DEPARTMENT OF THE AIR FORCE
AIR FORCE CIVIL ENGINEER CENTER
INSTALLATION RESTORATION PROGRAM
OTIS AIR NATIONAL GUARD BASE, MA 02542-1320

28 January 2021

AFCEC/JBCC
322 East Inner Road
Otis ANG Base, MA 02542-1320

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Mr. Leonard Pinaud
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Dear Mr. Lim and Mr. Pinaud:

AFCEC is hereby submitting the ***Final Explanation of Significant Differences for 1,4-Dioxane in Groundwater at Chemical Spill-10, Joint Base Cape Cod, MA*** dated January 2021. This document will be available on the U.S. Air Force Administrative Record (AR) at https://ar.afcec-cloud.af.mil/ under AR# 605530.

If you have any questions, please contact me at (508)968-4670 x5613 or email rose.forbes@us.af.mil.

Sincerely,

FORBES.ROSE.H.1036416218 Digitally signed by FORBES.ROSE.H.1036416218 Date: 2021.01.28 19:05:25 -05'00'

ROSE FORBES, P.E.
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Final Explanation of Significant Differences for 1,4-Dioxane in Groundwater at Chemical Spill-10, Joint Base Cape Cod, MA

January 2021

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Installation Restoration Program
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709298-EC-CS10-ESD-002

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ACRONYMS AND ABBREVIATIONS

AFCEC	Air Force Civil Engineer Center
AFCEE	Air Force Center for Engineering and the Environment
ANG	Air National Guard
AOC	Area of Concern
ARAR	applicable or relevant and appropriate requirement
ARNG	Army National Guard
BOMARC	Boeing Michigan Aerospace Research Center
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
COC	contaminant of concern
CS	Chemical Spill
CSM	conceptual site model
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
ETI	extraction, treatment, and infiltration
ETR	extraction, treatment, and reinjection
FFA	Federal Facility Agreement
FS	Fuel Spill
ft	foot or feet
GAC	granular activated carbon
gpm	gallons per minute
HQ	Hazard Quotient
IP	In-Plume
IROD	Interim Record of Decision
IRP	Installation Restoration Program
JBCC	Joint Base Cape Cod
LTM	long term monitoring

ACRONYMS AND ABBREVIATIONS

LUC	Land Use Control
MassDEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level
MMR	Massachusetts Military Reservation
MNA	monitored natural attenuation
MTU	mobile treatment unit
NCL	North Central Lobe
NCP	National Contingency Plan
NGB	National Guard Bureau
NL	Northern Lobe
NPL	National Priorities List
PCE	tetrachloroethene
RAO	Remedial Action Objective
RG	Remediation Goal
RI	Remedial Investigation
ROD	Record of Decision
SI	Site Inspection
SL	Southern Lobe
SPEIM	System Performance and Ecological Impact Monitoring
SRTF	Sandwich Road Treatment Facility
TCE	trichloroethene
USAF	U.S. Air Force
USC	United States Code
USCG	U.S. Coast Guard
UTES	Unit Training Equipment Site
µg/L	microgram per liter
1,1-DCE	1,1-dichloroethene
1,1,1-TCA	1,1,1-trichloroethane

1.0 INTRODUCTION

This *Final Explanation of Significant Differences for 1,4-Dioxane in Groundwater at Chemical Spill-10, Joint Base Cape Cod, MA* has been prepared to document changes to the remedy for the Chemical Spill-10 (CS-10) groundwater plume which include the addition of 1,4-dioxane as a contaminant of concern (COC) through the additional Remedial Action Objective (RAO) for 1,4-dioxane and adopting the existing CS-10 groundwater remedy documented in the *Final Record of Decision (ROD) for Chemical Spill-10 Groundwater* (AFCEE 2009a) for 1,4-dioxane. The Final Record of Decision (ROD) for CS-10 groundwater, which documented the selection of the remedy to address trichloroethene (TCE) and tetrachloroethene (PCE), was signed in August 2009 by the Air Force Center for Engineering and the Environment (AFCEE)[1] and the U.S. Environmental Protection Agency (EPA). In 2011, an Explanation of Significant Differences (ESD) was issued that clarified the inclusion of monitored natural attenuation (MNA) as a component of the selected remedy for CS-10 and several other Joint Base Cape Cod (JBCC)[2] Installation Restoration Program (IRP) groundwater sites, revised the Land Use Controls (LUCs), slightly modified the phrasing of the RAOs, and added text regarding the three-step process to achieve site closure (AFCEE 2011). In 2014, another ESD was prepared to document the changes to the CS-10 conceptual site model (CSM) which were identified during a data gap investigation (AFCEC 2013f), to modify the remedy to more aggressively remove contaminants from the aquifer so that cleanup levels can be achieved sooner (AFCEC 2014c), and to amend the original estimate of aquifer restoration timeframe at CS-10 presented in the ROD (AFCEC 2014a).

CS-10 is one of the IRP sites at JBCC; formerly known as the Massachusetts Military Reservation [MMR]), located on Cape Cod, Massachusetts (**Figures 1-1** and **1-2**). The Comprehensive Environmental Response, Compensation, and Liability Information System number for the MMR/JBCC site is MA2570024487.

1 In October 2012, AFCEE adopted a new organizational name, Air Force Civil Engineer Center (AFCEC). Therefore, the AFCEE and AFCEC acronyms refer to the same entity but are used in this document in relation to the date of a specific topic or document.

2 In July 2013, the Massachusetts Military Reservation (MMR) adopted a new name, the Joint Base Cape Cod (JBCC). Therefore, the MMR and JBCC acronyms refer to the same location but are used in this document in relation to the date of the specific topic/document.

Sampling for the emerging contaminant 1,4-dioxane at the CS-10 groundwater plume was a recommendation in the *Final 4th Five-Year Review, 2007-2012 Massachusetts Military Reservation (MMR) Superfund Site Otis Air National Guard Base, MA* (AFCEC 2013a). A presence/absence (Site Inspection [SI] equivalent) 1,4-dioxane field investigation at the CS-10 plume confirmed the presence of 1,4-dioxane in groundwater (AFCEC 2014b). A Supplemental Remedial Investigation (RI) was completed to characterize the nature and extent of 1,4-dioxane groundwater contamination at CS-10, evaluate its fate and transport, and determine if potentially unacceptable risks to human health and the environment exist from exposure to 1,4-dioxane in groundwater that would warrant remedial action (AFCEC 2017). Remedial alternatives for 1,4-dioxane were evaluated and documented in a Supplemental Feasibility Study report (AFCEC 2018) and the selected alternative is summarized in Section 3.0.

This ESD was prepared in accordance with *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents* (EPA 1999). In accordance with Executive Order 12580, the U.S. Air Force (USAF) is the lead agency for remedial actions at the MMR and this document is being issued by the USAF as the lead agency. The MMR was added to the National Priorities List (NPL) in 1989. A Federal Facility Agreement (FFA), which provided the legal framework for investigating and remediating numerous operable units at the MMR, was signed in 1991 (EPA et al. 1991). In 1996, the FFA was amended to add the USAF as the lead agency for the cleanup at MMR (EPA et al. 2002). The FFA, as amended, requires the USAF to implement Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requirements at MMR. In addition to the USAF, the EPA and National Guard Bureau (NGB) are parties to the FFA for the MMR. The Massachusetts Department of Environmental Protection (MassDEP) is not a signatory of the FFA but is an active participant in the clean-up process and provides guidance and direction to the remedy selection and oversight process.

The selected remedy for CS-10 groundwater as specified in the ROD consists of continued operation of the CS-10 remedial system (**Figure 1-3**) plus expansion of the system through the addition of an extraction well (03EW2112) and reinjection well (03RI2112) to address the portion of the CS-10 TCE and PCE plume in the southern trench area that has migrated beyond the base boundary (AFCEE 2009a). The additional extraction well (03EW2112) and reinjection well (03RI2112) were installed in 2008 and became operational in February 2009 (AFCEE 2010). The remedial system optimization documented in the 2014 ESD (AFCEC 2014a), which is expected to reduce the aquifer restoration timeframe, included the addition of two new extraction wells (03EW2113 and 03EW2114), two new reinjection wells (03RI2113 and 03RI2114), a mobile treatment unit (MTU), and modified flow rates and effective screen intervals at selected existing wells (**Figure 1-3**).

This ESD that documents the addition of 1,4-dioxane as a CS-10 groundwater COC does not alter the scope or significantly change the cost of the existing remedy. The remedial system is performing as expected and through the combination of the active treatment and natural attenuation processes, groundwater cleanup levels are expected to be achieved for the existing COCs (TCE and PCE) and for 1,4-dioxane within the estimated aquifer restoration timeframe presented in 2014 (AFCEC 2014a). Since the LUCs are in place and are expected to continue to function as intended to prevent exposure to TCE, PCE, and 1,4-dioxane, the remedy will remain protective of human health and the environment (AFCEC 2018).

This ESD adds 1,4-dioxane as a COC for CS-10 groundwater with a site-specific, risk-based remediation goal (RG) of 0.46 micrograms per liter (µg/L) and adds a new RAO:

- Prevent residential exposure to CS-10 groundwater with 1,4-dioxane concentrations greater than the site-specific, risk-based remediation goal of 0.46 µg/L which is set at a 1E-06 cancer risk level.

The site-specific risk-based RG of 0.46 µg/L replaces the Massachusetts Contingency Plan Method 1 Groundwater-1 standard of 0.3 µg/L that was used to assess groundwater data in the *Final Supplemental Remedial Investigation Report for 1,4-Dioxane at Chemical Spill-10, Joint Base Cape Cod, MA* (AFCEC 2017), and the *Final Supplemental Feasibility Study Report for 1,4-Dioxane at Chemical Spill-10, Joint Base Cape Cod, MA* (AFCEE 2018). MassDEP and EPA guidelines for 1,4-dioxane were developed for different regulatory programs and each agency uses different assumptions when calculating the respective guidelines. The Air Force's cleanup of the CS-10 groundwater is being done through the federal CERCLA program. The applicable or relevant and appropriate requirement (ARARs) tables for the CS-10 groundwater plume, incorporating To Be Considered (TBC) EPA guidance documents used to develop the federal site-specific risk-based RG for 1,4-dioxane, are provided in **Appendix A**. The site-specific federal risk-based RG of 0.46 µg/L is based on a residential drinking water scenario with a cancer risk of 1E-06 and was selected because there is no enforceable Federal or State drinking water standard for 1,4-dioxane (i.e., Maximum Contaminant Level [MCL] or Massachusetts Maximum Contaminant Level).

1.1 STATEMENT OF PURPOSE

The AFCEC is issuing this ESD in accordance with §117(c) of CERCLA and 40 Code of Federal Regulations (CFR) Section 300.435(c)(2)(i) of the National Contingency Plan (NCP) which requires the publication of an ESD to document the addition of a COC that was not included in the ROD. As required by Section 300.825(a)(2) of the NCP, this ESD will become part of the Administrative Record for the CS-10 IRP site at the JBCC. The Administrative Record is available for public review by appointment at the AFCEC IRP Office (322 East Inner Road, Otis ANG Base, Massachusetts, 02542) Monday - Friday, 8 a.m. to 4 p.m., excluding federal and state holidays, and is also available on-line at http://afcec.publicadmin-record.us.af.mil.

1.2 AUTHORIZING SIGNATURES

The following signatures represent the decision to authorize this ESD for the CS-10 Groundwater IRP site at the JBCC.

U.S. AIR FORCE

MAYER.GREGORY.C.1147646824 Digitally signed by MAYER.GREGORY.C.1147646824 Date: 2020.12.17 07:47:22 -06'00'

Date: 12/17/2020

GREGORY C. MAYER, Col, USAF, P.E.
Deputy Director, Environmental Management
Air Force Civil Engineer Center (AFCEC)

U.S. ENVIRONMENTAL PROTECTION AGENCY

BRYAN OLSON Digitally signed by BRYAN OLSON Date: 2021.01.14 10:21:34 -05'00'

Date: 1/14/2021

BRYAN OLSON
Director, Superfund and Emergency Management Division
USEPA New England

2.0 SITE HISTORY, SITE CONTAMINATION, AND SELECTED REMEDY

This section presents background information on the CS-10 IRP groundwater site, including an overview of the physical and chemical characteristics, history, and selected remedy.

2.1 INSTALLATION LOCATION AND HISTORY

The JBCC, listed on the NPL as Otis Air National Guard/Camp Edwards, is located on upper Cape Cod, Massachusetts (**Figure 1-1**). The JBCC comprises approximately 22,000 acres on Cape Cod and provides facilities for several operating command units: the Air National Guard (ANG), the Massachusetts Army National Guard (ARNG), the USAF, the U.S. Coast Guard (USCG), and the Veterans Affairs. Past military training, maneuvers, and aircraft operations, maintenance and support activities at the JBCC have resulted in releases of hazardous substances, wastes, and materials that contaminated soil in source areas and generated plumes of contaminated groundwater in the unconfined sand and gravel aquifer that underlies the JBCC and the surrounding towns.

The CS-10 groundwater plume is located in the southeast area of the JBCC, extending off-base into the towns of Falmouth and Mashpee (**Figures 1-2** and **1-3**). The plume is currently defined as the extent of groundwater contaminated with TCE and PCE at concentrations exceeding the federal MCL of 5 µg/L for both compounds. There are four separate areas in the CS-10 plume: (1) the In-Plume (IP) area (2) the Sandwich Road lobe (3) the southern trench area (4) and the leading edge area which is comprised of three lobes: the Northern lobe (NL); North-Central lobe (NCL); and Southern lobe (SL). The main body of the CS-10 plume (which includes the IP area, Sandwich Road lobe, and Southern Trench area) is nearly three miles long and over one mile wide. The most upgradient portion of the CS-10 NL is located approximately 500 feet (ft) downgradient of the JBCC base boundary and is approximately 3,800 ft long and up to 660 ft wide. The NCL is approximately 3,600 ft long and up to 700 ft wide. The SL is approximately 1,000 ft long and up to 400 ft wide. The maximum depth to the bottom of the plume is approximately 330 ft below ground surface (AFCEC 2013f). The footprint of the four portions of the

CS-10 plume occupies approximately 1,302 acres (**Figure 1-3**). As presented in Section 1.0, this ESD is intended to add 1,4-dioxane as a CS-10 groundwater COC which is located within the northwest area of CS-10 IP. Further details on the nature and extent of 1,4-dioxane in CS-10 groundwater is included in Section 3.0.

