Final
Third Five-Year Review Report

Multiple Sites at Beale Air Force Base
Yuba County, California

USACE Contract No. W9123822C0027

Prepared for:

Air Force Civil Engineer Center

and

U.S. Army Corps of Engineers, Sacramento District

February 2024

Executive Summary

The U.S. Air Force (Air Force) has initiated this Third Five-Year Review (FYR) covering seven Environmental Restoration Program (ERP) sites at Beale Air Force Base (AFB) in Yuba County, California. This FYR is required pursuant to Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Section 121(c) and the National Contingency Plan [Title 40 Code of Federal Regulations Section 300.430(f)(4)(ii)] because hazardous substances, pollutants, or contaminants remain at the sites above levels that allow for unlimited use or unrestricted exposure.

Beale AFB is located approximately 50 miles north of Sacramento, California. The base is close to the town of Wheatland and the twin cities of Marysville and Yuba City and occupies approximately 23,157 acres of land. Table ES-1 lists the ERP sites at Beale AFB covered in this Third FYR. Figure ES-1 shows the locations of the Third FYR sites.

Table ES-1. Beale Air Force Base Third Five-Year Review Sites

Site ID	Site Name
LF013	Former Landfill No. 1
OT017	Best Slough
SD032	Building 1086
ST018	Bulk Fuel Storage Facility
TU509	Clinic Underground Storage Tanks
CG041	Basewide Groundwater
CG044	Western Groundwater Plumes

Site CG041 (Basewide Groundwater) includes plume sites CG041-010, CG041-016, CG041-017, CG041-018, CG041-029, CG041-035, and CG041-039. Site CG044 (Western Groundwater Plumes) includes plume sites CG044-003, CG044-013, CG044-031, CG044-032, and CG044-040.

This Third FYR Report covers the period of 01 July 2016 to 30 June 2022. Site inspections were conducted on 03 April 2023 and 18 May 2023 in support of this FYR.

ES.1. Purpose

The purpose of this Third FYR is to verify that the remedial actions implemented at the Beale AFB ERP sites evaluated in this report are protective of human health and the environment and are functioning as intended by the governing decision documents.

Table ES-2 provides the FYR summary form. The FYR process includes a review of relevant documents and data, site inspections, interviews of personnel and community members, and development of this report.

This report states whether each remedy is or will be protective, identifies any deficiencies, and recommends actions for improvement if the remedy has not performed, or is not performing, as designed.

Table ES-2. Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Beale AFB		
U.S. Environmental Protection Agency ID: Not Applicable		
Region: 9	**State:** CA	**County:** Yuba
SITE STATUS		
National Priorities List Status: Not Applicable		
Multiple Sites? Yes	**Has the site achieved construction completion?** With the exception of CG041-017, interim remedies and remedies have been implemented. CG041-017 implementation was delayed due to access limitations (i.e., bridge construction). Implementation of the selected remedy (hot spot treatment) to address COCs in groundwater at Plume CG041-017 began in August 2023. Portions of the remedy construction, including construction of the permeable reactive barrier (PRB) and two bioreactors, have been completed. Full remedy construction is expected to be completed in 2024.	
REVIEW STATUS		
Lead agency: Other Federal Agency ***[If "Other Federal Agency", enter Agency name]*:** Air Force		
Author name (Federal or State Project Manager): Darren Rector		
Author affiliation: ERP, Air Force Civil Engineer Center/CZOW		
Review period: July 2016–June 2022		
Date of site inspection: 4/3/2023 and 5/18/2023		
Type of review: Statutory		
Review number: 3		
Triggering action date: 7/18/2018		
Due date *(five years after triggering action date)*: 12/21/2023		

ES.2. Protectiveness Summary

With the exception of plume site CG041-017, the remedies documented in the respective decision documents for the ERP sites have been implemented. At plume site CG041-017, four of the five remedial components are in place and are being implemented. The fifth component (hotspot treatment with enhanced reductive dechlorination and permeable reactive barrier with in-situ chemical reduction) has not been implemented as of this FYR period because the site could not be accessed due to bridge construction. Implementation of the selected remedy (hotspot treatment) to address COCs in groundwater at Plume CG041-017 began in August 2023. Portions of the remedy construction, including construction of the PRB

and two bioreactors, have been completed. Full remedy construction is expected to be completed in 2024. Site inspections, document reviews, data reviews, and interviews indicate the remedies at the ERP sites are functioning as intended by the respective decision documents and are protective of human health and the environment as of the date of this FYR for Sites LF013, OT017, SD032, ST018, and TU509. The Third FYR indicates that the remedies are protective of human health and the environment in the short-term for Sites CG041 and CG044. The remedies will continue to be implemented and monitored.

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Abbreviations and Acronyms

AFB	Air Force Base
AFCEC	U.S. Air Force Civil Engineer Center
AFFF	Air Force facilities in aqueous film forming foam
Air Force	U.S. Air Force
AOC	Area of Concern
ARARs	applicable or relevant and appropriate requirements
ASTs	aboveground storage tanks
Bayside	Bayside Engineering Construction, Inc.
bgs	below ground surface
BGMP	Basewide Groundwater Monitoring Program
Brice	Brice Environmental Services Corporation
CalEPA	California Environmental Protection Agency
CAP	Corrective Action Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CH2M	CH2M HILL
COCs	chemicals of concern
CVOCs	chlorinated volatile organic compounds
CVWB	Central Valley Regional Water Quality Control Board
DCA	dichloroethane
DCE	dichloroethene
DTSC	Department of Toxic Substances Control
EA	enhanced attenuation
EISB	enhanced in-situ bioremediation
ELCR	excess lifetime cancer risk
EOD	explosive ordnance disposal
EPA	U.S. Environmental Protection Agency
ERD	enhanced reductive dechlorination
ERP	Environmental Restoration Program
ERRG	Engineering/Remediation Resources Group, Inc.
ESLs	environmental screening levels
EVO	emulsified vegetable oil
FFS	focused feasibility study
FPTA	Fire Protection Training Area
FYR	Five-Year Review
GAC	granular activated carbon

Abbreviations and Acronyms *(continued)*

GTS	groundwater treatment system
HHRA	Human Health Risk Assessment
HI	hazard index
IDP	Installation Development Plan
ISCO	in-situ chemical oxidation
IROD	Interim Record of Decision
Jacobs	Jacobs Engineering Group, Inc.
JP-TS	Jet Propellant Thermally Stable
LNAPL	light nonaqueous-phase liquid
LUCs	land use controls
LUCIP	Land Use Control Implementation Plan
MCLs	maximum contaminant levels
MOGAS	Motor Gasoline
MRP	Monitoring and Reporting Program
NCP	National Contingency Plan
O&M	operation and maintenance
OEHHA	Office of Environmental Health Hazard Assessment
OWSs	oil / water separators
PAHs	polycyclic aromatic hydrocarbons
PCE	tetrachloroethene
PFAS	perfluoroalkyl and polyfluoroalkyl substances
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonic acid
PHG	public health goal
ppbv	parts per billion by volume
PRB	permeable reactive barrier
PSLs	project screening levels
PWTP	photographic wastewater treatment plant
RAOs	remedial action objectives
RI	Remedial Investigation
ROD	Record of Decision
ROE	right-of-entry
RSLs	regional screening levels
RWQCB	Regional Water Quality Control Board

