in the spring since TY 2012.

Graph 3-6 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 sites and in-house maintenance on an additional two training sites and habitat patches throughout the base. These projects were conducted in Training Areas A-4, BA-3, BA-6, and BA-7.

3.5.6.1 – NBC Mastication

ITAM conducted a project devised in accordance with military requests to increase tactical training options at the NBC (Nuclear, Biological, Chemical) site in training area A-4. This site was chosen because it is a popular training venue with a variety of structural training aides and is conveniently located near major roads. The woods surrounding the site had increasingly overstocked understory and midstory, occluding lines of sight and hindering maneuver. Prescribed fire in this training area in 2004 provided exceptional relief visible in tree rings and overall forest health. Since that burn, white oak, in particular, has densely regrown reducing habitat quality for a variety of species, reducing training value, and reducing overall forest health through competition and shading.

This project masticated (mechanically mowed/mulched) trees ≤ 6” DBH (diameter at breast height) in 42 acres surrounding the current perimeter of the site. All material resulting from this project 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 perimeter defense training while also improving dismounted maneuver around the site, permitting infiltration training. The treatment unit before mastication had approximately 250 trees per acre, counting everything greater than 4" DBH as a tree. After treatment this was reduced to approximately 103

trees per acre, restoring functionally to the conditions immediately post-fire after prescribed burn operations in 2004. Basal area was reduced from 85 square feet per acre down to 62.5.

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.

3.5.6.2 – BA-7 Snag Mowing

Natural Resources conducted a snag (standing dead tree) mowing contract in training area BA-7, removing hazardous snag trees on 157 acres. This project involved pushing over and breaking up standing dead trees that posed risks for both soldier and natural resources personnel as well as prohibiting habitat maintenance using prescribed fire. This was a highly targeted approach to lay down decaying trees to allow reopening training area BA-7 for prescribed fire management and troop maneuver. The project was designed to leave an average of three snags standing per acre, to preserve habitat value for cavity nesters and bark dwellers. Bark dweller includes a whole host of taxa including birds (e.g., Brown Creeper), bats, a wide variety of invertebrates, and other species. Opportunistic understory patch mowing was incorporated only for access to snags being removed, which provided significant habitat benefit by introducing structural diversity in a mosaic, irregular pattern that also facilitates reentry with prescribed fire.

3.5.6.3 – In-House Management

ITAM conducted in-house mastication of 6 acres of mid and understory vegetation in BA-3 and BA-6. The mowing in BA-6 was a continuation of a multi-year effort to reduce snag risks to soldier safety, to stimulate a grassy and ericaceous understory, remove dangerous ladder fuels that posed a serious torching hazard, and to increase suitability for soldier training and bivouacking. The site has greatly varied conditions based on its decades of intense use for training and bivouacs. Mastication is primary managing encroaching young trees and dense scrub oak, both filling in the midstory canopy and densely shading the understory conditions and providing ladder fuels for wildfire. As such, it is not a significant change to overstory stem density (e.g., primary trees), but opening the midstory and exposing the understory plants to sunlight and restoring habitat for a variety of barrens specialists. All material generated by this activity is left on-site for future consumption by prescribed fire.

3.5.6.4 – Pending Projects for Fiscal Year 2022

The following two projects were conceived and funded in TY 2021 but are scheduled for execution in TY 2022.

BA-3 Training Area Management

This project was devised in accordance with military requests for a suitable training area to conduct Artillery Table VII evaluations. This site was chosen because of its historic intensive training use, its proximity to TTB Kelley and a well-established trail network, and need for habitat maintenance and restoration. The project entails creating a 7-acre area field in similar condition to restored battle positions and designed to meet the spatial requirements of a Field Artillery Battery conducting Table VII qualifications. Table VII does not include Artillery live fire. The site will be seeded with native warm and cool seasons grasses plus a mix of pollinator-friendly flowers for long term resilience.

This project also involves masticating vegetation ≤ 6” DBH in 68 acres surrounding the proposed artillery training site. This portion of the project will produce superb habitat for listed moths and an array of birds while significantly reducing what is a currently dangerous level of midstory fuels. This is already a focal area for

Barrens Buck Moth and many other rare species, but with degrading condition from high density regrowth in the understory and midstory. The project will also conduct a 50% harvest of trees > 5" DBH on 11 acres adjacent to the central artillery training site. This portion of the project will create a stable trail for towed artillery, increase lines of sight, facilitate dismounted maneuver, reduce potential vehicle impacts on trees, and reduce wildland fire fuel loading.

RAW3 Frost Bottom Restoration

This project aims to restore a natural functioning and self-maintaining frost bottom along the western boundary of the Impact Area. Frost bottoms are rare and focal habitats for a large number of habitat specialists within a pine barrens matrix, including state-listed plants. This project is part of the NHESP-approved mitigation efforts under the Conservation and Management Permit for the upcoming MPMG Range development and other projects. The habitat restoration efforts are focused on restoring a variety of "pine barrens" habitat conditions from scrub oak shrubland through pitch pine - scrub oak natural community, which are some of the rarest natural communities in the region and are of global conservation concern. Restoring these conditions outside the Impact Area, as mitigation under the CMP, provides a host of benefits for flora and fauna, while providing the opportunity to implement regular habitat maintenance for ecosystem health. All woody material and debris from this project will be removed from the base. The prime focus of this project is an 8-acre depression that is overgrown and lacks airflow for frost bottom ecological function. This portion of the harvest will remove all trees within the depression to reinvigorate the shrubby understory and restore growing season frost conditions.

Immediately west of the central clearing, this project will thin 14 acres of woods extending from the frost bottom to the top of the moraine. This thinning is intended to reduce fuels, invigorate the understory and facilitate the flow of cold air into the frost bottom. The final portion of this project is a 5-acre thinning to the north of the frost bottom. This will permit additional airflow to the frost bottom and will tie into a 2017 harvest conducted at OPs 9 and 10, creating contiguous habitat improvement and fuel reduction along the Impact Area.

3.6 FIRE MANAGEMENT

3.6.1 Prescribed Burn Program

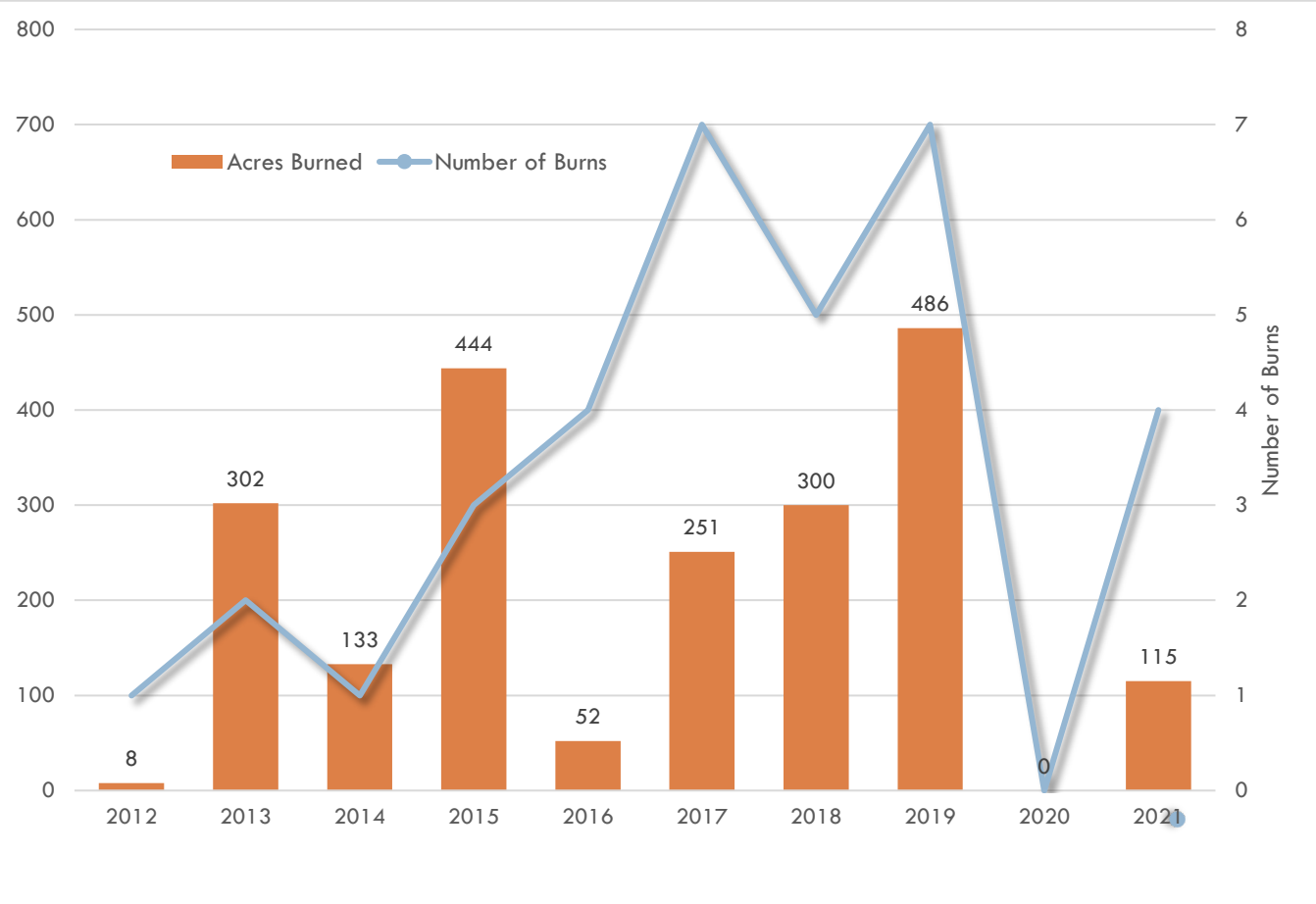
The Natural Resources Office utilizes a prescribed burn program to manage habitat, reduce fuel loads and help prevent wildfires. The prescribed burns are targeted to meet the multiple objectives of fuel reduction, habitat improvement, firefighter training, and soldier training support. The mix of those 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 November 4, 2020, and is valid through December 31, 2022.

Limited prescribed burning was conducted within the Training Area/Reserve in TY 2021. Weather conditions were unusually wet during this year, creating limited opportunities to conduct prescribed burns. The Covid-19 pandemic that began in TY 2020 continued to have impacts on prescribed burn operations, however to a lesser degree as a result of vaccinations and procedural controls that were established to help mitigate risk associated with Covid-19 transmittal during prescribed burn operations. A significant transition related to planning and implementation occurred during TY 2021. The availability of local contractors to conduct fire management projects no longer exists. This has created a need to rely to a greater extent on Natural Resource Office staff, other Camp Edwards program staff, Joint Base Cape Cod Fire Department, and partner agencies to accomplish prescribed burns and fire trainings.

During TY 2021 a total of four prescribed burns were conducted, two within the pine barrens (training area) and two with in the grasslands for a total of 115 acres. The ten-year prescribed fire accomplishment within the Training Area/Reserve is shown in Graph 3-7.

Prescribed fire goals for TY 2022 are to increase the operational burn days to 25, with an average burn size of 25 acres, take advantage of a larger burn window, and burn approximately 600 to 1,000 acres of pine barrens (550+ acres) and grassland habitat (40-60 acres). This is a good balance of objectives to 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) and more frequently shifting weather conditions – particularly with respect to precipitation.

Graph 3-7 Prescribed Fire Accomplishment within the Training Area/Reserve



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.

Wildland fire efforts for TY 2021 were focused on building the wildland fire program and planning efforts for future years. Approximatley 1.9 miles of fire break was improved along Jefferson Road on the north side of the central impact area, increasing safety and improving the ability to implement prescribed burns. During fall 2021 monthly wildland fire management meetings were initiated and helped to facilitate discussions with and between key leadership elements at Camp Edwards. A new 300 gallon wildland skid unit replaced a unit that was taken out

of service and was mounted on an exiting truck to make a Type 6 wildland engine. Two prescribed burn plan updates were contracted, covering approximatly 525 acres. Colorado State University was contracted to begin the Integrated Wildland Fire Mangement Plan update for Camp Edwards with an anticipated coompletion date in late 2022.

The Natural Resources office provided assitance to multiple partner agencies. All of this assistance was outside the Upper Cape Water Supply Reserve, but these partnership actions are critical to supporting habitat and ecosystem management within the Reserve. Various assistance for planning and active wildland fire was provided to the Massachusetts Division of Fisheries and Wildlife, DCR, Maine Army National Guard, New Hampshire Army National Guard, and others.

3.6.2 Fire Management Training

Wildland fire training remains a critical component of natural resources management and interagency partnerships. During the past twelve months limited training took place as a result of Covid-19 and lack of contractors capable of conducting trainings. Several trainings were still able to be held using in house and partner agency capacity but were scaled back to better address the situation and needs. Approximately fifteen Army National Guard Firefighting Detachment firefighters were provided wildland fire training. Three Natural Resources Office staff were provided Firefighter Training (S-130) and Introduction to Wildland Fire Behavior (S-190), enabling them to become part of the prescribed burn team. Twelve of the Camp Edwards prescribed burn team received first aid, CPR, and AED training to meet newly established Army prescribed burn crew training requirements. Fourteen people from Camp Edwards and partner agencies were provided Firefighter Type 1 (S-131) training. One Natural Resources Office burn crewmember became agency qualified as a Fire Fighter Type 1/Incident Commander Type 5. Over six individuals initiated work on their Fire Fighter Type 1/Incident Commander Type 5 or Fire Effects Monitor Position Task Books. The Wildland Fire Program Coordinator has started the processes of tracking trainings and qualifications in the Incident Qualification System (IQS).

Planning has begun for a fall 2022 wildland fire training academy to be held at Camp Edwards.

Photograph 3-3 A wildland firefighter provides ignition during a prescribed burn in the Cantonment Area grasslands.

3.7 PEST MANAGEMENT

During TY 2021, Natural Resources and ITAM conducted limited herbicide applications, limited to in-house control 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. 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 November 4, 2020. The permit is valid through December 31, 2022.

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.

Biennial smoke management reports administered by MassDEP require reporting and renewal submission at the end of each two-year period. The Camp Edwards smoke management permit (#4F02008) was renewed November 4, 2020 and is valid through December 31, 2022. The biennial smoke management report was submitted May 15, 2019. Information on prescribed burn activities within the Training Area/Reserve for TY 2020 is provided in Section 3.6.

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.

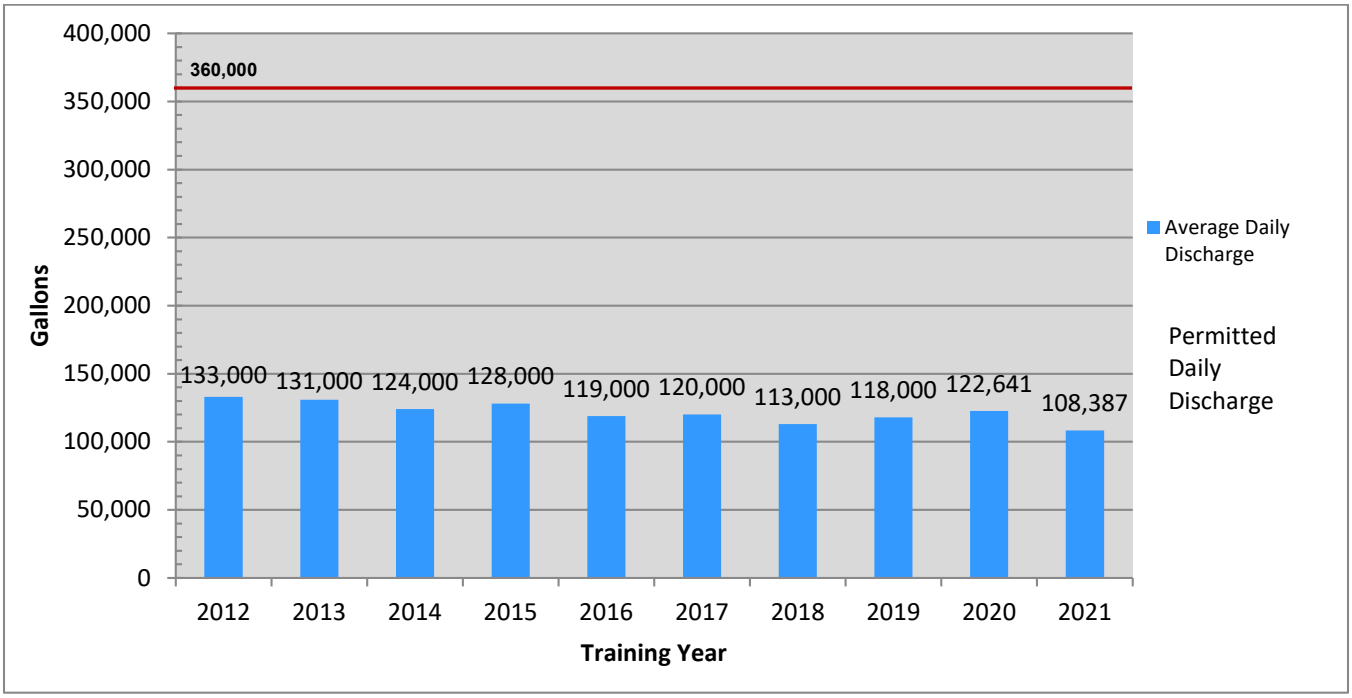
3.11 WASTEWATER MANAGEMENT

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 2021. The plant discharged 39,561,077 gallons of sewage into the sand filtration beds in the Training Area/Reserve; a daily average of 108,387 gallons versus its permitted twelve-month moving average flow of 360,000 gallons. Graph 3-8 shows the daily average pumping rate of the Otis system since TY 2012.

Graph 3-8 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 2021. 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. 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 report spills and/or releases of any size to Range Control immediately.

There was one small spill in the Training Area/Reserve during Ty 2021 below the reporting levels established in the Massachusetts Contingency Plan. Approximately 4 ounces of hydraulic fluid leaked from an excavator doing work in the Central Impact Area. 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 (IRP) 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.

Upon the completion of an internal review of the Camp Edwards hazardous waste program, it was determined that the Satellite Accumulation Area located within the Range Control complex was no longer necessary. Wastes generated within the Training Area/Reserve are now managed within the existing accumulation area located UTES, which is located outside of the Training Area/Reserve.

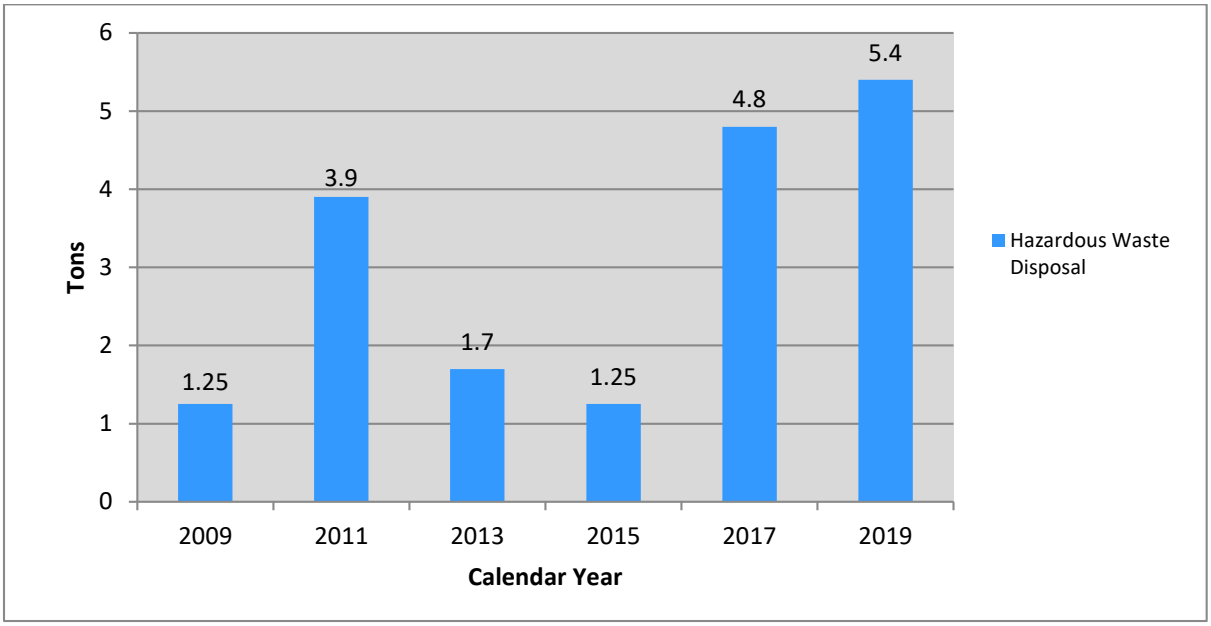
3.14.1 Hazardous Waste Disposal and Reporting

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 February 2020 for hazardous waste disposed of during calendar year 2019. Graph 3-9 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 MA ARNG within that year. In addition to the amounts generated and reported in the biennial report, the MAARNG removed approximately 4,400 tons of lead-contaminated soil as part of the IAGWSP cleanup effort in 2017. This material was not reported as part of the biennial report as it was exported to Canada and hazardous waste exported outside the US is not required to be reported in the biennial report.

3.15 VEHICLE MANAGEMENT

Unauthorized All Terrain Vehicle (ATV) and dirt bike access to the Training Area continued to be a problem in TY 2021. Range Control officials provided information to the Environmental Police as to locations and times such use was identified to help them adjust their patrols accordingly. As the level of unauthorized ATV and dirt bike access increases, continued coordination with the Environmental and local police takes place. Current efforts including sign posting, cameras, Camp Edwards Range Control inspections and Environmental and State Police patrols, have seemed to slow the illegal use of the Training Area/Reserve for ATV and dirt bike riding. However, this will be an ongoing effort. The entire Training Area/Reserve is now posted as off limits. This should help with public awareness and the enforcement of no trespass laws.

Graph 3-9 Hazardous Waste Disposal – Camp Edwards



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 February 18, 2021, the MAARNG reported to the EMC a noncompliance with EPS 19, or more specifically, with the OMMP for defined and approved use of a range. A unit conducted non-standard range use at Sierra Range on February 11, 2021, and at Echo Range on February 12 and February 13, 2021. The unit was found to have placed weapons zero targets on Sierra Range's 25 meter line because snowfall had made accessing the usual

25 meter zeroing targets difficult. The unit fired 700 5.56mm copper-only rounds of ammunition at those targets. On Echo Range, the unit conducted transition firing (transitioning between 5.56mm copper-only rifle and 9mm pistol fire) standing at 10 yards from stationary targets. A total of 17,000 5.56mm copper-only rounds were fired on Echo Range.

As is required for nonstandard range usage, the Officer in Charge and the Noncommissioned Officer in Charge did not seek approval for the nonstandard training from Camp Edwards Plans and Training, the Environmental & Readiness Center, and the EMC's Environmental Officer.

Corrective actions included counseling full-time Range Control staff on the importance of following established processes of consultation and approval for any non-standard training event; directing the Range Control maintenance manager that targets shall not be altered or additional targets installed 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; the Officer in Charge formalizing non-standard training requests (exceptions to policy) in a Standard Operating Procedure; retraining full-time Range Control staff; and written counseling for those personnel involved in approving the non-standard training.

In a letter dated March 16, 2021, the EMC determined that the "placement of additional targets and the use of the 5.56mm M855A-1 EPR ammunition at the range is inconsistent with the current OMMP for Echo Range and is a violation of EPS 19.0." The EMC also determined "that the placement of the 25-meter zero targets between lanes 6-7 is inconsistent with the current OMMP for Sierra Range and is considered a violation of EPS 19.0." Additionally, the "failure of the Range Control OIC and NCOIC to follow the approved OMMP for Sierra and Echo ranges constitutes a violation of Range Performance Standard EPS 19.0."

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.

In a September 28, 2021, letter to the EMC, the MAARNG confirmed they completed the corrective actions and additional EMC requirements listed above and provided the EMC with a copy of Regulation 350-2 and documentation of the required EPS/OMMP training.

Appendix H lists violations reported since TY 2012.

3.19 MITIGATION

Details of mitigation requirements and actions for TY 2021 may be found in the *Conservation and Management Permit Compliance and Mitigation Actions* in Appendix F.

SECTION 4
REMEDIATION PROGRAM ACTIVITIES

4.0 INTRODUCTION

This section of the Annual Report provides summaries on remediation activities in the Training Area/Reserve during TY 2021.

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.

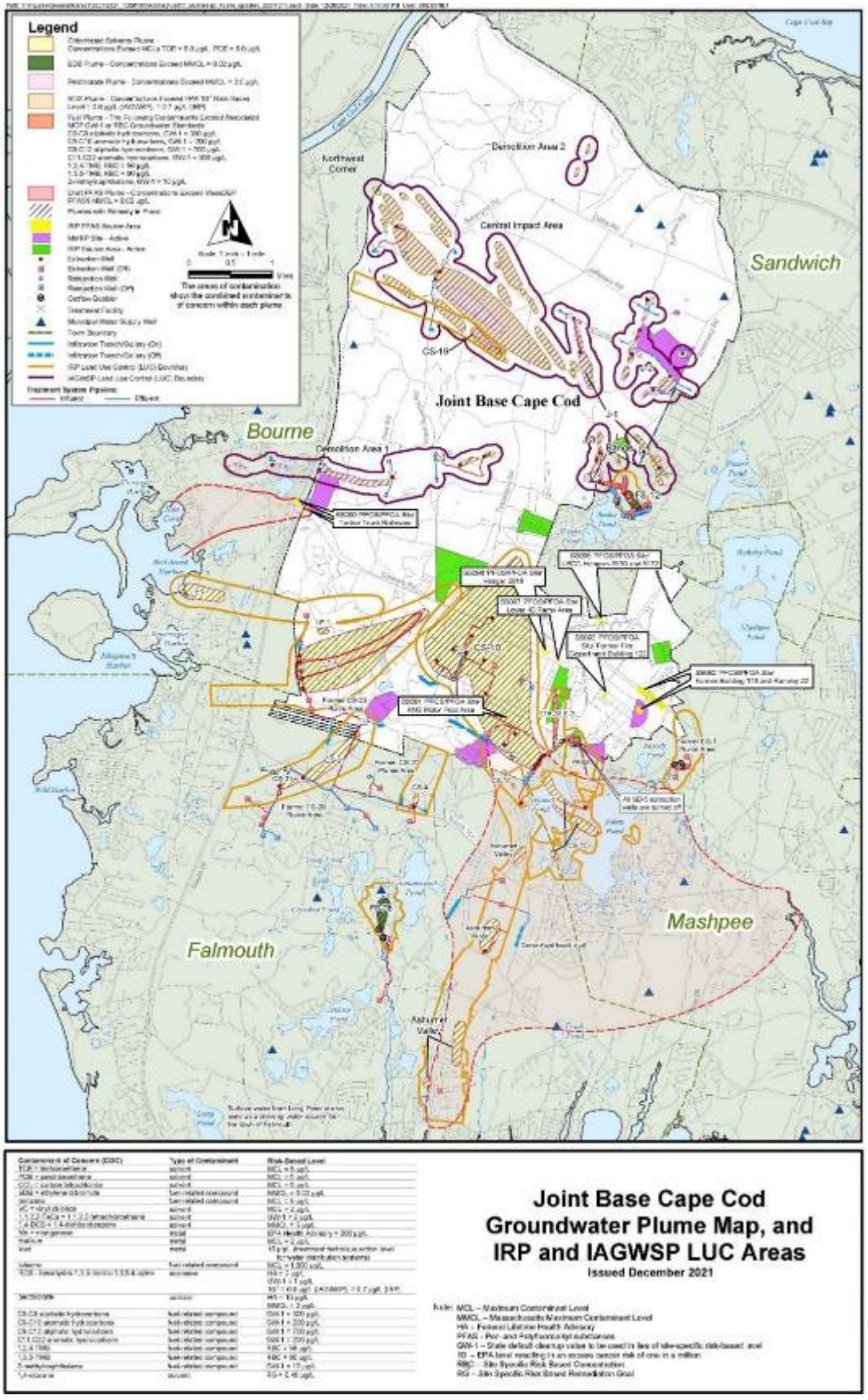
The IAGWSP is being managed by the Army National Guard. Investigation of the environmental impacts of legacy training in the upper 14,886 acres of JBCC began in 1996 and cleanup of groundwater contamination began in 2004. Seventeen treatment systems are currently operating on seven groundwater plumes to clean more than 4.1 million gallons of groundwater per day. More than 16 billion gallons of groundwater have been treated to date. While no public or private drinking water supplies are 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 2020, 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 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. 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. The MMRP sites in the Training Area/Reserve are all former training sites. In addition to the MMRP sites, AFCEC manages two groundwater plumes in the Training Area/Reserve (CS-19 and FS-12). AFCEC closed a former site referred to as CS-18, which was also located in the Training Area/Reserve.

In TY 2021, 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 1.4 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 2021.

4.3 IMPACT AREA GROUNDWATER STUDY PROGRAM ACTIVITIES

During TY 2021, 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 4.1 million gallons of water per day.

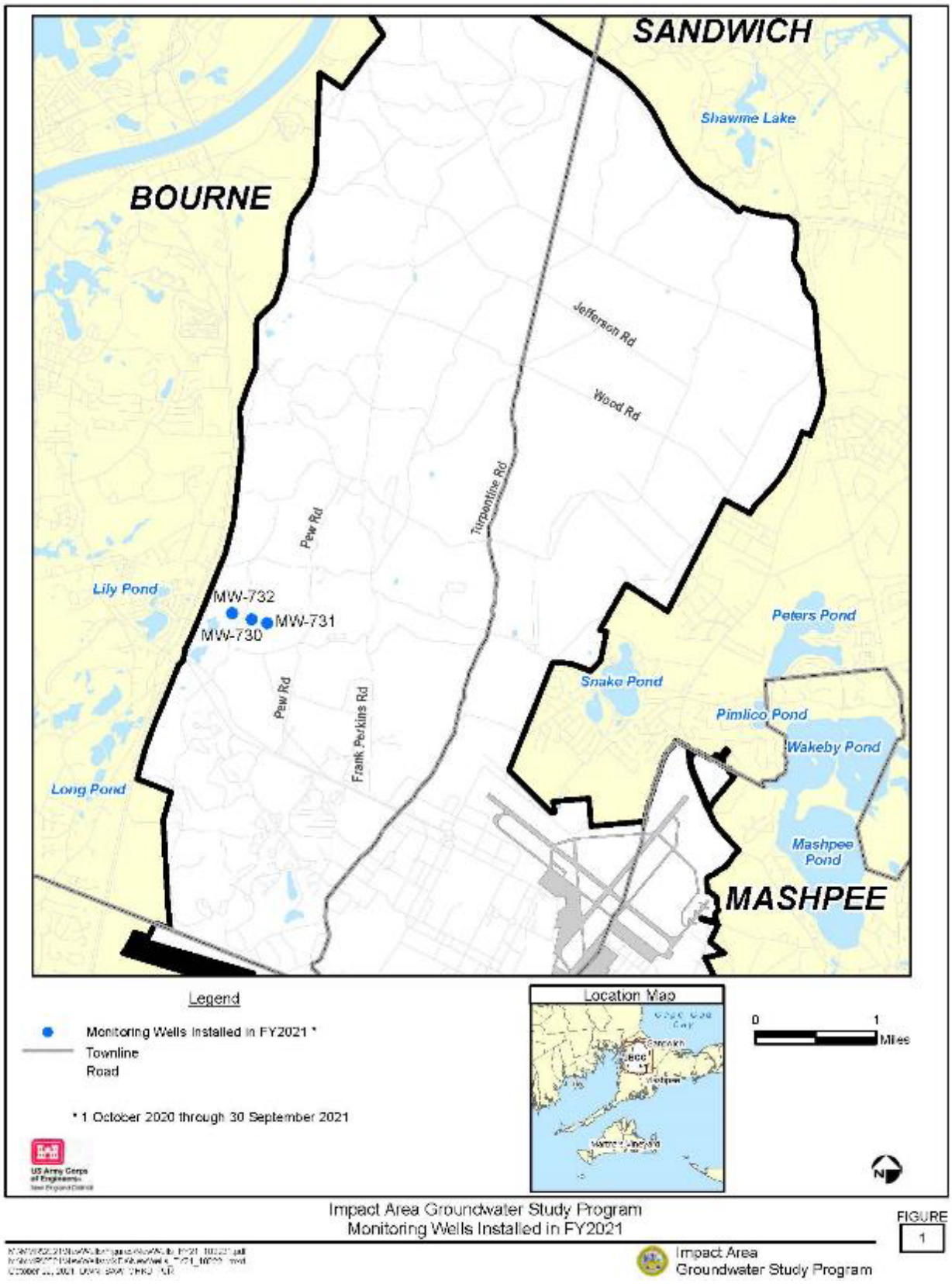
Removal of munitions from the source of the CIA groundwater plume continued in TY 2021. Work on Phase IV Area 1 (10 to 15 acres) of the CIA long-term source area response continued throughout the year. In the Central Impact Area, 93 acres have been cleared to 90%. Teams from the Army Corps of Engineers 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-3 Range 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 open burning/open detonation is known to have occurred. Groundwater sampling conducted in TY 2021 was conducted as follow-up to detections from 2020 PFAS sampling. Wells with the highest PFAS concentrations are located within and east of the former J-3 Range Demolition Area and in the vicinity of the former melt/pour building (where the melting/pouring or pressing of plastic bonded explosives occurred). Review of the data is ongoing and any recommendations for sampling of additional wells and further investigations will be developed for Agency review and approval.

Three new groundwater monitoring wells were added in TY 2021 (Figure 4-2) in support of groundwater investigations at the Demolition Area 1 plume. The wells were installed co-located and adjacent to the groundwater

monitoring well that had the highest detection of perchlorate during the 2020 reporting period. The wells will be used to further define the extent of perchlorate and RDX contamination in this area.

Figure 4-2 IAGWSP Wells Installed During TY 2021



SECTION 5
MISCELLANEOUS MILITARY AND CIVILIAN ACTIVITIES AND ENVIRONMENTAL PROGRAM PRIORITIES

5.0 MISCELLANEOUS MILITARY ACTIVITIES

5.0.1 Camp Edwards Tours

Camp Edwards hosted 10 tours of the training area open to community members from August to November. MAARNG soldier training venues, including simulated training and 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 200 members of the community attended the tours.

5.1 PROJECTS AT CAMP EDWARDS

A multiple-year effort to replace the roofs on the barracks at Camp Edwards with modern metal roofs was completed through the MAARNG's Construction and Facilities Office and the Directorate of Facilities Engineering. All eight barracks received sloped metal roofs that better safeguard the barracks, reduce the likelihood of roof leaks, and extend the useful life of the buildings for at least another 50 years. Initially, the roofs were funded out of Operations and Maintenance funding, but additional funds were competed for and ultimately awarded. The $4.38 million dollars' worth of additional funds allowed for the last three barracks roofs to be completed. In future years, the MAARNG will continue to use this model to fix the envelopes of the barracks to include repairing masonry and replacing windows and doors.

Photograph 5-1 Two of Camp Edwards's barracks with new, metal roofs.

5.2 JOINT BASE CAPE COD EXECUTIVE DIRECTOR

The Adjutant General of the Massachusetts National Guard established the position of the Executive Director of JBCC in late TY 2012. The primary roles of the position 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.

5.3 MISCELLANEOUS CIVILIAN ACTIVITIES

5.3.1 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 5-2). Eversource evaluated several sites for minimal loss of training land and impact to state priority habitat. Eversource is siting 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 the bill to change its use in August 2018. Eversource submitted an Environmental Notification Form 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

As part of the construction, approximately 68,000 cubic yards of soil was removed from the site. Eversource had the soil sampled with samples being tested for the following characterization parameters: PFAS, PFOA, volatile organic compounds, semi-volatile organic compounds, total petroleum hydrocarbons, polychlorinated biphenyls, Massachusetts Contingency Plan (MCP; 310 CMR 40.0000) 14 metals, conductivity, corrosivity, ignitability, reactivity, pH, pesticides, herbicides, perchlorate, and explosives. All samples were below or within regulatory guidelines, specifically MassDEP S1 standards. The MAARNG will be able to repurpose most of the material for use on Camp Edwards at Dig Site 3 to be used for repair and maintenance as needed and for engineering training within the dig site. Over the last nine 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.

5.3.2 Cape Cod Canal Area Transportation Improvement 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 likely include replacing the Bourne Bridge and Sagamore Bridge, improvements to the approach roadway network, multimodal improvements, and utility relocations. MassDOT released the final Cape Cod Canal Transportation Study in October 2019, which recommended various improvements and upgrades to infrastructure around the Canal Area including to the rotaries near the Bourne Bridge and adding an additional Route 6 eastbound travel lane from the Canal to approximately Exit 59 (the old Exit 2). Some changes could have potential impacts to JBCC and specifically the Camp Edwards Training Site. The final report is available online at https://www.mass.gov/lists/cape-cod-canal-study-documents#cape-cod-canal-transportation-study:-final-report-.

Data collection continues and will inform future alternatives analysis. The information will be used to determine impacts to property, local and regional traffic patterns, environmental resources, cultural, historical, and archeological resources and economic development. MassDOT held virtual public update meetings in June 2021 and November 2021. Documents and meeting materials related to the program may be found at: https://www.mass.gov/lists/documents-meeting-materials-cape-cod-canal-area-transportation-improvement-program.

5.4 ENVIRONMENTAL PROGRAM PRIORITIES

5.4.1 TY 2021 Environmental Program Priorities

The following subsections provide a list of the environmental program priorities established for TY 2021 as published in the TY 2020 Annual Report for its activities associated with the Training Area/Reserve and the status of achieving them..

Natural Resources and ITAM Management

- Finalize Sikes Act signatures on updated INRMP and implement annual review. (Completed)
- 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. (Accomplished for TY 2021 and ongoing)

- Continue to address potential federal status changes to species at Camp Edwards through interagency consultation, planning, and partnership. (Ongoing)
- Further develop supplemental plans for Natural Resources/ITAM long-term budgets and implementation, including invasive species, wildland fire, and land rehabilitation. (Ongoing)
- Continue implementation and refinement of management focused monitoring of rare species, habitat management, and training capabilities. (Ongoing; completed some target plans such as moth and vegetation monitoring)
- 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)
- 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)
- Develop water feature conservation plans that provide for ephemeral features (e.g., vernal pools) while minimizing impacts to wildlife and training. (Ongoing)
- 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)

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 operationally 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 2020 *State of the Reservation Report.* (Accomplished)

5.4.2 TY 2022 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 2022.

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.
- 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.
- 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.
- 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.
- 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.
- 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 operationally 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 2021 *State of the Reservation Report.*

APPENDIX A
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 B
LIST OF CONTACTS

LIST OF CONTACTS

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Environmental Management Commission Environmental Officer

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APPENDIX C
SMALL ARMS RANGE AND SOLDIER VALIDATION LANE INFORMATION

Operations Maintenance and Monitoring Activities

OPERATIONS, MAINTENANCE & MONITORING ACTIVITIES
JULIET & KILO RANGE
TY 2021

Date	Juliet	Kilo
1 Oct 20	Maintenance: 70 gallons pumped (1 cm)	Maintenance: 110 gallons pumped (W 4 cm; E 6.5 cm)
13 Oct 20	Maintenance: 70 gallons pumped (0 cm)	Maintenance: 80 gallons pumped (W 2 cm; E 6.5 cm)
20 Oct 20	Maintenance: 410 gallons pumped (0 cm)	Maintenance: 600 gallons pumped (W 0 cm; E 0 cm)

Note: The STAPP™ bullet capture systems on Juliet and Kilo ranges was dismantled in Fall 2020. Juliet and Kilo Ranges are currently operationally inactive ranges.