2.2 CS-10 SITE HISTORY, CONTAMINATION, AND REMEDIAL ACTIONS

The main source of the CS-10 groundwater plume is referred to as Area of Concern (AOC) CS-10/Fuel Spill-24 (FS-24). AOC CS-10/FS-24 occupies approximately 38 acres at the eastern boundary of the JBCC to the west of Snake and Weeks ponds (**Figure 1-3**). Originally, the AOC CS-10/FS-24 consisted of a number of buildings constructed as part of the former Boeing Michigan Aerospace Research Center (BOMARC) site (which operated from 1960 to 1973) and the Unit Training Equipment Site (UTES) (which has been in operation since 1978 and is currently used by the Massachusetts ARNG as the UTES facility for maintenance and storage of vehicles) (AFCEE 2008a). Numerous other sources of contamination are presumed to have contributed to the CS-10 plume as it traveled beneath the cantonment area of JBCC (E.C. Jordan Co. 1989 and 1990).

A ROD for AOC CS-10/FS-24 source areas was finalized in 1999 (AFCEE 1999) and source area remedial actions were implemented (ABB-ES 1992, AFCEE 2005b and 2008a). The impact of source area activities on local groundwater quality was investigated (E.C. Jordan Co. 1986, 1989 and 1990; ABB-ES 1992; and CDM 1996 and 1997) and the groundwater plume was defined north of Ashumet Pond (CDM 1997).

In 1995, the NGB, Department of Defense, EPA, MassDEP, and local communities approved a Plume Response Plan that presented an accelerated effort toward “simultaneous containment” of seven groundwater plumes including CS-10. An Interim ROD (IROD) for the seven groundwater plumes emanating from the MMR was signed on 25 September 1995 (ANG 1995). The IROD stated that groundwater extraction and treatment systems should be designed, installed, and operated until a final remedy for the site is chosen. For CS-10, the interim remedy included active treatment for the plume upgradient of Ashumet Pond and the Sandwich Road extraction, treatment, and reinjection (ETR) system and the CS-10 IP extraction, treatment, and infiltration (ETI) system were installed under the IROD. The Sandwich Road ETR system began operation on 18 May 1999 and the CS-10 IP ETI system began operation on 24 June 1999. On 27 April 2000, the CS-10 IP system was supplemented with the start-up of the Southwest/Southern system (AFCEE 2001b).

An additional RI was completed between 1997 and 2001 to investigate the leading edge of the CS-10 plume and the NL, NCL, and SL were delineated (AFCEE 2001a). In 2000, a time-critical removal action was completed for the NL due to high TCE concentrations in groundwater potentially discharging to Johns Pond surface water. The action consisted of the installation of one extraction well which began operation in January 2000 to prevent discharge of TCE into Johns Pond (AFCEE 2000).

In 2004, extraction well 03EW2111 was added to the IP system as part of an optimization effort to address contamination in the southern trench area (AFCEE 2005c). A southern trench data gap investigation was completed between 2005 and 2007 to further delineate contamination located outside of the remedial system capture zone (AFCEE 2008c). As a result of this investigation, the TCE and PCE plume shells and the CS-10 groundwater flow model were revised to more accurately represent aquifer conditions in the area, and to predict future contaminant migration under current CS-10 remedial system operating conditions (AFCEE 2009b). The optimized pumping condition determined during this evaluation was presented as Alternative 10 in the *Final Supplement to the Chemical Spill-10 Groundwater Feasibility Study Addendum* (AFCEE 2008b) and is the selected alternative in the *Final Record of Decision for Chemical Spill-10 Groundwater* (AFCEE 2009a). This alternative included the installation of a new extraction well (03EW2112) at the leading edge of the Southern Trench lobe, the installation of a new reinjection well (03RI2112) southeast of 03EW2111, and modification of the Sandwich Road and CS-10 IP extraction and reinjection/infiltration well flow rates. The new extraction well (03EW2112) and reinjection well (03RI2112) were installed in 2008 and the system optimization was implemented in February 2009.

2.3 CS-10 GROUNDWATER EXISTING SELECTED REMEDY

The following RAOs were developed for the CS-10 groundwater plume (AFCEE 2009a and 2011):

- Prevent residential exposure to CS-10 groundwater with TCE concentrations greater than the MCL of 5 µg/L.
- Prevent residential exposure to CS-10 groundwater with PCE concentrations greater than the MCL of 5 µg/L.
- Restore usable groundwaters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site.

The final selected remedy for CS-10 in the ROD (AFCEE 2009a) was groundwater pump and treat with LUCs and long term monitoring (LTM) which included the following components:

- Continued operation of the IP, NL, and Sandwich Road remedial systems installed under the IROD with system expansion into the Southern Trench area with an additional extraction well and an additional reinjection well installed in 2008 as part of the final remedy to improve capture of the plume in that area. The contaminated groundwater is removed from the aquifer through extraction wells and piped to the treatment plants. TCE and PCE are removed from the groundwater through granular activated carbon (GAC) filtration. The treated groundwater is returned to the aquifer via infiltration trenches or reinjection wells.
- Implementation of LUCs with the performance objectives of:
    - Preventing access to, or use of, contaminated groundwater from the CS-10 plume (both off-site and on-site) until the groundwater no longer poses an unacceptable risk, and
    - Maintaining the integrity of the current or future remedial or monitoring system such as the treatment systems and monitoring wells.
- Chemical and hydraulic monitoring of the plume under the System Performance and Ecological Impact Monitoring (SPEIM) program, as long as active remediation continues, and chemical monitoring of the plume until the RAOs are met.
- Completion of CERCLA reviews every five years throughout the lifetime of the remedial action.

Since the groundwater remedy was selected in 2009, the following changes have occurred:

- An ESD for the IRP groundwater plumes, including the CS-10 plume, was prepared in 2011 (AFCEE 2011). This ESD clarified the inclusion of MNA as a component of the selected remedy for CS-10, slightly modified the phrasing of the RAOs, and revised the three-step process developed for assessing site contaminants in groundwater in order to achieve site closure. The three-step process consists of:
  - Step 1: Operate the remedial systems and/or monitor the plumes following regulator-approved plans to track progress toward meeting the overarching objective of aquifer restoration. Step 1 is concluded when it can be demonstrated that cleanup goals have been reached.
  - Step 2: Complete a residual risk assessment, if deemed necessary, which considers human health and ecological exposure under unlimited use/unrestricted exposure conditions.
  - Step 3: Assess the feasibility of approaching or achieving background.
- A data gap investigation was initiated in 2008 and continued through June 2012 to provide information needed to optimize the CS-10 remedial systems. The data gap investigation identified previously uncharacterized TCE mass in the IP area at higher concentrations and deeper in the aquifer where hydraulic conductivities are lower than previously assumed at the time of remedy selection in 2009. This contamination was located outside the capture zone of the remedial system configuration identified in the ROD. The additional TCE/PCE contaminant mass that was discovered during the post-ROD data gap investigation increased the predicted aquifer restoration timeframe presented in the ROD from 2094 to greater than 2113 (the end of the 100-year modeled timeframe) assuming the system selected at the time of the ROD was not modified (AFCEC 2013f).
- An optimization evaluation was completed in 2013 in response to the findings of the post-ROD data gap investigation to improve TCE/PCE plume capture and reduce the aquifer restoration timeframe (AFCEE 2013 and AFCEC 2013d). The CS-10 IP remedial system was expanded to include the installation of a new deep-screened IP extraction well (03EW2113) to improve hydraulic capture of newly delineated deep contamination, installation of a new reinjection well (03RI2113) to accommodate increased flow from the CS-10 IP extraction well and to improve hydraulic capture, installation of a new Eastern IP extraction well (03EW2114) to capture contamination in the Eastern IP lobe, an MTU to treat contamination from 03EW2114, and installation of a new reinjection well (03RI2114) to return treated water from the MTU (AFCEC 2013c and 2014c). The expanded CS-10 remedial system (**Figure 1-3**) began operating under optimized operating conditions on 07 July 2014 (AFCEC 2015).
- An ESD was prepared in 2014 to document the changes to the CS-10 CSM, amend the estimate of aquifer restoration timeframe at CS-10 presented in the ROD, and modify the remedy to more aggressively remove contaminants from the aquifer so that cleanup levels can be achieved sooner (AFCEC 2014a).

A summary of the four remedial systems that have been installed to remediate the CS-10 plume is as follows: (1) the CS-10 Sandwich Road ETR system, which consists of eight closely-spaced extraction wells for the Sandwich Road plume, a Southern Trench extraction well, four GAC treatment trains within the Sandwich Road Treatment Facility (SRTF), and six reinjection wells; (2) the CS-10 IP ETI/ETR system, which consists of ten extraction wells located within the body of the plume, four GAC treatment trains within two treatment plant buildings, two infiltration trenches, and a reinjection well; (3) the CS-10 NL extraction well, which utilizes the SRTF and the Storm Drain-5 North reinjection wells; and (4) the CS-10 MTU, which treats contamination from the Eastern IP extraction well, and utilizes a reinjection well to return the treated water. The Sandwich Road ETR system began operation in May 1999; the CS-10 IP ETI system began operation in June 1999; the CS-10 NL extraction well began operation in January 2000; and the CS-10 MTU began operation in June 2014.

As of November 2020, the CS-10 treatment systems were operating at a combined flow rate of 3,370 gallons per minute (gpm) comprised of the following:

- 585 gpm at Sandwich Road ETR system,
- 2,575 gpm at the IP ETI/ETR system,
- 210 gpm at the NL extraction well, and
- 0 gpm at the MTU (system was shut down in February 2020 with regulatory approval).

The predicted remedial system shutdown date (when the last CS-10 extraction well is shut off) presented in the ROD was 2055 and the expected aquifer restoration timeframe (when COC concentrations drop below the MCL throughout the plume) was 2094 for the main body and 2046 for the leading edge lobes (AFCEE 2009a). Aquifer restoration timeframe was significantly reduced, from greater than 2113 under current operating conditions, to 2060 under the selected optimized scenario (AFCEC 2013c and 2014c). This updated aquifer restoration timeframe of 2060 is also significantly less than the aquifer restoration timeframe of 2094 for the selected remedy in the ROD (AFCEE 2009a).

The most recent transport model simulations completed in 2014 and based on TCE and PCE characterization data collected through 2013 predict that the last operating CS-10 extraction well (03EW2113) can be shut down by approximately 2055 (AFCEC 2013c and 2014c). TCE MCL exceedances are predicted to remain in the main body of the plume until approximately 2060 (AFCEC 2014c), the NL until approximately 2030, and the NCL and SL until approximately 2025 (AFCEE 2005a).

3.0 DESCRIPTION OF SIGNIFICANT DIFFERENCES AND EXPECTED OUTCOMES

This section describes the CSM for 1,4-dioxane contamination in the CS-10 groundwater plume and the RAO and the selected remedy for the addition of 1,4-dioxane as a COC for the CS-10 groundwater plume. The addition of 1,4-dioxane as a CS-10 groundwater COC does not change the predictions for remedial system shutdown (2055) or for aquifer restoration timeframe (2060) that were presented in the *Final Chemical Spill-10 Groundwater Explanation of Significant Differences* (AFCEC 2014a) and are summarized in Section 2.3.

3.1 SIGNIFICANT DIFFERENCES FROM THE SELECTED REMEDY

The primary industrial use of 1,4-dioxane was to stabilize solvents, particularly 1,1,1-trichloroethane (1,1,1-TCA), which is less chemically stable than other common solvents such as PCE and TCE. Therefore, 1,4-dioxane is commonly associated with 1,1,1-TCA, or its breakdown product 1,1-dichloroethene (1,1-DCE). Both 1,1,1-TCA and 1,1-DCE have been detected in CS-10 groundwater in the past (AFCEC 2014b); therefore, a recommendation to perform sampling for 1,4-dioxane at the CS-10 plume was presented in the *Final 4th Five-Year Review, 2007-2012 Massachusetts Military Reservation (MMR) Superfund Site Otis Air National Guard Base, MA* (AFCEC 2013a). A presence/absence (SI equivalent) 1,4-dioxane field investigation was completed between October 2013 and June 2014 which confirmed the presence of 1,4-dioxane in CS-10 groundwater (AFCEC 2014b). Supplemental RI field sampling was completed between December 2015 and April 2016 which determined the nature and extent of 1,4-dioxane contamination and assessed associated risk (AFCEC 2017). A Supplemental Feasibility Study was completed to evaluate remedial alternatives to address the 1,4-dioxane groundwater contamination and the Final Supplemental Feasibility Study was submitted in January 2018 (AFCEC 2018).

1,4-Dioxane Conceptual Site Model

The source of the 1,4-dioxane contamination detected at CS-10 is believed to be associated with the release of chlorinated solvents. Following its release at the ground or near ground surface, 1,4-dioxane would have migrated vertically through the unsaturated, vadose zone. This chemical would have dissolved into infiltrating water from precipitation and readily leached into groundwater due to its high aqueous solubility. Once in groundwater, 1,4-dioxane contamination would travel on the same flow path and likely concurrent with the CS-10 TCE/PCE plume and contamination would be transported through advection and dispersion with natural attenuation processes (primarily dispersion and dilution) reducing the mass, volume, and concentration over time. It is noted that degradation is also a mechanism for attenuation of 1,4-dioxane in aerobic aquifers (Adamson et al. 2015; Gedalanga et al. 2016; Jackson et al. 2019) and based on data collected over the long history of sampling at CS-10, the aquifer is highly oxygenated and aerobic (AFCEC 2013e).

The CS-10 TCE/PCE plume has detached from its primary source areas (UTES/BOMARC) and groundwater data collected downgradient of the source areas indicate that there is no continuing source of 1,4-dioxane contamination to groundwater. 1,4-Dioxane was detected at concentrations exceeding the site-specific, risk-based 1,4-dioxane RG of 0.46 µg/L in nine of the 69 monitoring wells sampled. These nine monitoring wells are located in the northwestern portion of the CS-10 plume (**Figure 3-1**) which is also where the highest TCE concentrations are currently detected (AFCEC 2017). 1,4-Dioxane contamination is defined as two connected lobes generally located to the north of 03EW2014 and north of 03EW2012. The maximum detected 1,4-dioxane concentration, 3.7 µg/L, was at monitoring wells 03MW1066A (06 March 2017) and 03MW1066B (02 February 2016); these two wells are located to the northwest of extraction well 03EW2104 (**Figure 3-1**). The two adjacent lobes of 1,4-dioxane contamination extend over an area that is approximately 2,600 ft wide, up to 3,000 ft long, and up to 130 ft thick (**Figure 3-1**).

Contaminant transport modeling predicts that by 2044 there is only a small area of 1,4-dioxane contamination left at concentrations above 0.46 µg/L that is located deep in the aquifer between extraction wells 03EW2104 and 03EW2107 and this contamination attenuates to below the site-specific, risk-based RG of 0.46 µg/L by the year 2051 (**Appendix B**). This timeframe of 2051 is within the model-predicted aquifer restoration timeframe estimate of 2060 for the CS-10 TCE plume (AFCEC 2014a and 2014c). Therefore, the presence of 1,4-dioxane in CS-10 groundwater is not expected to extend the current estimate of restoration timeframe that is approximately 2060 for TCE.