Abbreviations and Acronyms *(continued)*

STOP	SVE termination or optimization process
SVE	soil vapor extraction
SWRCB	State Water Resources Control Board
TCA	trichloroethane
TCP	trichloropropane
TCE	trichloroethene
TDS	total dissolved solids
TeCA	tetrachloroethane
TEFA	Technical and Economic Feasibility Analysis
TPH	total petroleum hydrocarbon
TPH-D	total petroleum hydrocarbon as diesel-range organics
TPH-G	total petroleum hydrocarbon as gasoline-range organics
USTs	underground storage tanks
UU	unlimited use
UE	unrestricted exposure
VFC	vapor forming chemical
VI	vapor intrusion
VOC	volatile organic compound
WDR	Waste Discharge Requirement
YCWA	Yuba County Water Agency
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
§	Section

1. Introduction

The purpose of a Five-Year Review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

This is the third FYR for Beale Air Force Base (AFB) in Yuba County, California (Figure 1-1). This report addresses seven Environmental Restoration Program (ERP) sites at Beale AFB (Table 1-1 and Figure 1-2). Beale AFB ERP sites DP019, SD011, SS035, and SS039 have been closed and are not evaluated in the Third FYR. This FYR is required pursuant to Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Section (§) 121(c) and the National Contingency Plan (NCP) [Title 40 Code of Federal Regulations (CFR) § 300.430(f)(4)(ii)] because hazardous substances, pollutants, or contaminants remain at the sites above levels that allow for unlimited use (UU) or unrestricted exposure (UE).

Table 1-1. Beale Air Force Base Third Five-Year Review Sites

Site ID	Site Name
LF013	Former Landfill No. 1
OT017	Best Slough
SD032	Building 1086
ST018	Bulk Fuel Storage Facility
TU509	Clinic Underground Storage Tanks
CG041	Basewide Groundwater
CG044	Western Groundwater Plumes

This FYR includes an evaluation of data generated between 01 July 2016 and 30 June 2022. Bayside Engineering Construction, Inc. (Bayside) has prepared this report for the U.S. Air Force Civil Engineer Center (AFCEC) under U.S. Army Corps of Engineers Sacramento District Contract No. W9123822C0027. Engineering/Remediation Resources Group, Inc. (ERRG) assisted Bayside with various tasks associated with the report.

This report was prepared using the guidelines provided in the Comprehensive FYR Guidance (U.S. Environmental Protection Agency [EPA], 2001) and follows the format and style of EPA's FYR Recommended Template (EPA, 2016).

1.1. Administrative Components

The U.S. Air Force (Air Force) is the lead agency responsible for remedial decisions, funding, and implementing remedial actions. Beale AFB is not listed on the National Priority List under the NCP; therefore, it does not have a Federal Facility Agreement with the federal and state regulatory oversight agencies. The California Environmental Protection Agency's (CalEPA) Department of Toxic Substances Control (DTSC) and the Central Valley Regional Water Quality Control Board (CVWB) are the primary regulatory oversight agencies representing the State of California. Appendix G includes Air Force responses to CVWB and DTSC comments on the draft final version of the subject third FYR report.

1.2. Site Background

Beale AFB is in northern California, approximately 50 miles north of Sacramento (Figure 1-1). Beale AFB is close to the town of Wheatland and the twin cities of Marysville and Yuba City and occupies approximately 23,000 acres of land in Yuba County (Air Force, 2018b). Beale AFB opened in October 1942 as Camp Beale and served as a training ground for infantry and armor units. Currently, approximately 10,000 military and civilian personnel are stationed at Beale AFB, working in support of the 9th Reconnaissance Wing, whose mission is mainly aerial surveillance.

As a result of past waste management and disposal practices, groundwater, soil, sediment, and surface water at Beale AFB became contaminated at multiple locations. In early 1980, a records search was conducted at Beale AFB as part of the Installation Restoration Program (now the ERP) (AECOM, 2018).

Beale AFB displays characteristics similar to both the Great Valley and the Sierra Nevada provinces, with relatively flat grassland in the western portion of the Base and low rolling hills along the eastern portion of the Base. The principal surface drainages within Beale AFB include the Dry Creek and Best Slough systems, Reeds Creek, and Hutchinson Creek, generally flowing from the northeast to the southwest. Dry Creek, Best Slough, and Reeds Creek typically flow year-round, while Hutchinson Creek is an intermittent stream flowing mainly in the winter (Air Force, 2018b).

Surface soil at most Beale AFB sites is part of the Laguna Formation consisting of a heterogeneous assemblage of silt, clay, sand, and minor gravel beds. Minor amounts of volcanic detritus from the Mehrten Formation and other volcanic formations are present in the Laguna Formation. Beneath the Laguna Formation is the Neroly Formation, which is largely derived from the weathering and erosion of volcanic rocks. Underlying the unconsolidated sediments of the Laguna and Neroly Formations is a marine claystone formation that includes deposits of the Capay Formation and is composed of claystones, siltstones, and mudstones (Air Force, 2018b).

Beale AFB's stratigraphy generally consists of unconsolidated sedimentary deposits, underlain by consolidated sedimentary bedrock, which is underlain by crystalline metamorphic bedrock of the Sierra Nevada basement complex. Groundwater occurs primarily in the unconsolidated sedimentary deposits. The

unconsolidated sedimentary deposits and the consolidated sedimentary bedrock are thickest in the western part of the Base, but thin and pinch out in the eastern part of the Base, where the crystalline metamorphic bedrock of the Sierra Nevada is exposed at the surface (Air Force, 2018b).

The general groundwater flow direction at Beale AFB is southwesterly but varies at the individual sites (Air Force, 2018b). The groundwater is affected by the significant irrigation pumping demands in the agricultural regions west of the Base. Further details on the Base, including geology, hydrogeology, hydrology, groundwater and surface water use, land use, and wildlife habitats can be found in previous Work Plans, FYRs, Record of Decision (ROD) documents, annual reports, and Remedial Investigation (RI) Reports available to the public on the AFCEC Administrative Record for public viewing (https://ar.afcec-cloud.af.mil/).

1.2.1. Current and Potential Land Use

Beale AFB is a secured installation. Access to the Base is generally limited to military members, their dependents, and Beale AFB civilian government employees. Land uses and development capabilities are presented in the Installation Development Plan (IDP) (Michael Baker, International, 2015). The IDP designates existing and planned future land use for the sites as industrial, thus residential land use is not currently allowed or planned for the foreseeable future.

Beale AFB is expected to remain an active military installation in the foreseeable future. Current land use at the site is reasonably anticipated to continue indefinitely to support the mission of the facility (Air Force, 2018b). Sections 2.1 through 2.7 describe the land use for each site covered in this FYR Report.

1.2.2. Groundwater Beneficial Uses

Although designated beneficial uses include domestic, agricultural, municipal, and industrial supply, groundwater at Beale AFB is not presently used as a water supply for any purposes. Currently, residents and workers at Beale AFB are supplied with drinking water from production wells located west of the flightline. The Base supply wells are completed in a portion of the aquifer that is not affected by contaminants (Air Force, 2018b).

2. Response Action Summary

This section summarizes the response actions for the Third FYR sites. The basis for action for soil and groundwater at Beale AFB is described below.