OPERATIONS, MAINTENANCE & MONITORING ACTIVITIES
SIERRA & INDIA RANGES
TY 2021

Date	Sierra	India
4 Oct 20	-----	Pre/post-fire inspection
15 Oct 20	-----	Pre/post-fire inspection
16 Oct 20	Pre/post-fire inspection	-----
17 Oct 20	Pre/post-fire inspection	Pre/post-fire inspection
23, 24 Oct 20	-----	Pre/post-fire inspection
24 Oct 20	Pre/post-fire inspection	-----
7, 8 Nov 20	Pre/post-fire inspection	Pre/post-fire inspection
14 Nov 20	Pre/post-fire inspection	Pre/post-fire inspection
4, 6 Feb 21	Pre/post-fire inspection	Pre/post-fire inspection
6, 7 Mar 21	Pre/post-fire inspection	-----
13 Mar 21	Pre/post-fire inspection	Pre/post-fire inspection
14 Mar 21	Pre/post-fire inspection	-----
18 Mar 21	Pre/post-fire inspection	
19, 21 Mar 21	-----	Pre/post-fire inspection
20, 21 Mar 21	Pre/post-fire inspection	-----
25 Mar 21	Pre/post-fire inspection	-----
26, 27 Mar 21	Pre/post-fire inspection	Pre/post-fire inspection
7, 9 Apr 21	Pre/post-fire inspection	Pre/post-fire inspection
10 Apr 21	Pre/post-fire inspection	-----
14, 15 Apr 21	Pre/post-fire inspection	-----
16, 17 Apr 21	-----	Pre/post-fire inspection
16-18 Apr 21	Pre/post-fire inspection	-----
19, 20 Apr 21	Maintenance: Bullet pocket repair on berms	Maintenance: Bullet pocket repair on berms
1 May 21	Pre/post-fire inspection	-----
14, 15 May 21	Pre/post-fire inspection	-----
14, 16 May 21	-----	Pre/post-fire inspection
19 May 21	Pre/post-fire inspection	-----
21, 23 May 21	Pre/post-fire inspection	Pre/post-fire inspection
5, 6 Jun 21	Pre/post-fire inspection	Pre/post-fire inspection
8 Jun 21	-----	Pre/post-fire inspection
9 Jun 21	Pre/post-fire inspection	-----
11 Jun 21	Pre/post-fire inspection	
11, 12 June	-----	Pre/post-fire inspection
12, 13 Jun 21	Pre/post-fire inspection	-----
20 Jun 21	-----	Pre/post-fire inspection
20, 23 Jun 21	Pre/post-fire inspection	-----
25, 27 Jun 21	Pre/post-fire inspection	-----
9 Jul 21	Pre/post-fire inspection	-----
12, 13 Jul 21	Pre/post-fire inspection	Pre/post-fire inspection
18 Jul 21	Pre/post-fire inspection	-----

Date	Sierra	India
24 Jul 21	Pre/post-fire inspection	-----
27, 29 Aug 21	Pre/post-fire inspection	-----
10, 12 Sep 21	-----	Pre/post-fire inspection
11 Sep 21	Pre/post-fire inspection	-----
24, 25 Sep 21	Pre/post-fire inspection	-----

OPERATIONS, MAINTENANCE & MONITORING ACTIVITIES
LIMA RANGE
TY 2021

Date	Activity
19, 21 Oct 20	Pre/post-fire inspection
30 Apr 21	Pre/post-fire inspection
16 May 21	Pre/post-fire inspection
10 Jun 21	Pre/post-fire inspection

OPERATIONS, MAINTENANCE & MONITORING ACTIVITIES
ECHO RANGE
TY 2021

Date	Activity
17 Oct 20	Pre/post-fire inspection
24 Oct 20	Pre/post-fire inspection
9, 13 Nov 20	Pre/post-fire inspection
14, 15 Nov 20	Pre/post-fire inspection
5 Feb 21	Pre/post-fire inspection
14 Mar 21	Pre/post-fire inspection
25 Mar 21	Pre/post-fire inspection
27 Mar 21	Pre/post-fire inspection
14, 15 Apr 21	Pre/post-fire inspection
16, 17 Apr 21	Pre/post-fire inspection
30 Apr 21	Pre/post-fire inspection
4 May 21	Pre/post-fire inspection
15, 16 May 21	Pre/post-fire inspection
21, 22 May 21	Pre/post-fire inspection
5 Jun 21	Pre/post-fire inspection
10 Jul 21	Pre/post-fire inspection
23, 24 Jul 21	Pre/post-fire inspection
27 Aug 21	Pre/post-fire inspection
28 Aug 21	Pre/post-fire inspection
10, 11 Sep 21	Pre/post-fire inspection
11, 12 Sep 21	Pre/post-fire inspection

Lead Ammunition Use

Juliet, Kilo, Tango and Echo Ranges

LEAD AMMUNITION USE HISTORY ECHO RANGE			
Training Year	**.40 Cal Lead**	**9 mm Lead**	**Total**
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**	**74,568**	**73,919**

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 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	**78,044**	**2,120**	**1,993**	**344,026**	**474,910**	**949,135**	**1,846,203**

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.

LEAD AMMUNITION USE HISTORY JULIET RANGE								
Training Year	**.40 Cal Lead**	**9 mm Lead**	**7.62 mm Lead**	**5.56 mm Lead**	**.38 Cal Lead**	**.45 Cal Lead**	**.233 Cal Lead**	**Total**
TY 2020	0	7,690	0	0	0	0	0	7,690
TY 2019	0	17,774	0	12,315	0	0	0	30,089
TY 2018	0	12,781	0	23,802	0	0	0	36,583
TY 2017	0	26,108	0	25,789	0	0	0	51,897
TY 2016	0	9,200	0	51,852	0	0	0	61,052
TY 2015	2,500	24,828	0	36,938	0	1,000	0	65,266
TY 2014	2,400	18,874	9,000	6,663	0	0	0	36,937
TY 2013	2,450	9,260	0	27,286	0	0	1,200	40,196
TY 2012	750	12,819	0	14,457	0	0	3,000	31,026
TY 2011	0	16,911	0	46,630	0	0	0	63,541
TY 2010	0	7,311	0	27,060	0	0	0	34,371
TY 2009	0	4,780	0	11,482	0	0	0	16,262
TY 2008	0	0	0	0	0	0	0	0
TY 2007	0	0	0	0	0	0	0	0
TOTAL	**8,100**	**168,336**	**9,000**	**284,274**	**0**	**1,000**	**4,200**	**474,910**

Note: A STAPP™ bullet capture system was installed at Juliet Range in August/September 2008 and dismantled in Fall 2020. Juliet Range is currently an operationally inactive range; the range was not used in TY 2021.

LEAD AMMUNITION USE HISTORY KILO RANGE								
Training Year	**.40 Cal Lead**	**9 mm Lead**	**7.62 mm Lead**	**5.56 mm Lead**	**.38 Cal Lead**	**.45 Cal Lead**	**.233 Cal Lead**	**Total**
TY 2020	0	61,480	0	21,052	0	1,500	0	84,032
TY 2019	0	44,428	0	36,751	0	0	0	81,179
TY 2018	0	25,803	0	93,539	0	0	0	119,342
TY 2017	0	50,147	0	65,515	0	0	0	115,662
TY 2016	0	21,373	0	28,265	0	0	0	49,638
TY 2015	0	15,601	0	54,372	0	0	0	69,973
TY 2014	0	31,304	0	49,052	0	0	0	80,356
TY 2013	0	731	0	73,011	0	0	0	73,742
TY 2012	0	7,181	0	52,731	0	0	0	59,912
TY 2011	14,362	9,850	0	100,942	0	0	0	125,154
TY 2010	1,450	7,500	0	51,412	0	0	0	60,362
TY 2009	0	6,675	0	23,108	0	0	0	29,783
TY 2008	0	0	0	0	0	0	0	0
TY 2007	0	0	0	0	0	0	0	0
TOTAL	**15,812**	**282,073**	**0**	**649,750**	**0**	**1,500**	**0**	**949,135**

Note: A STAPP™ bullet capture system was installed at Kilo Range in August/September 2008 and dismantled in Fall 2020. Kilo Range is currently an operationally inactive range; the range was not used in TY 2021.

LEAD AMMUNITION USE HISTORY TANGO RANGE									
Training Year	**.40 Cal Lead**	**9 mm Lead**	**7.62 mm Lead**	**5.56 mm Lead**	**.38 Cal Lead**	**.45 Cal Lead**	**.233 Cal Lead**	**.22 Cal Lead**	**Total**
TY 2017	0	2,250	4,240	9,380	0	0	0	625	16,495
TY 2016	0	4,200	0	0	0	0	0	0	4,200
TY 2015	0	5,240	0	1,720	0	0	0	0	6,960
TY 2014	0	0	0	3,220	0	0	0	0	3,220
TY 2013	1,600	1,800	0	2,000	0	0	4,550	0	9,950
TY 2012	2,800	7,373	0	1,944	0	0	0	0	12,117
TY 2011	5,200	6,765	0	25,157	0	0	0	0	37,122
TY 2010	40,341	2,496	0	41,042	0	6,449	0	0	90,328
TY 2009	0	31,985	0	105,077	300	0	0	0	137,362
TY 2008	4,075	9,094	4,556	0	0	0	0	0	17,725
TY 2007	0	0	0	8,547	0	0	0	0	8,547
TOTAL	**54,016**	**71,203**	**8,796**	**198,087**	**300**	**6,449**	**4,550**	**625**	**344,026**

Note: A STAPP™ bullet capture system was installed at Tango Range in July 2006 and dismantled in October 2017. During TY 2021, Tango Range was reconfigured for use as a copper ammunition-only zeroing range.

Copper Ammunition Use

Sierra and India Ranges

COPPER AMMUNITION USE HISTORY SIERRA AND INDIA RANGES				
Training Year	**Sierra Range 5.56 Copper**	**India Range 5.56 Copper**	**India Range 7.62 Copper**	**Total**
TY 2021	221,756	73,400	0	295,156
TY 2020	131,274	90,849	0	222,123
TY 2019	98,426	71,098	0	169,524
TY 2018	98,393	105,143	0	203,536
TY 2017	95,905	105,099	4,793	205,797
TY 2016	80,747	60,571	0	141,318
TY 2015	66,086	12,947	0	79,033
TY 2014	46,804	27,872	0	74,676
TY 2013	34,493	10,918	0	45,411
TY 2012	34,359	6,601	0	40,960
TOTAL	**908,243**	**564,498**	**4,793**	**1,477,534**

Note: Firing of copper ammunition began at Sierra Range on July 8, 2012 and at India Range on September 15, 2012.

Small Arms Range Sampling Reports

Soil Sampling Results

Fall 2021

Range	Sample Code	Method	Analysis Date	Analyte	Result	Units	OMMP Action Level Mg/Kg	Detection Flag	Qualifiers	Method Detction Limit	Reporting Detection Limit	Quantitation Limit	Detection Limit Units
Echo	SSERNG001_SEP21A-09132021	SW6010C	10/4/2021 15:12	Antimony	1.5	mg/kg	300	Y	J	0.8	1.6	2.2	mg/kg
Echo	SSERNG001_SEP21A-09132021	SW6010C	10/4/2021 15:12	Calcium	780	mg/kg		Y		15	55	110	mg/kg
Echo	SSERNG001_SEP21A-09132021	SW9056	9/22/2021 19:56	Chloride	33	mg/kg		N	UM	13	33	33	mg/kg
Echo	SSERNG001_SEP21A-09132021	SW6010C	10/4/2021 15:12	Copper	1.2	mg/kg	10,000	Y	J	0.24	0.88	5.5	mg/kg
Echo	SSERNG001_SEP21A-09132021	SW6010C	10/4/2021 15:12	Iron	57	mg/kg		Y	J	9.1	22	88	mg/kg
Echo	SSERNG001_SEP21A-09132021	SW6010C	10/5/2021 8:23	Lead	14	mg/kg	3,000	Y	Q	0.34	0.88	0.99	mg/kg
Echo	SSERNG001_SEP21A-09132021	SW6010C	10/4/2021 15:12	Magnesium	400	mg/kg		Y		8.7	22	33	mg/kg
Echo	SSERNG001_SEP21A-09132021	SW9045D	10/7/2021 13:41	pH adj. to 25 deg C	5.3	pH units		Y	HF	0.1	0.1	0.1	pH units
Echo	SSERNG001_SEP21A-09132021	SW6010C	10/4/2021 15:12	Potassium	1600	mg/kg		Y		45	180	330	mg/kg
Echo	SSERNG001_SEP21A-09132021	SW6010C	10/4/2021 15:12	Sodium	1700	mg/kg		Y		32	110	550	mg/kg
Echo	SSERNG001_SEP21A-09132021	SW9056	9/22/2021 19:56	Sulfate	28	mg/kg		N	UM	10	28	55	mg/kg
Echo	SSERNG001_SEP21B-09132021	SW6010C	10/4/2021 15:15	Antimony	2.2	mg/kg	300	N	U	1.1	2.2	2.9	mg/kg
Echo	SSERNG001_SEP21B-09132021	SW6010C	10/4/2021 15:15	Calcium	840	mg/kg		Y		20	73	150	mg/kg
Echo	SSERNG001_SEP21B-09132021	SW9056	9/22/2021 20:12	Chloride	48	mg/kg		N	U	19	48	48	mg/kg
Echo	SSERNG001_SEP21B-09132021	SW6010C	10/4/2021 15:15	Copper	6.3	mg/kg	10,000	Y	J	0.31	1.2	7.3	mg/kg
Echo	SSERNG001_SEP21B-09132021	SW6010C	10/4/2021 15:15	Iron	11000	mg/kg		Y		12	29	120	mg/kg
Echo	SSERNG001_SEP21B-09132021	SW6010C	10/5/2021 8:26	Lead	19	mg/kg	3,000	Y	Q	0.45	1.2	1.3	mg/kg
Echo	SSERNG001_SEP21B-09132021	SW6010C	10/4/2021 15:15	Magnesium	1000	mg/kg		Y		11	29	44	mg/kg
Echo	SSERNG001_SEP21B-09132021	SW9045D	10/7/2021 13:41	pH adj. to 25 deg C	5.3	pH units		Y	HF	0.1	0.1	0.1	pH units
Echo	SSERNG001_SEP21B-09132021	SW6010C	10/4/2021 15:15	Potassium	670	mg/kg		Y		59	230	440	mg/kg
Echo	SSERNG001_SEP21B-09132021	SW6010C	10/4/2021 15:15	Sodium	60	mg/kg		Y	J	42	150	730	mg/kg
Echo	SSERNG001_SEP21B-09132021	SW9056	9/24/2021 18:22	Sulfate	40	mg/kg		N	U	15	40	81	mg/kg
Echo	SSERNG001_SEP21C-09132021	SW6010C	10/4/2021 15:32	Antimony	1.8	mg/kg	300	N	U	0.86	1.8	2.3	mg/kg
Echo	SSERNG001_SEP21C-09132021	SW6010C	10/4/2021 15:32	Calcium	680	mg/kg		Y		17	59	120	mg/kg
Echo	SSERNG001_SEP21C-09132021	SW9056	9/22/2021 20:29	Chloride	33	mg/kg		N	UM	13	33	33	mg/kg
Echo	SSERNG001_SEP21C-09132021	SW6010C	10/4/2021 15:32	Copper	5.3	mg/kg	10,000	Y	J	0.25	0.94	5.9	mg/kg
Echo	SSERNG001_SEP21C-09132021	SW6010C	10/4/2021 15:32	Iron	9500	mg/kg		Y		9.7	23	94	mg/kg
Echo	SSERNG001_SEP21C-09132021	SW6010C	10/5/2021 8:30	Lead	15	mg/kg	3,000	Y	Q	0.36	0.94	1.1	mg/kg
Echo	SSERNG001_SEP21C-09132021	SW6010C	10/4/2021 15:32	Magnesium	880	mg/kg		Y		9.3	23	35	mg/kg
Echo	SSERNG001_SEP21C-09132021	SW9045D	10/7/2021 13:41	pH adj. to 25 deg C	5.2	pH units		Y	HF	0.1	0.1	0.1	pH units
Echo	SSERNG001_SEP21C-09132021	SW6010C	10/4/2021 15:32	Potassium	520	mg/kg		Y		48	190	350	mg/kg
Echo	SSERNG001_SEP21C-09132021	SW6010C	10/4/2021 15:32	Sodium	48	mg/kg		Y	J	34	120	590	mg/kg
Echo	SSERNG001_SEP21C-09132021	SW9056	9/22/2021 20:29	Sulfate	27	mg/kg		N	UM	10	27	55	mg/kg

Range	Sample Code	Method	Analysis Date	Analyte	Result	Units	OMMP Action Level Mg/Kg	Detection Flag	Qualifiers	Method Detction Limit	Reporting Detection Limit	Quantitation Limit	Detection Limit Units
Echo	SSERNG002_SEP21-09132021	SW6010C	10/4/2021 15:35	Antimony	1.7	mg/kg	300	N	U	0.82	1.7	2.2	mg/kg
Echo	SSERNG002_SEP21-09132021	SW6010C	10/4/2021 15:35	Calcium	630	mg/kg		Y		16	56	110	mg/kg
Echo	SSERNG002_SEP21-09132021	SW9056	9/22/2021 20:45	Chloride	36	mg/kg		N	UM	14	36	36	mg/kg
Echo	SSERNG002_SEP21-09132021	SW6010C	10/4/2021 15:35	Copper	4.9	mg/kg	10,000	Y	J	0.24	0.9	5.6	mg/kg
Echo	SSERNG002_SEP21-09132021	SW6010C	10/4/2021 15:35	Iron	8600	mg/kg		Y		9.3	22	90	mg/kg
Echo	SSERNG002_SEP21-09132021	SW6010C	10/5/2021 8:33	Lead	13	mg/kg	3,000	Y	Q	0.35	0.9	1	mg/kg
Echo	SSERNG002_SEP21-09132021	SW6010C	10/4/2021 15:35	Magnesium	760	mg/kg		Y		8.9	22	34	mg/kg
Echo	SSERNG002_SEP21-09132021	SW9045D	10/7/2021 13:41	pH adj. to 25 deg C	5.3	pH units		Y	HF	0.1	0.1	0.1	pH units
Echo	SSERNG002_SEP21-09132021	SW6010C	10/4/2021 15:35	Potassium	480	mg/kg		Y		46	180	340	mg/kg
Echo	SSERNG002_SEP21-09132021	SW6010C	10/4/2021 15:35	Sodium	35	mg/kg		Y	J	32	110	560	mg/kg
Echo	SSERNG002_SEP21-09132021	SW9056	9/22/2021 20:45	Sulfate	30	mg/kg		N	UM	11	30	60	mg/kg
Echo	SSERNG003_SEP21-09132021	SW6010C	10/4/2021 15:39	Antimony	1.6	mg/kg	300	N	U	0.79	1.6	2.2	mg/kg
Echo	SSERNG003_SEP21-09132021	SW6010C	10/4/2021 15:39	Calcium	610	mg/kg		Y		15	54	110	mg/kg
Echo	SSERNG003_SEP21-09132021	SW9056	9/22/2021 21:02	Chloride	37	mg/kg		N	U	14	37	37	mg/kg
Echo	SSERNG003_SEP21-09132021	SW6010C	10/4/2021 15:39	Copper	5.5	mg/kg	10,000	Y		0.23	0.86	5.4	mg/kg
Echo	SSERNG003_SEP21-09132021	SW6010C	10/4/2021 15:39	Iron	8500	mg/kg		Y		8.9	22	86	mg/kg
Echo	SSERNG003_SEP21-09132021	SW6010C	10/5/2021 8:37	Lead	14	mg/kg	3,000	Y	Q	0.33	0.86	0.97	mg/kg
Echo	SSERNG003_SEP21-09132021	SW6010C	10/4/2021 15:39	Magnesium	820	mg/kg		Y		8.5	22	32	mg/kg
Echo	SSERNG003_SEP21-09132021	SW9045D	10/7/2021 13:41	pH adj. to 25 deg C	5.3	pH units		Y	HF	0.1	0.1	0.1	pH units
Echo	SSERNG003_SEP21-09132021	SW6010C	10/4/2021 15:39	Potassium	480	mg/kg		Y		44	170	320	mg/kg
Echo	SSERNG003_SEP21-09132021	SW6010C	10/4/2021 15:39	Sodium	32	mg/kg		Y	J	31	110	540	mg/kg
Echo	SSERNG003_SEP21-09132021	SW9056	9/22/2021 21:02	Sulfate	31	mg/kg		N	UM	11	31	62	mg/kg
Echo	SSERNG004_SEP21-09132021	SW6010C	10/4/2021 15:42	Antimony	1.7	mg/kg	300	N	U	0.81	1.7	2.2	mg/kg
Echo	SSERNG004_SEP21-09132021	SW6010C	10/4/2021 15:42	Calcium	660	mg/kg		Y		16	55	110	mg/kg
Echo	SSERNG004_SEP21-09132021	SW9056	9/22/2021 21:18	Chloride	35	mg/kg		N	UM	13	35	35	mg/kg
Echo	SSERNG004_SEP21-09132021	SW6010C	10/4/2021 15:42	Copper	5	mg/kg	10,000	Y	J	0.24	0.88	5.5	mg/kg
Echo	SSERNG004_SEP21-09132021	SW6010C	10/4/2021 15:42	Iron	8600	mg/kg		Y		9.1	22	88	mg/kg
Echo	SSERNG004_SEP21-09132021	SW6010C	10/5/2021 8:40	Lead	14	mg/kg	3,000	Y	Q	0.34	0.88	0.99	mg/kg
Echo	SSERNG004_SEP21-09132021	SW6010C	10/4/2021 15:42	Magnesium	870	mg/kg		Y		8.7	22	33	mg/kg
Echo	SSERNG004_SEP21-09132021	SW9045D	10/7/2021 13:41	pH adj. to 25 deg C	5.4	pH units		Y	HF	0.1	0.1	0.1	pH units
Echo	SSERNG004_SEP21-09132021	SW6010C	10/4/2021 15:42	Potassium	500	mg/kg		Y		45	180	330	mg/kg
Echo	SSERNG004_SEP21-09132021	SW6010C	10/4/2021 15:42	Sodium	33	mg/kg		Y	J	32	110	550	mg/kg
Echo	SSERNG004_SEP21-09132021	SW9056	9/22/2021 21:18	Sulfate	29	mg/kg		N	U	11	29	58	mg/kg

Range	Sample Code	Method	Analysis Date	Analyte	Result	Units	OMMP Action Level Mg/Kg	Detection Flag	Qualifiers	Method Detction Limit	Reporting Detection Limit	Quantitation Limit	Detection Limit Units
Echo	SSERNG005_SEP21-09132021	SW6010C	10/4/2021 15:45	Antimony	1.6	mg/kg	300	N	U	0.79	1.6	2.1	mg/kg
Echo	SSERNG005_SEP21-09132021	SW6010C	10/4/2021 15:45	Calcium	680	mg/kg		Y		15	54	110	mg/kg
Echo	SSERNG005_SEP21-09132021	SW9056	9/22/2021 21:35	Chloride	38	mg/kg		N	UM	15	38	38	mg/kg
Echo	SSERNG005_SEP21-09132021	SW6010C	10/4/2021 15:45	Copper	6	mg/kg	10,000	Y		0.23	0.86	5.4	mg/kg
Echo	SSERNG005_SEP21-09132021	SW6010C	10/4/2021 15:45	Iron	9600	mg/kg		Y		8.9	21	86	mg/kg
Echo	SSERNG005_SEP21-09132021	SW6010C	10/5/2021 8:43	Lead	16	mg/kg	3,000	Y	Q	0.33	0.86	0.97	mg/kg
Echo	SSERNG005_SEP21-09132021	SW6010C	10/4/2021 15:45	Magnesium	920	mg/kg		Y		8.5	21	32	mg/kg
Echo	SSERNG005_SEP21-09132021	SW9045D	10/7/2021 13:41	pH adj. to 25 deg C	5.4	pH units		Y	HF	0.1	0.1	0.1	pH units
Echo	SSERNG005_SEP21-09132021	SW6010C	10/4/2021 15:45	Potassium	560	mg/kg		Y		44	170	320	mg/kg
Echo	SSERNG005_SEP21-09132021	SW6010C	10/4/2021 15:45	Sodium	36	mg/kg		Y	J	31	110	540	mg/kg
Echo	SSERNG005_SEP21-09132021	SW9056	9/24/2021 18:37	Sulfate	32	mg/kg		N	U	12	32	64	mg/kg
Echo	SSERNG005_SEP21-09132021LR	SW9056	9/22/2021 21:51	Chloride	38	mg/kg		N	UM	15	38	38	mg/kg
Echo	SSERNG005_SEP21-09132021SD	SW9056	9/22/2021 22:24	Chloride	609	mg/kg		Y		14	36	36	mg/kg
Echo	SSERNG005_SEP21-09132021SD	SW9056	9/24/2021 19:22	Sulfate	553	mg/kg		Y	M	11	30	60	mg/kg
Echo	SSERNG006_SEP21-09132021	SW6010C	10/4/2021 14:55	Antimony	1.7	mg/kg	300	N	UJ1	0.83	1.7	2.3	mg/kg
Echo	SSERNG006_SEP21-09132021	SW6010C	10/4/2021 14:55	Calcium	690	mg/kg		Y	J1	16	57	110	mg/kg
Echo	SSERNG006_SEP21-09132021	SW9056	9/22/2021 23:13	Chloride	35	mg/kg		N	UM	13	35	35	mg/kg
Echo	SSERNG006_SEP21-09132021	SW6010C	10/4/2021 14:55	Copper	8.4	mg/kg	10,000	Y	J1	0.25	0.91	5.7	mg/kg
Echo	SSERNG006_SEP21-09132021	SW6010C	10/4/2021 14:55	Iron	8800	mg/kg		Y	J1	9.4	23	91	mg/kg
Echo	SSERNG006_SEP21-09132021	SW6010C	10/5/2021 9:00	Lead	17	mg/kg	3,000	Y	Q	0.35	0.91	1	mg/kg
Echo	SSERNG006_SEP21-09132021	SW6010C	10/4/2021 14:55	Magnesium	840	mg/kg		Y	J1	9	23	34	mg/kg
Echo	SSERNG006_SEP21-09132021	SW9045D	10/7/2021 13:41	pH adj. to 25 deg C	5.4	pH units		Y	HF	0.1	0.1	0.1	pH units
Echo	SSERNG006_SEP21-09132021	SW6010C	10/4/2021 14:55	Potassium	470	mg/kg		Y	J1	47	180	340	mg/kg
Echo	SSERNG006_SEP21-09132021	SW6010C	10/4/2021 14:55	Sodium	60	mg/kg		Y	JJ1	33	110	570	mg/kg
Echo	SSERNG006_SEP21-09132021	SW9056	9/22/2021 23:13	Sulfate	29	mg/kg		N	UM	11	29	58	mg/kg
Echo	SSERNG006_SEP21-09132021SD	SW6010C	10/4/2021 15:05	Antimony	26.7	mg/kg	300	Y	J1	0.86	1.8	2.3	mg/kg
Echo	SSERNG006_SEP21-09132021SD	SW6010C	10/4/2021 15:05	Calcium	4050	mg/kg		Y		17	59	120	mg/kg
Echo	SSERNG006_SEP21-09132021SD	SW6010C	10/4/2021 15:05	Copper	74.9	mg/kg	10,000	Y		0.25	0.94	5.9	mg/kg

Range	Sample Code	Method	Analysis Date	Analyte	Result	Units	OMMP Action Level Mg/Kg	Detection Flag	Qualifiers	Method Detction Limit	Reporting Detection Limit	Quantitation Limit	Detection Limit Units
Echo	SSERNG006_SEP21-09132021SD	SW6010C	10/4/2021 15:05	Iron	9550	mg/kg		Y	4	9.7	23	94	mg/kg
Echo	SSERNG006_SEP21-09132021SD	SW6010C	10/5/2021 9:10	Lead	79.7	mg/kg	3,000	Y	Q	0.36	0.94	1.1	mg/kg
Echo	SSERNG006_SEP21-09132021SD	SW6010C	10/4/2021 15:05	Magnesium	4200	mg/kg		Y		9.3	23	35	mg/kg
Echo	SSERNG006_SEP21-09132021SD	SW6010C	10/4/2021 15:05	Potassium	3820	mg/kg		Y		48	190	350	mg/kg
Echo	SSERNG006_SEP21-09132021SD	SW6010C	10/4/2021 15:05	Sodium	3260	mg/kg		Y		34	120	590	mg/kg
India	SSIRNG001_SEP21-09152021	SW6010C	10/5/2021 10:04	Antimony	1.7	mg/kg	300	N	U	0.84	1.7	2.3	mg/kg
India	SSIRNG001_SEP21-09152021	SW6010C	10/5/2021 10:04	Calcium	1000	mg/kg		Y		16	57	110	mg/kg
India	SSIRNG001_SEP21-09152021	SW9056	9/23/2021 3:19	Chloride	13	mg/kg		Y	JM	13	33	33	mg/kg
India	SSIRNG001_SEP21-09152021	SW6010C	10/5/2021 10:04	Copper	35	mg/kg	10,000	Y		0.25	0.92	5.7	mg/kg
India	SSIRNG001_SEP21-09152021	SW6010C	10/5/2021 10:04	Iron	9600	mg/kg		Y		9.5	23	92	mg/kg
India	SSIRNG001_SEP21-09152021	SW6010C	10/5/2021 10:04	Lead	90	mg/kg	3,000	Y	Q	0.36	0.92	1	mg/kg
India	SSIRNG001_SEP21-09152021	SW6010C	10/5/2021 10:04	Magnesium	1300	mg/kg		Y		9.1	23	34	mg/kg
India	SSIRNG001_SEP21-09152021	SW9045D	10/7/2021 13:41	pH adj. to 25 deg C	5.5	pH units		Y	HF	0.1	0.1	0.1	pH units
India	SSIRNG001_SEP21-09152021	SW6010C	10/5/2021 10:04	Potassium	670	mg/kg		Y		47	180	340	mg/kg
India	SSIRNG001_SEP21-09152021	SW6010C	10/5/2021 10:04	Sodium	48	mg/kg		Y	J	33	110	570	mg/kg
India	SSIRNG001_SEP21-09152021	SW9056	9/23/2021 3:19	Sulfate	28	mg/kg		N	UM	10	28	56	mg/kg
India	SSIRNG001_SEP21-09152021LR	SW9045D	10/7/2021 13:41	pH adj. to 25 deg C	5.5	pH units		Y		0.1	0.1	0.1	pH units
Lima	SSLRNG001_SEP21-09152021	SW6010C	10/5/2021 10:01	Antimony	1.9	mg/kg	300	N	U	0.91	1.9	2.5	mg/kg
Lima	SSLRNG001_SEP21-09152021	SW6010C	10/5/2021 10:01	Calcium	1200	mg/kg		Y		17	62	120	mg/kg
Lima	SSLRNG001_SEP21-09152021	SW9056	9/23/2021 3:03	Chloride	17	mg/kg		Y	JM	14	36	36	mg/kg
Lima	SSLRNG001_SEP21-09152021	SW6010C	10/5/2021 10:01	Copper	11	mg/kg	10,000	Y		0.27	0.99	6.2	mg/kg
Lima	SSLRNG001_SEP21-09152021	SW6010C	10/5/2021 10:01	Iron	9300	mg/kg		Y		10	25	99	mg/kg
Lima	SSLRNG001_SEP21-09152021	SW6010C	10/5/2021 10:01	Lead	13	mg/kg	3,000	Y	Q	0.38	0.99	1.1	mg/kg
Lima	SSLRNG001_SEP21-09152021	SW6010C	10/5/2021 10:01	Magnesium	1400	mg/kg		Y		9.8	25	37	mg/kg
Lima	SSLRNG001_SEP21-09152021	SW9045D	10/7/2021 13:41	pH adj. to 25 deg C	5.5	pH units		Y	HF	0.1	0.1	0.1	pH units
Lima	SSLRNG001_SEP21-09152021	SW6010C	10/5/2021 10:01	Potassium	690	mg/kg		Y		51	200	370	mg/kg
Lima	SSLRNG001_SEP21-09152021	SW6010C	10/5/2021 10:01	Sodium	44	mg/kg		Y	J	36	120	620	mg/kg
Lima	SSLRNG001_SEP21-09152021	SW9056	9/23/2021 3:03	Sulfate	30	mg/kg		N	UM	11	30	60	mg/kg

Range	Sample Code	Method	Analysis Date	Analyte	Result	Units	OMMP Action Level Mg/Kg	Detection Flag	Qualifiers	Method Detction Limit	Reporting Detection Limit	Quantitation Limit	Detection Limit Units
Sierra	SSSRNG001_SEP21-09152021	SW6010C	10/5/2021 9:58	Antimony	1.9	mg/kg	300	N	U	0.91	1.9	2.5	mg/kg
Sierra	SSSRNG001_SEP21-09152021	SW6010C	10/5/2021 9:58	Calcium	1300	mg/kg		Y		18	62	120	mg/kg
Sierra	SSSRNG001_SEP21-09152021	SW9056	9/23/2021 2:46	Chloride	15	mg/kg		Y	JM	14	37	37	mg/kg
Sierra	SSSRNG001_SEP21-09152021	SW6010C	10/5/2021 9:58	Copper	23	mg/kg	10,000	Y		0.27	1	6.2	mg/kg
Sierra	SSSRNG001_SEP21-09152021	SW6010C	10/5/2021 9:58	Iron	9700	mg/kg		Y		10	25	100	mg/kg
Sierra	SSSRNG001_SEP21-09152021	SW6010C	10/5/2021 9:58	Lead	22	mg/kg	3,000	Y	Q	0.39	1	1.1	mg/kg
Sierra	SSSRNG001_SEP21-09152021	SW6010C	10/5/2021 9:58	Magnesium	1300	mg/kg		Y		9.9	25	37	mg/kg
Sierra	SSSRNG001_SEP21-09152021	SW9045D	10/7/2021 13:41	pH adj. to 25 deg C	5.8	pH units		Y	HF	0.1	0.1	0.1	pH units
Sierra	SSSRNG001_SEP21-09152021	SW6010C	10/5/2021 9:58	Potassium	570	mg/kg		Y		51	200	370	mg/kg
Sierra	SSSRNG001_SEP21-09152021	SW6010C	10/5/2021 9:58	Sodium	48	mg/kg		Y	J	36	120	620	mg/kg
Sierra	SSSRNG001_SEP21-09152021	SW9056	9/24/2021 23:06	Sulfate	31	mg/kg		N	UM	11	31	62	mg/kg
Tango	SSTRNG001_SEP21A-09142021	SW6010C	10/4/2021 15:49	Antimony	1.9	mg/kg	300	N	U	0.91	1.9	2.5	mg/kg
Tango	SSTRNG001_SEP21A-09142021	SW6010C	10/4/2021 15:49	Calcium	5500	mg/kg		Y		18	62	120	mg/kg
Tango	SSTRNG001_SEP21A-09142021	SW9056	9/22/2021 23:29	Chloride	33	mg/kg		Y	JM	14	37	37	mg/kg
Tango	SSTRNG001_SEP21A-09142021	SW6010C	10/4/2021 15:49	Copper	17	mg/kg	10,000	Y		0.27	0.99	6.2	mg/kg
Tango	SSTRNG001_SEP21A-09142021	SW6010C	10/4/2021 15:49	Iron	23000	mg/kg		Y		10	25	99	mg/kg
Tango	SSTRNG001_SEP21A-09142021	SW6010C	10/5/2021 9:17	Lead	29	mg/kg	3,000	Y	Q	0.38	0.99	1.1	mg/kg
Tango	SSTRNG001_SEP21A-09142021	SW6010C	10/4/2021 15:49	Magnesium	3600	mg/kg		Y		9.8	25	37	mg/kg
Tango	SSTRNG001_SEP21A-09142021	SW9045D	10/7/2021 13:41	pH adj. to 25 deg C	6.1	pH units		Y	HF	0.1	0.1	0.1	pH units
Tango	SSTRNG001_SEP21A-09142021	SW6010C	10/4/2021 15:49	Potassium	1500	mg/kg		Y		51	200	370	mg/kg
Tango	SSTRNG001_SEP21A-09142021	SW6010C	10/4/2021 15:49	Sodium	65	mg/kg		Y	J	36	120	620	mg/kg
Tango	SSTRNG001_SEP21A-09142021	SW9056	9/24/2021 20:07	Sulfate	89	mg/kg		Y	B	11	31	62	mg/kg
Tango	SSTRNG001_SEP21B-09142021	SW6010C	10/4/2021 15:52	Antimony	1.6	mg/kg	300	N	U	0.77	1.6	2.1	mg/kg
Tango	SSTRNG001_SEP21B-09142021	SW6010C	10/4/2021 15:52	Calcium	4000	mg/kg		Y		15	52	100	mg/kg
Tango	SSTRNG001_SEP21B-09142021	SW9056	9/22/2021 23:46	Chloride	19	mg/kg		Y	J	11	30	30	mg/kg
Tango	SSTRNG001_SEP21B-09142021	SW6010C	10/4/2021 15:52	Copper	12	mg/kg	10,000	Y		0.23	0.84	5.2	mg/kg
Tango	SSTRNG001_SEP21B-09142021	SW6010C	10/4/2021 15:52	Iron	18000	mg/kg		Y		8.7	21	84	mg/kg
Tango	SSTRNG001_SEP21B-09142021	SW6010C	10/5/2021 9:20	Lead	25	mg/kg	3,000	Y	Q	0.32	0.84	0.94	mg/kg
Tango	SSTRNG001_SEP21B-09142021	SW6010C	10/4/2021 15:52	Magnesium	2800	mg/kg		Y		8.3	21	31	mg/kg
Tango	SSTRNG001_SEP21B-09142021	SW9045D	10/7/2021 13:41	pH adj. to 25 deg C	5.8	pH units		Y	HF	0.1	0.1	0.1	pH units
Tango	SSTRNG001_SEP21B-09142021	SW6010C	10/4/2021 15:52	Potassium	1200	mg/kg		Y		43	170	310	mg/kg
Tango	SSTRNG001_SEP21B-09142021	SW6010C	10/4/2021 15:52	Sodium	51	mg/kg		Y	J	30	100	520	mg/kg
Tango	SSTRNG001_SEP21B-09142021	SW9056	9/24/2021 20:22	Sulfate	170	mg/kg		Y	B	9	25	49	mg/kg