Selected Alternative for 1,4-Dioxane

The 2012 CS-10 groundwater flow model (AFCEC 2013f) and the revised 2016 1,4-dioxane plume shell were used to evaluate alternatives in the Supplemental Feasibility Study and Alternative 2, Existing Remedy Including 1,4-Dioxane as a COC, was the selected alternative (AFCEC 2018).

Remediation goals for COCs, in the absence of an ARAR, are set at a concentration that has cancer risk in the range of 1E-04 to 1E-06 or a Hazard Quotient (HQ) =1, whichever concentration is lower. The remediation goal for 1,4-dioxane is set at 0.46 µg/L which is based on a cancer risk of 1E-06, which is lower than 6.26 µg/L which equates to a HQ =1.

Alternative 2 includes continued implementation of the existing groundwater extraction and treatment remedy presented in the 2009 ROD for the CS-10 TCE and PCE plume (i.e., GAC treatment, LUCs, and LTM), and the revisions made for the site-wide groundwater remedies through the 2011 ESD, including modifications to the three-step process and the inclusion of MNA as a component of the remedy for PCE and TCE at CS-10. Alternative 2 relies on MNA (primarily dispersion and dilution) for 1,4-dioxane within the CS-10 groundwater plume and the LUC components of the existing remedy.

Several factors played a role in continuing the existing remedy (i.e., the MNA and LUCs portion of the remedy) without modification. This ESD demonstrates how the MNA component of the remedy meets conditions in EPA guidance for MNA remedies. The 1,4-dioxane plume is believed to be located within the TCE plume and is not expected to expand beyond the current boundaries. The cleanup goal for 1,4-dioxane is estimated to be achieved throughout the plume by 2051, prior to the estimated time to achieve cleanup goals for TCE and PCE (2060). Incidental extraction of the 1,4-dioxane plume by CS-10 extraction wells is taking place; however, 1,4-dioxane was not detected at concentrations above the reporting limit of 0.2 μg/L in samples from the four existing CS-10 extraction wells located near the 1,4-dioxane plume when analyzed in January 2019. Furthermore, 1,4-dioxane was not detected in the CS-10 IP treatment plant influent when sampled in October 2017. Based on current data and modeling, the 1,4-dioxane concentrations at these sampling locations are not expected to exceed the RG in the future. Lastly, the degradation of 1,4-dioxane does not result in toxic by-products.

Monitoring would be conducted to: confirm that 1,4-dioxane groundwater contaminant concentrations at CS-10 continue to decrease through the processes of natural attenuation; ensure that 1,4-dioxane concentrations in the combined effluent of the CS-10 IP remedial system do not exceed the site-specific, risk-based RG of 0.46 μg/L (subject to the requirements of the O&M Plan for the CS-10 Treatment Plant which would be updated with this 1,4-dioxane monitoring approach) since the current CS-10 IP GAC treatment is ineffective at removing 1,4-dioxane; and to determine when 1,4-dioxane concentrations have reached cleanup levels within the aquifer.

As noted, this alternative also includes continuing the existing LUCs (AFCEC 2013b) to prevent exposure to 1,4-dioxane contaminated groundwater until concentrations decrease below cleanup levels throughout the plume. The CS-10 LUC Program consists of implementing and monitoring controls that prevent people currently living or working near the CS-10 plume from being exposed to CS-10 contaminated groundwater at concentrations greater than applicable MCLs (for PCE and TCE) and site-specific, risk-based RG (for 1,4-dioxane).

The CS-10 SPEIM/LTM program is ongoing and will be modified to include sampling of monitoring wells, extraction wells, and treatment plant ports for 1,4-dioxane; reporting; and implementation of LUCs. Details of the CS-10 1,4-dioxane monitoring program, including locations and sampling frequencies, will be submitted in a future deliverable. As remediation progresses, the monitoring data will be used to determine the extent of the

1,4-dioxane plume and to assess the effectiveness of the LUCs. Groundwater monitoring would continue after the cleanup levels were met to ensure the aquifer has been restored and to support step one of the three-step process to site closure (AFCEE 2009a). In the event that monitoring revealed that the plume was not attenuating in the manner anticipated, the IRP would evaluate the protectiveness of the remedy and, where necessary to protect human health and the environment from unacceptable risk, modify the remedy in accordance with CERCLA [42 United States Code (USC) § 9617(c)] and the NCP [40 CFR § 300.435(c)].

Under Alternative 2, 1,4-dioxane would be assessed along with TCE and PCE at CS-10 groundwater as part of the base wide CERCLA Five-Year Review. A residual risk assessment would be performed, if deemed necessary, as part of the three-step process to site closure specified in the CS-10 ROD (AFCEE 2009a), and this residual risk assessment would include an evaluation of all the CS-10 groundwater COCs (i.e., TCE, PCE, and 1,4-dioxane).

It is noted that the 1,4-dioxane plume is located within the boundaries of the CS-10 TCE plume which is being captured by the northwestern CS-10 IP extraction wells. Although the current CS-10 IP GAC treatment is ineffective at removing 1,4-dioxane, the 1,4-dioxane influent concentrations at the CS-10 IP treatment plants are well below the site-specific, risk-based RG. In fact, 1,4-dioxane influent concentrations are currently below the reporting limit of 0.2 µg/L and are not expected to exceed the RG in the future. Therefore, additional treatment for 1,4-dioxane at the CS-10 IP treatment plant is currently not necessary to meet the ARARs that have been established for the CS-10 groundwater plume and is not anticipated to be needed in the future, however, this will continue to be verified through routine monitoring and will be documented in five year reviews. Details of the CS-10 1,4-dioxane monitoring program, including locations and sampling frequencies, will be submitted in a future deliverable.

Additional Remedial Action Objective

The RAOs that were developed for the CS-10 groundwater plume for TCE and PCE, (AFCEE 2009a and 2011) presented in Section 2.3 continue to be applicable. Based on the presence of 1,4-dioxane within the existing CS-10 TCE/PCE groundwater plume at concentrations exceeding the site-specific, risk-based RG of 0.46 µg/L that require remedial action, 1,4-dioxane will be added as a CS-10 groundwater COC through the addition of the following RAO:

- Prevent residential exposure to CS-10 groundwater with 1,4-dioxane concentrations greater than the site-specific, risk-based RG of 0.46 µg/L which is set at a 1E-06 cancer risk level.

The site-specific, risk-based RG of 0.46 µg/L for 1,4-dioxane is being used to establish the cleanup level for 1,4-dioxane in the CS-10 plume since no Federal or State MCL or MCL goals are available for 1,4-dioxane (**Appendix A**).

3.2 EXPECTED OUTCOMES

The purpose of this ESD is to formally document the addition of 1,4-dioxane as a COC for CS-10 groundwater through the additional RAO for 1,4-dioxane and adopting the existing CS-10 groundwater remedy documented in the *Final Record of Decision (ROD) for Chemical Spill-10 Groundwater* (AFCEE 2009a) for 1,4-dioxane. The proposed changes in this ESD do not fundamentally change the CS-10 groundwater remedy with respect to scope, performance, or cost (AFCEE 2009a and 2011; AFCEC 2014 and 2018). Since the LUCs are in place and are functioning as intended, the remedy is expected to remain protective after the addition of 1,4-dioxane as a COC (AFCEC 2018).

Monitoring will continue under the CS-10 SPEIM/LTM program to provide the necessary data to manage potential exposure risks, determine when RAOs have been met, and to evaluate future optimization opportunities. Monitoring for 1,4-dioxane will be incorporated into the CS-10 SPEIM program and will include the sampling of monitoring wells, extraction wells, and the CS-10 IP treatment plant; all with the goal of providing data to demonstrate remedial progress, protectiveness of the remedy, including the LUC

Program, and compliance with ARARs. It is estimated that the additional costs associated with monitoring, reporting, and maintaining of LUCs for 1,4-dioxane will be $830,887 which is approximately an 1.75 % increase to the estimated lifecycle cost for optimized Scenario 7 ($47.6 million) that was presented in the *Final Chemical Spill-10 Groundwater Explanation of Significant Differences* (AFCEC 2014a) and is a 1.66 % increase to the total post-ROD cost ($50.2 million) that was included in the Interim Remedial Action Report (AFCEE 2010) for Alternative 10 operating conditions. It is noted that these future lifecycle cost estimates do not include all anticipated costs to run the remedial systems (such as labor and materials for operation and maintenance, the cost of GAC, data analysis and reporting), but do, however, provide a metric to compare the relative cost to implement each scenario based primarily on electrical usage, LTM costs, and implementation costs.

4.0 STATUTORY DETERMINATION

This ESD documents the addition of 1,4-dioxane as a COC for CS-10 groundwater through the additional RAO for 1,4-dioxane and adopting the existing CS-10 groundwater remedy documented in the *Final Record of Decision (ROD) for Chemical Spill-10 Groundwater* (AFCEE 2009a) for 1,4-dioxane (AFCEC 2018). The CS-10 groundwater remedy is protective of human health and the environment, complies with federal and Commonwealth of Massachusetts requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. The CS-10 groundwater remedy utilizes permanent solutions to the maximum extent practicable, and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element, in accordance with Section 121 of CERCLA. The proposed changes in this ESD do not fundamentally change the CS-10 groundwater remedy with respect to scope, performance, or cost.

The CS-10 SPEIM/LTM program is ongoing and will be modified to include sampling of monitoring wells, extraction wells, and treatment plant ports for 1,4-dioxane; reporting; and implementation of LUCs. Details of the CS-10 1,4-dioxane monitoring program, including locations and sampling frequencies, will be submitted in a future deliverable. Since the LUCs are in place and are functioning as intended for TCE and PCE, the remedy is also expected to remain protective with the addition of 1,4-dioxane as a COC (AFCEC 2018).

5.0 REGULATORY AGENCY COMMENTS AND PUBLIC PARTICIPATION ACTIVITIES

As part of the ESD review process, the regulatory agencies (EPA and MassDEP) were given the opportunity to comment on the draft version of this ESD. Responses to the regulatory agency comments were documented in the 16 September 2019 *Response to Comment Letter* and the 24 July 2020 *Memorandum of Resolution*. The EPA and MassDEP concurred with the AFCEC on 28 July 2020 and 31 July 2020, respectively.

5.1 CONCURRENCE FROM THE MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

MassDEP concurrence with this ESD can be found in **Appendix C**.

5.2 PUBLIC PARTICIPATION ACTIVITIES

In accordance with Section 117(d) of CERCLA, 42 USC §9617(D), AFCEC published a notice in the local newspapers describing this ESD and its availability in the Administrative Record. In accordance with 40 CFR Section 300.435(c)(2)(i)(A) and 300.825(a)(2), this ESD and all documents that support the changes and clarifications are contained in the Administrative Record for the IRP at JBCC.

A 30-day public comment period was held from 17 August 2020 to 15 September 2020. A summary of comments received and responses is included in **Appendix D**.

6.0 REFERENCES

ABB-ES. 1992 (April). Interim Remedial Investigation, UTES BOMARC and BOMARC Area Fuel Spill (AOC CS-10 and AOC FS-24). Prepared for HAZWRAP (Hazardous Waste Remedial Actions Program) and ANG/MMR Installation Restoration Program and ANG, Otis Air National Guard Base, MA.

Adamson, D.T., R.H. Anderson, S. Mahendra, and C.J. Newell. Evidence of 1,4-Dioxane Attenuation at Groundwater Sites Contaminated with Chlorinated Solvents and 1,4-Dioxane. Environ. Sci. Technol. 2015, 49, 6510−6518.

AFCEC (Air Force Civil Engineer Center). 2018 (January). *Final Supplemental Feasibility Study Report for 1,4-Dioxane at Chemical Spill-10, Joint Base Cape Cod, MA.* 658003-EC-CS10-RPT-004. Prepared by CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2017 (March). *Final Supplemental Remedial Investigation Report for 1,4-Dioxane at Chemical Spill-10, Joint Base Cape Cod, MA.* 658003-EC-CS10-RPT-002. Prepared by CH2M for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2015 (March). *CS-10 2014 Summary Letter Report.* 652000-SPEIM-CS10-SLR-001. Prepared by EA Engineering, Science and Technology and CH2M HILL for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2014a (September). *Final Chemical Spill-10 Groundwater Explanation of Significant Differences*. 473147-SPEIM-CS10-ESD-002. Prepared by CH2M HILL for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2014b (August). *1,4-Dioxane Monitoring Well Sample Results Data Presentation Project Note*. 473147-SPEIM-MULTIPLE-PRJNOT-007. Prepared by CH2M HILL for AFCEC/JBCC, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2014c (March). *Chemical Spill-10 2013 Remedial System Optimization Project Note*. 473147-SPEIM-CS10-PRJNOT-001. Prepared by CH2M HILL for AFCEC/JBCC, Installation Restoration Program, Otis ANG Base, MA.