- **Soil:** The basis for action is to maintain the protection of human health and the environment from releases of hazardous substances, pollutants, or contaminants into the environment. The chemicals of concern (COCs) in soil and the response actions vary by site and are discussed in Sections 2.1 through 2.5.
- **Groundwater:** The basis for action is to protect public health from unacceptable risk caused by actual or threatened releases of hazardous substances into the environment that may present an imminent and substantial endangerment to public health or welfare. The COCs in groundwater and the response actions vary by site and are discussed in Sections 2.6 and 2.7.

Sections 2.1 through 2.7 summarizes the response actions for the seven ERP sites at Beale AFB.

2.1. Site LF013 – Former Landfill No. 1

Site LF013 comprises approximately 429 acres and is located on the southwestern boundary of Beale AFB (Figures 1-2 and 2-1). Open fields and grazing land surround Site LF013, and Hutchinson Creek flows along its southern and western boundaries. Site LF013 encompasses former Landfill No.1 and portions of a former photographic wastewater treatment plant (PWTP; formerly WP002) that treated and disposed of wastewater from the Base photographic laboratory (Site WP002) (Air Force, 2016a).

Former Landfill No. 1 was a trench-and-fill landfill used by local farmers for disposal of domestic waste prior to the establishment of Camp Beale in 1942. From 1942 to 1948, while the U.S. Army occupied Camp Beale, both the U.S. Army and civilians continued to use the landfill for disposal. Disposal of Base operations-related waste continued into the mid-1950s (Air Force, 2016a).

Site WP002 comprised portions of the former PWTP that consisted of several facilities used for the transport, treatment, and disposal of wastewater from the Base photographic laboratory (Air Force, 2016a). All the facilities and structures associated with the PWTP have been removed. The Site WP002 decision document specified no further response action for continued industrial land use and included land use controls (LUCs; Air Force, 2016a). Because Site WP002 is contained wholly within Site LF013, the LUCs for Site WP002 were transferred to Site LF013. Groundwater underlying Site LF013 is currently addressed as part of CG044-013, as discussed in Section 2.7.2.

Preliminary assessment/site inspection activities at Site LF013 began in 1985; subsequently, a phased RI was completed to delineate the extent of soil, soil vapor, and groundwater contamination at the site (Air Force, 2016a). Between 1996 and 2011, the Air Force completed several interim cleanup actions at Site LF013 to address contamination in soil and soil vapor. The interim cleanup actions included removal of contaminated soil and debris, placement of a soil cover over the former landfill, installation and operation

of two soil vapor extraction (SVE) systems, and bioventing (Air Force, 2016a). Table 2-1 includes a chronology of major activities and events associated with Site LF013.

Table 2-1. Chronology of Major Activities and Events, Site LF013

Activity/Event	Year
Preliminary Assessment/Site Inspection	1985
Remedial Investigation Field Activities	1988–2001
Interim Remedial Action (soil vapor extraction east and west)	1997–2010
Interim Remedial Action (M-5 ointment tube and ash excavation)	1996
Remedial Investigation and Feasibility Study Reports	2001–2003
Interim Remedial Action (landfill soil cover)	2004
Interim Record of Decision	2010
Interim Remedial Action (bioreactor)	2011
Data Gap Investigation Activities	2013–2014
Final Site LF013 Record of Decision	2016
Land Use Control Implementation, Landfill Cover Inspection, and Pipeline Soil Cover Inspection	Ongoing

An Interim Record of Decision (IROD) was approved for Site LF013 in April 2010 (Air Force, 2010a) with the remedial action objectives (RAOs) listed below.

1. Continue to control and treat groundwater contamination to protect designated beneficial uses of water resources.
2. Restore groundwater to interim cleanup goals within a reasonable time.
3. Continue operation of the West SVE system to optimize groundwater cleanup and prevent the migration of contaminants from soil to groundwater at concentrations that could result in an exceedance of interim cleanup goals.
4. Restrict potential exposure to chlorinated volatile organic compounds (CVOCs) in groundwater.

In September 2010, an area of volatile organic compound (VOC)-contaminated soil within the former landfill (in the vicinity of VMP-1) was removed, and an in-situ bioreactor was installed at Site LF013. The bioreactor was used to promote degradation of residual trichloroethene (TCE) in the extracted groundwater. During excavation of the bioreactor in 2010, additional M-5 ointment tubes and related debris were encountered, and an additional 150 tons of waste soil and tubes was removed. During the expansion of the bioreactor in 2011, the M-5 ointment tube disposal cell was reencountered and subsequently excavated to the northwest. An additional 243 tons of waste materials was removed from the M-5 ointment tube disposal cell at that time.

In 2013, a data gaps investigation was conducted at the former landfill at Site LF013 to assess current concentrations of VOCs. No VOCs were detected in shallow (10 feet below ground surface [bgs] or less) soil vapor at concentrations that exceeded project screening levels (PSLs) during the investigation (Air Force, 2016a). The investigation results indicated that no further remediation of VOCs in vadose zone soil was required (Air Force, 2016a).

The Final ROD for LF013 (Air Force, 2016a) established the RAOs for soil at Site LF013, which are listed below.

- Protect human health by preventing exposure to COCs in soil that would result in an unacceptable risk to onsite residents and/or workers.
- Protect ecological receptors from exposure to COCs in soil that may pose an unacceptable risk.

The remedy for Site LF013 selected in the Final ROD consisted of a prohibition on residential land use and further implementing LUCs necessary to maintain the prohibition, a restriction on intrusive activities, and a requirement to maintain the integrity of the soil covers over the former landfill and portions of the former PWTP wastewater pipeline. The Air Force would maintain LUCs at Site LF013 in perpetuity. Figure 2-1 shows the LUC boundary for Site LF013.

2.1.1. Status of Implementation

At Site LF013, LUCs required by the Final ROD (Air Force, 2016a) are implemented in accordance with the Land Use Control Implementation Plan (LUCIP; Brice Environmental Services Corporation [Brice], 2021a). Prior to issuance of the Final ROD, LUCs were implemented in accordance with the LF013 IROD (Air Force, 2010a). On a semiannual basis, the Air Force monitors and inspects Site LF013 to assess the LUCs and inspects the integrity of the soil covers over the former landfill and portions of the former PWTP wastewater pipeline. Section 2.7.2 describes the LUC inspections associated with plume site CG044-13 (i.e., groundwater associated with Site LF013).

The annual LUC inspection reports document the activities and findings associated with LUC inspections, landfill cover inspections, and pipeline soil cover inspection activities (CH2M HILL [CH2M], 2017b, 2018e, 2019a, and 2020a; Brice, 2020, 2021b, and 2022e). The significant maintenance activities implemented between 2016 and 2022 are summarized below.

- During the March 2016 inspection, a single warning sign and the accompanying t-post were missing from the southernmost pipeline soil cover. They were replaced during the second quarter of 2016 (CH2M, 2017b).
- On 01 and 02 June 2017, two relatively shallow depressions were cleared of vegetation, backfilled with clean soil, wheel-rolled, and compacted in place. Both areas were reseeded with a Base-approved seed mixture on 02 November 2017 (CH2M, 2018e).