Range	Sample Code	Method	Analysis Date	Analyte	Result	Units	OMMP Action Level Mg/Kg	Detection Flag	Qualifiers	Method Detction Limit	Reporting Detection Limit	Quantitation Limit	Detection Limit Units
Tango	SSTRNG001_SEP21C-09142021	SW6010C	10/4/2021 15:55	Antimony	1.6	mg/kg	300	N	U	0.79	1.6	2.2	mg/kg
Tango	SSTRNG001_SEP21C-09142021	SW6010C	10/4/2021 15:55	Calcium	4300	mg/kg		Y		15	54	110	mg/kg
Tango	SSTRNG001_SEP21C-09142021	SW9056	9/23/2021 3:52	Chloride	24	mg/kg		Y	JM	12	30	30	mg/kg
Tango	SSTRNG001_SEP21C-09142021	SW6010C	10/4/2021 15:55	Copper	13	mg/kg	10,000	Y		0.23	0.87	5.4	mg/kg
Tango	SSTRNG001_SEP21C-09142021	SW6010C	10/4/2021 15:55	Iron	20000	mg/kg		Y		8.9	22	87	mg/kg
Tango	SSTRNG001_SEP21C-09142021	SW6010C	10/5/2021 9:24	Lead	25	mg/kg	3,000	Y	Q	0.34	0.87	0.97	mg/kg
Tango	SSTRNG001_SEP21C-09142021	SW6010C	10/4/2021 15:55	Magnesium	3000	mg/kg		Y		8.6	22	32	mg/kg
Tango	SSTRNG001_SEP21C-09142021	SW9045D	10/7/2021 13:41	pH adj. to 25 deg C	5.9	pH units		Y	HF	0.1	0.1	0.1	pH units
Tango	SSTRNG001_SEP21C-09142021	SW6010C	10/4/2021 15:55	Potassium	1300	mg/kg		Y		44	170	320	mg/kg
Tango	SSTRNG001_SEP21C-09142021	SW6010C	10/4/2021 15:55	Sodium	51	mg/kg		Y	J	31	110	540	mg/kg
Tango	SSTRNG001_SEP21C-09142021	SW9056	9/24/2021 23:21	Sulfate	110	mg/kg		Y	B	9.2	25	50	mg/kg
Tango	SSTRNG002_SEP21-09142021	SW6010C	10/5/2021 9:41	Antimony	1.7	mg/kg	300	N	U	0.82	1.7	2.2	mg/kg
Tango	SSTRNG002_SEP21-09142021	SW6010C	10/5/2021 9:41	Calcium	1200	mg/kg		Y		16	56	110	mg/kg
Tango	SSTRNG002_SEP21-09142021	SW9056	9/23/2021 0:02	Chloride	40	mg/kg		Y	M	12	33	33	mg/kg
Tango	SSTRNG002_SEP21-09142021	SW6010C	10/5/2021 9:41	Copper	12	mg/kg	10,000	Y		0.24	0.9	5.6	mg/kg
Tango	SSTRNG002_SEP21-09142021	SW6010C	10/5/2021 9:41	Iron	14000	mg/kg		Y		9.3	22	90	mg/kg
Tango	SSTRNG002_SEP21-09142021	SW6010C	10/5/2021 9:41	Lead	33	mg/kg	3,000	Y	Q	0.35	0.9	1	mg/kg
Tango	SSTRNG002_SEP21-09142021	SW6010C	10/5/2021 9:41	Magnesium	1700	mg/kg		Y		8.9	22	34	mg/kg
Tango	SSTRNG002_SEP21-09142021	SW9045D	10/7/2021 13:41	pH adj. to 25 deg C	5.7	pH units		Y	HF	0.1	0.1	0.1	pH units
Tango	SSTRNG002_SEP21-09142021	SW6010C	10/5/2021 9:41	Potassium	890	mg/kg		Y		46	180	340	mg/kg
Tango	SSTRNG002_SEP21-09142021	SW6010C	10/5/2021 9:41	Sodium	68	mg/kg		Y	J	32	110	560	mg/kg
Tango	SSTRNG002_SEP21-09142021	SW9056	9/24/2021 20:37	Sulfate	26	mg/kg		Y	JB	9.9	27	54	mg/kg
Tango	SSTRNG003_SEP21-09142021	SW6010C	10/5/2021 9:44	Antimony	1.6	mg/kg	300	N	U	0.8	1.6	2.2	mg/kg
Tango	SSTRNG003_SEP21-09142021	SW6010C	10/5/2021 9:44	Calcium	1400	mg/kg		Y		15	55	110	mg/kg
Tango	SSTRNG003_SEP21-09142021	SW9056	9/23/2021 0:19	Chloride	80	mg/kg		Y	M	14	37	37	mg/kg
Tango	SSTRNG003_SEP21-09142021	SW6010C	10/5/2021 9:44	Copper	13	mg/kg	10,000	Y		0.24	0.87	5.5	mg/kg
Tango	SSTRNG003_SEP21-09142021	SW6010C	10/5/2021 9:44	Iron	15000	mg/kg		Y		9	22	87	mg/kg
Tango	SSTRNG003_SEP21-09142021	SW6010C	10/5/2021 9:44	Lead	33	mg/kg	3,000	Y	Q	0.34	0.87	0.98	mg/kg
Tango	SSTRNG003_SEP21-09142021	SW6010C	10/5/2021 9:44	Magnesium	1900	mg/kg		Y		8.6	22	33	mg/kg
Tango	SSTRNG003_SEP21-09142021	SW9045D	10/7/2021 13:41	pH adj. to 25 deg C	5.8	pH units		Y	HF	0.1	0.1	0.1	pH units
Tango	SSTRNG003_SEP21-09142021	SW6010C	10/5/2021 9:44	Potassium	950	mg/kg		Y		45	170	330	mg/kg
Tango	SSTRNG003_SEP21-09142021	SW6010C	10/5/2021 9:44	Sodium	79	mg/kg		Y	J	31	110	550	mg/kg
Tango	SSTRNG003_SEP21-09142021	SW9056	9/24/2021 20:52	Sulfate	35	mg/kg		Y	JB	11	31	61	mg/kg

Range	Sample Code	Method	Analysis Date	Analyte	Result	Units	OMMP Action Level Mg/Kg	Detection Flag	Qualifiers	Method Detction Limit	Reporting Detection Limit	Quantitation Limit	Detection Limit Units
Tango	SSTRNG004_SEP21-09142021	SW6010C	10/5/2021 9:47	Antimony	1.7	mg/kg	300	N	U	0.81	1.7	2.2	mg/kg
Tango	SSTRNG004_SEP21-09142021	SW6010C	10/5/2021 9:47	Calcium	1400	mg/kg		Y		16	55	110	mg/kg
Tango	SSTRNG004_SEP21-09142021	SW9056	9/23/2021 0:35	Chloride	27	mg/kg		Y	JM	13	35	35	mg/kg
Tango	SSTRNG004_SEP21-09142021	SW6010C	10/5/2021 9:47	Copper	13	mg/kg	10,000	Y		0.24	0.88	5.5	mg/kg
Tango	SSTRNG004_SEP21-09142021	SW6010C	10/5/2021 9:47	Iron	15000	mg/kg		Y		9.1	22	88	mg/kg
Tango	SSTRNG004_SEP21-09142021	SW6010C	10/5/2021 9:47	Lead	33	mg/kg	3,000	Y	Q	0.34	0.88	0.99	mg/kg
Tango	SSTRNG004_SEP21-09142021	SW6010C	10/5/2021 9:47	Magnesium	1800	mg/kg		Y		8.7	22	33	mg/kg
Tango	SSTRNG004_SEP21-09142021	SW9045D	10/7/2021 13:41	pH adj. to 25 deg C	5.7	pH units		Y	HF	0.1	0.1	0.1	pH units
Tango	SSTRNG004_SEP21-09142021	SW6010C	10/5/2021 9:47	Potassium	920	mg/kg		Y		45	180	330	mg/kg
Tango	SSTRNG004_SEP21-09142021	SW6010C	10/5/2021 9:47	Sodium	75	mg/kg		Y	J	32	110	550	mg/kg
Tango	SSTRNG004_SEP21-09142021	SW9056	9/24/2021 21:07	Sulfate	15	mg/kg		Y	JMB	11	29	58	mg/kg
Tango	SSTRNG005_SEP21-09142021	SW6010C	10/5/2021 9:51	Antimony	1.7	mg/kg	300	N	U	0.83	1.7	2.3	mg/kg
Tango	SSTRNG005_SEP21-09142021	SW6010C	10/5/2021 9:51	Calcium	1200	mg/kg		Y		16	57	110	mg/kg
Tango	SSTRNG005_SEP21-09142021	SW9056	9/23/2021 0:52	Chloride	27	mg/kg		Y	JM	12	32	32	mg/kg
Tango	SSTRNG005_SEP21-09142021	SW6010C	10/5/2021 9:51	Copper	12	mg/kg	10,000	Y		0.25	0.9	5.7	mg/kg
Tango	SSTRNG005_SEP21-09142021	SW6010C	10/5/2021 9:51	Iron	13000	mg/kg		Y		9.3	23	90	mg/kg
Tango	SSTRNG005_SEP21-09142021	SW6010C	10/5/2021 9:51	Lead	31	mg/kg	3,000	Y	Q	0.35	0.9	1	mg/kg
Tango	SSTRNG005_SEP21-09142021	SW6010C	10/5/2021 9:51	Magnesium	1600	mg/kg		Y		9	23	34	mg/kg
Tango	SSTRNG005_SEP21-09142021	SW9045D	10/7/2021 13:41	pH adj. to 25 deg C	5.7	pH units		Y	HF	0.1	0.1	0.1	pH units
Tango	SSTRNG005_SEP21-09142021	SW6010C	10/5/2021 9:51	Potassium	860	mg/kg		Y		46	180	340	mg/kg
Tango	SSTRNG005_SEP21-09142021	SW6010C	10/5/2021 9:51	Sodium	65	mg/kg		Y	J	33	110	570	mg/kg
Tango	SSTRNG005_SEP21-09142021	SW9056	9/24/2021 21:22	Sulfate	18	mg/kg		Y	JB	9.7	26	53	mg/kg
Tango	SSTRNG005_SEP21-09142021LR	SW9056	9/23/2021 1:08	Chloride	26.7	mg/kg		Y	JM	12	32	32	mg/kg
Tango	SSTRNG005_SEP21-09142021LR	SW9056	9/24/2021 21:37	Sulfate	17	mg/kg		Y	J	9.7	26	53	mg/kg
Tango	SSTRNG005_SEP21-09142021SD	SW9056	9/23/2021 1:41	Chloride	602	mg/kg		Y		13	34	34	mg/kg
Tango	SSTRNG005_SEP21-09142021SD	SW9056	9/24/2021 22:06	Sulfate	517	mg/kg		Y	M	10	28	56	mg/kg
Tango	SSTRNG006_SEP21-09142021	SW6010C	10/5/2021 9:54	Antimony	1.7	mg/kg	300	N	U	0.85	1.7	2.3	mg/kg
Tango	SSTRNG006_SEP21-09142021	SW6010C	10/5/2021 9:54	Calcium	1400	mg/kg		Y		16	58	120	mg/kg
Tango	SSTRNG006_SEP21-09142021	SW9056	9/23/2021 2:30	Chloride	27	mg/kg		Y	J	15	38	38	mg/kg
Tango	SSTRNG006_SEP21-09142021	SW6010C	10/5/2021 9:54	Copper	13	mg/kg	10,000	Y		0.25	0.92	5.8	mg/kg
Tango	SSTRNG006_SEP21-09142021	SW6010C	10/5/2021 9:54	Iron	11000	mg/kg		Y		9.6	23	92	mg/kg
Tango	SSTRNG006_SEP21-09142021	SW6010C	10/5/2021 9:54	Lead	31	mg/kg	3,000	Y	Q	0.36	0.92	1	mg/kg

Range	Sample Code	Method	Analysis Date	Analyte	Result	Units	OMMP Action Level Mg/Kg	Detection Flag	Qualifiers	Method Detction Limit	Reporting Detection Limit	Quantitation Limit	Detection Limit Units
Tango	SSTRNG006_SEP21-09142021	SW6010C	10/5/2021 9:54	Magnesium	1400	mg/kg		Y		9.2	23	35	mg/kg
Tango	SSTRNG006_SEP21-09142021	SW9045D	10/7/2021 13:41	pH adj. to 25 deg C	5.9	pH units		Y	HF	0.1	0.1	0.1	pH units
Tango	SSTRNG006_SEP21-09142021	SW6010C	10/5/2021 9:54	Potassium	760	mg/kg		Y		47	180	350	mg/kg
Tango	SSTRNG006_SEP21-09142021	SW6010C	10/5/2021 9:54	Sodium	73	mg/kg		Y	J	33	120	580	mg/kg
Tango	SSTRNG006_SEP21-09142021	SW9056	9/24/2021 22:21	Sulfate	15	mg/kg		Y	JMB	12	32	64	mg/kg

Notes:

µg/L = microgram(s) per liter

U = not detected

M = manual integrated compound

D = reported value is from a dilution

J = estimated value

H = Field parameter with a holding time of 15 minutes. Test performed by laboratory at client's request.

Q = One or more quality control criteria failed.

B = Blank contamination: The analyte was detected above one-half the reportinglimit in an associated blank.

4 = MS, MSD: The analyte present in the original sample is greater than 4 times the matrix spike concentration; therefore, control limits are not applicable.

JI = Estimated: The quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

Small Arms Range Sampling Reports

Lysimeter Sampling Results

Fall 2021

Range	Sample Code	Method	Analysis Date	Analyte	Result	Units	Detection Flag	Qualifier	OMMP Action Level	Method Detection Limit	Reporting Detection Limit	Quantitation Limit	Detection Limit Units
India	LYIRNG001_SEP21-09212021	SM2320B	9/29/2021 20:50	Alkalinity	10	ug/l	Y			3.1	6.4	10	ug/l
India	**LYIRNG001_SEP21-09212021**	**SW6010C**	**10/7/2021 3:43**	**Antimony**	**12**	**ug/l**	**N**	**U**	**6**	**5.2**	**12**	**20**	**ug/l**
India	LYIRNG001_SEP21-09212021	SW6010C	10/7/2021 3:43	Calcium	1300	ug/l	Y			78	160	1000	ug/l
India	LYIRNG001_SEP21-09212021	SW9056	9/29/2021 17:15	Chloride	1.5	ug/l	Y	JM		1	2.5	3	ug/l
India	LYIRNG001_SEP21-09212021	SW6010C	10/7/2021 3:43	Copper	7.9	ug/l	Y	J	1,300	4.2	10	15	ug/l
India	LYIRNG001_SEP21-09212021	SM5310B	10/4/2021 23:26	Dissolved Organic Carbon	3.4	ug/l	Y			0.35	0.8	1	ug/l
India	LYIRNG001_SEP21-09212021	SW6010C	10/7/2021 3:43	Iron	29	ug/l	Y	J		22	85	100	ug/l
India	LYIRNG001_SEP21-09212021	SW6010C	10/7/2021 3:43	Lead	9	ug/l	N	U	15	2.7	9	15	ug/l
India	LYIRNG001_SEP21-09212021	SW6010C	10/7/2021 3:43	Magnesium	420	ug/l	Y	J		26	60	500	ug/l
India	LYIRNG001_SEP21-09212021	E365.4	10/11/2021 13:10	Phosphates, Total as P	0.072	ug/l	Y	J		0.041	0.057	0.1	ug/l
India	LYIRNG001_SEP21-09212021	SW6010C	10/7/2021 3:43	Potassium	990	ug/l	Y	J		240	940	3000	ug/l
India	LYIRNG001_SEP21-09212021	SW6010C	10/7/2021 3:43	Sodium	2300	ug/l	Y	J		370	1000	5000	ug/l
India	LYIRNG001_SEP21-09212021	SW9056	9/29/2021 17:15	Sulfate	1	ug/l	Y	J		1	2.5	5	ug/l
India	LYIRNG002_SEP21-09212021	SM2320B	9/29/2021 20:39	Alkalinity	17	ug/l	Y			3.1	6.4	10	ug/l
India	**LYIRNG002_SEP21-09212021**	**SW6010C**	**10/7/2021 4:00**	**Antimony**	**12**	**ug/l**	**N**	**U**	**6**	**5.2**	**12**	**20**	**ug/l**
India	LYIRNG002_SEP21-09212021	SW6010C	10/7/2021 4:00	Calcium	14000	ug/l	Y			78	160	1000	ug/l
India	LYIRNG002_SEP21-09212021	SW9056	9/29/2021 17:32	Chloride	4.8	ug/l	Y	M		1	2.5	3	ug/l
India	LYIRNG002_SEP21-09212021	SW6010C	10/7/2021 4:00	Copper	270	ug/l	Y		1,300	4.2	10	15	ug/l
India	LYIRNG002_SEP21-09212021	SM5310B	10/5/2021 0:11	Dissolved Organic Carbon	13	ug/l	Y			0.35	0.8	1	ug/l
India	LYIRNG002_SEP21-09212021	SW6010C	10/7/2021 4:00	Iron	44	ug/l	Y	J		22	85	100	ug/l
India	LYIRNG002_SEP21-09212021	SW6010C	10/7/2021 4:00	Lead	9	ug/l	N	U	15	2.7	9	15	ug/l
India	LYIRNG002_SEP21-09212021	SW6010C	10/7/2021 4:00	Magnesium	3800	ug/l	Y			26	60	500	ug/l
India	LYIRNG002_SEP21-09212021	E365.4	10/11/2021 13:40	Phosphates, Total as P	7.4	ug/l	Y	D		0.41	0.57	1	ug/l
India	LYIRNG002_SEP21-09212021	SW6010C	10/7/2021 4:00	Potassium	2200	ug/l	Y	J		240	940	3000	ug/l
India	LYIRNG002_SEP21-09212021	SW6010C	10/7/2021 4:00	Sodium	4200	ug/l	Y	J		370	1000	5000	ug/l
India	LYIRNG002_SEP21-09212021	SW9056	9/29/2021 17:32	Sulfate	16	ug/l	Y			1	2.5	5	ug/l
Juliet	LYJRNG001_SEP21 FD-09212021	SM2320B	9/29/2021 2:53	Alkalinity	35	ug/l	Y			3.1	6.4	10	ug/l
Juliet	**LYJRNG001_SEP21 FD-09212021**	**SW6010C**	**10/7/2021 4:03**	**Antimony**	**12**	**ug/l**	**N**	**U**	**6**	**5.2**	**12**	**20**	**ug/l**
Juliet	LYJRNG001_SEP21 FD-09212021	SW6010C	10/7/2021 4:03	Calcium	6700	ug/l	Y			78	160	1000	ug/l
Juliet	LYJRNG001_SEP21 FD-09212021	SW9056	9/29/2021 17:48	Chloride	3.3	ug/l	Y	M		1	2.5	3	ug/l
Juliet	LYJRNG001_SEP21 FD-09212021	SW6010C	10/7/2021 4:03	Copper	10	ug/l	N	U	1,300	4.2	10	15	ug/l

Range	Sample Code	Method	Analysis Date	Analyte	Result	Units	Detection Flag	Qualifier	OMMP Action Level	Method Detection Limit	Reporting Detection Limit	Quantitation Limit	Detection Limit Units
Juliet	LYJRNG001_SEP21 FD-09212021	SM5310B	10/5/2021 0:26	Dissolved Organic Carbon	4.1	ug/l	Y			0.35	0.8	1	ug/l
Juliet	LYJRNG001_SEP21 FD-09212021	SW6010C	10/7/2021 4:03	Iron	85	ug/l	N	U		22	85	100	ug/l
Juliet	LYJRNG001_SEP21 FD-09212021	SW6010C	10/7/2021 4:03	Lead	9	ug/l	N	U	15	2.7	9	15	ug/l
Juliet	LYJRNG001_SEP21 FD-09212021	SW6010C	10/7/2021 4:03	Magnesium	3600	ug/l	Y			26	60	500	ug/l
Juliet	LYJRNG001_SEP21 FD-09212021	E365.4	10/11/2021 12:55	Phosphates, Total as P	0.057	ug/l	N	U		0.041	0.057	0.1	ug/l
Juliet	LYJRNG001_SEP21 FD-09212021	SW6010C	10/7/2021 4:03	Potassium	940	ug/l	N	U		240	940	3000	ug/l
Juliet	LYJRNG001_SEP21 FD-09212021	SW6010C	10/7/2021 4:03	Sodium	2600	ug/l	Y	J		370	1000	5000	ug/l
Juliet	LYJRNG001_SEP21 FD-09212021	SW9056	9/29/2021 17:48	Sulfate	2.5	ug/l	N	U		1	2.5	5	ug/l
Juliet	LYJRNG001_SEP21-09212021	SM2320B	9/29/2021 20:34	Alkalinity	36	ug/l	Y			3.1	6.4	10	ug/l
Juliet	**LYJRNG001_SEP21-09212021**	**SW6010C**	**10/7/2021 5:19**	**Antimony**	**12**	**ug/l**	**N**	**U**	**6**	**5.2**	**12**	**20**	**ug/l**
Juliet	LYJRNG001_SEP21-09212021	SW6010C	10/7/2021 5:19	Calcium	6700	ug/l	Y			78	160	1000	ug/l
Juliet	LYJRNG001_SEP21-09212021	SW9056	9/30/2021 1:12	Chloride	3.3	ug/l	Y	M		1	2.5	3	ug/l
Juliet	LYJRNG001_SEP21-09212021	SW6010C	10/7/2021 5:19	Copper	10	ug/l	N	U	1,300	4.2	10	15	ug/l
Juliet	LYJRNG001_SEP21-09212021	SM5310B	10/5/2021 5:25	Dissolved Organic Carbon	4.2	ug/l	Y			0.35	0.8	1	ug/l
Juliet	LYJRNG001_SEP21-09212021	SW6010C	10/7/2021 5:19	Iron	85	ug/l	N	U		22	85	100	ug/l
Juliet	LYJRNG001_SEP21-09212021	SW6010C	10/7/2021 5:19	Lead	9	ug/l	N	U	15	2.7	9	15	ug/l
Juliet	LYJRNG001_SEP21-09212021	SW6010C	10/7/2021 5:19	Magnesium	3600	ug/l	Y			26	60	500	ug/l
Juliet	LYJRNG001_SEP21-09212021	E365.4	10/13/2021 12:35	Phosphates, Total as P	0.057	ug/l	N	U		0.041	0.057	0.1	ug/l
Juliet	LYJRNG001_SEP21-09212021	SW6010C	10/7/2021 5:19	Potassium	940	ug/l	N	U		240	940	3000	ug/l
Juliet	LYJRNG001_SEP21-09212021	SW6010C	10/7/2021 5:19	Sodium	2600	ug/l	Y	J		370	1000	5000	ug/l
Juliet	LYJRNG001_SEP21-09212021	SW9056	9/30/2021 1:12	Sulfate	2.5	ug/l	N	U		1	2.5	5	ug/l
Juliet	LYJRNG002_SEP21-09212021	SM2320B	9/29/2021 20:55	Alkalinity	32	ug/l	Y			3.1	6.4	10	ug/l
Juliet	**LYJRNG002_SEP21-09212021**	**SW6010C**	**10/7/2021 4:07**	**Antimony**	**12**	**ug/l**	**N**	**U**	**6**	**5.2**	**12**	**20**	**ug/l**
Juliet	LYJRNG002_SEP21-09212021	SW6010C	10/7/2021 4:07	Calcium	4700	ug/l	Y			78	160	1000	ug/l
Juliet	LYJRNG002_SEP21-09212021	SW9056	9/29/2021 18:05	Chloride	2.5	ug/l	N	U		1	2.5	3	ug/l
Juliet	LYJRNG002_SEP21-09212021	SW6010C	10/7/2021 4:07	Copper	10	ug/l	N	U	1,300	4.2	10	15	ug/l
Juliet	LYJRNG002_SEP21-09212021	SM5310B	10/5/2021 1:10	Dissolved Organic Carbon	3.6	ug/l	Y			0.35	0.8	1	ug/l
Juliet	LYJRNG002_SEP21-09212021	SW6010C	10/7/2021 4:07	Iron	44	ug/l	Y	J		22	85	100	ug/l
Juliet	LYJRNG002_SEP21-09212021	SW6010C	10/7/2021 4:07	Lead	9	ug/l	N	U	15	2.7	9	15	ug/l

Range	Sample Code	Method	Analysis Date	Analyte	Result	Units	Detection Flag	Qualifier	OMMP Action Level	Method Detection Limit	Reporting Detection Limit	Quantitation Limit	Detection Limit Units
Juliet	LYJRNG002_SEP21-09212021	SW6010C	10/7/2021 4:07	Magnesium	3000	ug/l	Y			26	60	500	ug/l
Juliet	LYJRNG002_SEP21-09212021	E365.4	10/11/2021 13:11	Phosphates, Total as P	0.041	ug/l	Y	J		0.041	0.057	0.1	ug/l
Juliet	LYJRNG002_SEP21-09212021	SW6010C	10/7/2021 4:07	Potassium	940	ug/l	N	U		240	940	3000	ug/l
Juliet	LYJRNG002_SEP21-09212021	SW6010C	10/7/2021 4:07	Sodium	2400	ug/l	Y	J		370	1000	5000	ug/l
Juliet	LYJRNG002_SEP21-09212021	SW9056	9/29/2021 18:05	Sulfate	2.5	ug/l	N	U		1	2.5	5	ug/l
Juliet	LYJRNG003_SEP21-09212021	SM2320B	9/29/2021 21:01	Alkalinity	94	ug/l	Y			3.1	6.4	10	ug/l
Juliet	**LYJRNG003_SEP21-09212021**	**SW6010C**	**10/7/2021 4:24**	**Antimony**	**25**	**ug/l**	**Y**		**6**	**5.2**	**12**	**20**	**ug/l**
Juliet	LYJRNG003_SEP21-09212021	SW6010C	10/7/2021 4:24	Calcium	31000	ug/l	Y			78	160	1000	ug/l
Juliet	LYJRNG003_SEP21-09212021	SW9056	9/29/2021 18:21	Chloride	1.4	ug/l	Y	JM		1	2.5	3	ug/l
Juliet	LYJRNG003_SEP21-09212021	SW6010C	10/7/2021 4:24	Copper	5.3	ug/l	Y	J	1,300	4.2	10	15	ug/l
Juliet	LYJRNG003_SEP21-09212021	SM5310B	10/5/2021 1:25	Dissolved Organic Carbon	2.6	ug/l	Y			0.35	0.8	1	ug/l
Juliet	LYJRNG003_SEP21-09212021	SW6010C	10/7/2021 4:24	Iron	590	ug/l	Y			22	85	100	ug/l
Juliet	LYJRNG003_SEP21-09212021	SW6010C	10/7/2021 4:24	Lead	9	ug/l	N	U	15	2.7	9	15	ug/l
Juliet	LYJRNG003_SEP21-09212021	SW6010C	10/7/2021 4:24	Magnesium	1800	ug/l	Y			26	60	500	ug/l
Juliet	LYJRNG003_SEP21-09212021	E365.4	10/11/2021 13:00	Phosphates, Total as P	0.053	ug/l	Y	J		0.041	0.057	0.1	ug/l
Juliet	LYJRNG003_SEP21-09212021	SW6010C	10/7/2021 4:24	Potassium	940	ug/l	N	U		240	940	3000	ug/l
Juliet	LYJRNG003_SEP21-09212021	SW6010C	10/7/2021 4:24	Sodium	3600	ug/l	Y	J		370	1000	5000	ug/l
Juliet	LYJRNG003_SEP21-09212021	SW9056	9/29/2021 18:21	Sulfate	3.7	ug/l	Y	J		1	2.5	5	ug/l
Kilo	LYKRNG001_SEP21-09222021	SM2320B	9/29/2021 20:44	Alkalinity	36	ug/l	Y			3.1	6.4	10	ug/l
Kilo	**LYKRNG001_SEP21-09222021**	**SW6010C**	**10/7/2021 4:27**	**Antimony**	**12**	**ug/l**	**N**	**U**	**6**	**5.2**	**12**	**20**	**ug/l**
Kilo	LYKRNG001_SEP21-09222021	SW6010C	10/7/2021 4:27	Calcium	7900	ug/l	Y			78	160	1000	ug/l
Kilo	LYKRNG001_SEP21-09222021	SW9056	9/29/2021 20:00	Chloride	5.2	ug/l	Y	M		1	2.5	3	ug/l
Kilo	LYKRNG001_SEP21-09222021	SW6010C	10/7/2021 4:27	Copper	10	ug/l	N	U	1,300	4.2	10	15	ug/l
Kilo	LYKRNG001_SEP21-09222021	SM5310B	10/5/2021 1:40	Dissolved Organic Carbon	4.1	ug/l	Y			0.35	0.8	1	ug/l
Kilo	LYKRNG001_SEP21-09222021	SW6010C	10/7/2021 4:27	Iron	85	ug/l	N	U		22	85	100	ug/l
Kilo	LYKRNG001_SEP21-09222021	SW6010C	10/7/2021 4:27	Lead	9	ug/l	N	U	15	2.7	9	15	ug/l
Kilo	LYKRNG001_SEP21-09222021	SW6010C	10/7/2021 4:27	Magnesium	4200	ug/l	Y			26	60	500	ug/l
Kilo	LYKRNG001_SEP21-09222021	E365.4	10/11/2021 12:53	Phosphates, Total as P	0.057	ug/l	N	U		0.041	0.057	0.1	ug/l
Kilo	LYKRNG001_SEP21-09222021	SW6010C	10/7/2021 4:27	Potassium	960	ug/l	Y	J		240	940	3000	ug/l
Kilo	LYKRNG001_SEP21-09222021	SW6010C	10/7/2021 4:27	Sodium	3300	ug/l	Y	J		370	1000	5000	ug/l

Range	Sample Code	Method	Analysis Date	Analyte	Result	Units	Detection Flag	Qualifier	OMMP Action Level	Method Detection Limit	Reporting Detection Limit	Quantitation Limit	Detection Limit Units
Kilo	LYKRNG001_SEP21-09222021	SW9056	9/29/2021 20:00	Sulfate	2.7	ug/l	Y	JM		1	2.5	5	ug/l
Kilo	LYKRNG002_SEP21-09222021	SM2320B	9/29/2021 2:48	Alkalinity	37	ug/l	Y			3.1	6.4	10	ug/l
Kilo	**LYKRNG002_SEP21-09222021**	**SW6010C**	**10/7/2021 4:31**	**Antimony**	**12**	**ug/l**	**N**	**U**	**6**	**5.2**	**12**	**20**	**ug/l**
Kilo	LYKRNG002_SEP21-09222021	SW6010C	10/7/2021 4:31	Calcium	10000	ug/l	Y			78	160	1000	ug/l
Kilo	LYKRNG002_SEP21-09222021	SW9056	9/29/2021 20:16	Chloride	14	ug/l	Y	MJ1		1	2.5	3	ug/l
Kilo	LYKRNG002_SEP21-09222021	SW6010C	10/7/2021 4:31	Copper	10	ug/l	N	U	1,300	4.2	10	15	ug/l
Kilo	LYKRNG002_SEP21-09222021	SM5310B	10/5/2021 1:57	Dissolved Organic Carbon	2.1	ug/l	Y			0.35	0.8	1	ug/l
Kilo	LYKRNG002_SEP21-09222021	SW6010C	10/7/2021 4:31	Iron	48	ug/l	Y	J		22	85	100	ug/l
Kilo	LYKRNG002_SEP21-09222021	SW6010C	10/7/2021 4:31	Lead	9	ug/l	N	U	15	2.7	9	15	ug/l
Kilo	LYKRNG002_SEP21-09222021	SW6010C	10/7/2021 4:31	Magnesium	6800	ug/l	Y			26	60	500	ug/l
Kilo	LYKRNG002_SEP21-09222021	E365.4	10/11/2021 13:01	Phosphates, Total as P	0.06	ug/l	Y	J		0.041	0.057	0.1	ug/l
Kilo	LYKRNG002_SEP21-09222021	SW6010C	10/7/2021 4:31	Potassium	730	ug/l	Y	J		240	940	3000	ug/l
Kilo	LYKRNG002_SEP21-09222021	SW6010C	10/7/2021 4:31	Sodium	3000	ug/l	Y	J		370	1000	5000	ug/l
Kilo	LYKRNG002_SEP21-09222021	SW9056	9/29/2021 20:16	Sulfate	1.1	ug/l	Y	J		1	2.5	5	ug/l
Kilo	LYKRNG003_SEP21-09222021	SM2320B	9/29/2021 2:58	Alkalinity	28	ug/l	Y			3.1	6.4	10	ug/l
Kilo	**LYKRNG003_SEP21-09222021**	**SW6010C**	**10/7/2021 4:34**	**Antimony**	**12**	**ug/l**	**N**	**U**	**6**	**5.2**	**12**	**20**	**ug/l**
Kilo	LYKRNG003_SEP21-09222021	SW6010C	10/7/2021 4:34	Calcium	6400	ug/l	Y			78	160	1000	ug/l
Kilo	LYKRNG003_SEP21-09222021	SW9056	9/29/2021 21:22	Chloride	2.1	ug/l	Y	JM		1	2.5	3	ug/l
Kilo	LYKRNG003_SEP21-09222021	SW6010C	10/7/2021 4:34	Copper	4.2	ug/l	Y	J	1,300	4.2	10	15	ug/l
Kilo	LYKRNG003_SEP21-09222021	SM5310B	10/5/2021 2:12	Dissolved Organic Carbon	4.2	ug/l	Y			0.35	0.8	1	ug/l
Kilo	LYKRNG003_SEP21-09222021	SW6010C	10/7/2021 4:34	Iron	4100	ug/l	Y			22	85	100	ug/l
Kilo	LYKRNG003_SEP21-09222021	SW6010C	10/7/2021 4:34	Lead	3.8	ug/l	Y	J	15	2.7	9	15	ug/l
Kilo	LYKRNG003_SEP21-09222021	SW6010C	10/7/2021 4:34	Magnesium	470	ug/l	Y	J		26	60	500	ug/l
Kilo	LYKRNG003_SEP21-09222021	E365.4	10/11/2021 13:02	Phosphates, Total as P	0.057	ug/l	N	U		0.041	0.057	0.1	ug/l
Kilo	LYKRNG003_SEP21-09222021	SW6010C	10/7/2021 4:34	Potassium	940	ug/l	N	U		240	940	3000	ug/l
Kilo	LYKRNG003_SEP21-09222021	SW6010C	10/7/2021 4:34	Sodium	1500	ug/l	Y	J		370	1000	5000	ug/l
Kilo	LYKRNG003_SEP21-09222021	SW9056	9/29/2021 21:22	Sulfate	1.1	ug/l	Y	J		1	2.5	5	ug/l
Kilo	LYKRNG004_SEP21-09222021	SM2320B	9/29/2021 20:24	Alkalinity	17	ug/l	Y			3.1	6.4	10	ug/l
Kilo	**LYKRNG004_SEP21-09222021**	**SW6010C**	**10/7/2021 4:38**	**Antimony**	**11**	**ug/l**	**Y**	**J**	**6**	**5.2**	**12**	**20**	**ug/l**
Kilo	LYKRNG004_SEP21-09222021	SW6010C	10/7/2021 4:38	Calcium	4300	ug/l	Y			78	160	1000	ug/l
Kilo	LYKRNG004_SEP21-09222021	SW9056	9/29/2021 21:38	Chloride	1.1	ug/l	Y	JM		1	2.5	3	ug/l

Range	Sample Code	Method	Analysis Date	Analyte	Result	Units	Detection Flag	Qualifier	OMMP Action Level	Method Detection Limit	Reporting Detection Limit	Quantitation Limit	Detection Limit Units
Kilo	LYKRNG004_SEP21-09222021	SW6010C	10/7/2021 4:38	Copper	7	ug/l	Y	J	1,300	4.2	10	15	ug/l
Kilo	LYKRNG004_SEP21-09222021	SM5310B	10/5/2021 2:27	Dissolved Organic Carbon	3.4	ug/l	Y			0.35	0.8	1	ug/l
Kilo	LYKRNG004_SEP21-09222021	SW6010C	10/7/2021 4:38	Iron	640	ug/l	Y			22	85	100	ug/l
Kilo	LYKRNG004_SEP21-09222021	SW6010C	10/7/2021 4:38	Lead	9	ug/l	N	U	15	2.7	9	15	ug/l
Kilo	LYKRNG004_SEP21-09222021	SW6010C	10/7/2021 4:38	Magnesium	240	ug/l	Y	J		26	60	500	ug/l
Kilo	LYKRNG004_SEP21-09222021	E365.4	10/12/2021 11:41	Phosphates, Total as P	0.057	ug/l	N	U		0.041	0.057	0.1	ug/l
Kilo	LYKRNG004_SEP21-09222021	SW6010C	10/7/2021 4:38	Potassium	940	ug/l	N	U		240	940	3000	ug/l
Kilo	LYKRNG004_SEP21-09222021	SW6010C	10/7/2021 4:38	Sodium	1700	ug/l	Y	J		370	1000	5000	ug/l
Kilo	LYKRNG004_SEP21-09222021	SW9056	9/29/2021 21:38	Sulfate	1.4	ug/l	Y	J		1	2.5	5	ug/l
Lima	LYLRNG001_SEP21-09232021	SM2320B	9/29/2021 3:25	Alkalinity	6.4	ug/l	Y	J		3.1	6.4	10	ug/l
Lima	**LYLRNG001_SEP21-09232021**	**SW6010C**	**10/7/2021 5:13**	**Antimony**	**12**	**ug/l**	**N**	**U**	**6**	**5.2**	**12**	**20**	**ug/l**
Lima	LYLRNG001_SEP21-09232021	SW6010C	10/7/2021 5:13	Calcium	1600	ug/l	Y			78	160	1000	ug/l
Lima	LYLRNG001_SEP21-09232021	SW9056	9/29/2021 23:49	Chloride	3.3	ug/l	Y	M		1	2.5	3	ug/l
Lima	LYLRNG001_SEP21-09232021	SW6010C	10/7/2021 5:13	Copper	5.4	ug/l	Y	J	1,300	4.2	10	15	ug/l
Lima	LYLRNG001_SEP21-09232021	SM5310B	10/5/2021 4:55	Dissolved Organic Carbon	6.3	ug/l	Y			0.35	0.8	1	ug/l
Lima	LYLRNG001_SEP21-09232021	SW6010C	10/7/2021 5:13	Iron	38	ug/l	Y	J		22	85	100	ug/l
Lima	LYLRNG001_SEP21-09232021	SW6010C	10/7/2021 5:13	Lead	9	ug/l	N	U	15	2.7	9	15	ug/l
Lima	LYLRNG001_SEP21-09232021	SW6010C	10/7/2021 5:13	Magnesium	330	ug/l	Y	J		26	60	500	ug/l
Lima	LYLRNG001_SEP21-09232021	E365.4	10/13/2021 12:21	Phosphates, Total as P	0.085	ug/l	Y	J		0.041	0.057	0.1	ug/l
Lima	LYLRNG001_SEP21-09232021	SW6010C	10/7/2021 5:13	Potassium	1100	ug/l	Y	J		240	940	3000	ug/l
Lima	LYLRNG001_SEP21-09232021	SW6010C	10/7/2021 5:13	Sodium	2200	ug/l	Y	J		370	1000	5000	ug/l
Lima	LYLRNG001_SEP21-09232021	SW9056	9/29/2021 23:49	Sulfate	1.4	ug/l	Y	J		1	2.5	5	ug/l
Lima	LYLRNG002_SEP21-09232021	SM2320B	9/29/2021 3:20	Alkalinity	73	ug/l	Y			3.1	6.4	10	ug/l
Lima	**LYLRNG002_SEP21-09232021**	**SW6010C**	**10/7/2021 5:16**	**Antimony**	**12**	**ug/l**	**N**	**U**	**6**	**5.2**	**12**	**20**	**ug/l**
Lima	LYLRNG002_SEP21-09232021	SW6010C	10/7/2021 5:16	Calcium	27000	ug/l	Y			78	160	1000	ug/l
Lima	LYLRNG002_SEP21-09232021	SW9056	9/30/2021 0:06	Chloride	2.9	ug/l	Y	JM		1	2.5	3	ug/l
Lima	LYLRNG002_SEP21-09232021	SW6010C	10/7/2021 5:16	Copper	10	ug/l	N	U	1,300	4.2	10	15	ug/l
Lima	LYLRNG002_SEP21-09232021	SM5310B	10/5/2021 5:10	Dissolved Organic Carbon	5.7	ug/l	Y			0.35	0.8	1	ug/l
Lima	LYLRNG002_SEP21-09232021	SW6010C	10/7/2021 5:16	Iron	85	ug/l	N	U		22	85	100	ug/l