_____. 2013a (October). *Final 4th Five-Year Review, 2007-2012 Massachusetts Military Reservation (MMR) Superfund Site, Otis Air National Guard Base, MA.* 473147-SPEIM-MULTIPLE-RPT-001. Prepared by CH2M HILL for AFCEC/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2013b (September). *Final Chemical Spill-10 Private Well Verification and Well Determination Project Note*. 437075-SPEIM-LUC-CS10-PRJNOT-002. Prepared by CH2M HILL for AFCEC/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2013c (July). *Final CS-10 2013 Technical Memorandum: Focused Feasibility Study for Remedial System Optimization*. 437075-SPEIM-CS10-TECHMEM-003. Prepared by CH2M HILL for AFCEC/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2013d (March). *CS-10 2012 Remedial System Optimization Workplan Project Note, Phase II Approach*. 437075-SPEIM-CS10-PRJNOT-002. Prepared by CH2M HILL for AFCEC/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2013e (March). *Chemical Spill-10 Groundwater Plume Conceptual Site Model*. 473075-SPEIM-CSM-001. Prepared by CH2M HILL for AFCEC/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2013f (January). *Final Chemical Spill-10 2012 Data Gap Investigation Technical Memorandum*. 437075-SPEIM-CS10-TECHMEM-001. Prepared by CH2M HILL for AFCEC/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

Air Force Center for Engineering and the Environment (AFCEE). 2013 (January). *CS-10 2012 Remedial System Optimization Workplan Project Note, Phase I Approach*. 437075-SPEIM-CS10-PRJNOT-001. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2011 (September). *Final Explanation of Significant Differences for the Installation Restoration Program Groundwater Plumes at the Massachusetts Military Reservation.* 404929-SPEIM-MULTIPLE-RPT-001. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2010 (August). *Final Updated Interim Remedial Action Report for Chemical Spill-10 and Ashumet Valley Groundwater Plumes.* Prepared by ECC for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2009a (August). *Final Record of Decision for Chemical Spill-10 Groundwater*. A4P-J23-35BC02VA-M26-0018. Prepared by Jacobs Engineering Group for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2009b (March). *Final CS-10 2008 Southern Trench System Optimization Project Note*. 371335-SPEIM-CS10-PRJNOT-008. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2008a (September). *Final 3rd Five-Year Review, 2002-2007 Massachusetts Military Reservation (MMR) Superfund Site, Otis Air National Guard Base, MA.* Prepared by Engineering Strategies Corp., Portage and CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2008b (August). *Final Supplement to the Chemical Spill-10 Groundwater Feasibility Study Addendum*. A4P-J23-35BC02VA-M16-0025. Prepared by Jacobs Engineering Group for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2008c (January). *Final Chemical Spill-10 2007 Southern Trench Technical Memorandum*. 337105-SPEIM-CS10-TECHMEM-003. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

Air Force Center for Environmental Excellence (AFCEE). 2005a (October). *Final Chemical Spill-10 Leading Edge Technical Memorandum*. 324146-SPEIM-CS10-TECHMEM-002. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2005b (June). *Chemical Spill No. 10 Detail C Vadose Zone Characterization Report*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 2005c (April). *Final Chemical Spill-10 2004 System Performance and Ecological Impact Monitoring Report*. 324146-SPEIM-CS10-ANRPT-001. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2001a (September). *Final Chemical Spill-10 Remedial Investigation Report*. AFC-J23-35U40702-M14-0005. Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2001b (May). *Final Chemical Spill-10 Interim Remedial Action Report*. Prepared by AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 2000 (February). *Final SD-5 South Plume - Hoophole Road and TCE Plume Time Critical Removal Action Wellfield Design Report*. AFC-J23-35S18404-M23-0008. Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 1999 (July). Record of Decision Area of Contamination CS-10/FS-24 Source Areas. Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

ANG. 1995 (September). *Final Record of Decision Interim Remedial Action Containment of Seven Groundwater Plumes at MMR, Cape Cod MA.* Prepared by Stone & Webster Environmental & Technology Services for ANG Readiness Center, Installation Restoration Program, Otis Air National Guard Base, MA.

CDM (Camp Dresser and McKee Federal Programs Corporation). 1997 (December). *Final Remedial Investigation, UTES/BOMARC and BOMARC Area Fuel Spill, AOC CS-10/ FS-24 (AOC CS-10 and AOC FS-24) Source Operable Units: CS-10A and CS-10B.* Prepared for AFCEE/MMR Installation Restoration Program and ANG, Otis Air National Guard Base, MA. Submitted by HAZWRAP (Hazardous Waste Remedial Actions Program), Oak Ridge, TN.

_____. 1996 (July). *Final Remedial Investigation, UTES/BOMARC and BOMARC Area Fuel Spill, AOC CS-10 Groundwater Operable Unit: CS-10D and Hydrogeologic Region II Study, Volume I.* Prepared for AFCEE/MMR Installation Restoration Program and ANG, Otis Air National Guard Base, MA. Submitted by HAZWRAP (Hazardous Waste Remedial Actions Program), Oak Ridge, TN.

E.C. Jordan. 1990 (March). Task 2-3B Site Inspection, Field Investigation Work Conducted Spring-Summer 1988; Installation Restoration Program; Massachusetts Military Reservation. Prepared by E.C. Jordan Co. Prepared for HAZWRAP; Portland, Maine.

_____. 1989 (March). Task 2-3A Site Inspection, Field Investigation Work Conducted Fall 1987; Installation Restoration Program; Massachusetts Military Reservation. Prepared by E.C. Jordan Co, Prepared for HAZWRAP; Portland, ME.

_____. 1986 (March). U.S. Air Force Installation Restoration Program, Phase I: Records Search, Air National Guard, Camp Edwards, U.S. Air Force, and Veterans Administration Facilities at Massachusetts Military Reservation. Prepared by E.C. Jordan Co. Prepared for HAZWRAP; Portland, ME.

EPA. 1999 (July). *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents*. EPA 540/R-98/031, OSWER 9200.1-23P.

EPA Region I, Department of the Air Force National Guard Bureau, and the U.S. Coast Guard. 2002 (June). *Federal Facility Agreement (FFA) Under CERCLA S120 and RCRA S7003 for the Massachusetts Military Reservation* as amended.

EPA Region I and the United States Department of Defense, National Guard Bureau. 1991 (and subsequently amended). *Federal Facility Agreement Under CERCLA § 120 and RCRA § 7003* In the matter of: The U.S. Department of Defense, National Guard Bureau, Massachusetts Military Reservation, Cape Cod, MA.

Gedalanga, P., A. Madison, Y. Miao, T. Richards, J. Hatton, W.H. DiGuiseppi, J. Wilson, and S. Mahendra. A Multiple Lines of Evidence Framework to Evaluate Intrinsic Biodegradation of 1,4-Dioxane. Remediation Winter 2016. DOI: 10.1002/rem.

Jackson, L.E. and L.D. Lemke. Evidence for Natural Attenuation of 1,4-Dioxane in a Glacial Aquifer System. Hydrogeology Journal. October 2019. https://doi.org/10.1007/s10040-019-02028-6.

FIGURES

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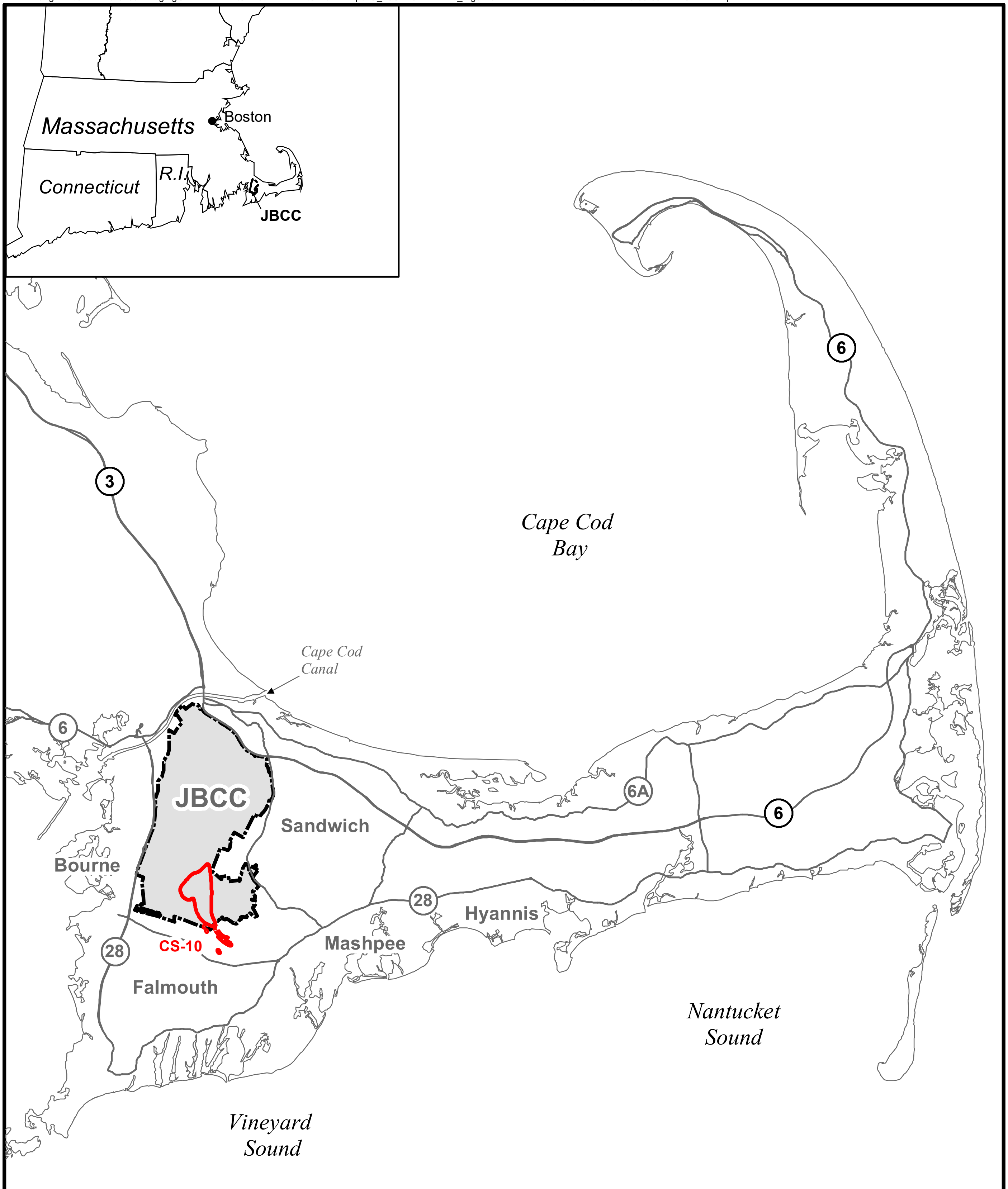

Legend

Joint Base Cape Cod

CS-10 Plume Boundary

Data Source: AFCEC, November 2020
JBCC Boundary From Massachusetts Air National Guard 2011

0 3 6 Miles

FIGURE 1-1

JOINT BASE CAPE COD, MASSACHUSETTS

AFCEC - Joint Base Cape Cod

Final Explanation of Significant Differences for 1,4-Dioxane in Groundwater at CS-10, JBCC, MA

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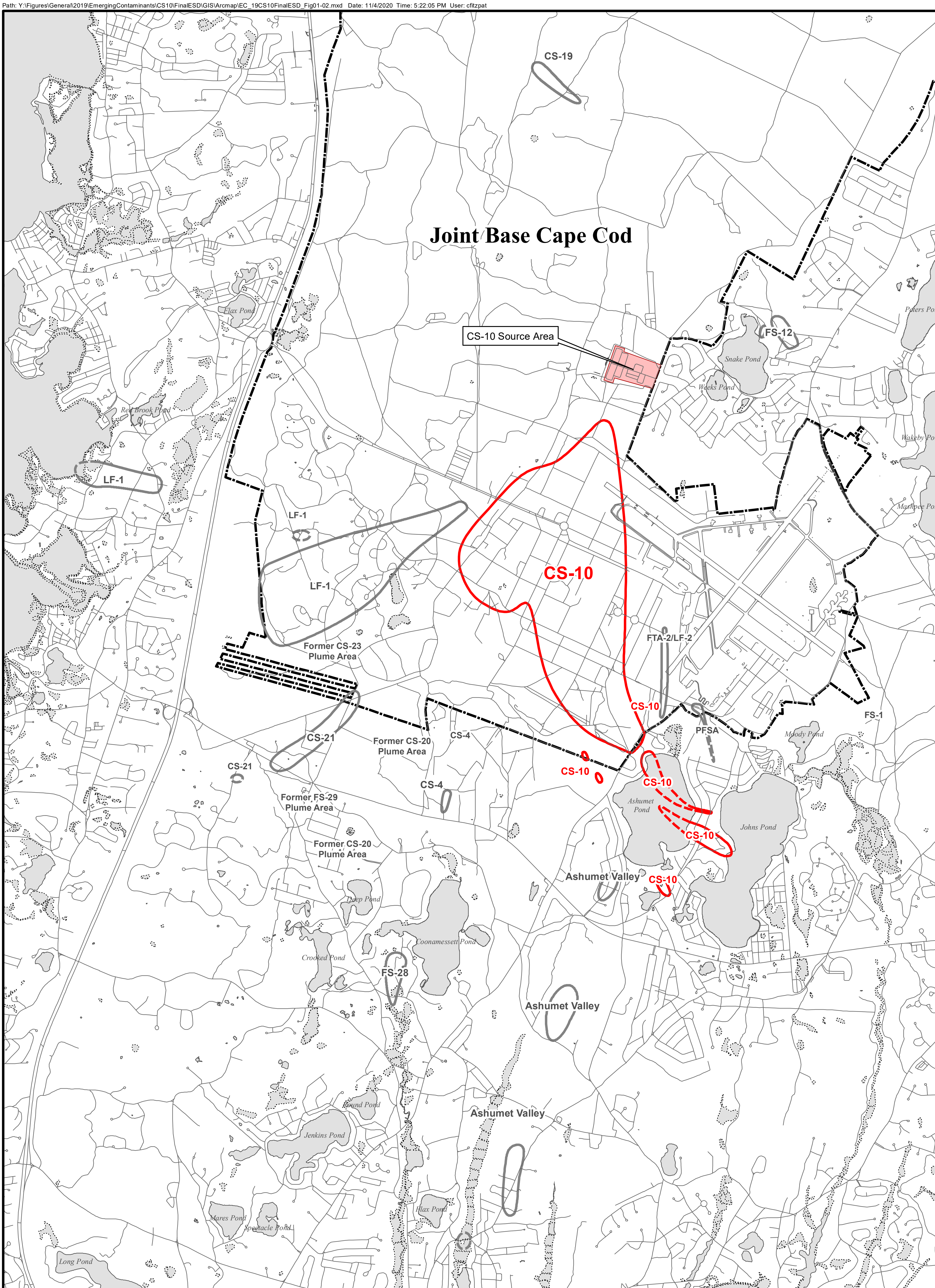

Legend

- Joint Base Cape Cod Boundary
- Other AFCEC Plume Boundary (Dashed Where Inferred)
- CS-10 Plume Boundary (Dashed Where Inferred)
- Bog/Wetland
- Source Area

Data Source: AFCEC, November 2020
JBCC Boundary from Massachusetts Air National Guard 2011

FIGURE 1-2

JBCC IRP PLUMES AND CS-10 PLUME BOUNDARY

AFCEC - Joint Base Cape Cod

Final Explanation of Significant Differences for 1,4-Dioxane in Groundwater at CS-10, JBCC, MA