- During 2018, maintenance actions for the soil cover at Landfill No. 1 included trimming excessive weed growth adjacent to the monitoring wells, groundwater treatment system (GTS) extraction wells, valve vaults, and electrical pull boxes located along the south side of the soil cover; using clean soil to fill gaps beneath the concrete pads at monitoring wells; and reseeding disturbed areas (CH2M, 2019a).
- During 2019, several maintenance actions were completed for the soil cover at Landfill No. 1, including filling gaps beneath the concrete pads at wells and filling subsidence cracks using soil from a stockpile located at Site LF003. Base Environmental Restoration staff had approved the stockpile for use as fill material (CH2M, 2020a).
- During the September 2020 inspection, all of the warning signs at the LF013 landfill cover, the three remote soil covers, and the former WP002 sludge ponds were replaced (Brice, 2020).

2.2. Site OT017 – Best Slough

Site OT017 occupies approximately 500 acres of primarily low, gently sloping grassland and riparian habitat adjacent to Best Slough in the southeastern portion of the Base (Figures 1-2 and 2-2). Best Slough flows along the north and west sides of Site OT017, and Dry Creek flows to the south along the east side of the site. Parks Lake, a relatively small shallow lake, is located in the center of the southern portion of Site OT017, between Best Slough and Dry Creek. Wetlands are present throughout the site. The site is partially fenced, but accessible via a network of dirt roads. The creeks restrict access along the east and west sides of the site. The Base boundary fence restricts access from the south.

Site OT017 was used as a disposal site for solvents and fuel. Eleven disposal trenches were discovered in 1985 (Air Force, 2018a). One of the trenches contained approximately 40 rusted 55-gallon steel drums. Preliminary assessment/site inspection activities began in 1987; subsequently, a phased RI and several response actions to address groundwater contamination were completed at Site OT017 (CH2M, 2015c). Trenches 2 and 3 were concluded to be the source of CVOCs and fuel-related compounds (total petroleum hydrocarbons [TPH]) in soil and groundwater (Air Force, 2018a). Table 2-2 includes a chronology of major activities and events, including the interim remedial actions, associated with Site OT017.

Table 2-2. Chronology of Major Activities and Events, Site OT017

Event	Date
Initial Site Investigation	1987
Remedial Investigation Field Activities	1988–2008
Interim Remedial Action	2000–2001
Remedial Investigation Report	2004
Feasibility Study Report	2005
Site 17 Interim Record of Decision	2007
Interim Remedial Action	2007
Focused Feasibility Study	2011

Table 2-2. Chronology of Major Activities and Events, Site OT017

Event	Date
Basewide Groundwater Focused Feasibility Study	2015
Final OT017 Record of Decision	2018
Land Use Control Implementation	Ongoing

While treatment of soil or soil vapor has not been conducted, through interim remedies for Site OT017, the Air Force rerouted Best Slough, removed drums and filled trenches; and installed two slurry walls, a pump-and-treat system, a phytoremediation system, and a permeable reactive barrier (PRB) that treated groundwater and ultimately reduced the toxicity and volume of impacted soil (including soil vapor) over time. The interim remedies satisfied the preference for permanent solutions and treatment technologies to the extent practicable (Air Force, 2018a). Groundwater underlying Site OT017 was formerly associated with this site; however, it is now being addressed under CERCLA as a part of basewide groundwater (CG041) under CG041-017 and is discussed in Section 2.6.3.

Groundwater is shallow at Site OT017 (less than 10 feet bgs) and acts as a continuing source of contamination to soil vapor (Air Force, 2018a). The RAO below was identified in the Final ROD for Site OT017 (Air Force, 2018a).

- Protect human health by preventing exposure to COCs in soil vapor that would result in an unacceptable risk to onsite residents, recreationalists, and/or workers.

The remedy for Site OT017 selected in the Final ROD is LUCs (Air Force, 2018a). Figure 2-2 shows the LUC boundary for Site OT017. LUCs for Site OT017 consist of a prohibition on residential land use (including houses, daycare centers, and schools) and industrial land use (unless appropriate engineering controls are implemented, such as vapor barriers) and restrictions on activities during which workers could be exposed to soil vapor (e.g., workers entering excavations or vaults). By restricting land use and invasive activities, the LUCs minimize the potential for exposure to VOCs in soil vapor, which protects human and ecological receptors. LUCs are to remain in place until groundwater is cleaned up or soil vapor concentrations allow for UU/UE.

At Site OT017, LUCs required by the Final ROD (Air Force, 2018a) are implemented in accordance with the LUCIP (Brice, 2021a). On a semiannual basis, the Air Force monitors and inspects Site OT017 to assess the LUCs specified in the Final ROD (Air Force, 2018a). The annual LUC inspection reports document the LUC inspection findings (CH2M, 2017b, 2018e, 2019a, and 2020a; Brice, 2020, 2021b, and 2022e). LUCs are being implemented as required by the Final ROD (Air Force, 2018a), and there were no instances of residential land use (including housing, daycare centers, and schools) within the LUC boundary. Additionally, no water supply wells, industrial buildings exist within the LUC boundaries and site access continues to be restricted. The Work Clearance Request process followed by the Operation Flight of the Civil Engineering Office has been effective in preventing disturbance of the ground surface at Site OT017

and in preventing exposure to soil vapor contaminated with VOCs from off-gassing at the groundwater surface.

2.3. Site SD032 – Building 1086

Site SD032 is in the eastern portion of the Flightline Area of Beale AFB (Figures 1-2 and 2-3). The site includes facilities used for aircraft maintenance and repair and Building 1086, which housed the Titan Missile Project (Air Force, 2017c). Historical operations at Building 1086 included assembly of Titan missiles and maintenance of equipment used on B-52 bombers. Those operations included use and storage of solvents, including TCE and trichloroethane (TCA).

Site SD032 also includes four underground storage tanks (USTs) and 13 oil/water separators (OWSs), two vehicle wash pads, and an aircraft wash pad. Site SD032 also includes Area of Concern (AOC) 39, which is a former jet-fuel storage area. AOC 39 consists of the unpaved areas along the east and west sides of Taxiway No. 10 to the north of Taxiway No. 7 (Air Force, 2017c). This section of Taxiway No. 10 was used for parking, maintaining, cleaning, and fueling of KC-135 aircraft until the late 1980s. According to flightline personnel, fuel and oil leaking from the aircraft were routinely washed to gravel-covered soil along the east and west sides of Taxiway No. 10 (Air Force, 2017c).

Site investigation and removal and remedial activities began in 1997. Previous removal actions at Site SD032 (including AOC 39) have addressed VOCs and TPH in soil. Remedial actions included excavation of several USTs and several OWSs, SVE, and a biovent system. Continuing operation of the SVE and biovent systems was selected as part of the remedy at Site SD032 (Air Force, 2007a). Those actions are documented in the Administrative Record, the IROD for Site 32/1 Investigation Area (Air Force, 2007a), and the Final ROD for Site SD032 (Air Force, 2017c). Table 2-3 includes a chronology of major activities and events, including the interim remedial actions, associated with Site SD032.