Range	Sample Code	Method	Analysis Date	Analyte	Result	Units	Detection Flag	Qualifier	OMMP Action Level	Method Detection Limit	Reporting Detection Limit	Quantitation Limit	Detection Limit Units
Lima	LYLRNG002_SEP21-09232021	SW6010C	10/7/2021 5:16	Lead	9	ug/l	N	U	15	2.7	9	15	ug/l
Lima	LYLRNG002_SEP21-09232021	SW6010C	10/7/2021 5:16	Magnesium	480	ug/l	Y	J		26	60	500	ug/l
Lima	LYLRNG002_SEP21-09232021	E365.4	10/13/2021 12:33	Phosphates, Total as P	0.057	ug/l	N	U		0.041	0.057	0.1	ug/l
Lima	LYLRNG002_SEP21-09232021	SW6010C	10/7/2021 5:16	Potassium	630	ug/l	Y	J		240	940	3000	ug/l
Lima	LYLRNG002_SEP21-09232021	SW6010C	10/7/2021 5:16	Sodium	2200	ug/l	Y	J		370	1000	5000	ug/l
Lima	LYLRNG002_SEP21-09232021	SW9056	9/30/2021 0:06	Sulfate	2.5	ug/l	N	U		1	2.5	5	ug/l
Sierra	LYSRNG001_SEP21-09222021	SM2320B	9/29/2021 3:03	Alkalinity	53	ug/l	Y			3.1	6.4	10	ug/l
Sierra	**LYSRNG001_SEP21-09222021**	**SW6010C**	**10/7/2021 4:41**	**Antimony**	**12**	**ug/l**	**N**	**U**	**6**	**5.2**	**12**	**20**	**ug/l**
Sierra	LYSRNG001_SEP21-09222021	SW6010C	10/7/2021 4:41	Calcium	18000	ug/l	Y			78	160	1000	ug/l
Sierra	LYSRNG001_SEP21-09222021	SW9056	9/29/2021 21:54	Chloride	5.1	ug/l	Y	M		1	2.5	3	ug/l
Sierra	LYSRNG001_SEP21-09222021	SW6010C	10/7/2021 4:41	Copper	10	ug/l	N	U	1,300	4.2	10	15	ug/l
Sierra	LYSRNG001_SEP21-09222021	SM5310B	10/5/2021 2:41	Dissolved Organic Carbon	7	ug/l	Y			0.35	0.8	1	ug/l
Sierra	LYSRNG001_SEP21-09222021	SW6010C	10/7/2021 4:41	Iron	85	ug/l	N	U		22	85	100	ug/l
Sierra	LYSRNG001_SEP21-09222021	SW6010C	10/7/2021 4:41	Lead	9	ug/l	N	U	15	2.7	9	15	ug/l
Sierra	LYSRNG001_SEP21-09222021	SW6010C	10/7/2021 4:41	Magnesium	1700	ug/l	Y			26	60	500	ug/l
Sierra	LYSRNG001_SEP21-09222021	E365.4	10/13/2021 12:18	Phosphates, Total as P	0.057	ug/l	N	U		0.041	0.057	0.1	ug/l
Sierra	LYSRNG001_SEP21-09222021	SW6010C	10/7/2021 4:41	Potassium	940	ug/l	N	U		240	940	3000	ug/l
Sierra	LYSRNG001_SEP21-09222021	SW6010C	10/7/2021 4:41	Sodium	4300	ug/l	Y	J		370	1000	5000	ug/l
Sierra	LYSRNG001_SEP21-09222021	SW9056	9/29/2021 21:54	Sulfate	2.8	ug/l	Y	J		1	2.5	5	ug/l
Sierra	LYSRNG002_SEP21-09222021	SM2320B	9/29/2021 20:29	Alkalinity	6	ug/l	Y	J		3.1	6.4	10	ug/l
Sierra	**LYSRNG002_SEP21-09222021**	**SW6010C**	**10/7/2021 4:45**	**Antimony**	**12**	**ug/l**	**N**	**U**	**6**	**5.2**	**12**	**20**	**ug/l**
Sierra	LYSRNG002_SEP21-09222021	SW6010C	10/7/2021 4:45	Calcium	880	ug/l	Y	J		78	160	1000	ug/l
Sierra	LYSRNG002_SEP21-09222021	SW9056	9/29/2021 22:44	Chloride	5.1	ug/l	Y			1	2.5	3	ug/l
Sierra	LYSRNG002_SEP21-09222021	SW6010C	10/7/2021 4:45	Copper	10	ug/l	N	U	1,300	4.2	10	15	ug/l
Sierra	LYSRNG002_SEP21-09222021	SM5310B	10/5/2021 2:56	Dissolved Organic Carbon	3.3	ug/l	Y			0.35	0.8	1	ug/l
Sierra	LYSRNG002_SEP21-09222021	SW6010C	10/7/2021 4:45	Iron	30	ug/l	Y	J		22	85	100	ug/l
Sierra	LYSRNG002_SEP21-09222021	SW6010C	10/7/2021 4:45	Lead	9	ug/l	N	U	15	2.7	9	15	ug/l
Sierra	LYSRNG002_SEP21-09222021	SW6010C	10/7/2021 4:45	Magnesium	220	ug/l	Y	J		26	60	500	ug/l
Sierra	LYSRNG002_SEP21-09222021	E365.4	10/13/2021 12:22	Phosphates, Total as P	0.057	ug/l	N	U		0.041	0.057	0.1	ug/l
Sierra	LYSRNG002_SEP21-09222021	SW6010C	10/7/2021 4:45	Potassium	3800	ug/l	Y			240	940	3000	ug/l

Range	Sample Code	Method	Analysis Date	Analyte	Result	Units	Detection Flag	Qualifier	OMMP Action Level	Method Detection Limit	Reporting Detection Limit	Quantitation Limit	Detection Limit Units
Sierra	LYSRNG002_SEP21-09222021	SW6010C	10/7/2021 4:45	Sodium	2900	ug/l	Y	J		370	1000	5000	ug/l
Sierra	LYSRNG002_SEP21-09222021	SW9056	9/29/2021 22:44	Sulfate	1.5	ug/l	Y	J		1	2.5	5	ug/l
a Backgr	LYSBGD01_SEP21-09232021	SM2320B	9/29/2021 3:09	Alkalinity	6.6	ug/l	Y	J		3.1	6.4	10	ug/l
a Backgr	**LYSBGD01_SEP21-09232021**	**SW6010C**	**10/7/2021 5:09**	**Antimony**	**12**	**ug/l**	**N**	**U**	**6**	**5.2**	**12**	**20**	**ug/l**
a Backgr	LYSBGD01_SEP21-09232021	SW6010C	10/7/2021 5:09	Calcium	3000	ug/l	Y			78	160	1000	ug/l
a Backgr	LYSBGD01_SEP21-09232021	SW9056	9/29/2021 23:33	Chloride	11	ug/l	Y	M		1	2.5	3	ug/l
a Backgr	LYSBGD01_SEP21-09232021	SW6010C	10/7/2021 5:09	Copper	10	ug/l	N	U	1,300	4.2	10	15	ug/l
a Backgr	LYSBGD01_SEP21-09232021	SM5310B	10/5/2021 4:40	Dissolved Organic Carbon	4.5	ug/l	Y			0.35	0.8	1	ug/l
a Backgr	LYSBGD01_SEP21-09232021	SW6010C	10/7/2021 5:09	Iron	85	ug/l	N	U		22	85	100	ug/l
a Backgr	LYSBGD01_SEP21-09232021	SW6010C	10/7/2021 5:09	Lead	9	ug/l	N	U	15	2.7	9	15	ug/l
a Backgr	LYSBGD01_SEP21-09232021	SW6010C	10/7/2021 5:09	Magnesium	700	ug/l	Y			26	60	500	ug/l
a Backgr	LYSBGD01_SEP21-09232021	E365.4	10/13/2021 12:28	Phosphates, Total as P	0.057	ug/l	N	U		0.041	0.057	0.1	ug/l
a Backgr	LYSBGD01_SEP21-09232021	SW6010C	10/7/2021 5:09	Potassium	1100	ug/l	Y	J		240	940	3000	ug/l
a Backgr	LYSBGD01_SEP21-09232021	SW6010C	10/7/2021 5:09	Sodium	9300	ug/l	Y			370	1000	5000	ug/l
a Backgr	LYSBGD01_SEP21-09232021	SW9056	9/29/2021 23:33	Sulfate	7.1	ug/l	Y	M		1	2.5	5	ug/l

Notes:
µg/L = microgram(s) per liter

J = The analyte was positively identified, and the associated numerical value is the approximate concentration of the analyte in the sample as a result of associated QC criteria results. The data are valid for project use to achieve project DQOs.

J1 = Estimated: The quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

M = manual integrated compound

U = The analyte was analyzed for but was not detected at a level greater than or equal to the method and sample-specific detection limit.

Juliet and Kilo Ranges, STAPP bullet catcher system, Camp Edwards, Massachusetts
LY=Lysimeter, MW=Monitoring Well, SS=Soil Sample

Tango Range with STAPP bullet catcher system, Camp Edwards, Massachusetts
LY=Lysimeter, MW=Monitoring Well, SS=Soil Sample

India Range, Copper Ammunition Only, Camp Edwards, Massachusetts.
LY=Lysimeter, MW=Monitoring Well, SS=Soil Sample

Small Arms Range Sampling Reports

Groundwater Sampling Results

Fall 2021

Range	Sample Code	Method	Analysis Date	Analyte	Result	Units	Detection Flag	Qualifiers	OMMP Action Level	Method Detection Limit	Reporting Limit	QuantitationLimit	Detection Limit Units
Echo	MW-468S_SEP21-09162021	SM2320B	9/24/2021 19:57	Alkalinity	9.1	ug/l	Y	J		3.1	6.4	10	ug/l
Echo	**MW-468S_SEP21-09162021**	**SW6010C**	**9/28/2021 20:49**	**Antimony**	**12**	**ug/l**	**N**	**U**	**3**	**5.2**	**12**	**20**	**ug/l**
Echo	MW-468S_SEP21-09162021	SW6010C	9/28/2021 20:49	Calcium	2300	ug/l	Y			78	160	1000	ug/l
Echo	MW-468S_SEP21-09162021	SW9056	9/26/2021 1:43	Chloride	9.8	ug/l	Y			1	2.5	3	ug/l
Echo	MW-468S_SEP21-09162021	SW6010C	9/28/2021 20:49	Copper	10	ug/l	N	U	650	4.2	10	15	ug/l
Echo	MW-468S_SEP21-09162021	SM5310B	10/11/2021 13:40	Dissolved Organic Carbon	0.8	ug/l	N	U		0.35	0.8	1	ug/l
Echo	MW-468S_SEP21-09162021	SW6010C	9/28/2021 20:49	Iron	1200	ug/l	Y			22	85	100	ug/l
Echo	**MW-468S_SEP21-09162021**	**SW6010C**	**9/28/2021 20:49**	**Lead**	**9**	**ug/l**	**N**	**U**	**7.5**	**2.7**	**9**	**15**	**ug/l**
Echo	MW-468S_SEP21-09162021	SW6010C	9/28/2021 20:49	Magnesium	1500	ug/l	Y			26	60	500	ug/l
Echo	MW-468S_SEP21-09162021	E365.4	10/7/2021 12:18	Phosphates, Total as P	0.057	ug/l	N	U		0.041	0.057	0.1	ug/l
Echo	MW-468S_SEP21-09162021	SW6010C	9/28/2021 20:49	Potassium	730	ug/l	Y	J		240	940	3000	ug/l
Echo	MW-468S_SEP21-09162021	SW6010C	9/28/2021 20:49	Sodium	7400	ug/l	Y			370	1000	5000	ug/l
Echo	MW-468S_SEP21-09162021	SW9056	9/26/2021 1:43	Sulfate	4.7	ug/l	Y	J		1	2.5	5	ug/l
India	MW-639S_SEP21-09202021	SM2320B	9/24/2021 19:15	Alkalinity	7.2	ug/l	Y	J		3.1	6.4	10	ug/l
India	**MW-639S_SEP21-09202021**	**SW6010C**	**9/28/2021 20:37**	**Antimony**	**12**	**ug/l**	**N**	**U**	**3**	**5.2**	**12**	**20**	**ug/l**
India	MW-639S_SEP21-09202021	SW6010C	9/28/2021 20:37	Calcium	2000	ug/l	Y			78	160	1000	ug/l
India	MW-639S_SEP21-09202021	SW9056	10/8/2021 18:00	Chloride	8.3	ug/l	Y	M		1	2.5	3	ug/l
India	MW-639S_SEP21-09202021	SW6010C	9/28/2021 20:37	Copper	10	ug/l	N	U	650	4.2	10	15	ug/l
India	MW-639S_SEP21-09202021	SM5310B	10/11/2021 12:33	Dissolved Organic Carbon	0.35	ug/l	Y	J		0.35	0.8	1	ug/l
India	MW-639S_SEP21-09202021	SW6010C	9/28/2021 20:37	Iron	160	ug/l	Y			22	85	100	ug/l
India	**MW-639S_SEP21-09202021**	**SW6010C**	**9/28/2021 20:37**	**Lead**	**9**	**ug/l**	**N**	**U**	**7.5**	**2.7**	**9**	**15**	**ug/l**
India	MW-639S_SEP21-09202021	SW6010C	9/28/2021 20:37	Magnesium	1500	ug/l	Y			26	60	500	ug/l
India	MW-639S_SEP21-09202021	E365.4	10/7/2021 12:17	Phosphates, Total as P	0.057	ug/l	N	U		0.041	0.057	0.1	ug/l
India	MW-639S_SEP21-09202021	SW6010C	9/28/2021 20:37	Potassium	570	ug/l	Y	J		240	940	3000	ug/l
India	MW-639S_SEP21-09202021	SW6010C	9/28/2021 20:37	Sodium	6400	ug/l	Y			370	1000	5000	ug/l
India	MW-639S_SEP21-09202021	SW9056	10/8/2021 18:00	Sulfate	6.1	ug/l	Y			1	2.5	5	ug/l
Juliet	MW-471S_SEP21 FD-09172021	SM2320B	9/24/2021 19:40	Alkalinity	11	ug/l	Y			3.1	6.4	10	ug/l
Juliet	**MW-471S_SEP21 FD-09172021**	**SW6010C**	**9/28/2021 20:30**	**Antimony**	**12**	**ug/l**	**N**	**U**	**3**	**5.2**	**12**	**20**	**ug/l**
Juliet	MW-471S_SEP21 FD-09172021	SW6010C	9/28/2021 20:30	Calcium	2500	ug/l	Y			78	160	1000	ug/l
Juliet	MW-471S_SEP21 FD-09172021	SW9056	10/8/2021 17:30	Chloride	6.1	ug/l	Y	M		1	2.5	3	ug/l
Juliet	MW-471S_SEP21 FD-09172021	SW6010C	9/28/2021 20:30	Copper	10	ug/l	N	U	650	4.2	10	15	ug/l
Juliet	MW-471S_SEP21 FD-09172021	SM5310B	10/5/2021 6:10	Dissolved Organic Carbon	0.53	ug/l	Y	J		0.35	0.8	1	ug/l

Range	Sample Code	Method	Analysis Date	Analyte	Result	Units	Detection Flag	Qualifiers	OMMP Action Level	Method Detection Limit	Reporting Limit	QuantitationLimit	Detection Limit Units
Juliet	MW-471S_SEP21 FD-09172021	SW6010C	9/28/2021 20:30	Iron	130	ug/l	Y			22	85	100	ug/l
Juliet	**MW-471S_SEP21 FD-09172021**	**SW6010C**	**9/28/2021 20:30**	**Lead**	**9**	**ug/l**	**N**	**U**	**7.5**	**2.7**	**9**	**15**	**ug/l**
Juliet	MW-471S_SEP21 FD-09172021	SW6010C	9/28/2021 20:30	Magnesium	1900	ug/l	Y			26	60	500	ug/l
Juliet	MW-471S_SEP21 FD-09172021	E365.4	10/7/2021 12:33	Phosphates, Total as P	0.057	ug/l	N	U		0.041	0.057	0.1	ug/l
Juliet	MW-471S_SEP21 FD-09172021	SW6010C	9/28/2021 20:30	Potassium	680	ug/l	Y	J		240	940	3000	ug/l
Juliet	MW-471S_SEP21 FD-09172021	SW6010C	9/28/2021 20:30	Sodium	4900	ug/l	Y	J		370	1000	5000	ug/l
Juliet	MW-471S_SEP21 FD-09172021	SW9056	10/8/2021 17:30	Sulfate	5.4	ug/l	Y	M		1	2.5	5	ug/l
Juliet	MW-471S_SEP21-09172021	SM2320B	9/24/2021 19:21	Alkalinity	11	ug/l	Y			3.1	6.4	10	ug/l
Juliet	**MW-471S_SEP21-09172021**	**SW6010C**	**9/28/2021 20:13**	**Antimony**	**12**	**ug/l**	**N**	**U**	**3**	**5.2**	**12**	**20**	**ug/l**
Juliet	MW-471S_SEP21-09172021	SW6010C	9/28/2021 20:13	Calcium	2600	ug/l	Y			78	160	1000	ug/l
Juliet	MW-471S_SEP21-09172021	SW9056	10/8/2021 17:15	Chloride	6	ug/l	Y	M		1	2.5	3	ug/l
Juliet	MW-471S_SEP21-09172021	SW6010C	9/28/2021 20:13	Copper	10	ug/l	N	U	650	4.2	10	15	ug/l
Juliet	MW-471S_SEP21-09172021	SM5310B	10/5/2021 5:55	Dissolved Organic Carbon	0.55	ug/l	Y	J		0.35	0.8	1	ug/l
Juliet	MW-471S_SEP21-09172021	SW6010C	9/28/2021 20:13	Iron	44	ug/l	Y	J		22	85	100	ug/l
Juliet	**MW-471S_SEP21-09172021**	**SW6010C**	**9/28/2021 20:13**	**Lead**	**9**	**ug/l**	**N**	**U**	**7.5**	**2.7**	**9**	**15**	**ug/l**
Juliet	MW-471S_SEP21-09172021	SW6010C	9/28/2021 20:13	Magnesium	2000	ug/l	Y			26	60	500	ug/l
Juliet	MW-471S_SEP21-09172021	E365.4	10/6/2021 13:49	Phosphates, Total as P	0.057	ug/l	N	U		0.041	0.057	0.1	ug/l
Juliet	MW-471S_SEP21-09172021	SW6010C	9/28/2021 20:13	Potassium	740	ug/l	Y	J		240	940	3000	ug/l
Juliet	MW-471S_SEP21-09172021	SW6010C	9/28/2021 20:13	Sodium	5100	ug/l	Y			370	1000	5000	ug/l
Juliet	MW-471S_SEP21-09172021	SW9056	10/8/2021 17:15	Sulfate	5.1	ug/l	Y			1	2.5	5	ug/l
Juliet	**MW-472S_SEP21-09172021**	**SW6010C**	**9/28/2021 20:00**	**Antimony**	**12**	**ug/l**	**N**	**U**	**3**	**5.2**	**12**	**20**	**ug/l**
Juliet	MW-472S_SEP21-09172021	SW6010C	9/28/2021 20:00	Calcium	2700	ug/l	Y			78	160	1000	ug/l
Juliet	MW-472S_SEP21-09172021	SW9056	10/8/2021 16:30	Chloride	6.3	ug/l	Y	M		1	2.5	3	ug/l
Juliet	MW-472S_SEP21-09172021	SW6010C	9/28/2021 20:00	Copper	10	ug/l	N	U	650	4.2	10	15	ug/l
Juliet	MW-472S_SEP21-09172021	SM5310B	10/5/2021 5:40	Dissolved Organic Carbon	0.69	ug/l	Y	J		0.35	0.8	1	ug/l
Juliet	MW-472S_SEP21-09172021	SW6010C	9/28/2021 20:00	Iron	32	ug/l	Y	J		22	85	100	ug/l
Juliet	**MW-472S_SEP21-09172021**	**SW6010C**	**9/28/2021 20:00**	**Lead**	**9**	**ug/l**	**N**	**U**	**7.5**	**2.7**	**9**	**15**	**ug/l**
Juliet	MW-472S_SEP21-09172021	SW6010C	9/28/2021 20:00	Magnesium	2600	ug/l	Y			26	60	500	ug/l
Juliet	MW-472S_SEP21-09172021	E365.4	10/6/2021 13:51	Phosphates, Total as P	0.057	ug/l	N	U		0.041	0.057	0.1	ug/l
Juliet	MW-472S_SEP21-09172021	SW6010C	9/28/2021 20:00	Potassium	830	ug/l	Y	J		240	940	3000	ug/l
Juliet	MW-472S_SEP21-09172021	SW6010C	9/28/2021 20:00	Sodium	4400	ug/l	Y	J		370	1000	5000	ug/l
Juliet	MW-472S_SEP21-09172021	SW9056	10/8/2021 16:30	Sulfate	5.4	ug/l	Y			1	2.5	5	ug/l
Kilo	MW-474S_SEP21-09172021	SM2320B	9/24/2021 19:51	Alkalinity	11	ug/l	Y			3.1	6.4	10	ug/l

Range	Sample Code	Method	Analysis Date	Analyte	Result	Units	Detection Flag	Qualifiers	OMMP Action Level	Method Detection Limit	Reporting Limit	QuantitationLimit	Detection Limit Units
Kilo	**MW-474S_SEP21-09172021**	**SW6010C**	**9/28/2021 20:33**	**Antimony**	**12**	**ug/l**	**N**	**U**	**3**	**5.2**	**12**	**20**	**ug/l**
Kilo	MW-474S_SEP21-09172021	SW6010C	9/28/2021 20:33	Calcium	1900	ug/l	Y			78	160	1000	ug/l
Kilo	MW-474S_SEP21-09172021	SW9056	10/8/2021 17:45	Chloride	7.2	ug/l	Y	M		1	2.5	3	ug/l
Kilo	MW-474S_SEP21-09172021	SW6010C	9/28/2021 20:33	Copper	10	ug/l	N	U	650	4.2	10	15	ug/l
Kilo	MW-474S_SEP21-09172021	SM5310B	10/11/2021 11:47	Dissolved Organic Carbon	0.8	ug/l	N	U		0.35	0.8	1	ug/l
Kilo	MW-474S_SEP21-09172021	SW6010C	9/28/2021 20:33	Iron	85	ug/l	N	U		22	85	100	ug/l
Kilo	**MW-474S_SEP21-09172021**	**SW6010C**	**9/28/2021 20:33**	**Lead**	**9**	**ug/l**	**N**	**U**	**7.5**	**2.7**	**9**	**15**	**ug/l**
Kilo	MW-474S_SEP21-09172021	SW6010C	9/28/2021 20:33	Magnesium	2200	ug/l	Y			26	60	500	ug/l
Kilo	MW-474S_SEP21-09172021	E365.4	10/7/2021 12:34	Phosphates, Total as P	0.057	ug/l	N	U		0.041	0.057	0.1	ug/l
Kilo	MW-474S_SEP21-09172021	SW6010C	9/28/2021 20:33	Potassium	680	ug/l	Y	J		240	940	3000	ug/l
Kilo	MW-474S_SEP21-09172021	SW6010C	9/28/2021 20:33	Sodium	5700	ug/l	Y			370	1000	5000	ug/l
Kilo	MW-474S_SEP21-09172021	SW9056	10/8/2021 17:45	Sulfate	4.6	ug/l	Y	J		1	2.5	5	ug/l
Kilo	MW-474S_SEP21-09172021SD	SM5310B	10/11/2021 12:16	Dissolved Organic Carbon	26.8	ug/l	Y			0.35	0.8	1	ug/l
Sierra	MW-465S_SEP21 FD-09202021	SM2320B	9/24/2021 20:02	Alkalinity	23	ug/l	Y			3.1	6.4	10	ug/l
Sierra	**MW-465S_SEP21 FD-09202021**	**SW6010C**	**9/28/2021 20:46**	**Antimony**	**12**	**ug/l**	**N**	**U**	**3**	**5.2**	**12**	**20**	**ug/l**
Sierra	MW-465S_SEP21 FD-09202021	SW6010C	9/28/2021 20:46	Calcium	4100	ug/l	Y			78	160	1000	ug/l
Sierra	MW-465S_SEP21 FD-09202021	SW9056	9/26/2021 1:29	Chloride	5.6	ug/l	Y			1	2.5	3	ug/l
Sierra	MW-465S_SEP21 FD-09202021	SW6010C	9/28/2021 20:46	Copper	7.1	ug/l	Y	J	650	4.2	10	15	ug/l
Sierra	MW-465S_SEP21 FD-09202021	SM5310B	10/11/2021 13:23	Dissolved Organic Carbon	0.8	ug/l	N	U		0.35	0.8	1	ug/l
Sierra	MW-465S_SEP21 FD-09202021	SW6010C	9/28/2021 20:46	Iron	2800	ug/l	Y			22	85	100	ug/l
Sierra	**MW-465S_SEP21 FD-09202021**	**SW6010C**	**9/28/2021 20:46**	**Lead**	**9**	**ug/l**	**N**	**U**	**7.5**	**2.7**	**9**	**15**	**ug/l**
Sierra	MW-465S_SEP21 FD-09202021	SW6010C	9/28/2021 20:46	Magnesium	2000	ug/l	Y			26	60	500	ug/l
Sierra	MW-465S_SEP21 FD-09202021	E365.4	10/7/2021 12:43	Phosphates, Total as P	0.057	ug/l	N	U		0.041	0.057	0.1	ug/l
Sierra	MW-465S_SEP21 FD-09202021	SW6010C	9/28/2021 20:46	Potassium	570	ug/l	Y	J		240	940	3000	ug/l
Sierra	MW-465S_SEP21 FD-09202021	SW6010C	9/28/2021 20:46	Sodium	5900	ug/l	Y			370	1000	5000	ug/l
Sierra	MW-465S_SEP21 FD-09202021	SW9056	9/26/2021 1:29	Sulfate	5.3	ug/l	Y			1	2.5	5	ug/l
Sierra	MW-465S_SEP21-09202021	SM2320B	9/24/2021 19:10	Alkalinity	22	ug/l	Y			3.1	6.4	10	ug/l
Sierra	**MW-465S_SEP21-09202021**	**SW6010C**	**9/28/2021 20:43**	**Antimony**	**12**	**ug/l**	**N**	**U**	**3**	**5.2**	**12**	**20**	**ug/l**
Sierra	MW-465S_SEP21-09202021	SW6010C	9/28/2021 20:43	Calcium	4100	ug/l	Y			78	160	1000	ug/l
Sierra	MW-465S_SEP21-09202021	SW9056	9/26/2021 0:05	Chloride	5.7	ug/l	Y			1	2.5	3	ug/l
Sierra	MW-465S_SEP21-09202021	SW6010C	9/28/2021 20:43	Copper	10	ug/l	N	U	650	4.2	10	15	ug/l

Range	Sample Code	Method	Analysis Date	Analyte	Result	Units	Detection Flag	Qualifiers	OMMP Action Level	Method Detection Limit	Reporting Limit	QuantitationLimit	Detection Limit Units
Sierra	MW-465S_SEP21-09202021	SM5310B	10/11/2021 13:07	Dissolved Organic Carbon	0.8	ug/l	N	U		0.35	0.8	1	ug/l
Sierra	MW-465S_SEP21-09202021	SW6010C	9/28/2021 20:43	Iron	23	ug/l	Y	J		22	85	100	ug/l
Sierra	**MW-465S_SEP21-09202021**	**SW6010C**	**9/28/2021 20:43**	**Lead**	**9**	**ug/l**	**N**	**U**	**7.5**	**2.7**	**9**	**15**	**ug/l**
Sierra	MW-465S_SEP21-09202021	SW6010C	9/28/2021 20:43	Magnesium	2000	ug/l	Y			26	60	500	ug/l
Sierra	MW-465S_SEP21-09202021	E365.4	10/7/2021 12:36	Phosphates, Total as P	0.057	ug/l	N	U		0.041	0.057	0.1	ug/l
Sierra	MW-465S_SEP21-09202021	SW6010C	9/28/2021 20:43	Potassium	610	ug/l	Y	J		240	940	3000	ug/l
Sierra	MW-465S_SEP21-09202021	SW6010C	9/28/2021 20:43	Sodium	5900	ug/l	Y			370	1000	5000	ug/l
Sierra	MW-465S_SEP21-09202021	SW9056	9/26/2021 0:05	Sulfate	5.5	ug/l	Y			1	2.5	5	ug/l
Sierra	MW-466S_SEP21-09202021	SM2320B	9/24/2021 19:05	Alkalinity	23	ug/l	Y			3.1	6.4	10	ug/l
Sierra	**MW-466S_SEP21-09202021**	**SW6010C**	**9/28/2021 20:40**	**Antimony**	**12**	**ug/l**	**N**	**U**	**3**	**5.2**	**12**	**20**	**ug/l**
Sierra	MW-466S_SEP21-09202021	SW6010C	9/28/2021 20:40	Calcium	4400	ug/l	Y			78	160	1000	ug/l
Sierra	MW-466S_SEP21-09202021	SW9056	10/8/2021 18:15	Chloride	5	ug/l	Y	M		1	2.5	3	ug/l
Sierra	MW-466S_SEP21-09202021	SW6010C	9/28/2021 20:40	Copper	10	ug/l	N	U	650	4.2	10	15	ug/l
Sierra	MW-466S_SEP21-09202021	SM5310B	10/11/2021 12:50	Dissolved Organic Carbon	0.58	ug/l	Y	J		0.35	0.8	1	ug/l
Sierra	MW-466S_SEP21-09202021	SW6010C	9/28/2021 20:40	Iron	100	ug/l	Y			22	85	100	ug/l
Sierra	**MW-466S_SEP21-09202021**	**SW6010C**	**9/28/2021 20:40**	**Lead**	**9**	**ug/l**	**N**	**U**	**7.5**	**2.7**	**9**	**15**	**ug/l**
Sierra	MW-466S_SEP21-09202021	SW6010C	9/28/2021 20:40	Magnesium	1900	ug/l	Y			26	60	500	ug/l
Sierra	MW-466S_SEP21-09202021	E365.4	10/7/2021 12:35	Phosphates, Total as P	0.057	ug/l	N	U		0.041	0.057	0.1	ug/l
Sierra	MW-466S_SEP21-09202021	SW6010C	9/28/2021 20:40	Potassium	650	ug/l	Y	J		240	940	3000	ug/l
Sierra	MW-466S_SEP21-09202021	SW6010C	9/28/2021 20:40	Sodium	7300	ug/l	Y			370	1000	5000	ug/l
Sierra	MW-466S_SEP21-09202021	SW9056	10/8/2021 18:15	Sulfate	6.8	ug/l	Y			1	2.5	5	ug/l
Tango	MW-467S_SEP21 EB-09222021	SM2320B	9/29/2021 3:14	Alkalinity	15	ug/l	Y			3.1	6.4	10	ug/l
Tango	**MW-467S_SEP21 EB-09222021**	**SW6010C**	**10/7/2021 5:02**	**Antimony**	**12**	**ug/l**	**N**	**U**	**3**	**5.2**	**12**	**20**	**ug/l**
Tango	MW-467S_SEP21 EB-09222021	SW6010C	10/7/2021 5:02	Calcium	4500	ug/l	Y			78	160	1000	ug/l
Tango	MW-467S_SEP21 EB-09222021	SW9056	9/29/2021 23:00	Chloride	18	ug/l	Y			1	2.5	3	ug/l
Tango	MW-467S_SEP21 EB-09222021	SW6010C	10/7/2021 5:02	Copper	10	ug/l	N	U	650	4.2	10	15	ug/l
Tango	MW-467S_SEP21 EB-09222021	SM5310B	10/5/2021 4:11	Dissolved Organic Carbon	0.8	ug/l	N	U		0.35	0.8	1	ug/l
Tango	MW-467S_SEP21 EB-09222021	SW6010C	10/7/2021 5:02	Iron	26	ug/l	Y	J		22	85	100	ug/l
Tango	**MW-467S_SEP21 EB-09222021**	**SW6010C**	**10/7/2021 5:02**	**Lead**	**9**	**ug/l**	**N**	**U**	**7.5**	**2.7**	**9**	**15**	**ug/l**
Tango	MW-467S_SEP21 EB-09222021	SW6010C	10/7/2021 5:02	Magnesium	2000	ug/l	Y			26	60	500	ug/l
Tango	MW-467S_SEP21 EB-09222021	E365.4	10/13/2021 12:19	Phosphates, Total as P	0.057	ug/l	N	U		0.041	0.057	0.1	ug/l

Range	Sample Code	Method	Analysis Date	Analyte	Result	Units	Detection Flag	Qualifiers	OMMP Action Level	Method Detection Limit	Reporting Limit	QuantitationLimit	Detection Limit Units
Tango	MW-467S_SEP21 EB-09222021	SW6010C	10/7/2021 5:02	Potassium	880	ug/l	Y	J		240	940	3000	ug/l
Tango	MW-467S_SEP21 EB-09222021	SW6010C	10/7/2021 5:02	Sodium	13000	ug/l	Y			370	1000	5000	ug/l
Tango	MW-467S_SEP21 EB-09222021	SW9056	9/29/2021 23:00	Sulfate	5.8	ug/l	Y			1	2.5	5	ug/l
Tango	MW-467S_SEP21-09222021	SM2320B	9/29/2021 3:43	Alkalinity	22	ug/l	Y			3.1	6.4	10	ug/l
Tango	**MW-467S_SEP21-09222021**	**SW6010C**	**10/7/2021 5:06**	**Antimony**	**12**	**ug/l**	**N**	**U**	**3**	**5.2**	**12**	**20**	**ug/l**
Tango	MW-467S_SEP21-09222021	SW6010C	10/7/2021 5:06	Calcium	8700	ug/l	Y			78	160	1000	ug/l
Tango	MW-467S_SEP21-09222021	SW9056	9/29/2021 23:17	Chloride	5	ug/l	Y	M		1	2.5	3	ug/l
Tango	MW-467S_SEP21-09222021	SW6010C	10/7/2021 5:06	Copper	10	ug/l	N	U	650	4.2	10	15	ug/l
Tango	MW-467S_SEP21-09222021	SM5310B	10/5/2021 4:25	Dissolved Organic Carbon	0.65	ug/l	Y	J		0.35	0.8	1	ug/l
Tango	MW-467S_SEP21-09222021	SW6010C	10/7/2021 5:06	Iron	300	ug/l	Y			22	85	100	ug/l
Tango	**MW-467S_SEP21-09222021**	**SW6010C**	**10/7/2021 5:06**	**Lead**	**9**	**ug/l**	**N**	**U**	**7.5**	**2.7**	**9**	**15**	**ug/l**
Tango	MW-467S_SEP21-09222021	SW6010C	10/7/2021 5:06	Magnesium	3500	ug/l	Y			26	60	500	ug/l
Tango	MW-467S_SEP21-09222021	E365.4	10/13/2021 12:20	Phosphates, Total as P	0.057	ug/l	N	U		0.041	0.057	0.1	ug/l
Tango	MW-467S_SEP21-09222021	SW6010C	10/7/2021 5:06	Potassium	810	ug/l	Y	J		240	940	3000	ug/l
Tango	MW-467S_SEP21-09222021	SW6010C	10/7/2021 5:06	Sodium	8700	ug/l	Y			370	1000	5000	ug/l
Tango	MW-467S_SEP21-09222021	SW9056	9/29/2021 23:17	Sulfate	16	ug/l	Y			1	2.5	5	ug/l

Notes:
µg/L = microgram(s) per liter

J = The analyte was positively identified, and the associated numerical value is the approximate concentration of the analyte in the sample as a result of associated QC criteria results. The data are valid for project use to achieve project DQOs.

J1 = Estimated: The quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

M = manual integrated compound

U = The analyte was analyzed for but was not detected at a level greater than or equal to the method and sample-specific detection limit.

Mobility of Lead and Antimony in Shooting Range Soils:

Column Leaching Study

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Amanda J. Barker and Jay L. Clausen

February 2021

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

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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.

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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.

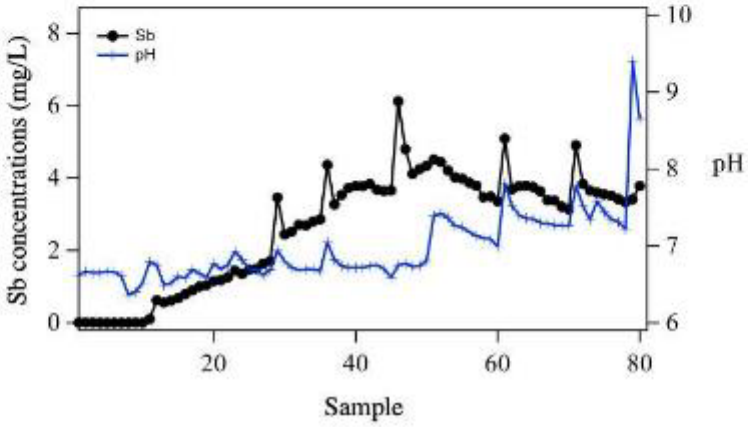
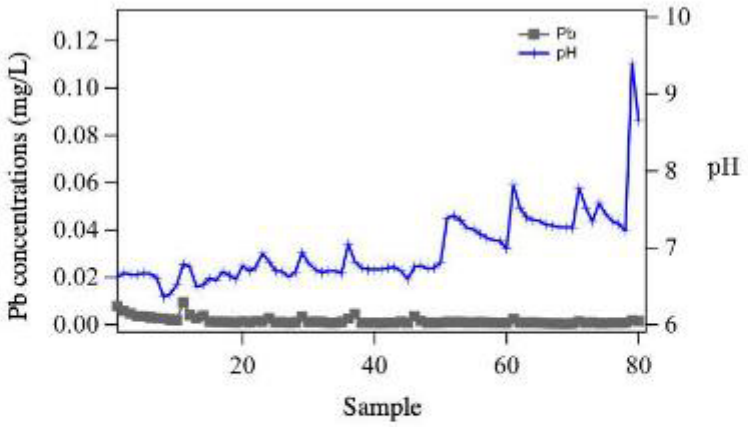


Figure 2. Concentrations of Pb as a function of pH for experiment A.