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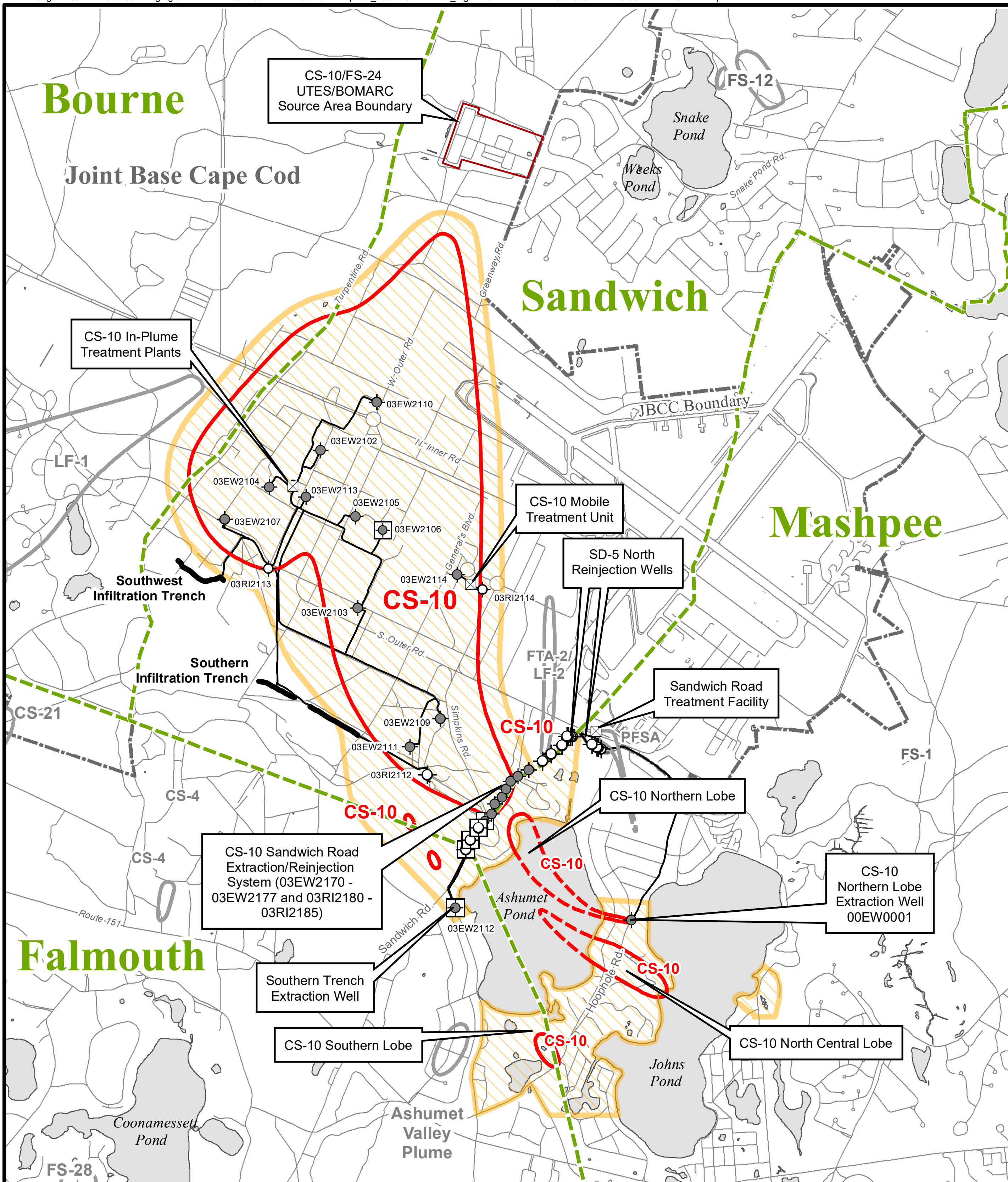

Legend

- CS-10 Plume Boundary (Dashed Where Inferred)
- Other Plume Boundary (Dashed Where Inferred)
- Town Boundary
- Joint Base Cape Cod
- Treatment System Piping
- Infiltration Trench
- Treatment Facility
- Extraction Well (On)
- Extraction Well (Off)
- Reinjection Well (On)
- Reinjection Well (Off)
- Source Area Boundary
- Land Use Control Area

Data Source: AFCEC, November 2020
JBCC Boundary from Massachusetts Air National Guard 2011

0 1,600 3,200
Feet

FIGURE 1-3

CS-10 GROUNDWATER PLUME AND TREATMENT SYSTEMS

AFCEC - Joint Base Cape Cod

Final Explanation of Significant Differences for 1,4-Dioxane in Groundwater at CS-10, JBCC, MA

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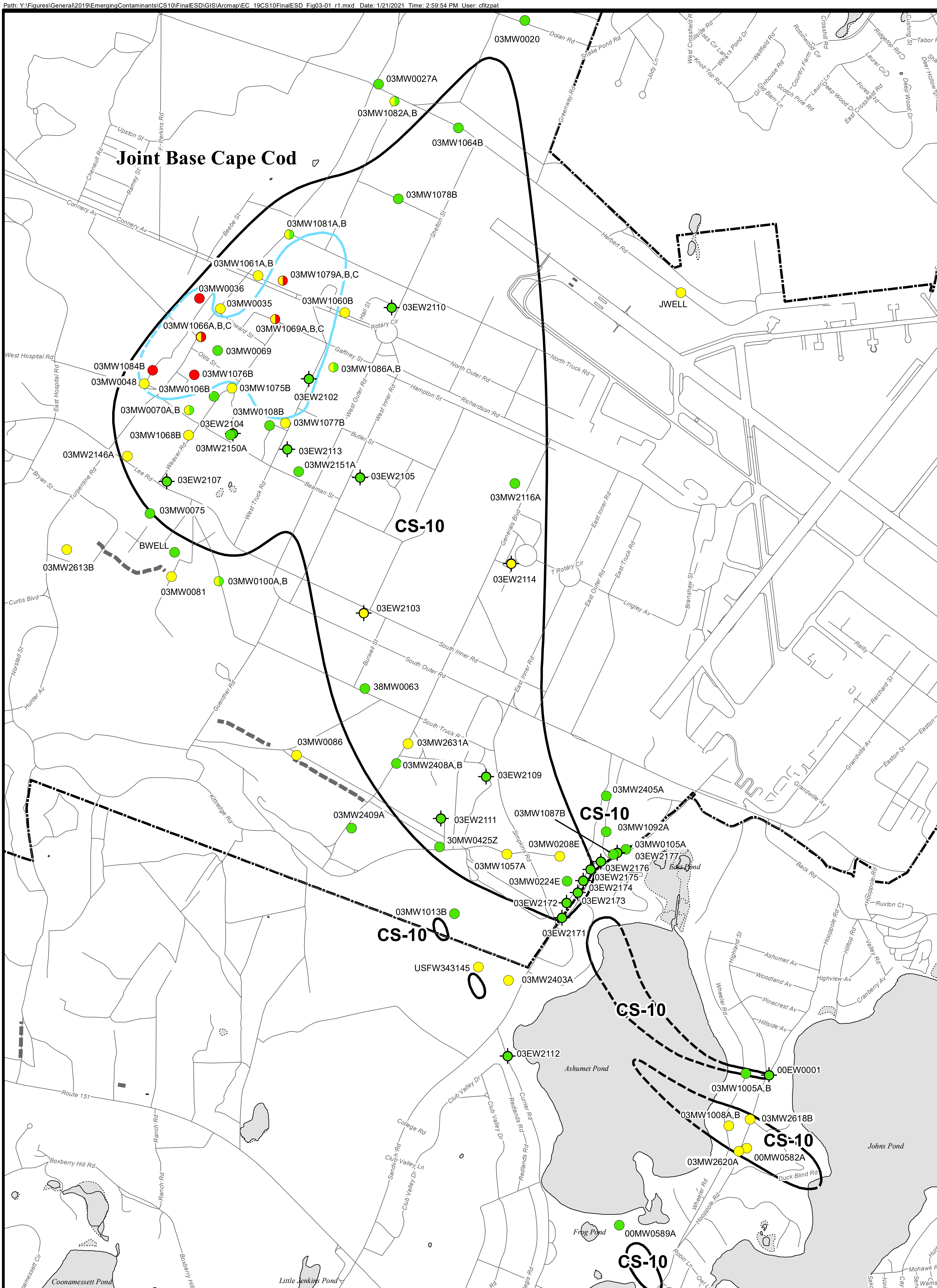

Data Source: AFCEC, November 2020
JBCC Boundary from Massachusetts Air National Guard 2011

Legend

- CS-10 TCE/PCE Plume Boundary (Dashed Where Inferred)
- Infiltration Trench
- CS-10 1,4-Dioxane Plume Boundary (Dashed Where Inferred)
- Bog/Wetland
- Extraction Well

1,4-Dioxane Detections in Groundwater:

- No Detections
- Detection Below or at Site-Specific, Risk-Based RG
- Detection Above Site-Specific, Risk-Based RG

1,4-Dioxane Site-Specific, Risk-Based RG = 0.46 µg/L

Note: The 'BWELL' is the irrigation well for the on-base golf course.
The 'JWELL' is the on-base water supply well.

0 690 1,380 Feet

FIGURE 3-1

CS-10 1,4-DIOXANE DETECTIONS IN GROUNDWATER

AFCEC - Joint Base Cape Cod

Final Explanation of Significant Differences for 1,4-Dioxane in Groundwater at CS-10, JBCC, MA

ch2m.

APPENDIX A

Applicable or Relevant and Appropriate Requirements

Appendix A - ARAR Tables from *Final Record of Decision for Chemical Spill-10 Groundwater*[1]

Table 1
Chemical-Specific ARARs for CS-10 Groundwater Selected Remedy (Alternative 10 for the main body and Alternative 3 for leading edge)

Media	Requirements	Requirement Synopsis	Action to be Taken to Attain Requirements	Status
Groundwater	FEDERAL - SDWA – MCLs (40 CFR 141.61-141.63)	MCLs have been promulgated for organic and inorganic contaminants. These levels regulate the concentration of contaminants in public drinking water supplies, but are also considered relevant and appropriate for CERCLA groundwater response actions where the groundwater aquifer is used or classified for use as drinking water.	These standards will be used as cleanup standards to be met through cleanup of the CS-10 plume, unless a more stringent state standard has been promulgated, in which case the more stringent standard will be met if necessary for protectiveness. LTM will determine when these cleanup standards are met.	Relevant and Appropriate
Groundwater	FEDERAL - SDWA – Non-Zero MCLGs (40 CFR 141.50-141.51)	Non-zero MCLGs are nonenforceable health goals for public water systems set at levels that would result in no known or expected adverse health effects with an adequate margin of safety. Non-zero MCLGs are also considered relevant and appropriate for CERCLA groundwater response actions where the groundwater aquifer is used or classified for use as drinking water.	These standards will be used as cleanup standards to be met through cleanup of the CS-10 plume, unless a more stringent state standard has been promulgated, in which case the more stringent standard will be met if necessary for protectiveness. LTM will determine when these cleanup standards are met.	Relevant and Appropriate
Groundwater	STATE – MA Drinking Water Standards (310 CMR 22.05-22.09)	These standards establish MCLs for public drinking water systems, but are also considered relevant and appropriate for CERCLA groundwater contamination response actions. When state MCLs are more stringent than federal levels, state levels must be used.	These standards will be used as cleanup standards to be met through cleanup of the CS-10 plume if these standards are more stringent than federal drinking water standards. LTM will determine when these cleanup standards are met.	Relevant and Appropriate
Groundwater	STATE – MA Groundwater Quality Standards (314 CMR 6.06)	These standards limit the concentration of certain materials allowed in classified Massachusetts waters. The groundwater beneath MMR has been classified as a Class I water or fresh groundwater found in the saturated zone of unconsolidated deposits and is designated as a source of potable water. The standards for Class I groundwater are the same as the state MCLs.	These standards will be used as cleanup standards to be met through cleanup of the CS-10 plume. LTM will determine when these cleanup standards are met.	Applicable

Table 1
Chemical-Specific ARARs for CS-10 Groundwater Selected Remedy (Alternative 10 for the main body and Alternative 3 for leading edge)

Media	Requirements	Requirement Synopsis	Action to be Taken to Attain Requirements	Status
Groundwater	FEDERAL – Risk Reference Doses (RfDs)	These are guidance values used in risk assessment to evaluate the potential carcinogenic hazard caused by exposure to contaminants. RfDs are considered the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.	These guidances will be used to determine human health risks from contaminated groundwater and to define final cleanup standards for the CS-10 plume. The residual risk assessment, if deemed necessary, will use the most up-to-date RfDs for all contaminants. EPA RfDs are also used to calculate risk-based groundwater screening or clean up levels for non-carcinogens when no federal or state MCL or non-zero MCLG or state GWQS is available.	TBC
Groundwater	FEDERAL – Cancer Slope Factors (CSFs)	These are guidance values used in risk assessment to evaluate the potential carcinogenic hazard caused by exposure to contaminants. CSFs represent EPA's most-up-to-date information on cancer risk.	These guidances will be used to determine human health risks from contaminated groundwater and to define final cleanup standards for the CS-10 plume. EPA CSFs are also used to calculate risk-based groundwater screening or clean up levels for carcinogens when no federal or state MCL or non-zero MCLG or state GWQS is available. A risk-based concentration has been calculated for 1,4-dioxane.	TBC
Groundwater	FEDERAL – Guidelines for Carcinogen Risk Assessment - EPA/630/P-03/001F (March 2005)	These guidelines are used to perform human health risk assessments.	These guidances will be used to determine human health risks from contaminated groundwater and to define final cleanup standards for the CS-10 plume.	TBC

Appendix A - ARAR Tables from *Final Record of Decision for Chemical Spill-10 Groundwater*[1]

Table 1
Chemical-Specific ARARs for CS-10 Groundwater Selected Remedy (Alternative 10 for the main body and Alternative 3 for leading edge)

Media	Requirements	Requirement Synopsis	Action to be Taken to Attain Requirements	Status
Groundwater	FEDERAL – Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens - EPA/630/R-03/003F (March 2005)	These guidelines are used to perform human health risk assessments.	These guidances will be used to determine human health risks from contaminated groundwater and to define final cleanup standards for the CS-10 plume.	TBC

ARAR	applicable or relevant and appropriate requirement
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	*Code of Federal Regulations*
CMR	*Code of Massachusetts Regulations*
CS-10	Chemical Spill-10
CSF	cancer slope factor
EPA	U.S. Environmental Protection Agency
GWQS	Groundwater Quality Standard
LTM	long term monitoring
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MMR	Massachusetts Military Reservation
RfD	reference dose
SDWA	Safe Drinking Water Act
TBC	to be considered (guidance)

[1] Table 1 is taken from Table 2-30 of the Final Record of Decision for Chemical Spill-10 Groundwater prepared for the Air Force Center for Engineering and the Environment Installation Restoration Program at the Massachusetts Military Reservation by Jacobs Engineering Group, Inc. August 2009 and has been modified where necessary for the addition of 1,4-dioxane as a groundwater contaminant of concern at CS-10.