Table 2-3. Chronology of Major Activities and Events, Site SD032

Activity / Event	Date
Removal of Two Underground Storage Tanks	1993
Removal of Two Solvent Underground Storage Tanks	1997
Soil Vapor Extraction Pilot Test	1997
Bioventing	1997–2011
Remedial Investigation Field Activities	1998–2002
Removal of Eight Oil/Water Separators	1999
Interim Remedial Action (soil vapor extraction)	2000
Interim Remedial Action (drainage soil and sediment excavation)	2007
Grouped with Other Flightline Area Sites for Remedial Investigation and Subsequent CERCLA Phases	2003
Site 32 Feasibility Study	2005

Table 2-3. Chronology of Major Activities and Events, Site SD032

Activity / Event	Date
Site 32 Interim Record of Decision	2007
Interim Remedial Action (in-situ chemical oxidation)	2007
In-Situ Chemical Oxidation Technical and Economic Feasibility Analysis (draft only)	2010
Data Gaps Investigation Activities	2013–2014
Final SD032 Record of Decision	2017
Land Use Control Implementation	Ongoing

Notes:
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act

As stated in the Final ROD for Site SD032 (Air Force, 2017c), the site-specific RAO for soil vapor at Site SD032 is to protect human health by preventing residential exposure to TCE in soil vapor (via vapor intrusion [VI] to indoor air) that would result in an unacceptable risk to hypothetical future residents (Air Force, 2017c).

The selected final remedy for soil (based on risk from soil vapor) at Site SD032, as documented in the Final ROD (Air Force, 2017c), is implementation of LUCs that prohibit residential land use, including housing, daycare centers, and schools over an approximately 0.3-acre area around well VE-4 (Figure 2-3). No action is necessary for sediment and surface water at Site SD032 to protect human health and the environment (Air Force, 2017c). Groundwater underlying the site is addressed under CG044-032 as discussed in Section 2.7.4.

At Site SD032, LUCs required by the Final ROD (Air Force, 2017c) are implemented in accordance with the LUCIP (Brice, 2021a). On a semiannual basis, the Air Force monitors and inspects LUCs at Site SD032. The annual LUC inspection reports document the LUC inspection findings (CH2M, 2017b, 2018e, 2019a, and 2020a; Brice, 2020, 2021b, and 2022e). LUCs are being implemented as required by the Final ROD (Air Force, 2017c), and there were no instances of residential land use (including housing, daycare centers, and schools) within the LUC boundary. The Work Clearance Request process followed by the Operation Flight of the Civil Engineering Office has been effective in preventing disturbance of the ground surface, groundwater use, and residential or other construction within the LUC boundary.

2.4. Site ST018 – Bulk Fuel Storage Facility

Site ST018, the Bulk Fuel Storage Facility, is located in the southwestern portion of Beale AFB, northeast of the intersection of Gavin Mandery Drive and J Street (Figures 1-2 and 2-4). A large portion of Site ST018 is developed or has disturbed ground covered with concrete. Unpaved portions are covered by annual grasslands. Surface water and wet sediments near ST018 are only present during short periods of time in wetlands (Air Force, 2017a). The site is relatively flat, with low areas and drainage swales present to the

east of the former Motor Gasoline (MOGAS) Facility. Site ST018 consists of two tank farms (one active and one former) and has been used for storage and distribution of fuel products since 1958 (Figure 2-4).

The active aviation gasoline Jet Fuel Tank Farm is the larger of the two tank farms and is located in the northeastern corner of Site ST018. A rupture of the below-ground Jet Propellant Thermally Stable (JP-TS) pipeline occurred in 1988 (Air Force, 2017a). The leaking pipe was reportedly replaced with a threaded pipe that also leaked from 1988 until discovery of the leak in 1996. The leaking pipe was again replaced in 1996. In 2008, the below-ground JP-TS pipeline was replaced with an aboveground pipeline. Jet Propellant 8 is also transported to the Jet Fuel Tank Farm via a below-grade pipeline. The former MOGAS Tank Farm (former MOGAS Facility) was located in the southwestern corner of Site ST018, where motor vehicle fuels (diesel and unleaded gasoline) were stored and distributed until late 2008. The former MOGAS Facility was demolished in late winter 2009 through spring 2010.

Underlying groundwater formerly associated with Site ST018 is now being addressed as a part of Site CG041 (basewide groundwater) under CG041-18 as described in Section 2.6.4.

Environmental investigations were initiated at Site ST018 in 1985 (Air Force, 2017a). Table 2-4 includes a chronology of major activities and events associated with Site ST018.

Table 2-4. Summary of Major Activities and Events, Site ST018

Activity /Event	Date
Phase II/Stage 1 Confirmation/Quantification Study	1985-1987
Remedial Investigation Field Activities	1988–2008
Interim Remedial Action (bioventing at Jet Fuel Tank Farm)	1996–2008
Interim Remedial Action (soil vapor extraction at Motor Gasoline Tank Farm)	1997–2010
Remedial Investigation and Feasibility Study Reports (Draft only)	2004–2005
Feasibility Study addendum	2010
Site 18 Interim Record of Decision (Final)	2011
Decommissioning Activities	2013–2015
Site ST018 Record of Decision (Final)	2017
Land Use Control Implementation (Final)	Ongoing

Media investigated included soil, groundwater, sediment, surface water, and soil vapor. Activities included a phased RI, soil vapor investigation, and several groundwater sampling events (Air Force, 2017a). Beale AFB has conducted several interim actions (bioventing, soil excavation, and SVE) to address soil contamination at Site ST018. The interim remedies treated contaminated soil and reduced toxicity, mobility, and volume of contaminants. Previous investigations and remedial actions are documented in the Administrative Record, the IROD for the Site 18 Bulk Fuel Storage Facility (Air Force, 2011a), and the Final ROD (Air Force, 2017a).

As discussed in the Final ROD for Site ST018 (Air Force, 2017a), polycyclic aromatic hydrocarbons (PAHs) were identified as risk drivers in soil at Site ST018, although overall risk was within the risk management range. The site-specific RAO for soil at Site ST018 documented in the Final ROD (Air Force, 2017a) is to protect human health by preventing exposure to PAHs in soil that could result in an unacceptable risk to future onsite residents.

The selected remedy for soil at Site ST018 presented in the Final ROD (Air Force, 2017a) is implementation of LUCs. LUCs for Site ST018 consist of a prohibition on residential land use (including housing, daycare centers, and schools). No action is necessary for sediment and surface water at Site ST018 to protect human health and the environment (Air Force, 2017a).

LUCs required by the Final ROD for ST018 (Air Force, 2017a) are implemented in accordance with the LUCIP (Brice, 2021a). The Air Force monitors and inspects LUCs at Site ST018 on a semiannual basis. The annual LUC inspection reports document the LUC inspection findings (CH2M, 2017b, 2018e, 2019a, and 2020a; Brice, 2020, 2021b, and 2022e). LUCs are being implemented as required by the Final ROD (Air Force, 2017a). There were no instances of residential land use (including housing, daycare centers, and schools) within the LUC boundary. The Work Clearance Request process followed by the Operation Flight of the Civil Engineering Office has been effective in preventing disturbance of the ground surface, groundwater use, and residential or other construction within the LUC boundary.

2.5. Site TU509 – Clinic Underground Storage Tanks

Site TU509 is located at the Base medical clinic at 15301 Warren Shingle Boulevard, near the intersection with Camp Beale Highway (Figures 1-2 and 2-5). The medical clinic was constructed in the late 1950s and was enlarged in the mid-1960s (CH2M, 2016). The clinic was identified as an environmental site in 1998, when soil contamination was discovered during removal and/or in-place abandonment of three diesel USTs (CH2M, 2016).