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.

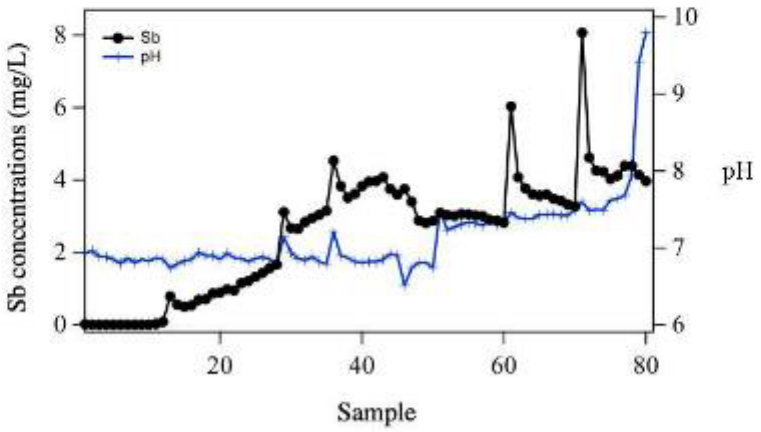
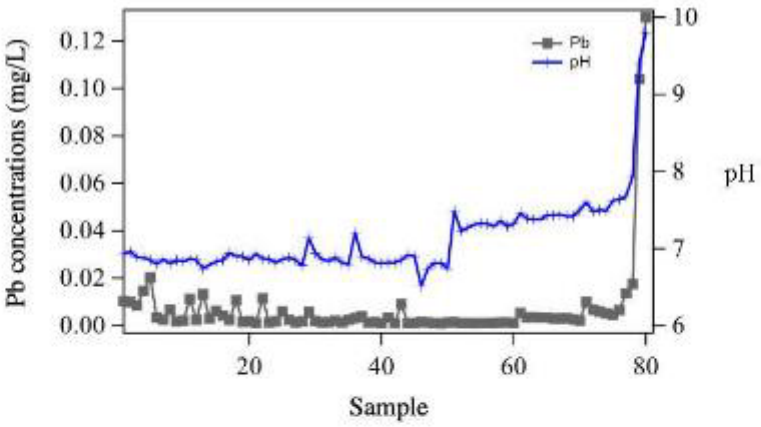


Figure 4. Concentrations of Pb as a function of pH for experiment B.



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	6.63	24	0.0069	0.0079		Incia soil packed and simulated rain
2	a	9/10/20 10:10 AM	4.35	145	6.63	22	0.0057	0.0039		
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	6.62	25	0.0025	0.0031		
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	25	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	0.0030		
11	a	9/10/20 12:20 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	0.0043		
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	6.53	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	0.0012		
17	a	9/11/20 10:40 AM	4.45	146	6.69	22	0.896	0.0012		
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	0.0012		
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	0.0013		
31	a	9/12/20 10:20 AM	4.45	146	6.72	19	2.52	0.0012		
32	a	9/12/20 10:30 AM	4.45	146	6.68	22	2.71	0.0013		
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	6.63	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	3.21	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	3.53	0.000772	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	6.73	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	0.0012		
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	6.73	16	4.80	0.0016		
48	a	9/17/20 10:20 AM	4.50	149	6.72	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	-5	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	0.000879	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	-161	7.83	-41	5.09	0.0034		
62	a	9/18/20 10:10 AM	10.03	-164	7.52	-25	3.69	0.0010		
63	a	9/18/20 10:20 AM	10.05	-161	7.40	-18	3.77	0.0009	Pb*	
64	a	9/18/20 10:30 AM	10.03	-164	7.36	-16	3.59	0.0010	Pb*	
65	a	9/18/20 10:40 AM	10.05	-161	7.35	-15	3.75	0.0008	Pb*	
66	a	9/18/20 10:50 AM	10.03	-164	7.30	-12	3.65	0.0009	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	10.03	-164	7.23	-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	10.03	-164	7.26	-10	3.14	0.000459	Pb*	
71	a	9/19/20 10:00 AM	10.99	-214	7.78	-29	4.90	0.0014		
72	a	9/19/20 10:10 AM	10.99	-214	7.52	-25	3.85	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 10:20 AM	10.99	-214	7.38	-28	3.80	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	3.35	0.000496	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	8.62	-87	3.36	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	0.0105		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	0.0052	0.0055		
7	b	9/20/20 11:00 AM	4.49	144	6.86	12	0.0036	0.0023		
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 12:00 PM	4.49	144	6.83	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	0.0135		
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	0.0065		
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	0.0025		
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	6.82	12	0.591	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	6.83	11	0.949	0.0119		
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	2.07	0.0019		
31	b	9/22/20 10:20 AM	4.60	137	6.86	13	2.65	0.0015		
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	-2	4.58	0.0052		
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	6.83	11	3.51	0.0015		
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		$Ca_3(PO_4)_2$ solution added
52	b	9/27/20 1:10 PM	9.39	-126	7.23	-9	3.05	0.0011		
53	b	9/27/20 1:20 PM	9.39	-126	7.23	-11	3.01	0.0011		
54	b	9/27/20 1:30 PM	9.39	-126	7.31	-15	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	0.0015		
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	0.0026		
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	0.0051		
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	7.43	-19	3.43	0.0052		
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	0.0049		
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	-25	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	4.05	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	4.59	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

February, 2022

(NHESP Tracking No.: 08-24210)

Soldier Validation Lane Use

No site composition changes occurred in FY21.

SVL Assessments after 2021 Training Season

All sites with containers were visited in February 2022 to evaluate training impacts during the 2021 training season. The assessment methodology matched the assessment performed in the Baseline Condition Assessment Report and FYs 12-19, 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 any sites during 2021 and management activity was limited to Roads and Grounds personnel mowing around existing infrastructure

Conclusion

All regulatory conditions were followed during use of the SVLs and BPs for training. Most erosion and rutting impacts have remained static on the lanes as expected with regular levels of vehicle use and regular stormwater runoff on dirt roads. MAARNG will continue to strive to minimize environmental impacts from these lanes by following the established guidelines.

APPENDIX D
ENVIRONMENTAL LAWS AND REGULATIONS

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

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

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

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

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

APPENDIX E
WATER SUPPLY INFORMATION

2021 Long Term Monitoring Sentry Well Sampling Results
Upper Cape Regional Water Supply Cooperative

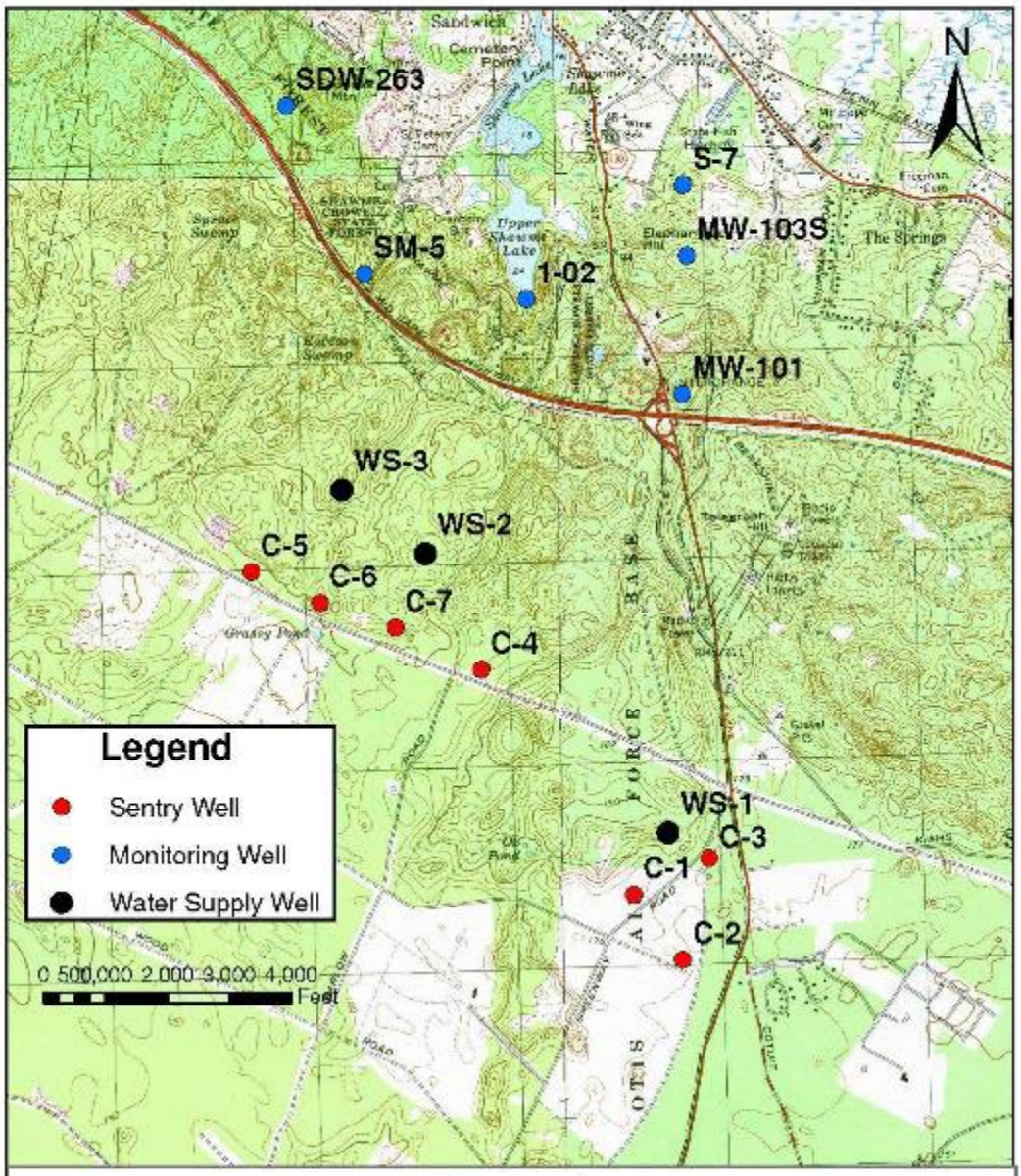


Figure 1
Long-term Monitoring Well Network
Upper Cape Regional Water Supply Cooperative
Cape Cod, Massachusetts

Watermark
175 Cabot Street • Lowell, MA 01854
Office 978.452.9696 Fax 978.453.9988

LETTER OF TRANSMITTAL

DATE:	06/29/2021	JOB NO:	17006-00
ATTENTION:	Mr. Richard Rondeau		
RE:	Sentry Well Sampling Results 2021 Sampling Round		
Upper Cape Regional Water Supply (UCRWS)			
Long-Term Monitoring, Sentry Well Sampling Results			

TO: MA Department of Environmental Protection
Southeast Regional Office
20 Riverside Drive
Lakeville, MA 02347

WE ARE SENDING YOU:

✓ Attached ____ Under separate cover via ☐ FedEx ☐ UPS ☐ USPS **the following items:**

____ Shop Drawings ____ Prints ____ Plans ____ Samples ✓ Reports

____ Copy of Letter ____ Change Order No. _____

NO.	ITEM	QUANTITY	DESCRIPTION
1	Hard Copy	1	UCRWS Long-Term Monitoring Sentry Well Sampling Results – 2021 Sampling Round

THESE ARE TRANSMITTED as checked below:

____ For approval ____ Approved as submitted ____ Resubmit ____ Copies for approval

✓ For your use ____ Approved as noted ____ Submit ____ Copies for distribution

____ As requested ____ Returned for corrections ____ Return ____ Corrected prints

____ For review and comment ____ For bids due _____ ____ Prints returned after loan to Watermark

REMARKS:

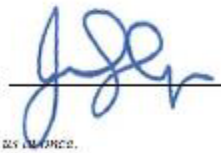
Hi Richard,

Attached are the results for the Upper Cape Regional Water Supply Cooperative 2021 Sentry Well Sampling Round of the shallow and deep screens. If you have any questions or require additional information, please give me a call at 978-452-9696.

Thank you,

Joe Spangenberger

COPY TO: Dan Mahoney – UCRWS, w/enc
File 17006-00/WLC3770

SIGNED: 

If enclosures are not as noted, kindly notify us at once.

Thank You!

Form No. 032 (June 2009)

Watermark
Engineering • Construction • Operations

Environmental
Infrastructure
Buildings & Facilities

June 25, 2021

Mr. Dan Mahoney, Chair
Upper Cape Regional Water Supply (UCRWS) Cooperative
P.O. Box 373
Mashpee, MA 02649-0373

Subject: **Results of 2021 Sampling Round**
Long-Term Monitoring Well Sampling Services
UCRWS Cooperative – Long-Term Monitoring Plan

Dear Mr. Mahoney:

In accordance with our proposal dated July 29, 2015, and as authorized by the UCRWS on April 1, 2021, we are pleased to submit the results of the 2021 Sampling Round that was performed by Watermark Environmental, Inc. (Watermark) between May 18 and 20, 2021. During the 2021 Sampling Round, seven (7) shallow well screens (C-1S through C-7S) and seven (7) deep well screens (C-1D through C-7D) were sampled in accordance with the UCRWS Long-Term Monitoring (LTM) Plan, as amended on October 22, 2007. The groundwater sample analyses were performed by Envirotech Laboratories, Inc. of Sandwich, Massachusetts (Envirotech), Eurofins TestAmerica Laboratories, Inc. of Savannah, Georgia and its subsidiaries (Eurofins TestAmerica), and their subcontractor Alpha Analytical of Westborough, Massachusetts.

On May 25, 2021, Eurofins TestAmerica's subcontractor, Chemserve, Inc., who is the only Massachusetts Department of Environmental Protection (MassDEP)-approved lab that can analyze for perchlorate using EPA Method 314.0, informed Watermark they were unable to meet the detection limit of less than 2.0 micrograms per liter (µg/L). Typically this method has a detection limit of 0.30 µg/L. TestAmerica therefore suggested analyzing the perchlorate samples by EPA Method 332.0 to achieve a lower detection limit. In addition, fourteen groundwater samples (C-1S, C-1D, C-2S, C-2D, C3-S, C3-D, C4-S, C4-D, C5-S, C5-D, C6-S, C6-D, C7-S, and C7-D) submitted for explosives analysis, were received by the lab above 6.0 degrees Celsius (°C) due to a delay by the shipping company. Since the time that samples were above 6°C was limited, the potential for biological degradation was believed to be low by the laboratory.

Nevertheless, on May 26, 2021, Ms. Maura Callahan (Callahan Consulting, Inc.), spoke with Mr. James McLaughlin, Drinking Water Program Chief for the MassDEP Southeast Regional Office (SERO) regarding the possibility of using a new perchlorate method and if the results for the samples received above 6.0 °C would be accepted by MassDEP. Mr. McLaughlin verbally approved the use of EPA Method 332.0 and the data associated with the analysis of the samples that were received above 6.0 °C.

We have completed a review of the Sample Data Summary and Extended Data Packages provided by Eurofins TestAmerica and by Envirotech, and have confirmed that the quality control objectives established for field sampling and laboratory analyses efforts have been effectively met (with the qualifiers mentioned above). The laboratory results of the sampling effort have been tabulated in the attached 2021 Sampling Results Tables (Attachment A). Results for all volatile organic compounds (VOCs), 1,2-dibromoethane (EDB), and explosives compounds were non-detect, with the exception of chloroform and perchlorate.

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Chloroform was detected in all but one monitoring well (C-6S) and perchlorate was detected in monitoring wells C-2S, C-4D, and C-6S. Chloroform results are consistent with historical data. Since EPA Method 332.0 has a lower detection limit, perchlorate was detected in two wells (C-2S and C-6S) at concentrations below 0.30 µg/L. Perchlorate was detected in one well (C-4D) at a concentration of 0.304 µg/L. The chloroform and perchlorate detections were all below the Massachusetts Drinking Water Standards. Water quality results were below their respective standards.

Once again, we appreciate this opportunity to be of service to the UCRWS, and we look forward to working with you in the future. If you have any questions regarding this submittal, please do not hesitate to contact me at (978) 452-9696.

Sincerely,
WATERMARK

Olaf Westphalen, PG, LSP
Project Manager

Attachments:
Attachment A: 2021 Sampling Results Tables
Attachment B: Chain of Custody Forms, Low Flow Data – Field Results, 2021 Sampling Event

cc: J. Spangenberger (Watermark)
File 17006-00/WLC3770

ATTACHMENT A

2021 Sampling Results Tables

Table 1-1
Physical-Chemical Parameters
Shallow and Deep Screens at Sentry Wells
2021 Sampling Results, UCRWS, Massachusetts

Sample ID	Water Quality Standard Level[1]	Laboratory Reporting Limit	C-1S	C-1D	C-2S	C-2D	C-3S	C-3D	C-4S	C-4D	C-5S	C-5D	C-6S	C-6D	C-7S	C-7D
Sample Date			05/18/2021	05/20/2021	05/19/2021	05/19/2021	05/18/2021	05/20/2021	05/19/2021	05/19/2021	05/20/2021	05/20/2021	05/19/2021	05/19/2021	05/19/2021	05/19/2021
Physical-Chemical																
pH Method SM 4500 H-B	6.5 - 8.5[2]	NS	6.35	6.75	7.23	6.45	6.49	6.85	6.58	6.87	6.36	6.49	6.36	6.82	6.57	6.84
Alkalinity - Total, as $CaCO_3$ (mg/L) Method SM 2320 B	NS	2.5	6.4	30	8.8	10	7.2	14	5.8	17	11	6.8	20	9.0	6.8	11
Turbidity (NTU) Method SM 2130 B	TT	1.0	1.6	<1.0	1.5	1.9	1.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Specific Conductance (µmhos/cm @ 25 °C) Method EPA 120.1	NS	10.0	57	57	52	59	48	48	47	64	57	41	68	44	58	45

Notes:

[1] Water Quality Standard Levels are the Massachusetts Maximum Contaminant Level (CMCL, 2020) unless otherwise noted.

[2] Water Quality Standard Levels are from the Secondary Maximum Contaminant Levels (SMCLs, 2020).

Samples were analyzed by Environtech Laboratories Inc. of Sandwich, Massachusetts.

NS = Not Established
TT = Treatment Technique
NTU = Nephelometric Turbidity Unit
µmhos/cm = Micromhos per Centimeter
°C = degrees Celsius
NA = Not Applicable
< = Less Than
mg/L = Milligrams per Liter

Prepared By: JG
Checked By: MM

Table 1-2
Volatile Organic Compounds – EPA Method 524.2 (mg/L)
Shallow and Deep Screens at Sentry Wells
2021 Sampling Results, UCRWS, Massachusetts

Sample ID / Sample Date	Water Quality Standard Level[1] (mg/L)	Laboratory Reporting Limit* (mg/L)	C-1S 05/18/2021	C-1D 05/20/2021	C-2S 05/19/2021	C-2D 05/19/2021	C-3S 05/18/2021	C-3D 05/20/2021	C-4S 05/19/2021
VOCs									
Trans-1,3-Dichloropropene	0.0004[2][6]	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Ethylbenzene	0.7	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Trichlorofluoromethane	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Hexachlorobutadiene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Isopropylbenzene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
p-Isopropyltoluene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Methylene chloride (Dichloromethane)	0.005	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Naphthalene	0.140[2]	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Benzene	0.005	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
n-Propylbenzene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Styrene	0.1	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,1,1,2-Tetrachloroethane	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,1,2,2-Tetrachloroethane	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Tetrachloroethylene	0.005	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Toluene	1	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,2,3-Trichlorobenzene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,2,4-Trichlorobenzene	0.07	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,1,1-Trichloroethane	0.2	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,1,2-Trichloroethane	0.005	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Trichloroethene	0.005	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,2,3-Trichloropropane	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,2,4-Trimethylbenzene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,3,5-Trimethylbenzene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Vinyl chloride	0.002	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
o-Xylene	10[illegible]	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
m-Xylene & p-Xylene	10[illegible]	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Bromobenzene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Bromodichloromethane	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Bromoform	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Bromomethane	0.010[2]	0.001	< 0.001	<0.001	< 0.001	<0.001	< 0.001	<0.001	< 0.001
Methyl tert-butyl ether (MTBE)	0.070[2]	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
n-Butylbenzene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
sec-Butylbenzene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
tert-Butylbenzene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Carbon tetrachloride	0.005	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Chlorobenzene	0.1	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dibromochloromethane	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Chloroethane	NE	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chloroform	0.07[2]	0.0005	0.00094	0.0017	0.0012	0.0019	0.0018	0.0011	0.00076
Chloromethane	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
2-Chlorotoluene (o-Chlorotoluene)	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
4-Chlorotoluene (p-Chlorotoluene)	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dibromomethane	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,2-Dichlorobenzene (o-DCB)	0.6	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,3-Dichlorobenzene (m-DCB)	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,4-Dichlorobenzene (p-DCB)	0.005	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dichlorodifluoromethane	1.4[2]	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,1-Dichloroethane	0.070[2]	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,2-Dichloroethane	0.005	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,1-Dichloroethylene	0.007	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
cis-1,2-Dichloroethylene	0.07	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Trans-1,2-Dichloroethylene	0.1	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,2-Dichloropropane	0.005	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,3-Dichloropropane	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
2,2-Dichloropropane	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,1-Dichloropropene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
cis-1,3-Dichloropropene	0.0004[2][6]	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
2-Butanone (MEK)	4[2]	0.01	< 0.01	<0.01	< 0.01	<0.01	< 0.01	<0.01	< 0.01
4-Methyl-2-pentanone (MIBK)	0.35[2]	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Bromochloromethane	NE	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005

Table 1-2
Volatile Organic Compounds – EPA Method 524.2 (mg/L)
Shallow and Deep Screens at Sentry Wells
2021 Sampling Results, UCRWS, Massachusetts

Sample ID	Water Quality Standard Level[(1)] (mg/L)	Laboratory Reporting Limit* (mg/L)	C-4D	C-5S	C-5D	C-6S	C-6D	C-7S	C-7D
Sample Date			05/19/2021	05/20/2021	05/20/2021	05/19/2021	05/19/2021	05/19/2021	05/19/2021
VOCs									
Trans-1,3-Dichloropropene	0.0004[(2)(6)]	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Ethylbenzene	0.7	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Trichlorofluoromethane	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Hexachlorobutadiene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Isopropylbenzene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
p-Isopropyltoluene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Methylene chloride (Dichloromethane)	0.005	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Naphthalene	0.140[(2)]	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Benzene	0.005	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
n-Propylbenzene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Styrene	0.1	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,1,1,2-Tetrachloroethane	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,1,2,2-Tetrachloroethane	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Tetrachloroethylene	0.005	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Toluene	1	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,2,3-Trichlorobenzene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,2,4-Trichlorobenzene	0.07	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,1,1-Trichloroethane	0.2	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,1,2-Trichloroethane	0.005	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Trichloroethene	0.005	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,2,3-Trichloropropane	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,2,4-Trimethylbenzene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,3,5-Trimethylbenzene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Vinyl chloride	0.002	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
o-Xylene	10[(3)]	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
m-Xylene & p-Xylene	10[(3)]	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Bromobenzene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Bromodichloromethane	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Bromoform	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Bromomethane	0.010[(2)]	0.001	< 0.001	<0.001	< 0.001	<0.001	< 0.001	<0.001	< 0.001
Methyl tert-butyl ether (MTBE)	0.070[(2)]	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
n-Butylbenzene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
sec-Butylbenzene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
tert-Butylbenzene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Carbon tetrachloride	0.005	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Chlorobenzene	0.1	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dibromochloromethane	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Chloroethane	NE	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chloroform	0.07[(2)]	0.0005	**0.00045 J**	**0.00033 J**	**0.0029**	< 0.0005	**0.00031 J**	**0.002**	**0.00085**
Chloromethane	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
2-Chlorotoluene (o-Chlorotoluene)	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
4-Chlorotoluene (p-Chlorotoluene)	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dibromomethane	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,2-Dichlorobenzene (o-DCB)	0.6	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,3-Dichlorobenzene (m-DCB)	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,4-Dichlorobenzene (p-DCB)	0.005	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dichlorodifluoromethane	1.4[(2)]	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,1-Dichloroethane	0.070[(2)]	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,2-Dichloroethane	0.005	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,1-Dichloroethylene	0.007	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
cis-1,2-Dichloroethylene	0.07	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Trans-1,2-Dichloroethylene	0.1	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,2-Dichloropropane	0.005	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,3-Dichloropropane	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
2,2-Dichloropropane	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
1,1-Dichloropropene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
cis-1,3-Dichloropropene	0.0004[(2)(6)]	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
2-Butanone (MEK)	4[(2)]	0.01	< 0.01	<0.01	< 0.01	<0.01	< 0.01	<0.01	< 0.01
4-Methyl-2-pentanone (MIBK)	0.35[(2)]	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Bromochloromethane	NE	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005

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Upper Cape Regional Water Supply Cooperative, Mashpee, MA

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June 2021

Table 1-2
Volatile Organic Compounds – EPA Method 524.2 (mg/L)
Shallow and Deep Screens at Sentry Wells
2021 Sampling Results, UCRWS, Massachusetts

Notes:

Results in bold were detected above laboratory reporting limits.

Samples analyzed by TestAmerica Laboratories, Inc. of Savannah, Georgia.

* Limit of quantitation presented as detection limits.

(1) Water Quality Standard Levels are the Massachusetts Maximum Contaminant Level (MMCL, 2020) unless otherwise noted.

(2) Water Quality Standard Levels are the Massachusetts Drinking Water Guidelines developed by the Office of Research and Development.

(3) Xylene Standard based on Total Xylene.

(4) Water Quality Standard listed is for 1,3-dichloropropene (i.e., the sum of cis-1,3-dichloropropene and trans-1,3-dichloropropene).

J = Result is less than the reporting limit but greater than or equal to the method detection limit. Concentration is approximate.

mg/L = Milligrams per Liter

< = Less Than

NE = Not Established

Prepared By: BG

Checked By: MM

[illegible] Long-Term Monitoring Well Sampling Services
[illegible], MA

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June 202[illegible]
[illegible]

Table 1-3
Explosive Compounds – EPA Method SW8330 (mg/L)
Shallow and Deep Screens at Sentry Wells
2021 Sampling Results, UCRWS, Massachusetts

Sample ID	Water Quality Standard Level[1] (mg/L)	Laboratory Reporting Limit* (mg/L)	C-1S	C-1D	C-2S	C-2D	C-3S	C-3D	C-4S	C-4D	C-5S	C-5D	C-6S	C-6D	C-7S	C-7D
Sample Date			05/18/2021	05/20/2021	05/19/2021	05/19/2021	05/18/2021	05/20/2021	05/19/2021	05/19/2021	05/20/2021	05/20/2021	05/19/2021	05/19/2021	05/19/2021	05/19/2021
Explosives																
2,6-Diamino-4-nitrotoluene	NE	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
2,4-Diamino-6-nitrotoluene	NE	0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025
HMX	NE	0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025
RDX	NE	0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025
Picric acid	NE	0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025
1,3,5-Trinitrobenzene	NE	0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025
1,3-Dinitrobenzene	NE	0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025
Nitrobenzene	NE	0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025
Tetryl	NE	0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025
Nitroglycerin	NE	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
2,4,6-Trinitrotoluene	NE	0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025
4-Amino-2,6-dinitrotoluene	NE	0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025
2-Amino-4,6-dinitrotoluene	NE	0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025
2,6-Dinitrotoluene	NE	0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025
2,4-Dinitrotoluene	NE	0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025
2-Nitrotoluene	NE	0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025
3-Nitrotoluene	NE	0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025
4-Nitrotoluene	NE	0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025	< 0.00025
PETN	NE	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

Notes:

Samples analyzed by Eurofins TestAmerica Laboratories, Inc. of South Burlington, Vermont.

* Limit of quantitation presented as detection limits.

[1] Water Quality Standard Levels are the Massachusetts Maximum Contaminant Level (MMCL, 2020) unless otherwise noted.

NE – Not Established
< – Less Than
mg/L – Milligrams per Liter

Prepared By: BG
Checked By: MM

10026-01 Long Term Monitoring Well Sampling Services
Upper Cape Regional Water Supply Cooperative, Mashpee, MA

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June 2021
[illegible]

Table 1-4
Perchlorate – EPA Method 332.0 and EDB – EPA Method 504.1 (mg/L)
Shallow and Deep Screens at Sentry Wells
2021 Sampling Results, UCRWS, Massachusetts

Sample ID	Water Quality Standard Level[1] (mg/L)	Laboratory Reporting Limit (mg/L)	C 1S	C 1D	C 2S	C 2D	C 3S	C 3D	C 4S	C 4D	C 5S	C 5D	C 6S	C 6D	C 7S	C 7D
Sample Date			05/18/2021	05/20/2021	05/19/2021	05/19/2021	05/18/2021	05/20/2021	05/19/2021	05/19/2021	05/20/2021	05/20/2021	05/19/2021	05/19/2021	05/19/2021	05/19/2021
Perchlorate and EDB																
Perchlorate	0.002	0.00005	<0.00005	<0.00005	**0.00005**	<0.00005	<0.00005	<0.00005	<0.00005	**0.000304**	<0.00005	<0.00005	**0.000064**	<0.00005	<0.00005	<0.00005
1,2-Dibromoethane (EDB)	0.00002	0.000018	< 0.000018	< 0.000018	< 0.000018	< 0.000018	< 0.000018	< 0.000018	< 0.000018	< 0.000018	< 0.000018	< 0.000018	< 0.000018	< 0.000018	< 0.000018	< 0.000018

Notes:

Perchlorate analyzed by Alpha Analytical of Westboro, Massachusetts.

EDB analyzed by Eurofins TestAmerica Laboratories, Inc. of Savannah, Georgia

* Limit of quantitation presented as detection limits.

[1] Water Quality Standard Levels are the Massachusetts Maximum Contaminant Level (MMCL, 2020) unless otherwise noted.

NE = Not Established < = Less Than mg/L = Milligrams per Liter

Prepared By: BC
Checked By: MM

ATTACHMENT B

Chain of Custody Forms, Low Flow Data – Field Results, 2021 Sampling Event

Eurofins TestAmerica, Savannah
5102 LaRoche Avenue
Savannah, GA 31404
Phone: 912-354-7858 Fax: 912-352-0165

Chain of Custody Record

Boston #215

eurofins Environment Testing America

Client Information			
Client Contact: ~~Aimee Comeau~~ Olaf Westphalen	Sampler: Brian Granger	Lab PM: ~~Weinberg, Amy~~ Jerry Lanier	COC No: 680-125902-46790.2
Company: WaterMark Environmental, Inc	Phone: 617-960-6476	E-Mail: Jerry.Lanier@Eurofinset.com	Page: ~~Page 1 of 1~~ 1 of 2
Address: 175 Cabot Street	PWSID:	State of Origin:	Job #:
City: Lowell	Due Date Requested:		
State, Zip: MA, 01854	TAT Requested (days): 14 Days		
Phone: 978-771-8626	Compliance Project: Yes No		
Email: ~~aimee.comeau~~ Olaf.Westphalen@watermarkenv.com	PO #: ~~W17-48640~~ W21-12464		
Project Name: Joint Base Cape Cod - 2021	WO #:		
Site: Upper Cape Regional Water Supply	Project #: ~~68014480~~ 17006-00		
	SSOW#:		

Mike Mosca

Analysis Requested: Field Filtered Sample (Yes or No); Perform MS/MSD (Yes or No); 504.1 - (MOD) Requested Analytes (EDB); 8242 Preserved - (MOD) Custom Subtitle Template (VOCs); 8330B - 8330 Routine (Explosives); 8242 Preserved - (MOD) Custom Subtitle Template; E314.0 - Perchlorate; Total Number of containers

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix	Field Filtered	Perform MS/MSD	504.1 (EDB)	8242 (VOCs)	8330B (Explosives)	8242 Custom	E314.0 Perchlorate
Preservation Code:							R	N	N	A	
TB-051821	5/18/21	0800	N/A	Water	N	N	X	X		X	
C3-S-051821	" "	1340	Grab	Water	Y	N	X	X	X	X	X
C1-S-051821	↓	1510	Grab	Water	Y	N	X	X	X	X	X
C2-S-051921	5/19/21	0830	Grab	Water	Y	N	X	X	X	X	X
C2-D-051921	" "	0845	Grab	Water	Y	N	X	X	X	X	X
C4-S-051921		1010	Grab	Water	Y	N	X	X	X	X	X
C4-D-051921		1010	Grab	Water	Y	N	X	X	X	X	X
C7-S-051921		1155	Grab	Water	Y	N	X	X	X	X	X
C7-D-051921		1220	Grab	WATER	Y	N	X	X	X	X	X
C6-S-051921		1350	Grab	WATER	Y	N	X	X	X	X	X
C6-D-051921	↓	1400	Grab	WATER	Y	N	X	X	X	X	X

Preservation Codes: A - HCL, B - NaOH, C - Zn Acetate, D - Nitric Acid, E - NaHSO4, F - MeOH, G - Amchlor, H - Ascorbic Acid, I - Ice, J - DI Water, K - EDTA, L - EDA; M - Hexane, N - None, O - AsNaO2, P - Na2O4S, Q - Na2SO3, R - Na2S2O3, S - H2SO4, T - TSP Dodecahydrate, U - Acetone, V - MCAA, W - pH 4-5, Z - other (specify)

Other:

680-199232 Chain of Custody

Special Instructions/Note:
Field EDB Analysis, if EDB is detected in any sample Call PM to discuss
* Perchlorate Samples are field filtered
* Ship perchlorate samples to Chemserve, other analysis to be shipped to the Eurofins labs.

Possible Hazard Identification: Non-Hazard / Flammable / Skin Irritant / Poison B / Unknown / Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month): Return To Client / ☒ Disposal By Lab / Archive For ___ Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by: | Date: | Time: | Method of Shipment:

Relinquished by	Date/Time	Company	Received by	Date/Time	Company
B. M.	5/20/21 1511	Watermark	[signature]	5/20/21 1511	ETA
[signature]	5/20/21 1723	ETA			
			[signature]	5/21/21 1475	[illegible]

Custody Seals Intact: Yes No | Custody Seal No.:

Cooler Temperature(s) °C and Other Remarks: 0.2 (0.7) 2.1/2.8 13.4 (13.5) 16.4 (16.5)

Ver: 11/01/2020

Eurofins TestAmerica, Savannah
5102 LaRoche Avenue
Savannah, GA 31404
Phone 912-354-7858 Fax 912-352-0165

Chain of Custody Record

Boston #215

eurofins Environment Testing America

Client Information			
Client Contact: ~~Amber Gomeau~~ Olaf Westphalen	Sampler: Brian Genger / Mike Moschu	Lab PM: ~~Washburn, Amy~~ Jerry Lanier	COC No: 680-125905-48799.1
Company: WaterMark Environmental, Inc.	Phone: 617-460-6476	E-Mail: Jerry.Lanier@Eurofinset.com	Page: ~~Page 1 of 2~~ 2 of 2
Address: 175 Cabot Street	PWSID:	State of Origin:	Job #:
City: Lowell	Due Date Requested:		
State, Zip: MA, 01854	TAT Requested (days): 14 Days		
Phone: 978-771-8626	Compliance Project: ☐ Yes ☐ No		
Email: ~~agomeau~~@watermarkenv.com	PO #: ~~MA17-40540~~ W21-12464		
Project Name: Joint Base Cape Cod - 2021	WO #:		
Site: Upper Cape Regional Water Authority	Project #: ~~68000000~~ 17006-00		
	SSOW#:		

Analysis Requested: Field Filtered Sample (Yes or No); Perform MS/MSD (Yes or No); 504.1 - (MOD) Requested Analytes EDB; 524.2_Preserved - (MOD) Custom Subset Template (VOC); 8330B - 8330 Routine (Explosives); 524.2_Preserved - (MOD) Custom Subset Template; E314.0 Perchlorate; Total Number of containers

Preservation Codes: A - HCL; B - NaOH; C - Zn Acetate; D - Nitric Acid; E - NaHSO4; F - MeOH; G - Amchlor; H - Ascorbic Acid; I - Ice; J - DI Water; K - EDTA; L - EDA; M - Hexane; N - None; O - AsNaO2; P - Na2O4S; Q - Na2SO3; R - Na2S2O3; S - H2SO4; T - TSP Dodecahydrate; U - Acetone; V - MCAA; W - pH 4-5; Z - other (specify); Other:

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=grab)	Matrix	Field Filtered	Perform MS/MSD	504.1 EDB	524.2 VOC	8330B Explosives	524.2	E314.0 Perchlorate	Total Number of containers	Special Instructions/Note:
			Preservation Code:				R	N	N	A			
CS-S-052021	5/20/21	0805	GRAB	Water	N	N	X	X	X	X	X		See Page # 1
CS-D-052021	" "	0805	GRAB	Water	N	N	X	X	X	X	X		
C3-D-052021	↓	0935	GRAB	Water	N	✓	X	X	X	X	X		
C1-D-052021	↓	1125	GRAB	Water	N	✓	X	X	X	X	X		
				Water									
				Water									
				Water									
				Water									
				Water									
				Water									
				Water									

Possible Hazard Identification: ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month): ☐ Return To Client ☐ Disposal By Lab ☐ Archive For ___ Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by: | Date: | Time: | Method of Shipment:

Relinquished by	Date/Time	Company	Received by	Date/Time	Company
Relinquished by: [signature]	5/20/21 1511	Watermark	Received by: [signature]	5/20/21 1511	ETA
Relinquished by: [signature]	5/20/21 1725	Company	Received by:	Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by: [signature]	5/21/21 1015	Company: [signature]

Custody Seals Intact: ☐ Yes ☐ No | Custody Seal No.: | Cooler Temperature(s) °C and Other Remarks: 0.2 (0.3) 3.7 (2.8) 11.4 (13.5) 14.4 (16.5)

Ver: 11/01/2020

6/15/2021

CHAIN OF CUSTODY FORM

ENVIROTECH LABS, INC.
8 Jan Sebastian Dr., Unit 12
Sandwich, MA 02563
(508)888-6460/1-800-339-6460
FAX (508)888-6446

Client: Watermark Environmental
175 Cabot St
Address: Lowell, MA 01854
cell: 617-960-6476
Phone#: 978-452-9696 ext. 213
brian.geringer@watermarkenv.com

roj. No.