Appendix A - ARAR Tables from Final Record of Decision for Chemical Spill-10 Groundwater[1]

Table 2
Location-Specific ARARs for CS-10 Groundwater Selected Remedy (Alternative 10 for the main body and Alternative 3 for leading edge)

Media	Requirements	Requirement Synopsis	Action to be Taken to Attain Requirements	Status
Endangered and threatened species and their habitats	STATE – MA Endangered Species Act (321 CMR 10.00 et seq.)	Actions that jeopardize state-listed endangered or threatened species; or species of special concern or their habitats must be avoided, or appropriate mitigation measures must be taken.	The operation and maintenance of the remedial treatment systems, as well as the construction of any new monitoring wells, extraction well, reinjection well, or pipelines, will be designed to minimize effects to endangered or threatened species. Several state-listed species have been identified on the MMR. The Camp Edwards Natural Resource Office (http://www.eandrc.org/rarespecies.htm) continues to search for, identify, and map locations of rare species on the MMR and provides this information to the Massachusetts Division of Fisheries and Wildlife.	Applicable
Historic, archeological, and Native American artifacts and resources	FEDERAL – NHPA (16 USCA 470 et seq.; 36 CFR 800); AHPA (16 USCA 469a-c); ARPA (16 USC 470aa-ll; 43 CFR 7); NAGPRA (25 USCA 3001-3013; 43 CFR 10)	These statutes and regulations provide for the protection of historical, archaeological, and Native American burial sites, artifacts, and objects that might be lost as a result of a federal construction project. If a discovery is made, all activity in the area must stop and reasonable effort must be made to secure and protect the objects discovered.	After consultation with the Wampanoag Indian Tribes and the SHPO, the parties may determine that a cultural resources survey is needed to discover and identify objects and artifacts, particularly Native American artifacts of the Wampanoag Indian Tribes, if the monitoring wells, extraction well, reinjection well, or pipelines needs to be sited in areas that may have such resources. All such resources discovered during a survey or inadvertently discovered during on-site remedial activities will be secured and protected as required by law and in accordance with the consulting parties' memorandum of agreement.	Applicable
Historic, archeological, and Native American artifacts and resources	STATE – MA Historic Preservation Act (MGL Ch. 9 Sections 26-27C; MGL Ch. 7, Section 38A; MGL Ch. 38 Sections 6B-6C; and 950 CMR 70-71)	The MHC is the state historic preservation office and is authorized by Massachusetts law to identify, evaluate, and protect the Commonwealth's important historic and archaeological resources. The MHC administers state and federal preservation programs, including planning, review, and compliance.	After consultation with the Wampanoag Indian Tribes and the SHPO, the parties may determine that a cultural resources survey is needed to discover and identify objects and artifacts, particularly Native American artifacts of the Wampanoag Indian Tribes, if the monitoring wells, extraction well, reinjection well, or pipelines need to be sited in areas that may have such resources. All such resources discovered during a survey or inadvertently discovered during on-site remedial activities will be secured and protected as required by law and in accordance with the consulting parties' memorandum of agreement.	Applicable

Appendix A - ARAR Tables from Final Record of Decision for Chemical Spill-10 Groundwater[1]

Table 2
Location-Specific ARARs for CS-10 Groundwater Selected Remedy (Alternative 10 for the main body and Alternative 3 for leading edge)

Media	Requirements	Requirement Synopsis	Action to be Taken to Attain Requirements	Status
Wetlands	FEDERAL – Protection of Wetlands (EO 11990, 40 CFR 6, Appendix A)	Under this order, federal agencies are required to minimize the destruction, loss, or degradation of wetlands, and beneficial values of wetlands. Appendix A requires that no remedial alternatives adversely affect a wetland if another practicable alternative is available. If no alternative is available, effects from implementing the alternative must be mitigated.	These requirements are ARARs only if new treatment systems or SPEIM wells are sited in areas that would impact wetlands. The operation and maintenance of the treatment and well systems and construction of any new SPEIM wells, if needed, would be designed to minimize adverse effects to such wetlands and comply with these requirements.	Applicable
Wetlands	FEDERAL – Clean Water Act (CWA) Section 404 (40 CFR 230; 33 CFR Parts 320-323)	No activity that adversely affects a wetland shall be permitted if a practicable alternative with fewer effects is available. If no practicable alternative exists, impacts must be mitigated.	These requirements are ARARs only if new treatment systems or SPEIM wells are sited in areas that would adversely impact wetlands. Such potential impacts will be mitigated to comply with CWA 404 requirements.	Applicable
Wetlands	STATE – MassDEP Wetlands Protection Act (MGL Ch. 131, Section 40) and regulations (310 CMR 10.00)	This regulation outlines performance standards that must be met to work within 100 feet of a coastal or inland wetland and within 200 feet of a river. It governs all work involving the filling, dredging, or alteration of wetlands, banks, land under water bodies, waterways, land subject to flooding, and riverfront areas.	These requirements are ARARs only if new treatment systems or SPEIM wells are sited in areas that would adversely impact wetlands. The construction, operation, and maintenance of such systems and wells would be designed to meet the performance standards in 310 CMR 10.21 through 10.60 to minimize adverse effects to nearby wetlands.	Applicable
Wetlands	FEDERAL – Fish and Wildlife Coordination Act (40 CFR 6.302; 16 USC 661 et seq.)	This act and regulations require federal agencies to take into consideration the effect that water-related projects would have on fish and wildlife, and to consult with the U.S. Fish and Wildlife Service and the state to develop measures to prevent, mitigate, or compensate for project-related losses to fish and wildlife.	These requirements are ARARs only if new treatment systems or SPEIM wells are sited in areas that would adversely impact water bodies including wetlands. Remedial actions would be designed to minimize and/or compensate for adverse effects to fish and wildlife in any water bodies including wetland areas. Relevant federal and state agencies will be contacted, if indicated, to help analyze the effects of the systems or wells on fish and wildlife in water bodies including wetlands in and around the site.	Applicable

Table 2
Location-Specific ARARs for CS-10 Groundwater Selected Remedy (Alternative 10 for the main body and Alternative 3 for leading edge)

Media	Requirements	Requirement Synopsis	Action to be Taken to Attain Requirements	Status
Floodplains	FEDERAL – Protection of Floodplains (EO 11988, 40 CFR 6, Appendix A)	Requires federal agencies to minimize potential harm to or within floodplains and avoid the long- and short-term adverse impacts with modifications to floodplains. Appendix A requires that no remedial alternatives adversely affect a floodplain if another practicable alternative is available. If no alternative is available, effects from implementing the alternative must be mitigated.	These requirements are ARARs only if new treatment systems or SPEIM wells are sited in floodplains. If the placement of any such system or well is needed, these requirements will be complied with if the location of the new well(s) is within or affecting a floodplain.	Applicable
Floodplains	STATE – MassDEP Wetland Protection Act (MGL Ch. 131, Section 40, and 310 CMR 10.00)	Governs work proposed within land subject to flooding (100-year floodplain) and coastal storm flow. Compensatory flood storage is required for any loss of floodplain area.	These requirements are ARARs only if new treatment systems or SPEIM wells are sited in floodplains. If the placement of any such system or well is needed, these requirements will be complied with if the location of the new well(s) is within or affecting a floodplain.	Applicable

AHPA	Archaeological and Historic Preservation Act
ARAR	applicable or relevant and appropriate requirement
ARPA	Archaeological Resources Protection Act
CFR	Code of Federal Regulations
Ch.	chapter
CMR	Code of Massachusetts Regulations
CS-10	Chemical Spill-10
MA	Massachusetts
MGL	Massachusetts General Law
MHC	Massachusetts Historic Commission
MMR	Massachusetts Military Reservation
NAGPRA	Native American Graves Protection and Repatriation Act
NHPA	National Historic Preservation Act
SHPO	State Historic Preservation Officer
SPEIM	system performance and ecological impact monitoring
USC	United States Code
USCA	United States *Code, Annotated*

[1] Table 2 is taken from Table 2-31 of the *Final Record of Decision for Chemical Spill-10 Groundwater* prepared for the Air Force Center for Engineering and the Environment Installation Restoration Program at the Massachusetts Military Reservation by Jacobs Engineering Group, Inc. August 2009.

Appendix A - ARAR Tables from Final Record of Decision for Chemical Spill-10 Groundwater[1]

Table 3
Action-Specific ARARs for CS-10 Groundwater Selected Remedy (Alternative 10 for the main body and Alternative 3 for leading edge)

Media	Requirements	Requirement Synopsis	Action to be Taken to Attain Requirements	Status
Groundwater	FEDERAL – Underground Injection Control (UIC) Program (40 CFR 144-148)	These regulations outline minimum program and performance standards for underground injection wells and prohibit any injection into the aquifer that may cause a violation of any primary drinking water regulation under 40 CFR 142. The state program has been authorized by EPA and takes effect through the state requirements listed below.	SPEIM will be conducted to determine when groundwater contaminant levels are at or below the most stringent federal and state primary drinking water standards. Groundwater and monitoring well sample water will be treated prior to release to ensure that releases will not cause any violation of drinking water standards in the receiving aquifer.	Applicable
Groundwater	STATE – MA Underground Water Source Protection (310 CMR 27.00 et seq.)	These regulations prohibit the injection of fluid containing any pollutant into underground sources of drinking water where such pollutant will or is likely to cause a violation of any state drinking water regulations under 310 CMR 22.00 or adversely affect the health of persons.	SPEIM will be conducted to determine when groundwater contaminant levels are at or below the most stringent federal and state primary drinking water standards. Groundwater and monitoring well sample water will be treated prior to release to ensure that releases will not cause any violation of drinking water standards in the receiving aquifer.	Applicable
Groundwater	STATE – MassDEP Drinking Water Program, Private Well Guidelines (2008), available at http://www.mass.gov/dep/water/laws/prwellgd.doc	These are guidelines concerning well location, design, construction, development, water quality testing, operation, maintenance, and decommissioning.	These guidelines will be used in locating, designing, constructing, developing, testing, operating, maintaining, and decommissioning monitoring wells, extraction wells, and reinjection wells, and testing and decommissioning private water supply wells.	TBC
Groundwater	FEDERAL – EPA Guidance on "Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites" (9200.4-17P) (21 April 1999).	This guidance describes EPA's policy regarding the use of MNA for the cleanup of contaminated soil and groundwater. It provides guidance regarding necessary site-specific characterization data and analysis, a methodology for determining a reasonable timeframe for remediation, a preference for remediation of sources, appropriate performance monitoring and evaluation, and a preference for contingency remedies.	The source removal already undertaken complies with the preference for source remediation. LTM and evaluation will be conducted consistent with this guidance.	TBC

Table 3
Action-Specific ARARs for CS-10 Groundwater Selected Remedy (Alternative 10 for the main body and Alternative 3 for leading edge)

Media	Requirements	Requirement Synopsis	Action to be Taken to Attain Requirements	Status
Surface water	STATE – Surface Water Quality Standards (314 CMR 4.00)	These standards limit the concentration of certain materials allowed in classified Massachusetts surface waters. The surface water surrounding the MMR has been classified as Class SA and SB coastal waters and Class B inland water.	Levels of contaminants in untreated groundwater currently discharging to surface water bodies are below applicable surface water quality standards. SPEIM will verify that levels of contaminants in untreated groundwater discharging to surface water bodies continue to fall below applicable surface water quality standards in order to monitor the groundwater remedy.	Applicable
Air	STATE – MA Air Pollution Control Regulations (310 CMR 7.06, 7.08 – 7.10, 7.14, and 7.18 – 7.24)	Establishes the standards and requirements for air pollution control in the Commonwealth. Potentially relevant sections include those pertaining to: visible emissions (7.06); dust, odor, construction, and demolition (7.09); and noise (7.10). The regulations also contain air pollutant emission standards for, among other things, hazardous waste incinerators, organic materials, and VOCs.	Dust, noise, and visible emissions will be managed to meet the state requirements during remedial and SPEIM activities, including the construction of new extraction wells, reinjection wells, pipelines, and monitoring wells. Air emissions are not expected to be at a level high enough to trigger the standards for hazardous waste incinerators, organic materials, or VOCs.	Applicable
Stormwater runoff	FEDERAL – CWA NPDES Stormwater Discharge Requirements (40 CFR 122.26)	Establishes requirements for stormwater discharges associated with construction activities that result in a land disturbance area of equal to or greater than one acre of land. The requirements include good construction management techniques; phasing of construction projects; minimal clearing; and sediment, erosion, structural, and vegetative controls to be implemented to mitigate stormwater run-on and runoff.	If monitoring wells, extraction wells, reinjection wells, or pipelines need to be sited in areas that would trigger stormwater runoff releases to any nearby surface water body, including wetlands, and the area of land disturbance is greater than one acre of land, the runoff will be controlled in accordance with these requirements.	Applicable
Stormwater runoff	STATE – Stormwater Discharge Requirements (314 CMR 3.04 and 314 CMR 3.19)	Requires that stormwater discharges associated with construction activities be managed in accordance with the general permit conditions of 314 CMR 3.19 so as not to cause a violation of Massachusetts surface water quality standards in the receiving surface water body (including wetlands).	If monitoring wells, extraction wells, reinjection wells, or pipelines need to be sited in areas that would trigger stormwater runoff releases to any nearby surface water body, including wetlands, and the area of land disturbance is greater than one acre of land, the runoff will be controlled in accordance with these requirements.	Applicable
Stormwater runoff	STATE – Stormwater Management Program Policy (November 18, 1996)	Provides policies and guidance on complying with the state's stormwater discharge requirements.	If monitoring wells, extraction wells, reinjection wells, or pipelines need to be sited in areas that would trigger stormwater runoff releases to any nearby surface water body, including wetlands, the runoff will be controlled in accordance with this policy.	TBC

Table 3
Action-Specific ARARs for CS-10 Groundwater Selected Remedy (Alternative 10 for the main body and Alternative 3 for leading edge)

Media	Requirements	Requirement Synopsis	Action to be Taken to Attain Requirements	Status
Soil	STATE – MA Erosion and Sediment Control Guidelines for Urban and Suburban Areas (May 2003)	Provides guidance and best management practices regarding erosion and sediment control.	Construction, operation, and maintenance of treatment systems, wells, and pipelines will be performed in accordance with this guidance.	TBC
Hazardous waste	FEDERAL – Subtitle C Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities (40 CFR 264 et seq.)	These requirements establish minimum national standards that define the acceptable management of hazardous waste.	Because Massachusetts has been authorized to run the RCRA base program, hazardous materials will be managed according to the state requirements listed below.	Applicable
Hazardous waste	STATE – MA HWMR Requirements for Generators of Hazardous Waste (310 CMR 30.300-30.305)	A generator of solid waste must determine whether that waste is hazardous using various methods, including the TCLP method, or application of knowledge of hazardous characteristics of the waste. If waste is determined to be hazardous, it must be managed in accordance with applicable Massachusetts generator requirements, which require management in accordance with 310 CMR 30.000 et seq.	Hazardous materials generated during the remedial action will be managed in accordance with these regulations and disposed of off-site in a RCRA-permitted treatment, storage, and disposal facility.	Applicable
Hazardous waste	STATE – RCRA Identification and Listing of Hazardous Waste (310 CMR 30.120-125)	These requirements identify the concentrations of contaminants at or above which the waste would be considered characteristically hazardous waste.	RCRA status of groundwater, monitoring well samples, soils, and other materials generated during remedial activities, including well installations, will be determined based on generator knowledge or prescribed test methods. Materials will be analyzed as necessary. If results exceed the standards in 310 CMR 30.120-125, the material will be managed in accordance with hazardous waste regulations.	Applicable

ARAR	applicable or relevant and appropriate requirement
CFR	*Code of Federal Regulations*
CMR	*Code of Massachusetts Regulations*
CS-10	Chemical Spill-10
CWA	Clean Water Act
HWMR	Hazardous Waste Management Regulation
MA	Massachusetts
LTM	long term monitoring
MassDEP	Massachusetts Department of Environmental Protection
MNA	monitored natural attenuation
NPDES	National Pollutant Discharge Elimination System
RCRA	Resource Conservation and Recovery Act
SPEIM	system performance and ecological impact monitoring
TBC	to be considered (guidance)
TCLP	Toxicity Characteristic Leaching Procedure
VOC	volatile organic compound

[1] Table 3 is taken from Table 2-32 of the *Final Record of Decision for Chemical Spill-10 Groundwater* prepared for the Air Force Center for Engineering and the Environment Installation Restoration Program at the Massachusetts Military Reservation by Jacobs Engineering Group, Inc. August 2009 and has been modified to include EPA Guidance on use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites" (9200.4-17P) (21 April 1999).