USTs 5702-3 and 5702-4 were east of Building 5702; UST 5702-5 was west of the building. In April 1998, USTs 5702-3 and 5702-4 were closed in place and UST 5702-5 was excavated and removed. USTs 5702-3 and 5702-4 were later excavated and removed in 2009 (Brice, 2022b). After removal of the USTs, the clinic used two aboveground storage tanks (ASTs), located north of former USTs 5702-3 and 5702-4, to store diesel fuel for the backup generators and boilers. These ASTs have been removed, and fuel for the clinic's boilers and generators is now supplied from propane tanks located northeast of Building 5702 (Brice, 2022b). The COCs for TU509 are leachable TPH as diesel-range organics (TPH-D) and naphthalene in soil (CH2M, 2016). Table 2-5 includes a chronology of major activities and events associated with Site TU509. Groundwater contamination beneath the site is managed as Plume CG041-509 and is not evaluated in this FYR because it is managed under the State Water Resources Control Board's (SWRCB) Leaking Underground Fuel Tank Program as discussed in Section 2.6.

Table 2-5. Chronology of Major Activities and Events, Site TU509

Activity / Event	Date
Site Investigation Activities	1998–2010
Removal of USTs	1998, 2009
Corrective Action Field Activities (Removal of 717.65 tons of soil)	2014–2015

The TU509 Corrective Action Plan (CAP) selected excavation and enhanced bioremediation with LUCs as the corrective action for TU509 (CH2M, 2015a).

To address the CVWB concerns about potential re-contamination of soil by fluctuating groundwater, the selected corrective action alternative for Site TU509, was modified in the TU509 CAP Addendum by adding LUCs to the selected corrective action alternative to prevent residential exposure to contaminants in soil through the direct contact pathway and to contaminants potentially migrating from soil into indoor air through the VI pathway (CH2M, 2016). The LUCs for soil are as follows:

1. The selected corrective action for TU509 includes LUCs for soil to prevent residential exposure to contaminants in soil through the direct contact pathway and to contaminants potentially migrating from soil to indoor air through the VI pathway. The LUC objective is to prevent residential exposure to contaminants in soil and soil vapor that may potentially pose an unacceptable risk to human health until such time as both soil and groundwater (CG041-509) meet all general and media-specific criteria for low-threat closure under the State Water Resources Control Board's low-threat UST closure policy (SWRCB, 2012).
2. Construction of residential buildings will not be permitted within the LUC boundary without prior approval from the Air Force and appropriate regulatory agencies until such time as soil and groundwater (CG041-509) meet all general and media-specific criteria for low-threat closure under the State Water Board's low-threat UST closure policy (SWRCB, 2012).

The Air Force monitors and inspects LUCs at Site TU509 on a semiannual basis. The annual LUC inspection reports document the LUC inspection findings (CH2M, 2017b, 2018e, 2019a, and 2020a; Brice, 2020, 2021b, and 2022e). LUCs are being implemented as required by the TU509 CAP Addendum (CH2M, 2016). There were no instances of residential land use within the LUC boundary. The Work Clearance Request process followed by the Operation Flight of the Civil Engineering Office has been effective in preventing disturbance of the ground surface, groundwater use, and residential or other construction within the LUC boundary.

2.6. Site CG041 – Basewide Groundwater

The Air Force established Site CG041 in 2013 to separate (decouple) groundwater responses from soil responses and address basewide groundwater as one site (Air Force, 2018b). In 2016, the five western plumes (CG041-003, CG041-013, CG041-031, CG041-032, and CG041-040) shown on Figure 1-2 were removed from Site CG041 (Air Force, 2018b). These plumes are being addressed as part of a separate groundwater site (CG044) as described in Section 2.7.

Site CG041 currently consists of groundwater plumes underlying 11 soil sites. Table 2-6 presents each Site CG041 plume, the overlying site name, and the regulatory program under which it is addressed. Figure 2-6 shows the plume locations. Groundwater contamination plumes underlying seven sites (CG041-010, CG041-016, CG041-017, CG041-018, CG041-029, CG041-035, and CG041-039) (Table 2-6 and Figure 2-6) are addressed under CERCLA and are evaluated in this Third FYR Report. The groundwater plumes underlying the remaining four sites are addressed under either the Resource Conservation and Recovery Act or SWRCB's Leaking Underground Fuel Tank guidance and are not evaluated in this report.

Table 2-6. Site CG041 – Groundwater Plume Names, Overlying Site Names, and Regulatory Program

Plume Name	Overlying Site Name(s)	Regulatory Program
Addressed in this Third FYR Report		
CG041-010	Site SD010 (J-58 Test Cell)	CERCLA
CG041-016	Site WP016 (Explosive Ordnance Disposal Area)	CERCLA
CG041-017	Site OT017 (Best Slough)	CERCLA
CG041-018	Site ST018 (Bulk Fuel Storage Area)	CERCLA
CG041-029	Site FT029 (Burn Pit)	CERCLA
CG041-035	Site SS035 (Weapons Storage Area)	CERCLA
CG041-039	Site SS039 (Building 2145)	CERCLA
Not Addressed in this Third FYR Report		
None	Site SD023 (Ninth Transportation Refueling Vehicle Maintenance Shop)	RCRA[1]
CG041-517	Site CG517 (Clinic PCE Plume)	RCRA
CG041-508	Site SS508 (PCE Groundwater Plume Civil Engineering Yard)	RCRA
CG041-509	Site TU509 (Clinic UST Site)	LUFT

Notes:

1 = Site SD023 has historically been addressed under CERCLA; however, groundwater contamination underlying Site SD023 originates from Sites SS023 and OW034, which are addressed under RCRA. Groundwater underlying Site SD023 will be addressed with Sites SS023 and OW034 under RCRA.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
FYR = Five-Year Review
LUFT = Leaking Underground Fuel Tank
PCE = tetrachloroethene
RCRA = Resource Conservation and Recovery Act
UST = underground storage tank

Source: Air Force, 2018b

Sections 2.6.1 through 2.6.7 provide site background and response action summaries for each of the CG041 plume sites. In general, preliminary assessments and site inspections were conducted between 1984 and 2001 for the overlying sites, including the underlying groundwater (Air Force, 2018b). Subsequently, phased RIs, response actions, and groundwater monitoring were conducted. Consistent with the CERCLA process, interim remedial actions and/or response actions (such as tank removal, excavation, and installation of treatment systems) have been conducted at all of the overlying sites to address groundwater and/or, as

appropriate, soil sources posing potential threats to groundwater quality. The interim actions were conducted to accelerate site cleanup and are considered to provide adequate protection of human health and the environment until final remedies were selected in the CG041 Final ROD (Air Force, 2018b).

The site-specific RAOs for Site CG041 documented in the Final ROD (Air Force, 2018b) are described below.

- Reduce and/or monitor reductions in concentrations of COCs in groundwater to support restoration of groundwater to designated beneficial uses (domestic, municipal, agricultural, and industrial supply).
- Restrict potential exposure to COCs in groundwater (including exposure via VI in some areas) until concentrations are at such levels to allow for UU/UE.

The RAOs were used, along with site-specific applicable or relevant and appropriate requirements (ARARs), to select cleanup standards for groundwater. Cleanup levels for restoring designated beneficial uses of groundwater are based on the lowest of the federal or state primary maximum contaminant levels (MCLs) (Air Force, 2018b). Table 2-7 presents the numerical cleanup levels to be achieved by the selected remedies.