Project Name: Upper Cape Regional Water Supply
UCRWS-~~2019~~ 2021

ampler: Brian Geringer/ Mike Moscho

b ID:	Date	Time	Comp	Grab	Sample location	container	Pres.	Analysis Requested
	5/18/21	1340		X	C3-S-051821	500 ml	ice	pH,Specific Conductance,Turbidity, Alkalinity
	5/18/21	1510		X	C1-S-051821	500 ml	ice	pH, Specific Conductance, Turbidity, Alkalinity
				X		500 ml	ice	pH, Specific Conductance, Turbidity, Alkalinity
				X		500 ml	ice	pH, Specific Conductance, Turbidity, Alkalinity
				X		500 ml	ice	pH, Specific Conductance, Turbidity, Alkalinity
				X		500 ml	ice	pH, Specific Conductance, Turbidity, Alkalinity
				X		500 ml	ice	pH, Specific Conductance, Turbidity, Alkalinity
				X		500 ml	ice	pH, Specific Conductance, Turbidity, Alkalinity

elinquished:	Date/Time	Received:	Relinquished:	Date/Time	Received:
[signature]	5/18/21 1550	[signature] 15:50 5/18/21			
elinquished:	Date/Time	Received:	Relinquished:	Date/Time	Received:

CHAIN OF CUSTODY FORM

ENVIROTECH LABS, INC.
8 Jan Sebastian Dr., Unit 12
Sandwich, MA 02563
(508)888-6460/1-800-339-6460
FAX (508)888-6446

Client: Watermark Environmental
175 Cabot St
Address: Lowell, MA 01854
cell: 617-960-6476
Phone#: 978-452-9696 ext. 213
brian.geringer@watermarkenv.com

roj. No. | **Project Name:** Upper Cape Regional Water Supply UCRWS-~~2018~~ BG 2021

ampler: Brian Geringer / Mike Mache

sb ID:	Date	Time	Comp	Grab	Sample location	container	Pres.	Analysis Requested
	5/19/21	0830		X	C2-S - 051921	500 ml	ice	pH,Specific Conductance,Turbidity, Alkalinity
	5/19/21	0845		X	C2-D - 051921	500 ml	ice	pH, Specific Conductance, Turbidity, Alkalinity
	5/19/21	1010		X	C4-S - 051921	500 ml	ice	pH, Specific Conductance, Turbidity, Alkalinity
	5/19/21	1010		X	C4-D - 051921	500 ml	ice	pH, Specific Conductance, Turbidity, Alkalinity
	5/19/21	1155		X	C7-S-051921	500 ml	ice	pH, Specific Conductance, Turbidity, Alkalinity
	5/19/21	1220		X	C7-D-051921	500 ml	ice	pH, Specific Conductance, Turbidity, Alkalinity
	5/19/21	1350		X	C6-S-051921	500 ml	ice	pH, Specific Conductance, Turbidity, Alkalinity
	5/19/21	1400		X	C6-D-051921	500 ml	ice	pH, Specific Conductance, Turbidity, Alkalinity

Relinquished:	Date/Time	Received:	Reliquished:	Date/Time	Received:
Brian Geringer	5/19/21 1520	5/19/21 Forsea 15:20			
Relinquished:	Date/Time	Received:	Relinquished:	Date/Time	Received:

CHAIN OF CUSTODY FORM

ENVIROTECH LABS, INC.
8 Jan Sebastian Dr., Unit 12
Sandwich, MA 02563
(508)888-6460/1-800-339-6460
FAX (508)888-6446

Client: Watermark Environmental
175 Cabot St
Address: Lowell, MA 01854
cell: 617-960-6476
Phone#: 978-452-9696 ext. 213
brian.geringer@watermarkenv.com

Proj. No. | **Project Name:** Upper Cape Regional Water Supply UCRWS ~~2018~~ BG 2021

Sampler: Brian Geringer / Mina Mosche

Lab ID:	Date	Time	Comp	Grab	Sample location	container	Pres.	Analysis Requested
	5/20/21	0805		X	C5-S-052021	500 ml	ice	pH,Specific Conductance,Turbidity, Alkalinity
	5/20/21	0805		X	C5-D-052021	500 ml	ice	pH, Specific Conductance, Turbidity, Alkalinity
	5/20/21	0935		X	C3-D-052021	500 ml	ice	pH, Specific Conductance, Turbidity, Alkalinity
	5/20/21	1125		X	C1-D-052021	500 ml	ice	pH, Specific Conductance, Turbidity, Alkalinity
				X		500 ml	ice	pH, Specific Conductance, Turbidity, Alkalinity
				X		500 ml	ice	pH, Specific Conductance, Turbidity, Alkalinity
				X		500 ml	ice	pH, Specific Conductance, Turbidity, Alkalinity
				X		500 ml	ice	pH, Specific Conductance, Turbidity, Alkalinity

Relinquished:	Date/Time	Received:	Reliquished:	Date/Time	Received:
Brian Geringer	5/20/21 1:28pm	[signature]			
Relinquished:	Date/Time	Received:	Relinquished:	Date/Time	Received:

Eurofins TestAmerica, Savannah
5102 LaRoche Avenue
Savannah, GA 31404
Phone: 912-354-7858 Fax: 912-352-0165

Chain of Custody Record

L2128197

eurofins | Environment Testing America

Client Information (Sub Contract Lab)	Sampler	Lab PM: Lanier, Jerry A	Carrier Tracking No(s):	COC No: 680-654993.1
Client Contact: Shipping/Receiving	Phone	E-Mail: Jerry.Lanier@Eurofinset.com	State of Origin: Massachusetts	Page: Page 1 of 2
Company: Alpha Analytical Inc		Accreditations Required (See note): DoD ELAP - A2LA; DoD ELAP - L-A-B; Federal - US Fish & ...		Job #: 680-199232-1
Address: 8 Walkup Drive,	Due Date Requested: 6/11/2021	Analysis Requested		Preservation Codes:
City: Westboro	TAT Requested (days):			A - HCL; B - NaOH; C - Zn Acetate; D - Nitric Acid; E - NaHSO4; F - MeOH; G - Amchlor; H - Ascorbic Acid; I - Ice; J - DI Water; K - EDTA; L - EDA; M - Hexane; N - None; O - AsNaO2; P - Na2O4S; Q - Na2SO3; R - Na2S2O3; S - H2SO4; T - TSP Dodecahydrate; U - Acetone; V - MCAA; W - pH 4-5; Z - other (specify)
State, Zip: MA, 01581				
Phone:	PO #:			Other:
Email:	WO #:			
Project Name: Joint Base Cape Cod - 2017 - 2021	Project #: 68016167			
Site:	SSOW#:			

Sample Identification - Client ID (Lab ID)	Sample Date	Sample Time	Sample Type (C=Comp, G=grab)	Matrix (Water, Solid, Wastewater, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	SUB (EPA 332.0 Perchlorate) / EPA 332.0 Perchlorate	Total Number of containers	Special Instructions/Note:
			Preservation Code:						
C3-S-051821 (680-199232-2)	5/18/21	13:40 Eastern		Water			X	1	
C1-S-051821 (680-199232-3)	5/18/21	15:10 Eastern		Water			X	1	
C2-S-051821 (680-199232-4)	5/19/21	08:30 Eastern		Water			X	1	
C2-D-051821 (680-199232-5)	5/19/21	08:45 Eastern		Water			X	1	
C4-S-051821 (680-199232-6)	5/19/21	10:10 Eastern		Water			X	1	
C4-D-051821 (680-199232-7)	5/19/21	10:10 Eastern		Water			X	1	
C7-S-051821 (680-199232-8)	5/19/21	11:55 Eastern		Water			X	1	
C7-D-051821 (680-199232-9)	5/19/21	12:20 Eastern		Water			X	1	
C6-S-051821 (680-199232-10)	5/19/21	13:50 Eastern		Water			X	1	

Note: Since laboratory accreditations are subject to change, Eurofins TestAmerica places the ownership of method, analyte & accreditation compliance upon our subcontract laboratories. This sample shipment is forwarded under chain-of-custody. If the laboratory does not currently maintain accreditation in the State of Origin listed above for analysis/tests/matrix being analyzed, the samples must be shipped back to the Eurofins TestAmerica laboratory or other instructions will be provided. Any changes to accreditation status should be brought to Eurofins TestAmerica attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said compliance to Eurofins TestAmerica.

Possible Hazard Identification: Unconfirmed	Sample Disposal (A fee may be assessed if samples are retained longer than 1 month): ☐ Return To Client ☐ Disposal By Lab ☐ Archive For ___ Months
Deliverable Requested: I, II, III, IV, Other (specify) Primary Deliverable Rank: 2	Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:
Relinquished by:	Date/Time: 5-26-21 1551	Company: SAV	Received by: AGL Date/Time: 5/27/21 10:16 Company
Relinquished by:	Date/Time:	Company:	Received by: Date/Time: Company
Relinquished by:	Date/Time:	Company:	Received by: Date/Time: Company

Custody Seals Intact: ☐ Yes ☐ No | Custody Seal No.: | Cooler Temperature(s) °C and Other Remarks:

Eurofins TestAmerica, Savannah
5102 LaRoche Avenue
Savannah, GA 31404
Phone: 912-354-7858 Fax: 912-352-0165

Chain of Custody Record

L2128197

eurofins | Environment Testing America

Client Information (Sub Contract Lab)	Sampler:	Lab PM: Lanier, Jerry A	Carrier Tracking No(s):	COC No: 680-654993.2
Client Contact: Shipping/Receiving	Phone:	E-Mail: Jerry.Lanier@Eurofinset.com	State of Origin: Massachusetts	Page: Page 2 of 2
Company: Alpha Analytical Inc		Accreditations Required (See note): DoD ELAP - A2LA; DoD ELAP - L-A-E; Federal - US Fish & ...		Job #: 680-199232-1
Address: 8 Walkup Drive,	Due Date Requested: 6/11/2021	Analysis Requested		Preservation Codes:
City: Westboro	TAT Requested (days):			A - HCL; B - NaOH; C - Zn Acetate; D - Nitric Acid; E - NaHSO4; F - MeOH; G - Amchlor; H - Ascorbic Acid; I - Ice; J - DI Water; K - EDTA; L - EDA; M - Hexane; N - None; O - AsNaO2; P - Na2O4S; Q - Na2SO3; R - Na2S2O3; S - H2SO4; T - TSP Dodecahydrate; U - Acetone; V - MCAA; W - pH 4-5; Z - other (specify); Other:
State, Zip: MA, 01581				
Phone:	PO #:			
Email:	WO #:			
Project Name: Joint Base Cape Cod - 2017 - 2021	Project #: 68016167			
Site:	SSOW#:			

Sample Identification - Client ID (Lab ID)	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (w=water, s=solid, o=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	SUB (EPA 332.0 Perchlorate) EPA 332.0 Perchlorate	Total Number of containers	Special Instructions/Note:
			Preservation Code:						
C6-D-051821 (680-199232-11)	5/19/21	14:00 Eastern		Water			X	1	
C5-S-052021 (680-199232-12)	5/20/21	08:05 Eastern		Water			X	1	
C5-D-052021 (680-199232-13)	5/20/21	08:05 Eastern		Water			X	1	
C3-D-052021 (680-199232-14)	5/20/21	09:35 Eastern		Water			X	1	
C1-D-052021 (680-199232-15)	5/20/21	11:25 Eastern		Water			X	1	

Note: Since laboratory accreditations are subject to change, Eurofins TestAmerica places the ownership of method, analyte & accreditation compliance upon our subcontract laboratories. This sample shipment is forwarded under chain-of-custody. If the laboratory does not currently maintain accreditation in the State of Origin listed above for analysis/tests/matrix being analyzed, the samples must be shipped back to the Eurofins TestAmerica laboratory or other instructions will be provided. Any changes to accreditation status should be brought to Eurofins TestAmerica attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said compliance to Eurofins TestAmerica.

Possible Hazard Identification: Unconfirmed	Sample Disposal (A fee may be assessed if samples are retained longer than 1 month): ☐ Return To Client ☐ Disposal By Lab ☐ Archive For ____ Months
Deliverable Requested: I, II, III, IV, Other (specify) — Primary Deliverable Rank: 2	Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:
Relinquished by:	Date/Time: 5-26-21 1551	Company: SAV	Received by:	Date/Time: 5/27/21 1016	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:	Cooler Temperature(s) °C and Other Remarks:

Eurofins TestAmerica, Savannah
5102 LaRoche Avenue
Savannah, GA 31404
Phone: 912-354-7858 Fax: 912-352-0165

Chain of Custody Record

eurofins | Environment Testing America

Client Information (Sub Contract Lab)	Sampler:	Lab PM: Lanier, Jerry A	Carrier Tracking No(s):	COC No: 680-654730.1
Client Contact: Shipping/Receiving	Phone:	E-Mail: Jerry.Lanier@Eurofinset.com	State of Origin: Massachusetts	Page: Page 1 of 2
Company: TestAmerica Laboratories, Inc.		Accreditations Required (See note): DoD ELAP - A2LA; DoD ELAP - L-A-B; Federal - US Fish & ...		Job #: 680-199232-1
Address: 530 Community Drive, Suite 11,	Due Date Requested: 6/10/2021	Analysis Requested		Preservation Codes:
City: South Burlington	TAT Requested (days):			
State, Zip: VT, 05403				
Phone: 802-660-1990(Tel) 802-660-1919(Fax)	PO #:			
Email:	WO #:			
Project Name: Joint Base Cape Cod - 2017 - 2021	Project #: 68018167			
Site:	SSOW#:			

Preservation Codes:
A - HCL; B - NaOH; C - Zn Acetate; D - Nitric Acid; E - NaHSO4; F - MeOH; G - Amchlor; H - Ascorbic Acid; I - Ice; J - DI Water; K - EDTA; L - EDA
M - Hexane; N - None; O - AsNaO2; P - Na2O4S; Q - Na2SO3; R - Na2S2O3; S - H2SO4; T - TSP Dodecahydrate; U - Acetone; V - MCAA; W - pH 4-5; Z - other (specify)
Other:

Sample Identification - Client ID (Lab ID)	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	8330B/8330_P_SPE 8330 Routine	Special Instructions/Note:
C3-S-051821 (680-199232-2)	5/18/21	13:40 Eastern		Water	X	
C1-S-051821 (680-199232-3)	5/18/21	15:10 Eastern		Water	X	
C2-S-051821 (680-199232-4)	5/19/21	08:30 Eastern		Water	X	
C2-D-051821 (680-199232-5)	5/19/21	08:45 Eastern		Water	X	
C4-S-051821 (680-199232-6)	5/19/21	10:10 Eastern		Water	X	
C4-D-051821 (680-199232-7)	5/19/21	10:10 Eastern		Water	X	
C7-S-051821 (680-199232-8)	5/19/21	11:55 Eastern		Water	X	
C7-D-051821 (680-199232-9)	5/19/21	12:20 Eastern		Water	X	
C6-S-051821 (680-199232-10)	5/19/21	13:50 Eastern		Water	X	

Note: Since laboratory accreditations are subject to change, Eurofins TestAmerica places t... maintain accreditation in the State of Origin listed above for analysis/tests/matrix being ana... TestAmerica attention immediately. If all requested accreditations are current to date, retu... subcontract laboratories. This sample shipment is forwarded under chain-of-custody. If the laboratory does not currently ... laboratory or other instructions will be provided. Any changes to accreditation status should be brought to Eurofins ... TestAmerica.

680-199232 Chain of Custody

Possible Hazard Identification
Unconfirmed
Deliverable Requested: I, II, III, IV, Other (specify) | Primary ...

...isposal (A fee may be assessed if samples are retained longer than 1 month)
...urn To Client | Disposal By Lab | Archive For ____ Months
...nstructions/QC Requirements:

Empty Kit Relinquished by:		Date:		Method of Shipment:	
Relinquished by: [signature]	Date/Time: 052421 1700	Company:	Received by: Taylor Whitehouse	Date/Time: 5/25/21 1010	Company: ETA Bur
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:
Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:		Cooler Temperature(s) °C and Other Remarks:		

Ver: 11/01/2020

Page 96 of 102

6/15/2021

Eurofins TestAmerica, Savannah
5102 LaRoche Avenue
Savannah, GA 31404
Phone: 912-354-7858 Fax: 912-352-0165

Chain of Custody Record

eurofins | Environment Testing America

Client Information (Sub Contract Lab)	Sampler:	Lab PM: Lanier, Jerry A	Carrier Tracking No(s):	COC No: 680-654730.2
Client Contact: Shipping/Receiving	Phone:	E-Mail: Jerry.Lanier@Eurofinset.com	State of Origin: Massachusetts	Page: Page 2 of 2
Company: TestAmerica Laboratories, Inc.		Accreditations Required (See note): DoD ELAP - A2LA; DoD ELAP - L-A-B; Federal - US Fish & ...		Job #: 680-199232-1
Address: 530 Community Drive, Suite 11	Due Date Requested: 6/10/2021	Analysis Requested		Preservation Codes:
City: South Burlington	TAT Requested (days):			A - HCL; B - NaOH; C - Zn Acetate; D - Nitric Acid; E - NaHSO4; F - MeOH; G - Amchlor; H - Ascorbic Acid; I - Ice; J - DI Water; K - EDTA; L - EDA; M - Hexane; N - None; O - AsNaO2; P - Na2O4S; Q - Na2SO3; R - Na2S2O3; S - H2SO4; T - TSP Dodecahydrate; U - Acetone; V - MCAA; W - pH 4-5; Z - other (specify)
State, Zip: VT, 05403				
Phone: 802-660-1990(Tel) 802-660-1919(Fax)	PO #:			
Email:	WO #:			
Project Name: Joint Base Cape Cod - 2017 - 2021	Project #: 68018167			Other:
Site:	SSOW#:			

Sample Identification - Client ID (Lab ID)	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (Water, Solid, Organism, BT=Tissue, A=Air)	8330B/8330B_P_SPE 8330 Routine	Special Instructions/Note:
C6-D-051821 (680-199232-11)	5/19/21	14:00 Eastern		Water	X	
C5-S-052021 (680-199232-12)	5/20/21	08:05 Eastern		Water	X	
C5-D-052021 (680-199232-13)	5/20/21	08:05 Eastern		Water	X	
C3-D-052021 (680-199232-14)	5/20/21	09:35 Eastern		Water	X	
C1-D-052021 (680-199232-15)	5/20/21	11:25 Eastern		Water	X	

Note: Since laboratory accreditations are subject to change, Eurofins TestAmerica places the ownership of method, analyte & accreditation compliance upon our subcontract laboratories. This sample shipment is forwarded under chain-of-custody. If the laboratory does not currently maintain accreditation in the State of Origin listed above for analysis/tests/matrix being analyzed, the samples must be shipped back to the Eurofins TestAmerica laboratory or other instructions will be provided. Any changes to accreditation status should be brought to Eurofins TestAmerica attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said compliance to Eurofins TestAmerica.

Possible Hazard Identification	Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
Unconfirmed	☐ Return To Client ☐ Disposal By Lab ☐ Archive For Months
Deliverable Requested: I, II, III, IV, Other (specify) Primary Deliverable Rank: 2	Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:			
Relinquished by:	Date/Time: 05-24-21 1700	Company	Received by: Taylor Whittram	Date/Time: 5/25/21 1040	Company EMBU
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temperature(s) °C and Other Remarks:		

Ver: 11/01/2020

Site I.D.: UCR45

Well I.D.: C1-S

Pump Start: 1420
Sample Time: 1510

Watermark

GROUNDWATER SAMPLING DATA SHEET

Depth to NAPL = — ft

Static Water Level (WL) (from T.O.C.) = 106.05 ft

Well Depth (from T.O.C) = 150 ft

Height of Water in Well (T):
T = depth (ft) - Static Water Level (ft)
T = 150 - 106.05
T = 43.95 ft

Well Volume: ≈ 7.2 Gallons ≈ 27.3 Liters

Date: 5/18/21

Well Diameter (d) = 2 inches

Screen Depth 110 to 150 Feet below grade

Sampler(s): B. Grefinger

Low Flow Yes / No

Purging Device: Dedicated Bladder Pump

Sampling Device: "

Pump Intake (depth below TOC): — Feet

Actual Purge Volume: ≈ 4.0 (Gallons) ≈ 15 Liters

Time	Temp. (°C) (± 3%)	pH (SU) (± 0.1)	Specific Conductance (umhos/cm) (± 3%)	Turbidity (NTUs) (±10% if >1)	D.O. (mg/l) (± 10%)	ORP (mV) (± 10)	Flow Rate (ml/min)	Static water Level	Color/ Clarity	Comments
1425	10.9	6.03	63.4	1.26	10.66	146.3	300	106.05	Colorless/ Clear	No odor/sheen
1430	10.6	6.04	64.7	1.04	10.75	148.0	300	106.05	"	"
1435	11.0	6.00	64.9	0.88	10.66	153.2	300	106.05		
1440	11.1	5.97	65.4	0.31	10.53	157.1	300	106.05		
1445	11.0	5.97	65.2	0.26	10.48	160.4	300	106.5		
1450	10.9	5.97	64.9	0.21	10.37	162.1	300	106.5		
1455	10.9	5.96	64.9	0.19	10.33	164.3	300	106.5		
1500	10.9	5.96	65.1	0.17	10.34	164.4	300	106.5		
1505	10.9	5.96	65.1	0.16	10.34	164.5	300	106.5	↓	↓
	Reach Stabilization, Collect Sample for VOCs, EDB, explosives, Perchlorate and general Chemistry parameters (pH, Alkalinity, Turbidity, Specific Conductance)									

Volume in gallons/feet for common monitoring well sizes: 1-inch = 0.041, 2-inch = 0.163, 3-inch = 0.367, 4-inch = 0.652, 6-inch = 1.468

Site I.D.: Ocean

Well I.D.: C1-D

Pump Start: 1035
Sample Time: 1125

Watermark

GROUNDWATER SAMPLING DATA SHEET

Depth to NAPL = ~ ft

Static Water Level (WL) (from T.O.C.) = 106.06 ft

Well Depth (from T.O.C.) = 250 ft

Date: 5/20/21

Well Diameter (d) = 2.4 inches

Screen Depth: 210 to 250 Feet below grade

Sampler(s): B Geiger / M. Mascho

Height of Water in Well (T):
T = depth (ft) - Static Water Level (ft)
T = 250 - 106.06
T = 143.94 ft

Well Volume: ≈ 128 Liters ≈ 34 Gallons

Low Flow
Purging Device: Yes / Non Dedicated Bladder Pump
Sampling Device:
Pump Intake (depth below TOC): Feet
Actual Purge Volume: ≈ 5.0 (~~Gallons~~) Liters ≈ 1.3 Gallons

Time	Temp (°C) (± 3%)	pH (SU) (± 0.1)	Specific Conductance (umhos/cm) (± 3%)	Turbidity (NTUs) (±10% if >1)	D.O. (mg/l) (± 10%)	ORP (mV) (± 10)	Flow Rate (ml/min)	Static water Level	Color/ Clarity	Comments
1035	Start Pump	Control Box @ 110 psi		CPM2 18 sec Fill 12 sec discharge						
1040	10.1	5.91	65.1	0.62	10.20	234.0	80	106.06	Colorless/ Clear	NO odor / Sheen
1045	10.0	5.73	65.6	0.45	8.82	232.6	100	" "	" "	" "
1050	9.8	5.99	65.2	0.70	8.90	221.4	" "	" "	" "	" "
1055	9.8	6.02	65.1	0.94	9.23	219.2	" "	" "	" "	" "
1100	9.7	6.12	65.0	0.70	9.45	217.0	120	" "	" "	" "
1105	9.7	6.13	64.9	0.64	9.88	213.9	" "	" "	" "	" "
1110	9.7	6.14	65.0	0.88	10.06	212.8	" "	" "	" "	" "
1115	9.7	6.14	65.0	0.60	10.12	212.1	" "	" "	" "	" "
~~1120~~ 1120	9.6	6.16	65.1	0.58	10.16	211.7	" "	" "	" "	" "
	Reach Stabilization, Collect Sample for VOC, EDB, Perchlorate, Explosives									
			pH, Specific Conductance, Alkalinity, Turbidity							

Volume in gallons/feet for common monitoring well sizes: 1-inch = 0.041, 2-inch = 0.163, 3-inch = 0.367, 4-inch = 0.652, 6-inch = 1.468

2.4-inch = 0.235

Site I.D.: UCRUS

Well I.D.: C2-5

Pump Start: 0740
Sample Time: 0830

Watermark

GROUNDWATER SAMPLING DATA SHEET

Depth to NAPL = — ft

Static Water Level (WL) (from T.O.C.) = 103.20 ft

Well Depth (from T.O.C) = 130.00 ft

Height of Water in Well (T):
T = depth (ft) - Static Water Level (ft)
T = 130 - 103.20
T = 26.80 ft

Well Volume: ≈ 16.6 Liters ≈ 4.4 Gallons

Date: 5/19/21

Well Diameter (d) = 2 inches
Screen Depth 90 to 130 Feet below grade
Sampler(s): B. Gettinger

Low Flow Yes X No
Purging Device: Dedicated Bladder Pump
Sampling Device: " "
Pump Intake (depth below TOC): ≈ 50 Feet
Actual Purge Volume: (≈ 19 Liters) (Gallons)

Time	Temp. (°C) (±3%)	pH (SU) (±0.1)	Specific Conductance (umhos/cm) (±3%)	Turbidity (NTUs) (±10% if >1)	D.O. (mg/l) (±10%)	ORP (mV) (±10)	Flow Rate (mL/min)	Static water Level	Color/ Clarity	Comments
0745	10.3	6.00	54.6	0.66	10.11	138.3	450	103.20	Colorless/ Clear	No odor/Sheen
0750	10.1	5.97	57.3	0.34	10.15	141.1	450	103.20	" "	" "
0755	10.0	5.96	57.7	0.26	11.45	145.7	" "	" "	" "	" "
0800	10.0	5.95	57.9	0.23	11.47	149.3	" "	" "	" "	" "
0805	10.0	5.93	58.0	0.19	11.42	155.5	" "	" "	" "	" "
0810	10.0	5.93	58.0	0.16	11.10	157.5	" "	" "	" "	" "
0815	10.0	5.93	57.8	0.19	11.24	157.3	" "	" "	" "	" "
0820	10.0	5.93	57.8	0.18	11.30	158.1	" "	" "	" "	" "
0825	10.0	5.94	57.7	0.16	11.33	158.4	" "	" "	" "	" "
	Reached Stabilization, Collect Sample for the Following analysis:									
	VOCs, Explosives, EDB, Perchlorate									
	pH, Specific Conductance, Turbidity, Alkalinity									

Volume in gallons/feet for common monitoring well sizes. 1-inch = 0.041, 2-inch = 0.163, 3-inch = 0.367, 4-inch = 0.652, 6-inch = 1.468

Site I.D.: McCallen

Well I.D.: C-2D-051921

Pump Start: 0740

Sample Time: 0845

Watermark

GROUNDWATER SAMPLING DATA SHEET

Depth to NAPL – — ft

Static Water Level (WL) (from T.O.C.) – 103.1 ft

Well Depth (from T.O.C.) – 230.0 ft

Height of Water in Well (T):
T = depth (ft) – Static Water Level (ft)
T = 230.0 – 103.1
T = 126.9 ft

Well Volume: ≈ 30 Gallons ≈ 114 Liters

Date: 5-19-21

Well Diameter (d) – 2.5" inches

Screen Depth 190 to 230 Feet below grade

Sampler(s): [illegible]

Low Flow Yes/No

Purging Device: Dedicated bladder

Sampling Device: ~

Pump Intake (depth below TOC): Feet

Actual Purge Volume: ≈ 5.4 Liters ≈ 1.4 Gallons

Time	Temp. (°C) (± 3%)	pH (SU) (± 0.1)	Specific Conductance (umhos/cm) (± 3%)	Turbidity (NTUs) (±10% T>1)	D.O. (mg/l) (± 10%)	ORP (mV) (± 10)	Flow Rate (ml/min)	Static water Level	Color/ Clarity	Comments
0740	Pump Start						40	103.1		
0745	11.3	6.46	78.1	-0.05	8.71	226.6	↓	↓	clear/ colorless	odorless
0750	↓	6.42	74.8	0.14	8.48	218.7	↓	↓	↓	↓
0755	11.4	6.39	72.3	0.10	8.47	217.7	↓	↓	↓	↓
0800	↓	6.40	70.5	0.43	8.17	211.9	↓	↓	↓	↓
0805	10.9	6.32	66.7	0.94	8.47	216.3	↓	↓	↓	↓
0810	10.8	6.25	65.7	0.81	9.17	213.5	90	↓	↓	↓
0815	9.8	6.10	65.0	-0.40	9.26	213.0	↓	↓	↓	↓
0820	9.7	6.16	65.9	0.14	9.23	209.9	↓	↓	↓	↓
0825	9.6	5.80	66.7	0.21	9.58	229.5	↓	↓	↓	↓
0830	9.5	5.95	66.7	0.52	9.57	220.9	↓	↓	↓	↓
0835	9.5	6.04	66.9	0.37	9.72	214.1	↓	↓	↓	↓
0840	↓	6.05	67.0	0.29	9.65	209.5	↓	↓	↓	↓

* 0845 collect samples

Volume in gallons/feet for common monitoring well sizes: 1-inch = 0.041, 2-inch = 0.163, 3-inch = 0.367, 4-inch = 0.652, 6-inch = 1.468

2.4-inch = 0.235

Site I.D.: LNCRW

Well I.D.: C-35

Pump Start: 1250
Sample Time: 1340

Watermark

GROUNDWATER SAMPLING DATA SHEET

Depth to NAPL = — ft

Static Water Level (WL) (from T.O.C.) = 103.0 ft

Well Depth (from T.O.C.) = 183.0 ft

Height of Water in Well (T):
T = depth (ft) 183.0 - Static Water Level (ft) 103.0
T = 79.0 ft

Well Volume: ≈ 49 Liters ≈ 13 (gallons)

Date: 5-18-21

Well Diameter (d) – 2"
Screen Depth 135 to 183 Feet below grade
Sampler(s): M. Moscho B. Gerwig

Low Flow Yes ✓ No
Purging Device: Bladder dedicated
Sampling Device: Geo650 MDS
Pump Intake (depth below TOC):
Actual Purge Volume: ≈ 9.6 Liters ≈ 2.5 gallons

Time	Temp. (°C) (± 3%)	pH (SU) (± 0.1)	Specific Conductance (µmhos/cm) (± 3%)	Turbidity (NTUs) (±10% if >1)	D.O. (mg/l) (± 10%)	ORP (mV) (± 10)	Flow Rate (ml/min)	Static water Level	Color/ Clarity	Comments
1250	Pump start						215	103.0		
1255	9.6	5.46	58.7	48.4	5.83	168.7			clear/colorless	odorless
1300	9.9	5.62	58.1	27.2	5.57	169.1				
1305	9.8	5.61	58.3	16.1	5.77	174.7				
1310	↓	↓	58.7	1.52	5.83	174.9				
1315	↓	5.63	↓	1.18	6.13	175.9				
1320	9.9	5.66	58.9	1.16	6.40	176.3				
1325	9.8	5.76	58.5	1.10	6.46	177.7				
1330	9.9	5.78	58.9	0.95	6.36	178.4				
1335	9.7	5.79	57.5	0.83	6.86	183.4				
1340	X Collect	Samples								

Volume in gallons/feet for common monitoring well sizes: 1-inch = 0.041, 2-inch = 0.163, 3-inch = 0.367, 4-inch = 0.652, 6-inch = 1.468

Site I.D.: UCRNS

Well I.D.: C3-D

Pump Start: 0840
Sample Time: 0935

Watermark

GROUNDWATER SAMPLING DATA SHEET

Depth to NAPL – — ft

Static Water Level (WL) (from T.O.C.) – 103.34 ft

Well Depth (from T.O.C) – 310.0 ft

Height of Water in Well (T):
T = depth (ft) - Static Water Level (ft)
T – 310 - 103.34
T – 206.66 ft

Well Volume: ≈ 182 Liters, ≈ 49 gallons

Date: 5/20/21

Well Diameter (d) – 2.4 inches

Screen Depth 270 to 310 Feet below grade

Sampler(s): B.Gerger / M. Mosha

Low Flow Yes/No: Yes

Purging Device: Dedicated Bladder Pump

Sampling Device: " "

Pump Intake (depth below TOC): Feet

Actual Purge Volume: ≈ 3.0 ~~(Gallons)~~ Liters ≈ 0.8 Gallons

Time	Temp. (°C) (± 3%)	pH (SU) (± 0.1)	Specific Conductance (umhos/cm) (± 3%)	Turbidity (NTUs) (< 10% if >1)	D.O. (mg/l) (± 10%)	ORP (mV) (± 10)	Flow Rate (ml/min)	Static water Level	Color/ Clarity	Comments
0840	Start Pump –	115 psi,	CPM 2 17 sec	fill; 13 sec	discharge					
0845	9.4	6.02	57.6	1.05	10.41	246.6	220	103.34	Colorless/ Clear	No odor/ Sheen
0850	10.7	7.13	57.3	2.55	10.76	222.3	60	103.34	" "	" "
0855	11.5	6.60	57.1	3.16	15.84	221.4	60	" "	" "	" "
0900	10.4	6.47	57.3	5.61	14.84	222.2	60	" "	" "	" "
09 05	10.4	6.41	56.1	4.04	14.80	224.8	60	" "	" "	" "
0910	10.6	6.49	55.8	2.89	13.00	222.4	60	" "	" "	" "
0915	10.8	6.50	55.3	2.81	13.67	218.0	60	" "	" "	" "
0920	10.6	6.52	54.5	2.86	13.50	217.4	60	" "	" "	" "
0925	10.6	6.50	54.2	2.83	13.40	216.3	60	" "	" "	" "
0930	10.7	6.50	55.3	2.76	13.36	214.2	60	" "	" "	" "
	Reach Stabilization,	Collect	Sample For	VOCs, EDB, explosives,	Perchlorate					
				pH, Specific	Conductance, Alkalinity,	Turbidity				

Volume in gallons/feet for common monitoring well sizes: 1-inch = 0.041, 2-inch = 0.163, 3-inch = 0.367, 4-inch = 0.652, 6-inch = 1.468

24-inch = 0.235

Site I.D.: UCRWS

Well I.D.: C4-S

Pump Start: 0925
Sample Time: 1010

Watermark

GROUNDWATER SAMPLING DATA SHEET

Depth to NAPL = ___ ft

Static Water Level (WL) (from T.O.C.) = 132.05 ft

Well Depth (from T.O.C.) = 250 ft

Height of Water in Well (T):
T = depth (ft) - Static Water Level (ft)
T = 250 - 132.05
T = 117.95 ft

Well Volume: = 79 Liters ≈ 21 gallons

Date: 5/19/21

Well Diameter (d) = 2 inches
Screen Depth 200 to 250 Feet below grade:
Sampler(s): B. Grange

Low Flow Yes No
Purging Device: Dedicated Bladder Pump
Sampling Device:
Pump Intake (depth below TOC):
Actual Purge Volume: ≈ 12 Liters ≈ 3.0 gallons

Time	Temp. (°C) (± 3%)	pH (SU) (± 0.1)	Specific Conductance (umhos/cm); (± 3%)	Turbidity (NTUs) (±10% if >1)	D.O. (mg/l) (±10%)	ORP (mV) (± 10)	Flow Rate (ml/min)	Static water Level	Color/ Clarity	Comments
0930	10.7	6.06	56.0	1.31	8.84	155.5	300	132.05	Colorless/ Clear	No odor/ Sheen
0935	10.7	6.12	55.6	0.44	8.61	159.0	300	"	"	"
0940	10.8	6.19	54.4	0.36	9.30	160.5	"	"	"	"
0945	10.8	6.20	54.1	0.30	9.26	158.4	"	"	"	"
0950	10.9	6.20	54.3	0.27	9.21	158.3	"	"	"	"
0955	10.9	6.20	53.0	0.23	9.19	156.4	"	"	"	"
1000	11.0	6.20	53.6	0.18	9.18	156.0	"	"	"	"
1005	11.1	6.20	53.4	0.19	9.14	155.7	"	"	"	"
	Reached Stabilization, Collect Sample for the Following analysis									
	VOCs, Explosives, EDB, Perchlorate									
	pH, Specific Conductance, Turbidity, Alkalinity									

Volume in gallons/feet for common monitoring well sizes: 1-inch = 0.041, 2-inch = 0.163, 3-inch = 0.367, 4-inch = 0.652, 6-inch = 1.468

Site I.D.: U.C. R.C.W

Well I.D.: C-4D

Pump Start: 0925
Sample Time: 1010

Watermark

GROUNDWATER SAMPLING DATA SHEET

Depth to NAPL = — ft

Static Water Level (WL) (from T.O.C.) = 131.85 ft

Well Depth (from T.O.C) = 380.6 ft

Date: 5-19-21

Well Diameter (d) = 2.4" inches

Screen Depth 310 to 380 Feet below grade

Sampler(s): monte

Height of Water in Well (1):
T = depth (ft) - Static Water Level (ft)
T = 380.0 - 131.85
T = 248.15 ft

Well Volume: ≈ 211 Liters ≈ 56 (gallons)

Low Flow: Yes / No
Purging Device: Bladder Pump
Sampling Device:
Pump Intake (depth below TOC):
Actual Purge Volume: ≈ 9.2 Liters ≈ 2.4 gallons

Time	Temp. (°C) (± 3%)	pH (SU) (± 0.1)	Specific Conductance (mmhos/cm) (± 3%)	Turbidity (NTUs) (±10% if >1)	D.O. (mg/l) (± 10%)	ORP (mV) (± 10)	Flow Rate (ml/min)	Static water Level	Color/ Clarity	Comments
0925	Pump Start						230	131.85		
0930	9.6	5.42	67.3	0.24	5.46	230.5	↓	↓	clear/colorless	colorless
0935	9.5	5.86	67.0	1.92	5.17	221.4			↓	↓
0940	9.3	6.28	64.0	1.95	5.97	209.8				
0945	9.4	6.63	70.1	1.51	5.86	200.2				
0950	↓	6.68	70.3	2.32	6.08	197.4				
0955		6.69	70.8	3.01	6.01	194.3				
1000	↓	6.72	71.5	2.93	5.98	190.5				
1005	9.5	6.73	71.5	3.41	6.09	189.5	↓	↓	↓	↓
1010	X Collect	Samples								

Volume in gallons/feet for common monitoring well sizes: 1-inch = 0.041, 2-inch = 0.163, 3-inch = 0.367, 4-inch = 0.652, 6-inch = 1.468

Site I.D.: UCRWS

Well I.D.: C5-S

Pump Start: 0720
Sample Time: 0805

Watermark

GROUNDWATER SAMPLING DATA SHEET

Depth to NAPL = — ft

Static Water Level (WL) (from T.O.C.) = 135.83 ft

Well Depth (from T.O.C) = 180 ft

Height of Water in Well (T):
T = depth (ft) - Static Water Level (ft)
T = 180 - 135.83
T = 44.17 ft

Well Volume = ≈7.2 gallons = ≈27.4 Liters (gallons)

Date: 5/20/21

Well Diameter (d) = 2 inches

Screen Depth: 150 to 180 Feet below grade

Sampler(s): B. Geringer

Low Flow: Yes ☒ No ☐

Purging Device: Dedicated Bladder Pump

Sampling Device: " "

Pump Intake (depth below TOC): ≈ 7.2 Feet

Actual Purge Volume: ≈ 12 Liters (Gallons)

Time	Temp. (°C) (± 3%)	pH (SU) (± 0.1)	Specific Conductance (umhos/cm) (± 3%)	Turbidity (NTUs) (±10% if >1)	D.O. (mg/l) (± 10%)	ORP (mV) (± 10)	Flow Rate (ml/min)	Static water Level	Color/ Clarity	Comments
0715	10.3	6.00	56.3	1.12	10.03	138.4	300	135.83	Colorless/ Clear	No odor/ sheen
0730	10.2	6.02	58.9	0.83	9.86	140.6	" "	" "	" "	" "
0735	10.1	6.03	60.2	0.77	10.00	142.5	" "	" "	" "	" "
0740	10.0	6.04	61.3	0.75	9.70	144.6	" "	" "	" "	" "
0745	10.0	6.04	61.6	0.70	9.87	147.6	" "	" "	" "	" "
0750	10.0	6.04	62.1	0.64	9.88	150.1	" "	" "	" "	" "
0755	10.0	6.04	62.2	0.63	9.84	151.9	" "	" "	" "	" "
0800	10.1	6.04	62.1	0.60	9.78	152.5	" "	" "	" "	" "
	Reach Stabilization, Collect Sample for			UCS EDB, explosives, perchlorate						
				PH, Specific Conductance, Alkalinity, Turbidity						

Volume in gallons/feet for common monitoring well sizes: 1-inch = 0.041, 2-inch = 0.163, 3-inch = 0.367, 4-inch = 0.652, 6-inch = 1.468

Site I.D.: U.e.P.w

Well I.D.: C-5D

Pump Start: 0720

Sample Time: 0805

Watermark

GROUNDWATER SAMPLING DATA SHEET

Depth to NAPL – ~ ft

Static Water Level (WL) (from T.O.C.) – 135.63 ft

Well Depth (from T.O.C) – 260.2 ft

Date: 5-20-21

Well Diameter (d) = 2/4 inches

Screen Depth 230 to 260 Feet below grade

Sampler(s): mmorris

Low Flow Yes ☑ No ☐

Purging Device: Dedicated Bladder

Sampling Device:

Pump Intake (depth below TOC):

Actual Purge Volume: ≈ 5.2 Feet ( )

≈ 1.4 gallons Liters

Height of Water in Well (T):

T – depth (ft) – Static Water Level (ft)

T – 260.2 – 135.63

T – 124.57 ft Well Volume: ≈ 120 Liters ≈ 32 (gallons)

Time	Temp. (°C) (± 3%)	pH (SU) (± 0.1)	Specific Conductance (umhos/cm) (± 3%)	Turbidity (NTUs) (±10% if >1)	D.O (mg/l) (± 10%)	ORP (mV) (± 10)	Flow Rate (ml/min)	Static water Level	Color/ Clarity	Comments
0720	Purge start						130	135.63		
0725	9.3	5.74	51.0	-0.04	10.32	247.8			clear colorless	odorless
0730	9.4	5.89	49.7	-0.55	10.77	236.8				
0735	9.3	5.95	49.1	-0.37	10.98	236.2				
0740	9.4	5.98	48.9	-0.42	11.14	235.0				
0745	9.3	6.09	48.0	-0.41	11.47	231.7				
0750	↓	6.10	47.9	-0.17	11.45	231.0				
0755	9.3	6.14	47.6	-0.63	11.40	229.0				
0800	↓	↓	47.7	-0.58	11.36	228.7				
0805	*collect	Samples.								