APPENDIX B
CS-10 Groundwater Modeling Transport Animation

(Available Upon Request)

APPENDIX C

MassDEP Concurrence Letter

MassDEP
Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

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Charles D. Baker
Governor

Karyn E. Polito
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Secretary

Martin Suuberg
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January 13, 2021

Mr. Bryan Olson, Director
Superfund and Emergency Management Division
U.S. Environmental Protection Agency, Region 1
5 Post Office Square, Suite 100
Boston, MA 02109-3912

RE: **BOURNE - BWSC**
Release Tracking Number: 4-0000037
Joint Base Cape Cod (JBCC)
Final Explanation of Significant Differences for 1,4-Dioxane in Groundwater at Chemical Spill-10, Joint Base Cape Cod, MA, Concurrence

Dear Mr. Olson:

The Massachusetts Department of Environmental Protection (MassDEP) has reviewed the document **"Final Explanation of Significant Differences for 1,4-Dioxane in Groundwater at Chemical Spill-10, Joint Base Cape Cod, MA"** (the 1,4-dioxane ESD), dated November 2020. The 1,4-dioxane ESD was prepared for the Air Force Civil Engineer Center (AFCEC) Installation Restoration Program (IRP) at Joint Base Cape Cod (JBCC). The 1,4-dioxane ESD documents changes to the remedy for the Chemical Spill-10 (CS-10) groundwater Area of Concern (AOC) to include 1,4-dioxane as a contaminant of concern (COC) with a site-specific risk-based remediation goal (RG) of 0.46 microgram per liter (µg/L). The 1,4-dioxane ESD adds a new remedial action objective (RAO) for 1,4 dioxane, which is to prevent residential exposure to CS-10 groundwater with 1,4-dioxane concentrations greater than the RG of 0.46 µg/L. The existing CS-10 groundwater remedy for trichloroethene (TCE) and tetrachloroethene (PCE) documented in the *Final Record of Decision (ROD) for Chemical Spill-10 Groundwater* dated August 2009 (the 2009 ROD), including monitored natural attenuation and land use controls, will be adopted for 1,4-dioxane.

Background

The 2009 ROD documents remedial actions including groundwater extraction, treatment and infiltration/reinjection to address trichloroethene (TCE) and tetrachloroethene (PCE) groundwater contamination within the CS-10 AOC. In 2011, an Explanation of Significant Differences (ESD) was issued that clarified the inclusion of monitored natural attenuation (MNA) as a component of the selected remedy for CS-10 AOC and several other JBCC IRP groundwater sites, revised the Land Use Controls (LUCs), modified the phrasing of the Remedial Action Objectives, and added text regarding the process to achieve site closure. In 2014, an ESD was prepared to document changes to the CS-10 AOC conceptual site model, to modify the groundwater remedy to remove contaminants more aggressively from the aquifer so that cleanup levels can be achieved sooner, and to amend the original estimate of aquifer restoration timeframe for the CS-10 AOC presented in the 2009 ROD. This November 2020 1,4-dioxane ESD adds 1,4-dioxane as a COC for the CS-10 AOC with a site-specific, risk-based remediation goal (RG) of 0.46 micrograms per liter (µg/L).

Sampling for the emerging contaminant 1,4-dioxane at the CS-10 AOC was a recommendation in the *Final 4th Five-Year Review, 2007-2012 Massachusetts Military Reservation (MMR) Superfund Site Otis Air National Guard Base, MA* dated October 2013. The AFCEC performed a 1,4-dioxane field investigation in 2014, which confirmed the presence of 1,4-dioxane in the CS-10 AOC. A Remedial Investigation Report for 1,4-Dioxane at the CS-10 AOC dated March 2017 presented a characterization of the nature and extent of 1,4-dioxane groundwater contamination at CS-10, evaluated its fate and transport, and assessed potential risks to human health and the environment from exposure to 1,4-dioxane within the CS-10 AOC.

Remedial alternatives for 1,4-dioxane were evaluated and documented in a Feasibility Study Report for 1,4-Dioxane at the CS-10 AOC dated January 2018. The selected remedial alternative documented in that Report included MNA (primarily dispersion and dilution) and the LUC components of the 2009 ROD. The current CS-10 groundwater extraction, treatment and infiltration/reinjection system will continue to operate to address trichloroethene (TCE) and tetrachloroethene (PCE) groundwater contamination.

The CS-10 1,4-dioxane groundwater contamination is located entirely on JBCC within the boundaries of the portion of CS-10 TCE plume currently being captured by the northwestern CS-10 groundwater in-plume (IP) extraction wells. Although the current CS-10 IP groundwater treatment system is ineffective at removing 1,4-dioxane, the 1,4-dioxane influent concentrations at the CS-10 IP treatment systems are not expected to exceed the site-specific, risk-based remediation goal of 0.46 µg/L. Therefore, additional treatment for 1,4-dioxane at the CS-10 IP treatment system is currently not necessary to meet the Applicable, Relevant and Appropriate Requirements (ARARs) that have been established for the CS-10 groundwater plume pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Monitoring for 1,4-dioxane in groundwater monitoring wells, extraction wells, and treatment system sampling ports will be performed and will be documented in five-year reviews.

Determination

The MassDEP concurs with the significant differences to the remedy described in the 1,4-dioxane ESD, which adds 1,4-dioxane as a COC for the CS-10 AOC with a site-specific, risk-based remediation goal of 0.46 micrograms per liter (µg/L). The CS-10 groundwater remedial system is performing as expected, and the active treatment and natural attenuation processes are expected to attain RGs for the existing COCs (TCE and PCE) and for 1,4-dioxane within the established aquifer restoration timeframe. Since LUCs will remain in place exposure to TCE, PCE, and 1,4-dioxane will be prevented and the remedy will remain protective of human health and the environment.

MassDEP's concurrence is based upon representations made to MassDEP by the AFCEC and assumes that all information provided is substantially complete and accurate. Without limitation, if MassDEP determines that if any material omissions or misstatements exist or if new information becomes available regarding the CS-10 AOC indicating that potential or actual human exposure or threats to the environment exist, MassDEP reserves its authority under M.G.L. c. 21E, the MCP, CERCLA, the National Contingency Plan (NCP), and any other applicable law or regulation to require further response actions including, without limitation, additional investigation, remedial measures, and the implementation of LUCs. MassDEP will review relevant information as it becomes available, including, without limitation, new regulatory requirements or changes in environmental conditions, to determine if additional investigative and/or remedial measures are necessary for the protection of public health, safety, welfare, or the environment.

Please incorporate this letter into the Administrative Record for the CS-10 AOC. If you have any questions regarding this matter, please contact Leonard J. Pinaud, Chief, Federal Site Management Section, Bureau of Waste Site Cleanup in the MassDEP's Southeast Regional Office at (508) 946-2871.

Sincerely,

Paul W. Locke
Assistant Commissioner
MassDEP Bureau of Waste Site Cleanup

L/LP/EJ

Ec: Upper Cape Boards of Selectmen
Upper Cape Boards of Health
JBCC Cleanup Team

Gary Moran, Deputy Commissioner
Diane Baxter, Division Director, Federal Sites Program
Millie Garcia-Serrano, Regional Director
Lucas Rogers, Chief Counsel, BWSC
Gerard Martin, Deputy Regional Director, BWSC
Leonard J. Pinaud, Chief, Federal Site Management
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MassDEP Boston/Southeast Region

APPENDIX D

Responsiveness Summary

Air Force Civil Engineer Center

RESPONSIVENESS SUMMARY for the Explanation of Significant Differences for 1,4-Dioxane in Groundwater at Chemical Spill-10

INTRODUCTION

The purpose of this *Responsiveness Summary* is to provide written responses to the comments received during the public comment period for the Explanation of Significant Differences (ESD) for 1,4-Dioxane in Groundwater at Chemical Spill-10 (CS-10). The Public Comment Period started on 17 August 2020 and extended through 15 September 2020.

Comments	Responses
1) David Dow (public) comment received 11 August 2020: **Subject**: [Non-DoD Source] CS-10 Plume Differences Proposal to Add 1, , 4- dioxane to the Contaminants of Concern Since the CS-10 plume is one of the largest emanating from Joint Base Cape Cod and potentially discharges chlorlnated solvents into Ashumet Pond, I support adding 1,4-dioxane to the chlorinated solvents being addressed by an extraction/treatment/re-injection systems at the leading edge of the two plume fragments. Since I live downgradient of Ashumet Pond in the Yearling Meadows Development in East Falmouth, I have been engaged in the JBCC CERCLA/SDWA cleanup since the late 1980's. In the past I supported including an experimental in-plume treatment test conducted by an approach developed by a Canadian University. Unfortunately this experimental approach didn't work. Since I recently purchased a new iMac computer, I no longer have my former comments that were submitted on remediation approach utilized to remove the chlorinated solvents. In my comments on 1,4-dioxane in the CS-20 plume, I mentioned my concerns about the efficacy of the "natural attenuation" approach via either dilution by physical processes or microbial degradation (which seems unlikely to me for chlorinated solvents & 1,4- dioxane unless one has labile dissolved organic carbon compounds to provide the energy for this process). The biological component is likely to be altered by climate change effects on the soil microbes and their small predators which will effect the biogeochemical processes in the soil (a topic that is rarely discussed). Even though discharge of the CS-10 plume into Ashumet Pond will lead to dilution, I agree with the	1) The CS-10 groundwater plume is currently defined as the extent of groundwater contaminated with trichloroethene (TCE) and tetrachloroethene (PCE) at concentrations exceeding the federal Maximum Contaminant Level (MCL) of 5 micrograms per liter (µg/L) for both compounds. This ESD has been prepared to document changes to the remedy for the CS-10 groundwater plume which include the addition of 1,4-dioxane as a contaminant of concern (COC) through the additional Remedial Action Objective (RAO) for 1,4-dioxane and adopting the existing CS-10 groundwater remedy documented in the Final Record of Decision (ROD) for Chemical Spill-10 Groundwater for 1,4-dioxane which was submitted in August 2009. Four treatment systems were designed to remediate the CS-10 TCE/PCE plume: (1) the CS-10 Sandwich Road (SR) extraction, treatment, and reinjection (ETR) system, which includes the Southern Trench extraction well; (2) the CS-10 In-Plume (IP) extraction, treatment, and infiltration (ETI) system; (3) the CS-10 Northern lobe (NL) (i.e., the northernmost leading edge lobe) extraction well; and (4) the CS-10 mobile treatment unit (MTU), which includes the Eastern IP extraction well. Figure 1-3 in this ESD presents the locations of these remedial systems and illustrate that they are located within the main body of the CS-10 TCE/PCE plume and at the leading edges of the SR and NL areas, not just the two leading edge areas as stated in the comment. The CS-10 SR extraction fence was installed to contain the CS-10 chlorinated solvent groundwater plume at the base boundary along Sandwich Road and began operation in 1999. TCE and PCE concentrations in monitoring wells located off-base

Comments	Responses
Sierra Club national Toxics Team that dilution is not the answer to toxic pollution. AFCEC didn't allow this to be the solution for phosphorus contamination of Ashumet Pond which lead to water quality problems/periodic Cyanobacteria blooms in the Summer. Alum treatment of the sediments and a permeable restive barrier of iron filing along the shoreline was utilized to reduce the excess "P" loading. I don't know what the secondary effects might be on the freshwater biota and their habitats in Ashumet Pond of cocs from the CS-10 plume (if these cocs that are not removed by the system ETR (which didn't appear to stop PFAS contamination of public and private drinking water wells in Falmouth and Mashpee from the discharge at the surface of treated water from the Ashumet Valley Plume- where the water and sediment in the Pond are source areas for the downgradient plume). This didn't surprise me, since I used to be the Recreational Fisheries Coordinator at the Northeast Fisheries Science Center where methyl mercury and PCBs caused fish consumption alerts. Michigan has food safety alert levels for PFAS chemicals and there are concerns for cocs in the Landfill Plume contaminating shellfish in Buzzards Bay. I am quite concerned that neither Ma. DEP or EPA Region 1 have shown any interest in toxic PFAS chemicals exposure from food or the atmosphere (topic of a recent Massa. Breast Cancer Coalition webinar by Dr. Rainier Lohmann- Head of the URI STEEP grant program). A STEEP grant research project has Shown aerial PFAS transport contaminating seabirds on Stellwagen Bank and other locales. The Silent Spring Institute is conducting research on the effects of PFAS chemicals on the immune system of children 4-6 years of age (Comparing Barnstable, Ma. with Pease Tradeport Center, NH). Thanks for your consideration of this comment on the CS-10 addition of 1,4-dioxane to the contaminants of concern at the CS-10 plume (Explanation of Significant Difference or ESD). Dr. David D. Dow East Falmouth, Ma.	between Sandwich Road and Ashumet Pond have all decreased below the MCL since system startup. Decreasing concentrations are consistent with the conceptual site model (CSM) for this area and support the conclusion that operation of the SR extraction fence is containing the plume at the base boundary, eliminating the discharge of TCE/PCE contaminated groundwater from the CS-10 plume into Ashumet Pond. It is important to clarify that the CS-10 1,4-dioxane plume is limited to an on-base area located within the northwestern portion of the CS-10 TCE/PCE groundwater plume. 1,4-Dioxane contamination is not located off-base near the leading edges of the CS-10 groundwater plume and 1,4-dioxane contamination associated with CS-10 does not discharge into Ashumet Pond. Figure 1-4 in the ESD shows the area in the CS-10 groundwater plume where 1,4-dioxane contamination is located and is indicated by the red dots (yellow dots represent 1,4-dioxane detections but at concentrations below cleanup levels and green dots represent no detections). As presented in the ESD, the monitored natural attenuation component of the existing CS-10 remedy has been selected to address the 1,4-dioxane contamination in groundwater. In addition to the natural attenuation processes of dispersion and dilution, there is ample evidence of intrinsic biodegradation as a mechanism for 1,4-dioxane attenuation in aerobic aquifers which reduces the mass, volume, and concentration over time. Based on the long history of sampling at CS-10, it is well documented that the aquifer below Joint Base Cape Cod (JBCC) is highly oxygenated and aerobic. The following three references are provided as supportive information for the biodegradation of 1,4-dioxane in groundwater: ▪ Adamson, D.T., R.H. Anderson, S. Mahendra, and C.J. Newell. Evidence of 1,4-Dioxane Attenuation at Groundwater Sites Contaminated with Chlorinated Solvents and 1,4-Dioxane. Environ. Sci. Technol. 2015, 49, 6510−6518. ▪ Gedalanga, P., A. Madison, Y. Miao, T. Richards, J. Hatton, W.H. DiGuiseppi, J. Wilson, and S. Mahendra. A Multiple Lines of Evidence Framework to Evaluate Intrinsic Biodegradation of 1,4-Dioxane. Remediation Winter 2016. DOI: 10.1002/rem. ▪ Jackson, L.E. and L.D. Lemke. Evidence for Natural Attenuation of 1,4-Dioxane in a Glacial Aquifer System. Hydrogeology Journal. October 2019. https://doi.org/10.1007/s10040-019-02028-6.