Table 2-7. Site CG041 Groundwater Cleanup Levels

Chemical of Concern	Cleanup Level (µg/L)[1]	Basis for Cleanup Level
Benzene	1	California Primary MCL
Carbon tetrachloride	0.5	California Primary MCL
Chloroform	80	Federal Primary MCL
1,2-Dichloroethane	0.5	California Primary MCL
1,1-Dichloroethene	6	California Primary MCL
cis-1,2-Dichloroethene	6	California Primary MCL
trans-1,2-Dichloroethene	10	California Primary MCL
Perchlorate	6	California Primary MCL
Methylene chloride	5	Federal Primary MCL
Tetrachloroethene	5	Federal Primary MCL
1,1,2-Trichloroethane	5	Federal Primary MCL
1,1,2,2-Tetrachloroethane	1	California Primary MCL
Trichloroethene	5	Federal Primary MCL
Vinyl chloride	0.5	California Primary MCL

Notes:

1 = Cleanup levels are derived from the lowest of the state or federal primary MCLs referenced in Title 22 California Code of Regulations Section 64444 and Title 40 Code of Federal Regulations Section 300.430(e)(2)(I)(B).

MCL = maximum contaminant level

µg/L = micrograms per liter

Table 2-8 summarizes the selected remedies for Site CG041, which are documented in the Final ROD (Air Force, 2018b).

Table 2-8. Summary of Selected Remedies for Site CG041

Plume Name	Components of Selected Remedy
CG041-010	▪ Treatment with ERD at wells where concentrations are rebounding ▪ EA monitoring of COCs ▪ LUCs prohibiting residential use unless VI risks from groundwater at the proposed construction location are determined to be acceptable or appropriate engineering controls are implemented to mitigate VI ▪ LUCs prohibiting groundwater use and activities that would adversely affect implementation of the selected remedy until concentrations in groundwater allow for UU/UE
CG041-016	▪ EA monitoring of COCs ▪ LUCs prohibiting groundwater use and activities that would adversely affect implementation of the selected remedy until concentrations in groundwater allow for UU/UE
CG041-017	▪ Continued containment using existing slurry walls ▪ Hotspot treatment with ERD and PRB with ISCR (hotspot generally defined by residual TCE concentrations greater than 10,000 µg/L inside the slurry wall and 500 µg/L outside the slurry wall) ▪ EA monitoring of COCs ▪ LUCs prohibiting groundwater use and activities that would adversely affect implementation of the selected remedy until concentrations in groundwater allow for UU/UE ▪ Until soil vapor sampling results demonstrate that VI risks are acceptable, LUCs that prohibit residential and industrial land uses will be implemented in areas where VOC concentrations pose unacceptable risk via VI
CG041-018	TCE Plume: ▪ Hotspot treatment with ERD (hotspot generally defined by residual TCE concentrations greater than 300 µg/L) ▪ EA monitoring of COCs ▪ LUCs prohibiting residential use unless VI risks from groundwater at the proposed construction location are determined to be acceptable or appropriate engineering controls are implemented to mitigate VI ▪ LUCs prohibiting groundwater use and activities that would adversely affect implementation of the selected remedy until concentrations in groundwater allow for UU/UE
	Benzene Plume: ▪ Hotspot treatment with bioremediation (hotspot generally defined by residual benzene concentrations greater than 3 µg/L) ▪ Continued LNAPL recovery ▪ EA monitoring of COCs ▪ LUCs prohibiting residential use unless VI risks from groundwater at the proposed construction location are determined to be acceptable or appropriate engineering controls are implemented to mitigate VI ▪ LUCs prohibiting groundwater use and activities that would adversely affect implementation of the selected remedy until concentrations in groundwater allow for UU/UE

Table 2-8. Summary of Selected Remedies for Site CG041

Plume Name	Components of Selected Remedy
CG041-029	▪ EA monitoring of COCs ▪ LUCs prohibiting groundwater use and activities that would adversely affect implementation of the selected remedy until concentrations in groundwater allow for UU/UE
CG041-035	▪ Hotspot treatment with ERD (hotspot generally defined by residual TCE concentrations greater than 300 µg/L) ▪ EA monitoring of COCs ▪ LUCs prohibiting groundwater use and activities that would adversely affect implementation of the selected remedy until concentrations in groundwater allow for UU/UE ▪ Until soil vapor sampling demonstrates that VI risks are acceptable, LUCs prohibiting future residential and industrial land uses will be implemented in areas where VOC concentrations pose unacceptable risk via VI (current use of Building 1322 is acceptable)
CG041-039	▪ Hotspot treatment with ERD (hotspot generally defined by residual TCE concentrations greater than 300 µg/L) ▪ EA monitoring of COCs ▪ LUCs prohibiting residential use unless VI risks from groundwater at the proposed construction location are determined to be acceptable or appropriate engineering controls are implemented to mitigate VI ▪ LUCs prohibiting future buildings for industrial/commercial land use over a portion of the plume unless VI risks from groundwater at the proposed construction location are determined to be acceptable or appropriate engineering controls are implemented to mitigate VI ▪ LUCs prohibiting groundwater use and activities that would adversely affect implementation of the selected remedy until concentrations in groundwater allow for UU/UE

Notes:
COCs = chemicals of concern
EA = enhanced attenuation
ERD = enhanced reductive dechlorination
ISCR = in-situ chemical reduction
LNAPL = light nonaqueous-phase liquid
LUCs = land use controls
PRB = permeable reactive barrier
TCE = trichloroethene
UU/UE = unlimited use/unrestricted exposure
VI = vapor intrusion
VOC = volatile organic compound
µg/L = microgram(s) per liter

The following subsections summarize the response actions for CG041 plume sites.

2.6.1. Plume CG041-010

Plume CG041-010 is associated with Site SD010 (Former J-58 Test Stand) and is located in the north-central portion of Beale AFB, east of Doolittle Drive and the flightline area (Figures 2-6 and 2-7). Site SD010 consists of a paved area, with the former J-58 engine test stand building (Building 1152) located in the center and a latrine building located on the south side of the paved area (Air Force, 2018b). Much of the nearby land is open grassland that is not used for grazing.

Building 1152 was used as a test stand for SR-71 aircraft engines from 1959 to 1990 (Air Force, 2018b). As engines were tested, fuel was discharged onto the concrete pad and washed onto the surrounding ground surface, eventually discharging to a ditch southeast of the test cell. Two 10,000-gallon ASTs, located northwest of the engine test building, supplied JP-7 fuel to the engines on the test stand until their removal in 1997 (Air Force, 2018b). An underground septic leach field is located just south of the office/storage buildings. Solvents and other cleaning agents were stored in 55-gallon drums on a metal rack near the test stand (Air Force, 2018b).

In 1995, a biovent system was installed to address jet-fuel-range petroleum hydrocarbons in soil and VOCs in soil and soil gas (Air Force, 2018b). In 1996, the biovent system was converted to an SVE system (North). In 1998, a second SVE system (South) was installed. The South SVE system was decommissioned in 2000 (Air Force, 2018b). In 2004, the North SVE system was converted to a biovent system to address residual TPH soil contamination. It was shut down in 2006 (Air Force, 2018b).