Volume in gallons/feet for common monitoring well sizes: 1-inch = 0.041, 2-inch = 0.163, 3-inch = 0.367, 4-inch = 0.652, 6-inch = 1.468

2.4-inch = 0.235

Site I.D.: UCRIS

Well I.D.: C6-S

Pump Start: 1305
Sample Time: 1350

Watermark

GROUNDWATER SAMPLING DATA SHEET

Depth to NAPL = _____ ft

Static Water Level (WL) (from T.O.C.) = 142.56 ft

Well Depth (from T.O.C) = 183 ft

Height of Water in Well (1):
T = depth (ft) - Static Water Level (ft)
T = 183 - 142.56
T = 40.44 ft

Well Volume: ≈ 25 Liters ≈ 6.5 gallons (gallons)

Date: 5/19/21

Well Diameter (d) = 2 inches
Screen Depth 153 to 183 Feet below grade
Sampler(s): B. Boeringer

Low Flow Yes No
Purging Device: Dedicated Bladder Pump
Sampling Device:
Pump Intake (depth below TOC):
Actual Purge Volume: ≈ 14 Liters ≈ 3.7 gallons Feet (Gallons)

Time	Temp. (°C) (± 3%)	pH (SU) (± 0.1)	Specific Conductance (mmhos/cm) (± 3%)	Turbidity (NTUs) (±10% if >1)	D.O. (mg/l) (± 10%)	ORP (mV) (± 10)	Flow Rate (ml/min)	Static water Level	Color/ Clarity	Comments
1310	10.8	5.98	66.9	1.21	10.24	185.2	350	142.56	Colorless/ Clear	No odor / Sheen
1315	10.8	5.98	78.6	0.91	10.09	185.1	" "	" "	" "	" "
1320	10.6	5.99	77.8	0.78	10.04	185.3	" "	" "	" "	" "
1325	10.4	5.99	77.2	0.64	9.98	185.4	" "	" "	" "	" "
1330	10.4	5.99	76.7	8.50	9.94	184.6	" "	" "	" "	" "
1335	10.4	5.99	76.4	6.47	10.06	183.4	" "	" "	" "	" "
1340	10.5	5.98	75.8	0.44	10.14	182.7	" "	" "	" "	" "
1345	10.6	5.99	75.5	0.36	10.01	183.6	" "	" "	" "	" "
	Reached Stabilization Collect Sample for the following:									
	VOCs, EDB, Explosives, Perchlorate.									
	Ph, Specific Conductance, Turbidity, Alkalinity									

Volume in gallons/feet for common monitoring well sizes: 1-inch = 0.041, 2-inch = 0.163, 3-inch = 0.367, 4-inch = 0.652, 6-inch = 1.468

Site I.D.: UCRW

Well I.D.: C-6D

Pump Start: 1305
Sample Time: 1400

Watermark

GROUNDWATER SAMPLING DATA SHEET

Depth to NAPL: – ft

Static Water Level (WL) (from T.O.C.): 142.56 ft

Well Depth (from T.O.C): 280 ft

Height of Water in Well (T):
T = Depth (D) – Static Water Level (H)
T = 280 – 142.56
T = 137.44 ft

Well Volume: ≈ 35 (gallons) ≈ 132.5 Liters

Date: 5-19-21

Well Diameter (d): 2.4 inches
Screen Depth: 240 to 280 Feet below grade
Sampler(s): [illegible]

Low Flow: Yes ☑ No ☐
Purging Device: Bladder
Sampling Device:
Pump Intake (depth below TOC):
Actual Purge Volume: ≈ 2.2 L ≈ 0.6 gallons

Time	Temp. (°C) (± 3%)	pH (SU) (± 0.1)	Specific Conductance (umhos/cm) (± 3%)	Turbidity (NTUs) (10% if >1)	D.O. (mg/l) (± 10%)	ORP (mV) (± 10)	Flow Rate (ml/min)	Static water Level	Color/ Clarity	Comments
1305	Pump Start							142.56		
1310	19.7	6.16	71.1	1.93	9.93	205.6	30		clear colorless	odorless
1315	19.4	6.22	62.8	1.16	9.12	187.5				
1320	18.5	6.21	69.2	0.69	9.85	186.1				
1325	18.2	6.15	57.5	0.72	10.22	187.8				
1330	17.3	6.09	56.5	1.70	10.32	187.8				
1335	17.1	6.03	52.7	0.91	9.47	188.7				
1340	10.8	6.00	51.1	0.79	9.72	88.0				
1345	10.6	↓	51.3	0.85	10.00	186.6	↓			
1350	14.6	5.95	49.7	0.79	9.11	184.2	40			
1355	14.3	5.96	50.7	0.81	9.07	186.1	↓	↓	↓	↓
1400	* Collect Samples									

Volume in gallons/feet for common monitoring well sizes: 1-inch = 0.041, 2-inch = 0.163, 3-inch = 0.367, 4-inch = 0.652, 6-inch = 1.468

2.4-inch = 0.235

Site I.D.: UCRWS

Well I.D.: C7-S

Pump Start: 1105
Sample Time: 1155

Watermark

GROUNDWATER SAMPLING DATA SHEET

Depth to NAPL = — ft

Static Water Level (WL) (from T.O.C.) = 156.72 ft

Well Depth (from T.O.C.) = 239.00 ft

Date: 5/19/21

Well Diameter (d) = 2 inches

Screen Depth: 199 to 239 Feet below grade

Sampler(s): B. Geringer

Height of Water in Well (T):
T = depth (ft) - Static Water Level (ft)
T = 239 - 156.72
T = 82.28 ft

Well Volume: = 51 Liters ≈ 13.5 Gallons

Low Flow: Yes ☑ No ☐
Purging Device: Dedicated Bladder Pump
Sampling Device: " "
Pump Intake (depth below TOC): — Feet
Actual Purge Volume: ≈ 15 (Gallons) Liters ≈ 4.0 gallons

Time	Temp. (°C) (±3%)	pH (SU) (±0.1)	Specific Conductance (umhos/cm) (±3%)	Turbidity (NTUs) (±10% if >1)	D.O. (mg/l) (±10%)	ORP (mV) (±10)	Flow Rate (ml/min)	Static water Level	Color/ Clarity	Comments
1110	10.9	5.82	59.3	0.63	8.69	177.2	300	156.72	Colorless/ Clear	No odor/Sheen
1115	10.9	5.94	61.0	0.55	9.10	173.4	"	"	"	"
1120	10.8	6.05	64.4	0.50	9.35	168.8	"	"	"	"
1125	10.8	6.07	64.8	0.41	10.00	161.9	"	"	"	"
1130	10.8	6.07	65.1	0.34	10.16	154.5	"	"	"	"
1135	10.8	6.07	65.3	0.31	10.23	151.2	"	"	"	"
1145	10.7	6.08	65.5	0.34	10.20	151.3	"	"	"	"
1150	10.7	6.08	65.5	0.30	10.16	150.9	"	"	"	"

Reached Stabilization, Collect Sample for the Following analysis:
VOCs, EDB, Explosives, Perchlorate
pH, Specific Conductance, Turbidity, Alkalinity

Volume in gallons/feet for common monitoring well sizes: 1-inch = 0.041, 2-inch = 0.163, 3-inch = 0.367, 4-inch = 0.652, 6-inch = 1.468

Site I.D.: Cactus Row
Well I.D.: C7-D
Pump Start: 1105
Sample Time: 1220

Watermark

GROUNDWATER SAMPLING DATA SHEET

Depth to NAPL = — ft
Static Water Level (WL) (from T.O.C.) = 156.83 ft
Well Depth (from T.O.C) = 335 ft

Date: 8-19-21
Well Diameter (d) = 2, 4 inches
Screen Depth: 295 to 335 Feet below grade
Sampler(s): M. Mosher

Low Flow: Yes
Purging Device: Dedicated Bladder
Sampling Device:
Pump Intake (depth below TOC):
Actual Purge Volume: ≈ 4.8 L ≈ 1.3 gallons

Height of Water in Well (T):
T = depth (ft) 335 - Static Water Level (ft) 156.83
T = 178.17 ft
Well Volume: ≈ 172 liters ≈ 45 (gallons)

Time	Temp. (°C) (± 3%)	pH (SU) (± 0.1)	Specific Conductance (umhos/cm) (± 3%)	Turbidity (NTUs) (±10% if >1)	D.O. (mg/l) (± 10%)	ORP (mV) (± 10)	Flow Rate (ml/min)	Static water Level	Color/ Clarity	Comments
1105	Pump Start							156.83	Clear	odors
1110	* Max throttle on		Control box, skw		Purging		55		colorless	
1115	16.0	6.58	83.7	1.62	9.07	224.8	↓			
1120	15.4	6.15	61.2	7.63	8.31	208.4	30			
1125	13.1	6.08	52.5	8.51	9.74	210.3	70			
1130	12.7	6.06	51.8	5.14	9.99	216.8	80			
1135	12.2	5.88	51.3	9.91	9.15	213.1				
1140	12.1	↓	51.2	8.63	8.63	210.0				
1145	12.0	6.10	51.1	7.32	9.13	196.0				
1150	↓	6.20	51.0	1.10	8.60	190.0				
1155	12.1	6.23	51.2	0.98	8.65	190.6				
1200		6.24	50.9	0.86	↓	189.4				
1205	↓	6.25		1.04	9.02	187.8				
1210	12.2	6.26	↓	0.89	9.13	184.1				
1215	12.3	6.25	50.7	1.10	9.14	180.3	↓	↓	↓	↓

Volume in gallons/feet for common monitoring well sizes: 1-inch = 0.041, 2-inch = 0.163, 3-inch = 0.367, 4-inch = 0.653, 6-inch = 1.468
2.4-inch = 0.235

1220 * Collect Samples

102nd Intelligence Wing
Water Quality Report

2020 Annual Water Quality Report
For
Otis Air National Guard Base
Joint Base Cape Cod, Massachusetts
MassDEP PWS ID #4096001

To comply with State regulations, Otis Air National Guard Base, will be annually issuing a report describing the quality of your drinking water. The purpose of this report is to raise your understanding of drinking water and awareness of the need to protect our drinking water sources.

PUBLIC WATER SYSTEM (PWS) INFORMATION:

Address: Otis Air National Guard Base on Joint Base Cape Cod, Massachusetts
Contact Person: Mr. Richard Souza
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.

Where Does My Drinking Water Come From?

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 connected 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

DRINKING WATER SOURCE:

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.

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 (800-126-4791).

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.

UNITS OF MEASUREMENT:

MFL	= Million Fibers per Liter
mrem/year	= millimrems per year (a measure of radiation absorbed by the body)
N/A	= Not Applicable
ND	= Not Detected
pCi/L	= picocuries per liter (a measure of radioactivity)
ppb	= parts per billion, or micrograms per liter (ug/L)
ppm	= parts per million, or milligrams per liter (mg/L)
ppt	= parts per trillion, or nanograms per liter (ng/L)

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.

Bacteria	MCL/TT	MCLG	Value	Date	Violation (Y/N)	Possible Source(s) of Contamination
Total Coliform Bacteria (TC)	0	0	Positive	8 Dec 2020	N	Human and animal fecal waste

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 actions to identify any problems that were found during these assessments.

During the past year, we were required to conduct one **Level 1 Assessment** due to one positive result in December. As a result, we were required to take the necessary corrective actions, which have all been completed.

-The PWS DW staff did not retrieve a message of a TC+ sample until a week later at the Water Tower (Otis)/RS Sampling Code: T-3.

-Due to corrosion and exposure to the elements, the sampling tap at T-3 had been determined to be unclean and unsuitable for sampling.

-Both Water Tower sampling taps have been replaced.

-The PWS DW staff collected repeat samples; all negative.

-The PWS DW staff took action to ensure emails and voicemails are checked on daily basis during sampling activity.

What About Lead Exposure?

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 two 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 at (800) 426-4791 or on the Internet, at the following link: http://www.epa.gov/safewater/lead

Substance (unit of measurement)	Date(s) Collected	90^{TH} Percentile	Action Level	MCLG	# of sites sampled	# of sites above Action Level	Possible Source(s) of Contamination
Lead (ppb)	2018	0.2	15	0	40	0	Corrosion of household plumbing systems; Erosion of natural deposits
Copper (ppm)	2018	0.448	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	Range Detected	MCL or MRDL	MCLG or MRDLG	Violation (Y/N)	Possible Source(s) of Contamination
Inorganic Contaminants							
Asbestos (MFL)	2013	N/A	ND	7	7	N	Decay of asbestos cement water mains; erosion of natural deposits
Barium (ppm)	2018	0.016	0.00-0.016	2	2	N	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits
Chromium (ppb)	2013	0.51	0.00-0.51	100	100	N	Discharge from pulp mills; erosion of natural deposits
Fluoride (ppm)*	2020	0.00	0.00-0.25	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)	2020	0.31	0.00-0.31	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)	2020	ND	N/A	2	N/A	N	Rocket propellants, fireworks, munitions, flares, blasting agents

Radioactive Contaminants							
Radium 226 & 228 (pCi/L) (combined values)	2015	1.10	0.623-1.10	5	0	N	Erosion of natural deposits
Disinfectants and Disinfection By-Products							
Total Trihalomethanes (TTHMs) (ppb)	QTR3 (2020)	12.3	6.51-12.2	80	N/A	N	Byproduct of drinking water chlorination
Haloacetic Acids (HAA5) (ppb)	QTR3 (2020)	ND	N/A	60	N/A	N	Byproduct of drinking water disinfection
Chlorine (ppm)	Monthly in (2020)	1.86	0.03-1.86	4	4	N	Water additive used to control microbes

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(s) of Contamination
Bromodichloromethane	2019	6.73-8.61	7.67	N/A	N/A	Trihalomethane; by-product of drinking water chlorination
Bromoform	2019	2.24-2.92	2.58	N/A	N/A	Trihalomethane; by-product of drinking water chlorination
Chloroform (ppb)	2020	0.00-0.70	0.35	N/A	70	By product of drinking water chlorination (In non-chlorinated sources it may be naturally occurring)
Chromium-6	2015	0.0-0.29	0.145	N/A	N/A	Discharge from steel and pulp mills; Erosion of natural deposits
Dibromodichloromethane	2019	6.83-8.82	7.83	N/A	N/A	Trihalomethane; By-product of drinking water chlorination
Manganese* (ppb)	2020	<0.005	<0.005	N/A	300	Erosion of natural deposits
*US EPA has established a lifetime health advisory (HA) value of 300 ppb for manganese to protect against concerns of potential neurological effects, and a one-day and 10-day HA of 1000 ppb for acute exposure.						
Methyl tertiary butyl ether* or MTBE (ppb)	2016	0.63	0.315	20-40	70	Fuel additive; leaks and spills from gasoline storage tanks

Unregulated Contaminants	Date(s) Collected	Result or Range Detected	Average Detected	SMCL	ORSG	Possible Source(s) of Contamination
*EPA has established a lifetime Health Advisory (HA) of 0.3 mg/L and an acute HA at 1.0 mg/L.						
Sodium (ppm)	2019	5.1-5.6	5.3	N/A	30	Discharge from the use and improper storage of sodium-containing de-icing compounds or in water-softening agents, natural erosion, road salt

UPPER CAPE REGIONAL WATER SUPPLY COOPERATIVE 2020 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.

2020 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	2020	0.13 ppm	0.13 ppm	10 ppm	10 ppm	No	Runoff from fertilizer use; Leaching form septic tanks, sewage; Erosion of natural deposits
Unregulated and Secondary Contaminants	**Year Sampled**	**Amount Detected**	**Range of Detections**	**SMCL**	**ORSG**	**Violation**	**Possible Sources**
Chloroform	2020	2.19 ppb	1.46-2.19 ppb	NA	70 ppb	No	Trihalomethane by-product of drinking water chlorination. In non-chlorinated sources, chloroform may be naturally occurring
Chloride	2020	8.6 ppm	8.6 ppm	250 ppm	--	NO	Runoff and leaching from natural deposits; seawater influence
Copper	2020	0.014 ppm	0.014 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	2020	5.0 ppm	5.0 ppm	250 ppm	--	No	Runoff and leaching from natural deposits; industrial wastes

Does My Drinking Water Meet Current Health Standards?
We are committed to providing you with the best water quality available. We are proud to report that last year your drinking water met all applicable health standards regulated by the state and federal government.

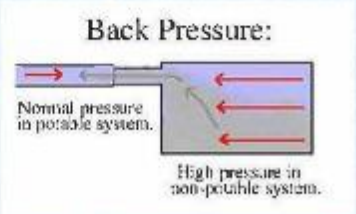
Health Effects Statements.
Total Coliform: Coliforms are bacteria that are naturally present in the environment and are used as an indicator that other potentially harmful bacteria may be present. Coliforms were found in more samples than allowed and this was a warning of potential problems. However, we've complied with the Fecal Coliform/E.coli MCL.

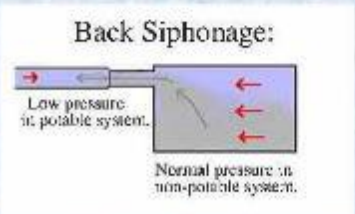
Fecal Coliforms and E.coli are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Microbes in these wastes can cause short-term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a special health risk for infants, young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

CROSS-CONNECTION CONTROL AND BACKFLOW PREVENTION:
Otis Air National Guard Base makes every effort to ensure that the water delivered to your home and business is clean, safe and free of contamination. Our staff works very hard to protect the quality of the water delivered to our customers from the time the water is extracted via deep wells from underground aquifers or withdrawal point from a surface water source, throughout the entire treatment and distribution system. But what happens when the water reaches your home or business? Is there still a need to protect the water quality from contamination caused by a cross-connection? If so, how?

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

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





What can I do to help prevent a cross-connection?

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

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

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

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.

This report was prepared by Otis Air National Guard Base
PWS ID# 4096001 Distributed: June 2021

Bourne Water District
Water Quality Report 2020

BOURNE WATER DISTRICT
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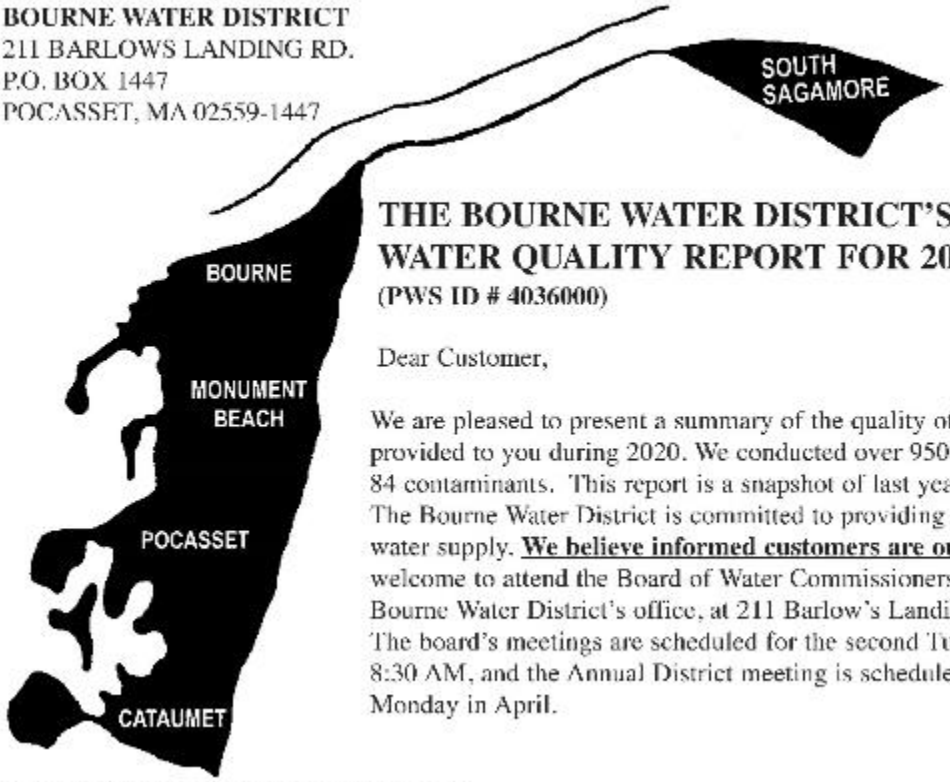


THE BOURNE WATER DISTRICT'S WATER QUALITY REPORT FOR 2020

(PWS ID # 4036000)

Dear Customer,

We are pleased to present a summary of the quality of the drinking water provided to you during 2020. 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**	1	0-1	0	0	yes	Naturally present in the environment
Fecal Coliform or E. Coli	0	0	0	0	No	Human and Animal Fecal Waste
*Compliance with the Fecal Coliform/E.Coli MCL is determined upon additional repeat testing						
**Total Coliform: Coliform are bacteria that are naturally present in the environment and are used as an indicator that other potentially harmful bacteria may be present						

Lead and Copper	Dates collected	90th Percentile	Action Level	MCGL	# of sites sampled	# Sites above Action Level	Violation	Possible Source of Contamination
Lead (ppb)	9/1/2020 to 10/1/2020	0.0057	15	0	30	0	No	Corrosion of household plumbing systems; Erosion of natural deposits
Copper (ppm)	9/1/2020 to 10/1/2020	0.311	1.3	1.3	30	0	No	Corrosion of household plumbing systems; Erosion of natural deposits

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

	SUMMARY OF FINISHED WATER CHARACTERISTICS						
Regulated Contaminants	Date(s) collected	Highest Detect Value	Range Detected	MCL	MCGL	Violation	
Inorganic Contaminants:							
Barium (ppm)	2020	0.009	0.002-0.009	2	2	No	Discharge of drilling waste; discharge from metal refineries; erosion of natural deposits
Nitrate * (ppm)	2020	0.7	0.06-0.70	10	10	No	Run-off from fertilizer use; leaching from septic tanks; sewage; erosion of natural deposits
Perchlorate ** (ppb)	2020	0	0	2	-	No	Rocket propellant; fireworks; munitions; flame retarding agents* (see note below)
*Nitrate	Nitrate in drinking water at levels of 10 ppm is a health risk for infants of less than six months of age. High nitrate levels in drinking water can cause blue baby syndrome. Nitrate levels may rise quickly for short periods of time because of rainfall or agricultural activity. If you are caring for an infant, you should seek advice from your health care provider.						
**Perchlorate (Perchlorate Chemical Abstract Service Registry Numbers (CASRN) for different chemical species	Perchlorate interferes with the normal function of the thyroid gland and thus has the potential to affect growth and development, causing brain damage and other adverse effects, particularly in fetuses and infants. Pregnant women, the fetus, infants and children up to the age of 12, and people with hypothyroid condition are particularly susceptible to perchlorate toxicity. *Values are required when the results are above the MDL (0.012) and below the MRL (2.06)						
Organic Contaminants							
Tetrachloroethylene (PCE) (ppb)	2020	1.64	0 -1.64	5	-	No	Discharge from factories and dry cleaners
chloroform (ppb	2020	1.75	0-1.75	ORSG 70	NA	No	By-product of drinking water chlorination
cis-1,2-Dichloroethylene (ppb)	2020	2.08	0-2.08	70	NA	No	Run-off from fertilizer use; leaching from septic tanks; sewage; erosion of natural deposits

Secondary Contaminants	Date(s) collected	Highest Detect Value	Range Detected	SMCL	ORSG	Possible Source of Contamination
Magnesium (ppm)	2020	3.6	1.1-3.6	-	-	Natural Mineral and Organic Matter
Chloride (ppm)	2020	40	7.2-40	250	NA	Natural Mineral, Road Salt
Calcium (ppm)	2020	6	2.5-6.0	-	-	Natural Mineral and Organic Matter
Iron (ppb)	2020	0.96	0-0.96	300	NA	Erosion of Natural Deposits and oxidation of iron components
Manganese (ppb)*	2020	0.034	0-0.034	50	NA	Erosion of Natural Deposits
Sodium(ppm)**	2020	28**	5.7-28	-	20	Road Salting; erosion of natural deposits
Potassium (ppm)	2020	1.3	0.7-1.3	-	-	Natural Mineral and Organic Matter
Sulfate (ppm)	2020	7.2	5.1-7.2	250	250	Natural Sources
Zinc (ppm)	2020	0.014	0-0.014	5	NA	Erosion of Natural Deposits and Industrial discharge

*EPA has established a lifetime health advisory (HA) for Manganese at 300ppb and an acute at 1000ppb

**Sodium is a naturally occurring element found in soil and water. It is necessary for the normal functioning of regulating fluids in human systems. Some people, however, have difficulty regulating fluid volumes as a result of several diseases, including congestive heart failure and hypertension. The guideline of 20mg/L for sodium represents a level in water that physicians and sodium sensitive individuals should be aware of in cases where sodium exposures are being carefully controlled. For additional information contact your health care provider, your local Board of Health or the Massachusetts Dept. of Public Health, Bureau of Environmental Health Assessment at 617 624-5757.

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 2020. **In August 2020 Bourne Water District had one detect of Total Coliform from a sample taken at the Bourne tank. Bourne Water District chlorinated the tank and rectified the issue. Bourne Water District completed the process with a Level 1 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.

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
2020 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.

2020 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	2020	0.13 ppm	0.13 ppm	10 ppm	10 ppm	No	Runoff from fertilizer use; Leaching form septic tanks, sewage; Erosion of natural deposits
Unregulated and Secondary Contaminants	**Year Sampled**	**Amount Detected**	**Range of Detections**	**SMCL**	**ORSG**	**Violation**	**Possible Sources**
Chloroform	2020	2.19 ppb	1.46 -2.19 ppb	NA	70 ppb	No	Trihalomethane: by-product of drinking water chlorination. In non-chlorinated sources, chloroform may be naturally occurring
Chloride	2020	8.6 ppm	8.6 ppm	250 ppm	--	NO	Runoff and leaching from natural deposits; seawater influence
Copper	2020	0.014 ppm	0.014 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	2020	5.0 ppm	5.0 ppm	250 ppm	--	No	Runoff and leaching from natural deposits; industrial wastes

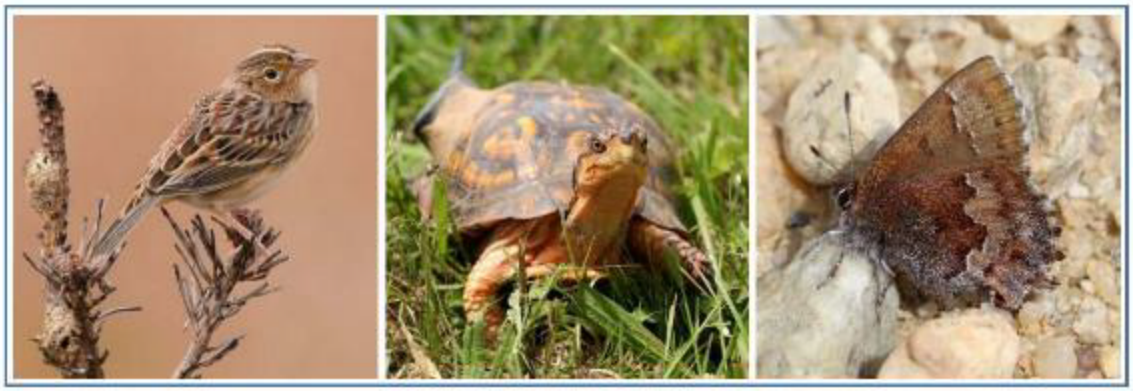
APPENDIX F
CONSERVATION AND MANAGEMENT PERMIT COMPLIANCE AND MITIGATION ACTIONS

Conservation and Management Permit Compliance and Mitigation Actions

Camp Edwards: Fiscal Year 2021

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 FY2021 period covering October, 2020, through September, 2021. 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); Federal FY: 01 October – 30 September)
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

The Pink Prominent Moth (*Hyparpax aurora*) is a stunning scrub oak (*Quercus ilicifolia*) associate that is rare throughout its range with very localized distribution in Massachusetts. This individual was observed during a MAARNG hosted Massachusetts Butterfly Club survey for Acadian Hairstreak Butterflies in Pine Barrens Mitigation Focal Area – North, with a high number of rare and state-listed species within a diverse barrens habitat mosaic, including powerline right of way, adjacent to a primary road and active soldier training features.

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

An initial CMP was developed in 2017 and 2018 to provide for localized road repair at Camp Edwards while providing for conservation of the Endangered Agassiz's Clam Shrimp (*Eulimnadia agassizii*, AgCS). Under that original permit two sites along Cat Road were repaired as *in situ* sites in Training Year (TY) 2020. Prior to that, in TY2019, one site was modified *in-situ* and five sites (Cat Road [3], Herbert Road [2]) were repaired and 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, were completed in TY 2020, but an additional year of monitoring was completed in TY21 due to the 2020 drought conditions and the focal conservation interest of the species for MAARNG.

Agassiz's Clam Shrimp survey and active relocation efforts supporting critical road maintenance.

Precipitation patterns were back to normal for the 2021 survey season. Natural Resources staff conducted repeated surveys following the standard approved protocol. In total, a subset of 12 puddles were surveyed. Four puddles were CMP mitigation puddles, five were puddles not surveyed previously, and five were known to support AgCS in previous years. From mid-May to October, puddles containing standing water were measured for area, depth, temperature and pH, and all aquatic life observed was recorded.

Clam shrimp were observed in seven of the twelve surveyed puddles, however, not all clam shrimp were identified to be AgCS. AgCS were encountered in five puddles with four puddles being new locations for AgCS records. American Clam Shrimp (*Limnadia lenticularis*, AmCS), a state-listed species of special concern, not previously confirmed on the base, were encountered in three puddles (two monitoring puddles contained both species). AmCS collected samples, along with AgCS, have been submitted to NHESP for verification of ID. Clam shrimp collected from one puddle were not able to be identified in the lab due to poor condition of the sample. This means that 50 percent of puddles surveyed in 2021 contained AgCS and/or AmCS, if we don't count the unknown clam shrimp species. This percent is up from 2019 and 2020 survey years in which approximately 30 percent of puddles surveyed contained AgCS. In 2018, the first year of monitoring, 25 puddles were surveyed and 80 percent of those contained clam shrimp. All data and results are provided separately to MassWildlife and observation reporting through Heritage Hub (https://www.mass.gov/ info-details/overview-of-the-heritage-hub). Additional FY21 monitoring results worth noting are that two of the four CMP puddles modified in-situ in TY2019 and TY2020 contained clam shrimp, one on Cat road contained AgCS and one on Canal View Road contained AmCS. The seven positive observations were distributed throughout Camp Edwards, occurring in all five training area zones. Zones are discussed below as part of the CMP amendment.

The primary effort for AgCS, other than ongoing monitoring, was collaboratively developing an amendment to the existing permit to provide for holistic AgCS conservation and road maintenance within the training area. The presence of AgCS within some larger puddles precluded necessary repairs, which led to the development of the original permit, relocation efforts, and repair of select features. The next step with MassWildlife was to apply lessons from the original effort to development of an overarching road maintenance strategy that could provide for both a sustainable and usable road network and sustainable and healthy AgCS 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 be critical to clam shrimp persistence as prolonged lack of maintenance quickly leads to exacerbation of puddles into unsuitable conditions for clam shrimp and eventually vegetation of the road bed and loss of roads and road puddles. Maintenance and use provides both roads and puddles.

Clam shrimp puddle signage is posted to protect known occupied sites – encourage driving and avoid filling.

Amendment of the original permit was completed in the summer of 2021. Both parties chose to amend the existing permit as it carries forward the framework of the original, including monitoring and Net Benefit through a combination of relocation and repair in place. The updated CMP establishes multiple categories of 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 ACS.

The priority action for FY21 was repair of the impact area perimeter roads (Jefferson, Barlow, Wheelock, and Crowell) and two key impact area access roads. These had become severely degraded and occasionally impassable, in large part due to prohibition on maintenance due to known ACS presence in puddles along the northern, western, and southern impact area boundary roads. These are key roads both for remediation activities and emergency response. The Clam Shrimp Conservation and Road Maintenance Plan (CSCRMP) establishes a Critical Road designation, which includes the existing paved roads, the impact area boundary and select access roads, and the primary access routes of Burgoyne and Gibbs Roads. These critical roads are intended to be frequently maintained and not intended for puddles, which will also serve to minimize box turtle risks on higher use roads. The impact area boundary repairs are ongoing currently through the Impact Area Groundwater Study Program (IAGWSP).

The permit amendment calls for an annual road maintenance and repair plan to be submitted to MassWildlife, which will include priority road and puddle repairs, current condition relative to repair standards in the CSCRMP, AgCS (and now AmCS) presence if documented, and impact on the zone puddle baseline. Additionally, the annual plan will outline mitigation requirements consistent with the described framework in the CSCRMP.

American Clam Shrimp from puddle 19a on July 9th, 2021. AgCS were successfully introduced to this puddle in 2019, though the introduction was incidental to repair and maintenance of the existing puddle to receive AgCS as mitigation. FY21 was the first year documenting AmCS.

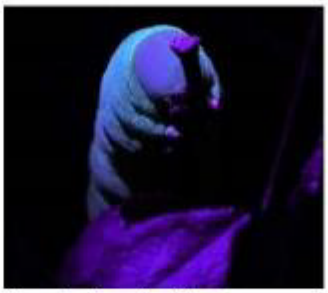
The CSCRMP and the Conservation and Management Permit were circulated through relevant stakeholders at Camp Edwards. However, two projects identified a need for more detailed training and internal communication. A troop labor road repair was implemented in September, 2021 on the western portion of Estey Road and southern portion of Fredrikson Road (Training Area A-3) without prior coordination. A previously developed engineering design was used and there were no existing puddles so no major issues occurred and no clam shrimp habitat was taken. However, it identified some communication and process gaps that have been addressed. Additionally, during the October/November road repairs implemented by IAGWSP, the working contractor graded a section of Wheelock Road without prior approval to facilitate material hauling. This section had received clam shrimp in three puddles as mitigation for the impact area boundary work and the puddles had been signed. Mitigation for this take is discussed in the annual road maintenance plan.

While the planning, preparation, and mitigation portions of the conservation plan are working well there are still weaknesses in communication and coordination that are being addressed. Two meetings have been held since the grading incident that included all potential road/trail maintenance and repair stakeholders. During these meetings, stakeholders were also able to identify roads and road sections in need of repair and planned for FY22. With this, required and/or voluntary mitigation was assessed based on potential impacts to available and known clam shrimp habitat, as well as other wildlife, and worked into the FY22 annual road work plan. This plan has been submitted to MassWildlife for review, coordination, and approval. A plan to mitigate for the loss of clam shrimp habitat and clam shrimp individuals from the Wheelock Road grading was also included in the work plan. It's the intent that these meetings involving all potential road/trail maintenance/repair stakeholders will occur on at least an annual basis for consensus on road work planning and clam shrimp habitat and mitigation requirements.

Agassiz's Clam Shrimp collected for identification confirmation of adults gathered for relocation to mitigation sites.

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



Slender Clearwing Moth larva feeding on Lowbush Blueberry. Detected and shown with ultra-violet light during rare caterpillar surveys at Sierra Range.

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. To support this master plan approach, a comprehensive mitigation plan was developed including establishing 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 location, Infantry Squad Battle Course at the formerly used Infantry Battle Course location, expansion of Tango and Sierra ranges, Cantonment modernization including a running track and classroom buildings, and potential future solar development. The mitigation plan combines project design/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.