<table>
<tr><th>Comments</th><th>Responses</th></tr>
<tr><td></td><td>It is noted that Per- and Polyfluoroalkyl Substances (PFAS) contamination is present in groundwater at JBCC but is not associated with the CS-10 site. PFAS contamination from the Ashumet Valley Plume is being investigated under the Ashumet Valley Supplemental Remedial Investigation which is ongoing. The PFAS related comments are not applicable to the CS-10 site or this ESD.</td></tr>
<tr><td>2) David Dow (public) comment:

FYI- this reinforces my concerns about the CS-10 plume where 1,4-dioxane and PFAS should be contaminants of concern I have participated in some of the Geosynthetics webinars on PFAS chemicals. They do consulting for the military.

Begin forwarded message:

From: David Duncan Dow <ddow420@comcast.net>

Subject: Geosynthetics Newsletter: New York Announces an MCL for 1,4-dioxane

Date: August 27, 2020 at 7:53:52 AM EDT

New York Adopts Standard for 1,4-Dioxane at a Maximum Contaminant Level of 1 part per billion

State Also Achieves Among the Lowest Standards set for PFOA and PFOS at a Maximum Contaminant Level of 10 parts per trillion

Governor Andrew M. Cuomo today announced that New York State has adopted a first-in-the-nation drinking water standard for emerging contaminant 1,4-Dioxane, setting the maximum contaminant level of 1 part per billion for 1,4-Dioxane. The Governor also announced maximum contaminant levels for emerging contaminants PFOA and PFOS in New York's drinking water, which are among the lowest in the U.S. for PFOA and PFOS at 10 parts per trillion. These announcements follow a public comment period and approval by the Public Health and Health Planning Council.

"While the federal government continues to leave emerging contaminants like 1,4-Dioxane, PFOA and PFOS unregulated, New York is leading the way by setting new national standards that help ensure drinking water quality and safeguard New Yorker's health from these chemicals," Governor Cuomo said. "The environmental movement was founded in this great state and we will continue to move forward to protect our most precious resources for generations to come."</td><td>2) This ESD has been prepared to document changes to the remedy for the CS-10 groundwater plume which includes the addition of 1,4-dioxane as a COC.

It is noted that PFAS contamination is not associated with the CS-10 site and therefore PFAS are not addressed in this ESD. PFAS contamination from other adjacent JBCC sites are being investigated under separate ongoing programs which are presented at public meetings and will be documented in future reports. These investigations and other PFAS related comments are not applicable to this ESD.

Standards in the state of New York are not applicable to JBCC which is located in Massachusetts. However, it is noted that a risk-based concentration of 0.46 µg/L has been adopted as the cleanup goal for 1,4-dioxane at CS-10 via issuance of this ESD which is lower and more protective than New York’s MCL of 1.0 µg/L (or 1.0 part per billion) that is cited in the comment.

On October 2, 2020 MassDEP published regulations that establish a drinking water standard (Massachusetts Maximum Contaminant Level or MMCL) for PFAS. The MMCL for PFAS establishes a limit of 20 parts per trillion for the sum of six PFAS compounds, called the PFAS6.</td></tr>
</table>

Comments	Responses
The new regulations require public water systems in the state to regularly test and monitor for these chemicals, regardless of size. All three contaminants have been detected in drinking water systems across the country, yet remain unregulated by the U.S. Environmental Protection Agency, which is responsible for setting regulatory limits under the federal Safe Drinking Water Act. In lieu of federal action and as part of the State's commitment to ensuring clean drinking water for all New Yorkers, the Drinking Water Quality Council was established as part of the 2017-2018 Executive Budget to provide recommendations to the New York State Department of Health to address emerging contaminants in drinking water resulting from decades-old industrial pollution in communities statewide. The Council's scientific review of PFOA, PFOS, and 1,4-Dioxane was part of its first directive to set standards for these man-made, emerging contaminants, which are persistent in the environment and have been detected in drinking water systems nationwide. The Council's members, comprised of academic scientists, engineers, public water system professionals, and experts from the New York State Departments of Health and Environmental Conservation, followed the available science regarding potential health impacts and technology available to remove these chemicals when recommending the standards for adoption. Per New York's rulemaking process, the amended regulations were published in January in the New York State Register for a 45 day public comment period. The proposal garnered more than 2,000 comments for consideration. In response to comments received, DOH drafted modifications to the proposed regulations that would establish a deferral process for public water systems who proactively tested to come into compliance with the proposed MCLs, without being issued a violation notice. Following today's PHHPC approval, and once approved by the Commissioner of Health, the final regulations will be published in the State Register. Once published, systems serving 10,000 people or more will be required to begin testing within 60 days, within 90 days for systems serving between 3,300 to 9,999 people, and within six months for systems serving less than 3,300 people. **New York State Health Commissioner Dr. Howard Zucker said,** "New York State's unwavering commitment to addressing emerging contaminants in drinking water is a cornerstone of protecting public health now and into the future. These new standards are some of the lowest and precedent-setting nationwide and were carefully considered over	

Comments	Responses
months of scientific review with stakeholder input to ensure successful implementation." **New York State Department of Environmental Conservation Commissioner Basil Seggos said,** "Today, in the continued absence of federal leadership to safeguard our communities from exposure to emerging contaminants, New York is adopting historic and protective drinking water standards for PFOA, PFOS, and 1,4-Dioxane. I commend my colleagues on the State's Drinking Water Quality Council for their critical and necessary leadership on this issue and look forward to working with our partners at the Department of Health on our continued efforts to ensure all New Yorkers have access to clean water." **New York State Environmental Facilities Corporation Acting President and Chief Executive Officer and General Counsel Maureen Coleman said,** "EFC is pleased to partner with DOH to provide state grants to fund 60% of the total costs of these critical projects. By offering low interest financing for the remaining project costs, we are making these projects affordable to communities and supporting Governor Cuomo's objective that all New York State residents have access to clean drinking water." **The Nation's Most Protective MCLs for PFOA/PFOS Accepted** At 10 ppt for PFOA and 10 ppt for PFOS, the MCLs are among the most protective levels in the nation. PFOA is a chemical that has previously been used to make non-stick, stain resistant, and water repellant products. PFOS has been used in aqueous film forming fire-fighting foam. New York State has invested millions through the State Superfund Program to install granular activated carbon filtration systems that are successfully removing PFOA and PFOS from impacted water supplies in several communities. Ultimately, the State is holding the potential polluters accountable for cleanup expenses incurred at state and local levels. **First in the Nation MCL for 1,4-Dioxane adopted** New York is the first state in the nation to adopt an MCL for 1,4-Dioxane and has set that standard at 1.0 ppb. 1,4-Dioxane is a chemical that has been used as a stabilizer in solvents, paint strippers, greases, and wax. The State approved an effective new treatment technology for 1,4-Dioxane called Advanced Oxidative Process, which was first approved to treat a well in the Suffolk County Water Authority on Long Island in 2018.	

Comments	Responses
The State's recommended levels for PFOA and PFOS are significantly lower than the U.S. EPA's current guidance levels of 70 parts per trillion. Any potential health effects of concern for these contaminants primarily results after a lifetime of exposure to 70 ppt, not exposure over short periods of time. While EPA does not have guidance on 1,4-Dioxane, in accepting the Drinking Water Quality Council's recommendations, DOH used the best available science to determine a similarly protective level of 1 ppb. Establishing such highly protective MCLs and requiring every public water system to regularly test and monitor, regardless of size, will ensure that contaminant levels never rise to the point of causing a public health risk. New York State agencies have taken unprecedented action to investigate and clean up PFAS contamination and to ensure New Yorkers have access to clean water. To support this effort, the Department of Environmental Conservation works with our partners at the State Department of Health and numerous entities, including local health departments, drinking water providers and authorities, and federal, state, county, and municipal governments to ensure groundwater and surface water resources are protected and clean. New York State has dedicated significant resources to assess emerging contaminants like PFAS and 1,4-Dioxane across the state. **Future Action to Protect New York Communities** New York State will continue to advance programs and policy guided by the best available science while holding polluters responsible for the harm that emerging contaminants cause to communities and the environment. Through cooperative efforts among state agencies, New York will conduct monitoring at Superfund, brownfield, potential firefighting foam hot spots, and inactive landfill sites to determine whether PFAS impacts are detectable. The State will build upon its work to date to address emerging contaminants through a suite of legal and regulatory actions coupled with swift on-the-ground response for sites where contamination is detected. In addition, the Drinking Water Quality Council will oversee evaluation of new and unregulated contaminants to safeguard public health.	

Comments	Responses
Contact the Governor's Press Office Contact us by phone: Albany: (518) 474 - 8418 New York City: (212) 681 - 4640 Contact us by email: Press.Office@exec.ny.gov	
3) David Dow (public) comment: **My Basic Concern About the CS-10 Plume at JBCC and the Contaminants of Concern** I have felt that the dose of a toxic chemical makes the poison and the resulting negative effects on human health and the environment. Thus the flux of 1,4-dioxane and PFAS chemicals from the large CS-10 plume into Ashumet and Johns Ponds over time can be significant if the contaminant of concern is stored in the sediments (methyl mercury) or bioaccumulated by biota in the water column (like PFAS chemicals). For most residents of the US the major route of PFAS exposure is food (seafood or vegetables grown in soils with solid waste residuals from industrial/ wastewater sludges added or the yards/gardens of homeowners) and not drinking water (where AFFF from fire fighting training or airports is a common source). CS-10 is a large plume with a significant flux of groundwater into Ashumet and Johns Ponds, so that even a low concentration of 1,4-dioxane and PFAS could yield significant pollution of the water column and sediments over time. As this contamination moves down gradient in the smaller Ashumet Valley Plume, it could lead to significant contamination of public and private drinking water wells. Most mcls are based upon contaminant concentrations and not the flux or amount of contaminant entering groundwater or a pond which is the actual source of contamination. This is why the Sierra Club opposes dilution as the answer to toxic contamination, even though this may be okay for nutrient pollution under the Clean Water Act. At Joint Base Cape Cod "Natural Attenuation" of a contaminant of concern occurs primarily by dilution with soil water from rain and melting snow. If the coc contaminated plume is deep in the groundwater, this dilution won't occur, so that it has a significant load of toxic chemicals traveling through the ground water at depth that is	3) The CS-10 1,4-dioxane plume is located within the northwestern portion of the CS-10 TCE/PCE groundwater plume. 1,4-Dioxane contamination is not located near the leading edges of the CS-10 TCE/PCE plume and 1,4-dioxane contamination from the CS-10 groundwater plume does not discharge into Ashumet Pond or Johns Pond. Figure 1-4 in the ESD illustrates the area in the CS-10 groundwater plume where 1,4-dioxane contamination is located and is indicated by the red dots. It is noted that PFAS are not related to the CS-10 plume. PFAS contamination from other JBCC sites (Ashumet Valley, Tanker Truck Rollover Sites, Landfill-1, and the Flight Line Area) are being investigated under separate ongoing programs; these investigations and other PFAS related comments are not applicable to this ESD.

Comments	Responses
not subject to natural attenuation by soil microbes (which require labile dissolved organic matter to provide a source for metabolism). For PFAS chemicals they can be broken down by incineration disposal processes or present in the concentrated water produced by Reverse Osmosis or the contaminated activated carbon produced by GAC treatment which are hard to dispose of in landfills or wastewater treatment plants, low molecular weight PFAS chemicals can reform in the environment into higher molecular weight forms like PFOS/PFOA or are more soluble in water than the higher molecular weight PFAS chemicals. These processes are discussed in greater detail in the Environmental Working Group's report: "Feeding the waste cycle: How PFAS "Disposal" Perpetuates Contamination" and the National Academy of Sciences Workshop Report: "Understanding, Controlling, and Preventing Exposure to PFAS: Proceeding of a Workshop- in Brief". Even though Ma. DEP proposed am mcl of 20 parts per trillion for the sum of 6 PFAS chemicals in April 2020, it has not yet been implemented. There was no discussion of waste site cleanup procedures in this guidance document which is a major challenge for the chemical spill plumes at JBCC. Thus the conceptual model of the CS-10 source area and down gradient groundwater plume which discharges into Ashumet pond is. overly simplistic from my perspective (based upon emergent PFAS scientific studies). This may not be unexpected, since Ma. DEP and EPA regulations are generally based upon commonly accepted science. For example, when I worked at the Fisheries Lab in Woods Hole I tried to get the New England Fishery Management Council's Habitat Plan Development Team to include climate change in Omnibus Habitat Amendment 2, my suggestion was rejected in 2009. In more recent times rapid warming of the Gulf of Maine and increased natural mortality of cod and sea herring stocks has forced both NOAA Fisheries in their Ecosystem Status Report and the NEFMC to acknowledge the effects of shifts of fish stocks and their prey in space and time in the management process in 2020. Given the amount of time and money involved in the JBCC SDWA/CERCLA cleanup, I feel that we need to find away to use cutting edge science to expedite the cleanup and make it more cost effective. I will leave the details of how to do this up to the regulators and the military and their contractors.	
No other Comments were received for the Draft CS-10 1,4-Dioxane ESD.	