Grass-leaved Ladies' tresses Orchid was newly documented for JBCC in the Grasslands Mitigation Focal Area in FY21.

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 1-4 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 of former parade field in cantonment. This transfer was included within the master CMP agreement. The parcel was transferred to Military Division in 2020 and will be fully transferred to MADFW with anticipated completion in 2022. MANG will receive a license to maintain overall access and use to meet perpetual habitat conversion and long-term management requirements under the mitigation agreement. There are no new updates for FY21 regarding real property actions. The MANG State Quartermaster has been in regular communication with the MA Department of Fish and Game General Counsel to develop Care, Custody, and Control agreements for the transferred parcels and to complete the transfer of Parcel H of Unit K.

Restored scrub oak shrubland pocket within Pine Barrens Mitigation Focal Area West (Training Area E-4, OP10); Sept. 2021. The original restoration (Nov. 2017); preceded mitigation, but it is an excellent reference site.

Construction Projects. Approval and construction of the flagship project – the MPMG Range – has been delayed and is pending resumption of the Environmental Management Commission process. However, the redevelopment of Tango Range, which was approved under the CMP in FY20, was completed at the end of FY21. Final reports are in development and near completion for Tango Range permit compliance. Additionally, the soil staging operation in partnership with Eversource was completed in FY21. Material from the redevelopment of the Bourne Switching station was accepted by Camp Edwards for clean fill material. The hauling and staging was permitted under the MAARNG CMP, including turtle protection provided by Eversource. The management of the turtle protection for the staged soil is being transferred to MAARNG in the late fall of 2021 and will persist until soil is used for the MPMG Range construction.

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 management, which itself is a subset within our 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.

Sum of Contract Cost	Fiscal Year			Grand
Project Type	2019	2020	2021	Total
Mitigation: Administrative	$6,020	$45,169	$11,262	$62,451
Mitigation: Construction support		$221,876		$221,876
Mitigation: Monitoring	$62,810	$103,248	$108,058	$274,116
Mitigation: Other				
Mitigation: Initial treatment, fire	$64,480			$64,480
Mitigation: Initial treatment, mechanical	$179,986	$88,458	$148,900	$417,344
Mitigation: Maintenance treatment, other		$55,950	$8,000	$63,950
Grand Total	**$313,295**	**$514,701**	**$276,220**	**$1,104,216**

Table 1. Contracted expenditure by federal fiscal year implementing the Master Plan CMP.

Sum of Mitigation Acreage	Fiscal Year				Grand
Project Type	2019	2020	2021	2022	Total
Pine Barrens	520	401	184.4	-155	950.4
Construction: Pine Barrens		-6		-412	-418
Mitigation: Initial treatment, fire	448			40	488
Mitigation: Initial treatment, mechanical	72	106	164	27	369
Mitigation: Maintenance treatment, fire			20	190	210
Mitigation: Maintenance treatment, other		40			40
Mitigation: Real Property		261			261
Sandplain Grassland	42	80	47	168	173
Construction: Sandplain Grassland				-36	-36
Mitigation: Initial treatment, fire	42			40	82
Mitigation: Initial treatment, mechanical		80			80
Mitigation: Maintenance treatment, fire			47		47
Mitigation: Maintenance treatment, other				14	14
Mitigation: Real Property				150	150
Grand Total	**562**	**481**	**231.4**	**13**	**1287**

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 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 PBFA West (Training Area A-5), Oct. 2021. The first mitigation project funded through the CMP has had strong results.

NR-ITAM personnel recording and applying radio-transmitters to two Eastern Box Turtles.

Mitigation investment for specific CMP implementation contracts and projects totaled $276,220. The primary difference from the previous year's higher investment was construction support for box turtles, which was contracted in 2020 to cover the entirety of the proposed Multi-Purpose Machine Gun (MPMG) Range construction. All requested funds for FY21 were received from National Guard Bureau to support proposed projects and all received funds were obligated within FY21. The breakdown by category of FY21 CMP expenditures is outlined in Table 1. This 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, state-listed species habitat restoration outside the focal areas, etc.). An additional $290,000 was spent on staff time and other state-listed species specific projects (i.e., where one or more state-listed species was the primary objective rather than general ecosystem or program).

Several major mitigation efforts were completed, ongoing, and/or initiated in FY21, addressing all the above-listed components of the master CMP. The mitigation actions implemented during FY21 totaled 231 acres of active habitat restoration. Prescribed fire remained limited in FY21, but was reinvigorated after FY20 did not have prescribed burning due to weather and the pandemic. Multiple trainings and four burn days occurred at Camp Edwards in FY21. Three prescribed burns were fully or partially within mitigation areas, though the Sierra Range barrens habitat 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 FY21 in addition to active habitat management. Projects undertaken in FY21 as part of mitigation efforts are summarized below. Note that projects and efforts that are programmatic in nature or otherwise not specifically meeting requirements of the Permits 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 develop a protective alternative for hibernating turtles.
  - **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 is in development and will be submitted to MADFW consistent with permit requirements with anticipated delivery by the end of 2021.

- **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. MEPA/MESA reviews and approvals are complete and notification will be made when funding is available to contract project implementation, including compliance with the CMP and turtle protection actions. Anticipated contracting is the middle of FY22.
- **ISBC Range –** Design consultation and internal review are ongoing. Anticipating environmental review of design in late FY22.

- **Species Protection**
  - **MPMG Range** – Intensive year 3 of Eastern Box Turtle surveys implementing the approved turtle protection plan. The FY20 report was submitted in February 2021 to NHESP, and the FY21 report will be submitted in early 2022. Additional pre-construction surveys were added to the plan given the delayed construction implementation. The protection plan and actions were amended given the lack of turtle exclusion barrier, which is part of the construction contract and requires unexploded ordnance support. A movement barrier was installed, with approval, by in-house personnel to provide an area of good hibernation habitat (based on observed density of use) near the proposed project site. Additional pre-construction surveys were completed in the fall of 2021. As winter approaches, turtles within the limits of work will be relocated behind the barrier to allow for winter installation of the silt fence and tree removal.
  - **Tango Range** – The preconstruction survey report was submitted in November 2020 and an interim, year-end report was submitted to NHESP in January 2021. In FY 2021, surveys during construction continued and oversight during silt fence removal was completed at the end of the project. The closeout report for turtle protection was submitted on 10-DEC-2021 and approved by NHESP on 14-DEC-2021.
  - **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** - Eversource completed a turtle protection project at the Dig Site to enclose the site, survey for turtles, and monitor. The Dig Site is being used as a stockpiling site for clean, tested on-site soil that will be used on future construction projects on base. The monitoring, maintenance and reporting for this site has been taken over by the MAARNG in FY22.

- **Species Monitoring (CMP focused)**
  - **Eastern Box Turtle (EBT)**
    - MAARNG NR-ITAM contracted the University of Illinois Wildlife Epidemiology Laboratory to implement an intensive box turtle health assessment. A total of 59 box turtles were sampled, the majority of which had physical assessments and blood samples taken multiple times through the summer to evaluate overall condition of the population and potential

influences leading to the prevalence of fly larvae, suspected sarcophagid, infestations and other potential health concerns. This project coordinated very closely with NR-ITAM, working from the same office, and others at Camp Edwards to gain efficiency from other ongoing turtle projects and opportunistic turtle observations from other site users. Oxbow Associates, working for on a turtle protection project for Eversource, tagged one turtle on Camp Edwards that was sampled and also escorted the veterinary student to sample 11 box turtles at their site in Sandwich. The veterinary student was also able to sample Spotted turtles captured during a Legacy funded project awarded to the Smithsonian. Sample analysis, data analysis, and reporting are ongoing. Updates from the field effort are available online from the veterinary student at: https://vetmed.illinois.edu/wel/author/capecodturtles/

- MAARNG applied radio transmitters and monitored previously transmittered turtles for an end of year total of 54 EBT during FY21 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.
- Preconstruction surveys referenced above led to the discovery of 5 new EBT (4 at the MPMG and one near Tango Range) and one previously tagged turtle that had lost a transmitter. Radiotransmitters were applied to all 6 individuals. Two mortalities were documented, including one road mortality in a nearby training area and one mortality from unknown causes. The signals for two turtles cannot be located, but one of the turtles was last heard coming from the Impact Area. Radio failure can also cause the loss of signal. Preconstruction survey and monitoring will continue for MPMG Range.
- 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. Seven (7) EBT were detected in FY21 as part of this effort and all individuals were outfitted with radio transmitters for long-term tracking.
- MAARNG, MADFW, and USFWS are coordinating with a graduate student at University of Massachusetts (UMass) Amherst's Massachusetts Cooperative Fish and Wildlife Research Unit (website) who plans to monitor and investigate the population of transmittered turtles at Camp Edwards.

Prairie Warbler is classified as a Species of Greatest Conservation Need and is locally relatively abundant and widespread at Camp Edwards, showing positive response to pine barrens habitat management.

- **Breeding Bird Point-counts**
  - Point-count surveys were conducted from 24 May through 24 June, 2021. 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 80 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 2020. This standard point-count methodology allows for analyzing both abundance and occupancy whereas the 1994-2013 methodology primarily supports occupancy analysis. Trends in occupancy were compared for the different periods and show positive or stable trends for nearly all Species of Greatest Conservation Need (SGCN) as identified by the State Wildlife Action Plan. Scarlet Tanager (*Piranga olivacea*) and Brown Thrasher (*Toxostoma rufum*) are two useful habitat indicators species, both of which were documented with significant increases over the 1994-2013 period (+2.6% and +2.0% per year, respectively) despite regional/rangewide declines for each (from -2% to -9% per year). Scarlet Tanager averaged over 76% occupancy at Camp Edwards from 2013-2020 with increasing occupancy trend similar to the previous period and a significantly increasing per point count trend, compared to a mean of 40% occupancy for the prior survey period. Additionally, Brown Thrasher averaged over 60% occupancy with increasing, but not statistically significant trends for both occupancy and count, compared to a mean of roughly 23% occupancy for the prior survey period. Likewise, species such as Field Sparrow (*Spizella pusilla*) and Prairie Warbler (*Setophaga discolor*) are showing notable, though not yet statistically significant, increases in the northern training area in response to expanded habitat restoration while concurrently declining within primary grassland habitat as expected with reduction in shrub cover through habitat restoration. A full report on the monitoring data analysis will be developed in 2022 and provided to MADFW and others.

- **Eastern Whip-poor-will (EWPW)**
  - MAARNG NR-ITAM personnel conducted EWPW point-count transect surveys on 19 May, 2021. 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 4.3 birds, continuing a long-term stable to increasing trend from 2013 through 2021. Surveys are completed in coordination with MADFW and follow the Northeastern 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 and these efforts provided consistent results. A full report on the effort has been sent to MADFW. Notably, in a 2021 publication (online access) researchers at Fort Drum Army Installation found that managed forest stands were preferred by EWPW reaching peak occupancy at a basal area of approximately 60 square feet per acre. This is very similar to the 80 square feet per acre or less target for southern pine beetle preparedness and shaded fuel break maintenance.

Grapholita tristrigana is a common barrens specialist moth at Camp Edwards with hostplant of Baptisia. It has a highly localized distribution in the eastern US.

- **Lepidoptera (Moths and Butterflies)**
  - Pine Barrens Moths: Development of a statistically robust and comprehensive moth monitoring protocol continued through a contract from MAARNG NR-ITAM with Western EcoSystems Technology, Inc. (WEST). The protocol and

supporting elements were completed and delivered at the end of November 2021. The initial round of vegetation surveys under the new protocol was completed during the summer of 2021. The overall protocol has a foundation of vegetation surveys that will evaluate change in structure and composition. In addition, protocols have been developed for nocturnal moth sampling and targeted diurnal sampling. The initial nocturnal UV trapping effort is anticipated during the summer of 2022.

- 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 of the survey units is within the Sandplain Grassland Mitigation Focal Area (Primary) while another is within the Sierra Range barrens habitat mitigation area (not part of the CMP mitigation). The third location is in the powerline right of way along Gibbs Road in Training Area C-13. Frosted Elfins were detected as adults at all three locations and appear to be expanding, especially in the grasslands sampling area. Follow-up larval surveys were completed with ultraviolet (UV) flashlights, which is particularly effective for Frosted Elfins, Slender Clearwing Moths (*Hemaris gracilis*), Barrens Buck Moth (*Hemileuca maia*) and other listed or otherwise rare Lepidoptera. Three nights of caterpillar surveys were completed in June and July 2021 covering the three sample sites with Frosted Elfins documented foraging on *Baptisia tinctoria* at all three. Slender Clearwing Moth was again documented with multiple individuals at the Sierra Range barrens habitat and new locations documented with a caterpillar at the northwestern elfin survey location and an adult photographed in the central grasslands of the SGMFA (Primary) for a total of four sites at Camp Edwards for this likely under-surveyed and secretive low blueberry specialist.
- General Moths: More opportunistic moth survey and documentation has continued forward from 2019. During FY21 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, many informal diurnal photography efforts by Jake McCumber led to documentation of rare barrens associated species, including multiple new species documented for Barnstable County and one new species for the Commonwealth (*Ptycerata buskella*). Of particular management interest is documentation of many rare barrens habitat specialists that are poorly represented in New England or throughout their ranges. The growing suite of online identification aids and digital photography are significant facilitators allowing for better documentation, in particular, of microlepidoptera.

- **State- listed Plants**
  - Frost bottom associates: 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. For FY21 broad-scale monitoring was not implemented. Effort focused on installation of a wooden "buck and pole" style fence around a frost bottom location for both species. It anecdotally appeared to eliminate

browsing by deer while having the benefit of being wooden and temporary fencing without soil impacts or digging.

- New listed species: A new MESA-listed species for JBCC was discovered in FY21 in two separate locations, both of which are within a mitigation focal area. Grass-leaved Ladies'-tresses Orchid is listed as Threatened in Massachusetts with similar threats as most other JBCC species, including development and habitat succession. This is a fairly expected species on-site and at the locations found. It is expected to respond positively to ongoing management efforts to expand and maintain suitable habitat. Location information is excluded here, but full reporting will be provided through Heritage Hub, MassWildlife's rare species reporting online database.

- **Habitat Management and Planning**
  - **Planning** – A comprehensive prescribed burn plan was developed for Training Areas BA-7 and BA-1 within PBMFA-South. This facilitates prescribed burn treatment following the completed mastication work described below and the BA-7 prescribed burns completed in 2013 with strongly positive rare species response.
  - **Pine Barrens Mechanical Restoration**
    - Implementation was completed for the previously (FY20) contracted mechanical treatment in BA-7, which involved mowing dead trees across 157 acres to facilitate reentry with prescribed fire. This was a critical restoration step and included patchy mowing of shrub vegetation to introduce more heterogeneity in shrub layer structure.
    - In-house scrub oak and other shrub mowing (7.4 acres) was ongoing in Training Area B-6 (PBMFA-South) as part of a small-scale and long term patch mowing to diversify age and structure composition in a good pitch pine – scrub oak area that is more challenging to burn and has needed maintenance after last having prescribed fire in 2009.
    - A whole-tree harvest project was contracted in FY21 for winter 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 will expose an overgrown kettle hole depression and its "airshed" with intent of restoring frost bottom ecological function with scrub oak shrubland 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 may be implemented and the project area will transition into the previously restored OP9/OP10 area (shown above).

Grassland unit GLU04a two months after prescribed fire and 1.5 years after brush mowing. The area had a vigorous response of important host plants followed by flush of little bluestem. Many rare habitat specialists were documented post burn including the rare *Sitochroa dasconalis* and *Pococera baptisiella*.

  - **Prescribed Burning**
    - A grassland habitat maintenance burn of 47 acres was completed in subunit GLU04a within SGMFA-Primary (Parcel H of Unit K) as part of the ongoing restoration and maintenance of that

150-acre parcel. The burn followed major restoration effort to remove trees from 2018, followed by brush mowing in 2021. Resprouting exotic shrubs were treated with herbicide in early FY22. This habitat area has been very effectively restored to functioning and diverse grassland and the burned area was the location for numerous rare moth observations this summer (Baptisia and heath specialists) along with an expansion area for both butterfly milkweed (*Asclepias tuberosa*) and one of its obligates – the state-listed Unexpected Cycnia Moth (*Cycnia inopinatus*).

- A pine barrens habitat maintenance prescribed burn of approximately 20 acres was conducted in Training Area E-3 (PBFA-West) in the OP-01 area on 14-APR-2021 as follow-up maintenance to the 2017 harvest and burn. The entire intended unit was not completed due to fire behavior more active than anticipated and the remainder of the unit will likely be completed in 2022. The partial burn provides good habitat heterogeneity and had excellent vegetative response– especially heath species.
- A pine barrens habitat management burn of 25 acres was conducted at the Sierra Range pine barrens mitigation zone, which is not part of this CMP, but is continuation of past completed mitigation commitment. This habitat burn was completed on 25-MAY-2021 and well met habitat objectives in a zone that has become high profile for habitat specialists such as the Slender Clearwing Moth and Frosted Elfin along with a high density of other listed species including Barrens Buckmoth and Eastern Whip-poor-will.

Sierra Range barrens habitat being treated with prescribed fire. This habitat area, its history, our management, and some of the species found there were highlighted by the US Fish and Wildlife Service Northeast Region in an April post titled Conservation Targets based on the successful restoration from open small arms range to focal conservation area with many rare species (https://medium.com/usfishandwildlifeservicenortheast/conservation-targets-72a068e6b103).

Fiscal Year 2022 Planning and Implementation

Army National Guard budgets have been substantially reduced in FY22, impacting facilities and environmental programs throughout the country. However, $134,000 has been funded specifically for state-listed species conservation projects between dedicated mitigation under the master development plan CMP ($57,000; MA175180002) and other state-listed species projects ($77,000; MA175150003), much of which supports the mitigation implementation. Additionally, extra funds are anticipated as we get further into the fiscal year. 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/management targets, resource monitoring, and data analysis.

Central-western portion of the Sandplain Grassland Mitigation Focal Area within a Frosted Elfin monitoring plot and following 2019 prescribed fire. This habitat supports high species diversity and this location had a new state record moth, Ptycorata buskella, documented June, 2021.

Mechanical implementation of habitat mitigation is expected to be minimal for FY22 as extensive mechanical work has occurred over the last three years of implementation. Significant focus has gone into planning for more active prescribed burning after challenges posed by COVID-19 and weather conditions. 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.

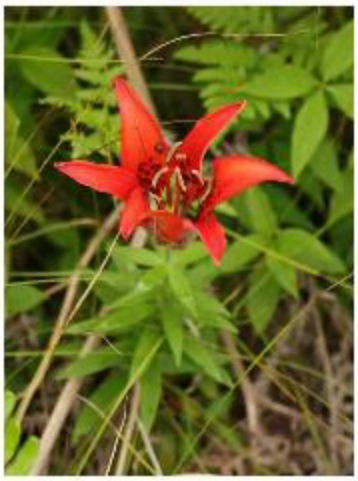
Monitoring and research efforts will be focal for FY22 with the first year of the long-term moth monitoring protocol and two developing box turtle research projects in partnership with UMass Amherst, MassWildlife, and US Fish and Wildlife Service.

- **Project Scoping, Design Minimization, and NHESP Review**
  - **MPMG Range** – Completion of the Environmental Management Commission process will hopefully be completed during the winter of FY22 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.
  - **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 FY22. 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 FY22 or FY23. Submission and completion of all pre-Work required information and tasks will be completed as appropriate and able 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.
  - **Track and Field** – Initiation and compliance of turtle protection plan consistent with approval if construction project is funded and awarded.

- **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, which will focus 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)** – Finalizing robust monitoring plan. Implementation of monitoring plan, including vegetation surveys, UV trap sampling, and pilot larval surveys for Barrens buckmoth, depending on resources.



The Wood Lily (Lilium philadelphicum) is not state-listed, but is an early successional habitat associate. It is a good indicator of barrens habitat condition at Camp Edwards and responds well to fire and restoration efforts.

- **Habitat Management and Planning (see map below)**
  - **Prescribed Fire** – Priority prescribed burn areas for mitigation include:
    - PBMFA (North): up to approximately 170 acres of the southern portion of Training Area C-14 including previously harvested area and scrub oak shrubland
    - PBMFA (West): Training Area E-2 of which approximately 200 acres of pitch pine – scrub oak habitat is unburned in recent history and 61 acres is previously burned (2019).
    - PBMFA (South): Training Areas B-6 and B-7 maintenance fires for pitch pine – scrub oak and pitch pine – heath habitat up to approximately 260 acres.

- SGMHA (Primary): approximately 61 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.

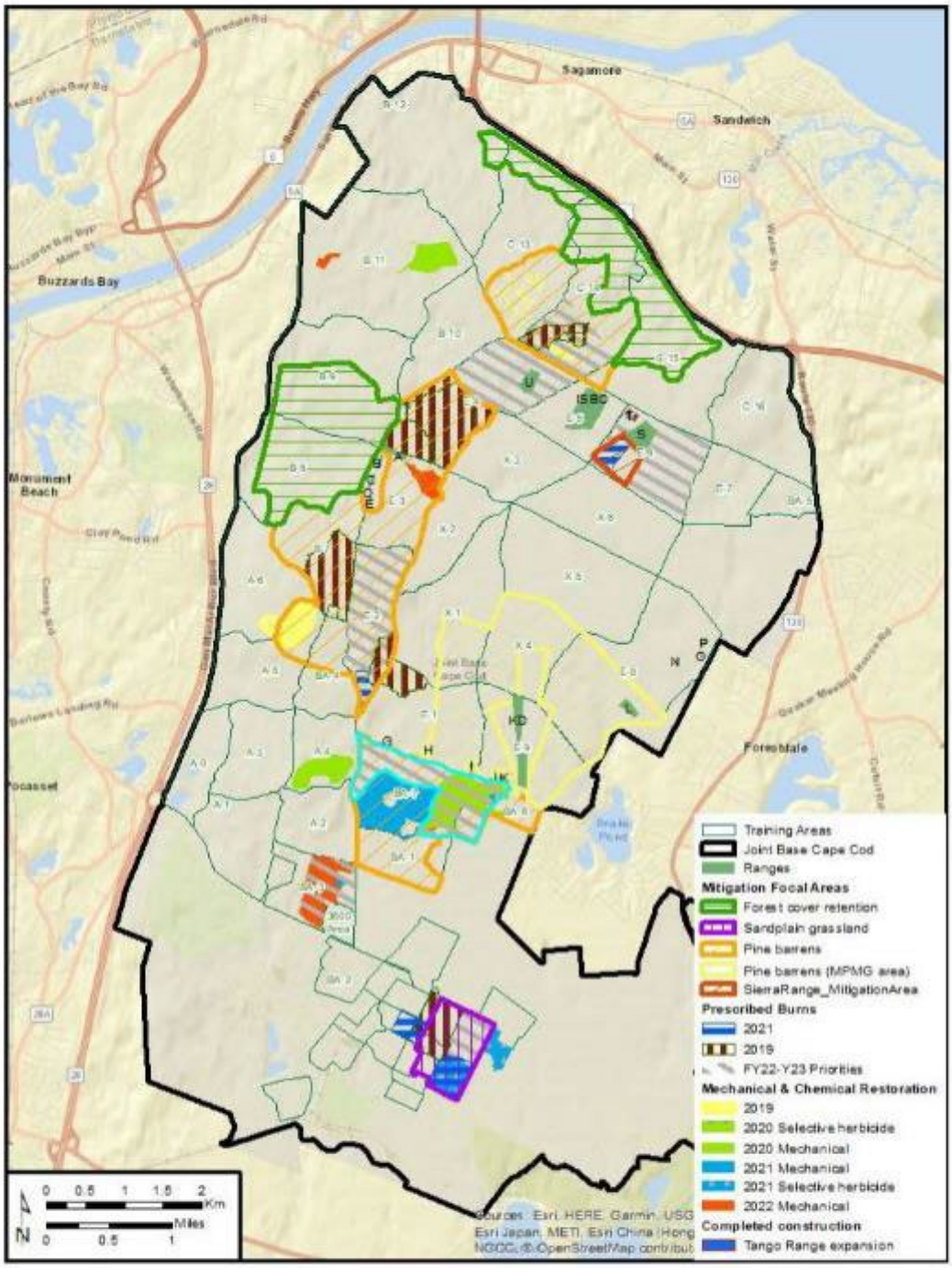
- Mechanical Restoration –
  - Completion of the 27 acre RAW3 harvest contracted in FY21. As described above this project focuses on restoration of a large kettle hole frost bottom system and surrounding pitch pine – scrub oak savannah.
  - Long-term and small scale patch mowing of understory shrubs and small trees will continue in Training Area BA-6 to provide complex structural diversity in support of both training and habitat objectives. Approximately 7 acres will be mowed in FY22.

- **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 foci, including extensive discussion of rare species, habitat needs, ongoing mitigation efforts under the CMP. These tours have garnered notable interest in listed fauna including listed moths and other early successional species. These tours, which were held from August through December, are expected to begin again in the spring and will continue to emphasize endangered species and habitat conservation.

Jake McCumber presenting a tracked Eastern Box Turtle during a Camp Edwards public tour. This old male was opportunistically found on the firing line of Sierra Range during the tour and provided an excellent and popular educational opportunity.

  - **Grassland Bird Tours** – These annual tours were halted for two years due to the pandemic, but will start again in FY22 focusing on localized specialties of sandplain grassland habitat at Camp Edwards. These have long been productive outreach with the public and bird enthusiasts for both grasslands habitat conservation and military conservation.
  - **Public presentations** – MAARNG personnel have already given a presentation in FY22 focused on the Barrens Buck Moth to the Upper Cape Naturalist Club. Additional talks and field trips for this group and others (MA Butterfly Club, etc.) are planned for the year highlighting rare species and habitat restoration fundamental to the mitigation efforts of the Permit.

All photos taken 2021 at Camp Edwards; MAARNG Natural Resources and Training Lands Program
Cover photos – Top: Barrens Buck Moth (*Hemileuca maia*) female. Bottom (from left): Grasshopper Sparrow (*Ammodramus savannarum*), Eastern Box Turtle (*Terrapene carolina*) with radio-transmitter, Frosted Elfin (*Callophrys irus*)



Map of Camp Edwards prescribed fires and mechanical pine barrens and training lands restoration projects from 2019 forward, including upcoming priorities. Designated mitigation areas are also shown.

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

Appendix F - 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 2012**	**TY 2013**	**TY 2014**	**TY 2015**	**TY 2016**	**TY 2017**	**TY 2018**	**TY 2019**	**TY 2020**	**TY 2021**
BIRDS												
Grasshopper Sparrow[13] *(Ammodramus savannarum)*	-	T	27	19	26	23	16	15	16	20	34	36
Northern Harrier[1] *(Circus cyaneus)*	-	T	5	8	12	Wintering	Wintering	Wintering	Wintering	Wintering	Wintering	Wintering
Upland Sandpiper[13] *(Bartramia longicauda)*	-	E	3	5	2	4	9	8	7	12	6	2
Eastern Meadowlark[13,16] *(Sturnella magna)*	-	SC	2	3	1	0	8	3	2	7	14	17
Long-eared Owl[1] *(Asio otus)*	-	SC	0	0	1	0	0	0	0	0	0	0
Vesper Sparrow *(Pooecetes gramineus)*	-	T	1	3	1	0	0	0	0	0	0	0
Whip-poor-will[2] *(Antrostomus vociferous)*	-	SC	201	51	156	96	87	52	110	53	99	136
Bald Eagle[1] *(Haliaeetus leucocephalus)*	-	SC	0	0	0	3	0	0	0	0	0	0
REPTILES and AMPHIBIANS												
Eastern Box Turtle *(Terrapene carolina carolina)*	-	SC	13	1	15	13	38	42	43	58	45	83
Eastern Hog-nosed Snake *(Heterodon platirhinos)*	-	SC	0	0	0	0	2	3	8	9	1	2

Individuals Reported												
Common/Scientific Names	**Fed Status[14]**	**State Status**	**TY 2012**	**TY 2013**	**TY 2014**	**TY 2015**	**TY 2016**	**TY 2017**	**TY 2018**	**TY 2019**	**TY 2020**	**TY 2021**
ODONATES												
Comet Darner[3] *(Anax longipes)*	-	-	4	0	5	0	N/A	N/A	N/A	N/A	N/A	N/A
Spatterdock Darner[3] *(Aeshna mutata)*	-	-	14	0	9	0	N/A	N/A	N/A	N/A	N/A	N/A
PLANTS												
Adder's Tongue Fern[4,6] *(Ophioglossum pusillum)*	-	T	84	542	1467	256	98	247	0	25	646	N/A
Spring Ladies Tresses *(Spiranthes vernalis)*	-	T	0	0	0	0	0	0	0	0	0	3
Broad Tinker's Weed[5,6] *(Triosteum perfoliatum)*	-	E	332	1230	297	N/A	113	127	0	200	6	N/A
American Arborvitae[9] (*Thuja occidentalis*)	-	E	0	0	0	0	4	N/A	N/A	N/A	N/A	N/A
BEES												
Walsh's Anthophora[15] *(Anthophora walshii)*	-	E	0	0	0	0	0	5 (1)	0	32 (9)	4	N/A
BUTTERFLIES and MOTHS[11]												
Buck Moth (*Hemileuca maia*)	-	SC	0	0	4	13	90	95	0	4	2	74
Pine Barrens Speranza *(Speranza exonerata)*	-	SC	0	0	0	0	44	13	0	0	0	0
Sandplain Euchlaena *(Euchlaena madusaria)*	-	SC	0	0	0	0	3	7	0	0	1	0
Heath Metarranthis *(Metarranthis pilosaria)*	-	SC	0	0	0	0	1	1	0	0	0	0
Melsheimer's Sack Bearer *(Cicinnus melsheimeri)*	-	T	0	0	0	0	2	0	0	0	7	0

Individuals Reported												
Common/Scientific Names	**Fed Status[14]**	**State Status**	**TY 2012**	**TY 2013**	**TY 2014**	**TY 2015**	**TY 2016**	**TY 2017**	**TY 2018**	**TY 2019**	**TY 2020**	**TY 2021**
Gerhard's Underwing *(Catocala herodias)*	-	SC	0	0	0	0	33	10	0	0	2	0
Pine Barrens Zale *(Zale lunifera)*	-	SC	0	0	0	0	13	8	0	0	0	0
Barrens Dagger Moth *(Acronicta albarufa)*	-	T	0	0	0	0	1	0	0	0	0	0
Chain-dotted Geometer *(Cingilia catenaria)*	-	SC	0	0	0	0	0	0	0	1	0	0
Drunk Apamea *(Apamea inebriata)*	-	SC	0	0	0	0	1	0	0	0	0	0
Pink Sallow *(Psectraglaea carnosa)*	-	SC	0	0	0	0	9	*5*	0	0	0	0
Pink Streak *(Dargida rubripennis)*	-	T	0	0	0	0	25	0	0	0	3	1
Collared Cycnia *(Cycnia collaris)*	-	T	0	0	0	0	0	1	0	11	33	200
Coastal Heathland Cutworm *(Abagrotis benjamini)*	-	SC	0	0	0	0	0	1	0	0	0	0
Woolly Gray *(Lycia ypsilon)*	-	T	0	0	0	0	0	2	0	0	0	0
Water-willow Stem Borer *(Papaipema sulphurata)*	-	T	0	0	0	0	0	1	0	0	0	0
Waxed Sallow Moth *(Chaetaglaea cerata)*	-	SC	0	0	0	0	0	2	0	0	0	0
Frosted Elfin[12] *(Callophrys irus)*	-	SC	0	0	0	0	*5*	*5*	*5*	TBD	25	*57*
Slender Clearwing Sphinx *(Hemaris gracilis)*	-	SC	0	0	0	0	0	0	0	0	*5*	3

Individuals Reported												
Common/Scientific Names	**Fed Status[14]**	**State Status**	**TY 2012**	**TY 2013**	**TY 2014**	**TY 2015**	**TY 2016**	**TY 2017**	**TY 2018**	**TY 2019**	**TY 2020**	**TY 2021**
CRUSTACEANS												
Agassiz's Clam Shrimp[10] *(Eulimnadia agassizii)*	-	E	0	0	0	1	0	6	38	9	3	5
American Clam Shrimp ^ *(Limnadia lenticularis)*	-	SC	0	0	0	0	0	0	0	0	0	3
MAMMALS												
Northern Long-Eared Bat[7,8] *(Myotis septentionalis)*	T	E	0	0	8	22 (2)	15 (1)	2	1	3	1	TBD
Little Brown Bat[7] *(Myotis lucifugus)*	UR	E	0	0	4	40	22	4	2	6	2	TBD
Tricolored Bat[7] (Perimyotis subflavus)	UR	E	0	0	11	11	7	3	2	3	1	TBD
Eastern Small-Footed Bat[7] *(Myotis leibii)*	UR	E	0	0	0	0	0	0	0	1	1	TBD

[1] 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).

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

[3] Comet and Spatterdock Darner are no longer on NHESP's rare species list. Also, Odonate surveys were suspended after TY 2015.

[4] Several known *Ophioglossum* sites could not be surveyed in TY 2016 due to a lack of cease-fire agreement with the off-base Monument Beach Shooting Club. 2019 numbers are likely under representative, as surveys occurred late in the season. In 2020 *Ophioglossum* was surveyed earlier in the year in order to get an accurate count.

[5] Actual 2019 numbers may be as few as 82, MAARNG staff is now studying the genetics of *Triosteum perfoliatum* and *T. aurantiacum* due to difficulty in accurately differentiating the two species. Once the genetics project is completed, 2020 numbers will be reported.

[6] In 2018, only sites with historic records and no recent records were surveyed, and this should not be interpreted as a loss of rare plants between 2017 and 2018.

[7] 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).

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

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

[10] Numbers represent only locations where species was found and ID confirmed by either NHESP Aquatic Ecologist or trained MAARNG staff.

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

[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] 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.

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

[15] 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.

[16] 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.

APPENDIX H
ENVIRONMENTAL PERFORMANCE STANDARDS VIOLATIONS HISTORY

EPS VIOLATIONS HISTORY			
TRAINING YEAR	REPORTED VIOLATION	EXPLANATION OF VIOLATION	CORRECTIVE ACTION
TY 2021	Range Performance EPS (EPS 19)	Additional targets were placed on the 25-meter line on Sierra Range. Transition firing was conducted on Echo Range. No consultation for approval was conducted with Camp Edwards Plans and Training, the Environmental & Readiness Center and the EMC's Environmental Officer. The MAARNG reported the nonconformance to the EMC on February 18, 2021.	Full-time Range Control staff were counseled on the importance of following established processes of consultation and approval for any non-standard training event; the Range Control maintenance manager was directed that he shall not alter or install additional targets on a range unless there is an approval in writing or the range is being prepared for an approved proof of concept for a future training event; OIC formalized non-standard training requests (exceptions to policy) in a Standard Operating Procedure; full-time Range Control staff was retrained; and those personnel involved in approving the non-standard training were given written counseling. In addition to corrective actions instituted by the MAARNG, the EMC required that the full-time Range Control staff undergo annual training on EPS 19.0 and the BMPs and OMMPs; newly assigned Range Control staff undergo training on EPS 19.0 and the BMPs and OMMP prior to being given authority for operational control of the small arms ranges; documenting the corrective actions and additional EMC requirements in Camp Edwards Operations and Training Regulation 350-2 and forwarding that to the EMC for review.
TY 2020	Training Area Fire Management EPS (EPS 11)	Three burn barrels (55-gallon drums) were found at SVLs 1 and 2. The MAARNG reported the nonconformance to the EMC on October 25, 2019.	All full-time and Mobilization Day staff are instructed to review Training Area Clearing processes and be re-briefed on guiding regulations and standards that apply to the Training Area/Reserve. Clear and obvious signage stating that open burning is prohibited has been posted at Range Control. The Camp Edwards Operations and Training Regulation 350-2 has been updated to clearly state the requirement for clearing training areas and that open burning is prohibited on Camp Edwards.
TY 2019	General Performance Standard	Three L600 M119 whistling booby trap simulators were used; they are not on the approved munitions list and were not authorized for use. The MAARNG reported a nonconformance to the EMC on September 17, 2019.	All levels: command, units training and the ASP will be provided a list of items permanently and temporarily authorized for a particular training event. The ASP will make a change in their ammunition reservation program that will not allow unauthorized ammunition or simulators to be reserved. Camp Edwards Range Control will do a final munition check as units check in for their reserved training area or venue.

TY 2018	Rare Species EPS (EPS 3)	A road puddle containing state-listed Agassiz clam shrimp was filled by a unit training at Dig Site 1. The MAARNG forwarded a formal notice of violation to the EMC on May 16, 2018.	Camp Edwards will, after relocation of the clam shrimp and in concert with the CMP, fill the puddles, use signage to avoid infilling of relevant puddles, and educate users as to how they are supposed to coordinate with Camp Edwards before taking actions outside of their training plan while in the Training Area/Reserve.
TY 2017	None	-----	-----
TY 2016	General Performance Standard	Eight thousand paintball rounds were fired by a unit on the IMT range (Dig Site 3) without permission or prior coordination. The MAARNG forwarded a formal notice of violation to the EMC on November 9, 2015.	Unit soldiers cleaned and cleared the area of debris, discussion of the seriousness of the violation with the Unit Commander and told of actions needed for compliance when wanting to train with any unapproved munition. Camp Edwards staff conducted a Range Officer in Charge and Range Safety brief audit to validate content and effectiveness. Range Control staff will conduct assessments of units while they are training in the Training Area/Reserve to ensure activities are within established performance standards.
TY 2015	Vehicle Performance Standard EPS (EPS 17)	A pickup truck was driven into, off road, and placed in Training Area BA-7 as a temporary training aid. The MAARNG forwarded a formal notice of violation to the EMC on June 5, 2015.	Camp Edwards staff conducted a Range Officer in Charge and Range Safety brief audit to validate content and effectiveness. Range Control staff will conduct assessments of units while they are training in the Training Area/Reserve to ensure activities are within established performance standards.
TY 2014	None	-----	
TY 2013	None	-----	-----

EPS VIOLATIONS HISTORY			
TRAINING YEAR	REPORTED VIOLATION	EXPLANATION OF VIOLATION	CORRECTIVE ACTION
TY 2012	Small Arms Range EPS (EPS 19)	On November 7, 2011, the EMC issued a notice for failure to remove water from bullet traps on all three operationally active small arms ranges within the prescribed time periods on multiple occasions during TY 2011. The EPA also cited the MAARNG for a violation for the same failure.	The MAARNG submitted a Response Packet to the EMC in early December 2011 which included: 1) a Notification Protocol should it not be able to comply with a requirement of the OMMPs; 2) a STAPP™ Range Tarp Cover Project Description; 3) Water Removal Contracting and Budgeting provisions; 4) creation of a Camp Edwards Sustainable Range Program Working Group; and 5) a Standard Operating Procedure for STAPP™ System Range Maintenance Procedures and Inspections.