In 2003 and 2004, a pilot test was conducted. Results indicated that enhanced in-situ bioremediation (EISB) could effectively remediate groundwater contaminated with TCE (Air Force, 2018b). In 2006, an EISB treatment system using sodium lactate and microbe amendments was constructed and targeted the source area portion of the plume with TCE concentrations of 500 micrograms per liter (µg/L) or higher. In 2009, the system was shut down for rebound analysis. Results showed the TCE mass in the treatment zone was reduced by 99 percent (Air Force, 2018b). As a result, EISB was selected as an interim remedial action in the Final Site 10 IROD (Air Force, 2010b).

In January 2010, a herd of cattle was pastured at SD010 during the winter and severely damaged the EISB system. During 2010, the aboveground piping and other equipment used for the EISB system were removed to the extent feasible. In 2011, a Technical and Economic Feasibility Analysis (TEFA) recommended the system be decommissioned because (1) TCE concentrations in all wells, except for one, within the treatment zone were less than the MCL; (2) contaminant reduction rates had been relatively flat for up to 2 years; and (3) further optimization and expansion of the system was noted to be not cost effective (Air Force, 2018b).

The COCs identified in the CG041 ROD (Air Force, 2018b) for plume site CG041-010 were cis-1,2-dichloroethene (-DCE), tetrachloroethene (PCE), TCE (primary), trans-1,2-DCE, and vinyl chloride (Air Force, 2018b). The selected remedy in the Final ROD for CG041 (Air Force, 2018b) to address COCs in groundwater at CG041-010 included the components listed below.

- Treatment with enhanced reductive dechlorination (ERD) at wells where concentrations are rebounding.
- Enhanced attenuation (EA) monitoring of COCs.

- LUCs prohibiting residential use unless VI risks from groundwater at the proposed construction location are determined to be acceptable or appropriate engineering controls are implemented to mitigate VI.
- LUCs prohibiting groundwater use and activities that would adversely affect implementation of the selected remedy until concentrations in groundwater allow for UU/UE.

The Plume CG041-010 Remedial Action Work Plan describes injecting emulsified vegetable oil (EVO) substrate into three existing wells where TCE concentrations were rebounding, as well as performance and compliance monitoring to evaluate remedial progress and monitor potential adverse secondary water quality effects associated with ERD (CH2M, 2018b). The EVO injections occurred from 10 July to 08 August 2018. The Plume CG041-010 Remedial Action-Construction Completion Report documents the injection activities (CH2M, 2019b). Groundwater monitoring is ongoing as part of the Basewide Groundwater Monitoring Program (BGMP) until the RAOs are met. LUCs restrict access to groundwater by prohibiting water supply wells until concentrations of COCs allow for UU/UE.

At Site CG041-010, LUCs required by the Final ROD for CG041 (Air Force, 2018b) are implemented in accordance with the LUCIP (Brice, 2021a). Prior to the issuance of the Final ROD for CG041, LUCs were implemented in accordance with the Site 10 IROD (Air Force, 2010b).

On a semiannual basis, the Air Force monitors and inspects LUCs at CG041-010 to assess the LUCs specified in the Final ROD for CG041 (Air Force, 2018b). The annual LUC inspection reports document the findings of LUC inspections (CH2M, 2017b, 2018e, 2019a, and 2020a; Brice, 2020, 2021b, and 2022e). LUC inspection findings indicated that no residences or water supply wells exist within the LUC boundary at CG041-010 and site access continues to be restricted. The Work Clearance Request process followed by the Operation Flight of the Civil Engineering Office has been effective in preventing disturbance of the ground surface, groundwater use, and residential construction.

2.6.2. Plume CG041-016

Site WP016, which includes the explosive ordnance disposal (EOD) area, is located in a restricted access area within a remote northern part of Beale AFB, approximately 3,000 feet south of the Base boundary, 1 mile north of the Cantonment Area, and 700 feet west of Upper Blackwelder Lake (Figures 1-2 and 2-6). Site WP016 is the former disposal trench located within the EOD Range (Air Force, 2018b). It is located within a fenced area, and access requires an escort from the Base Munitions Team.

CG041-016 is a groundwater plume beneath Site WP016 (Figures 2-6 and 2-8), where open burn/open detonation operations were conducted. The EOD Range is the current location for EOD training and emergency detonations. Historically, burned or exploded ordnance was temporarily disposed of in the former disposal trench prior to transporting ordnance off the site. The former disposal trench is the source of perchlorate contamination in groundwater at the site. In 1991 and 1998, contaminated soil and ordnance

remnants within the disposal trench were excavated, and the material was disposed of at an offsite facility, recycled, or reused on the site (Air Force, 2018b).

The selected final remedy in the Final ROD for CG041 (Air Force, 2018b) to address the COC (perchlorate) in groundwater at CG041-016 includes the components listed below.

- EA monitoring of COCs.
- LUCs prohibiting groundwater use and activities that would adversely affect implementation of the selected remedy until concentrations in groundwater allow for UU/UE.

LUCs will restrict access to groundwater that is contaminated with perchlorate at concentrations exceeding the MCL until the perchlorate concentrations in groundwater are at such levels to allow for UU/UE. At Site CG041-016, LUCs required by the Final ROD for CG041 (Air Force, 2018b) are implemented in accordance with the LUCIP (Brice, 2021a). On a semiannual basis, the Air Force monitors and inspects LUCs at CG041-016 to assess the LUCs specified in the CG041 Final ROD. The annual LUC inspection reports document the findings of the LUC inspections (CH2M, 2017b, 2018e, 2019a, and 2020a; Brice, 2020, 2021b, and 2022e). LUC inspection findings indicated that no residences or water supply wells exist within the LUC boundary at CG041-016 and site access continues to be restricted. The Work Clearance Request process followed by the Operation Flight of the Civil Engineering Office has been effective in preventing groundwater use and activities that would adversely affect implementation of the selected remedy until perchlorate concentrations in groundwater allow for UU/UE.

2.6.3. Plume CG041-017

Groundwater underlying Site OT017 is addressed under CG041-017 (Figures 2-6 and 2-9). As discussed in Section 2.2, Site OT017 contains approximately 500 acres of primarily low, gently sloping grassland adjacent to Best Slough. Section 2.2 further describes the Site OT-17 features. In 1985, 11 shallow disposal trenches were discovered in the northern portion of the site. CVOCs and fuel hydrocarbons were disposed of in the northern portion of the site (Air Force, 2018b). One of the disposal trenches contained approximately 40 rusted 55-gallon steel drums (contents and date discarded unknown) (Air Force, 2018b). Trenches 2 and 3 were confirmed to be sources of the CVOCs (Air Force, 2018b).

CG041-017 is divided into three specific areas, as shown on Figure 2-9. The primary source area (Area A) consists of approximately 5 acres, which formerly contained drums disposed of in shallow trenches. TCE concentrations in Area A groundwater have historically exceeded 100,000 µg/L, which typically indicates the presence of dense nonaqueous-phase liquid (Air Force, 2018b).

The secondary source area (Area B on Figure 2-9) consists of approximately 4 acres just south of the primary source area. Two source areas were identified in the northeastern portion of Area B that may have been the sites of historical dumping activities. TCE concentrations in Area B groundwater have also historically exceeded 100,000 µg/L. The distal groundwater plume area at OT017/CG041-017 (Area C on

Figure 2-9) comprises the downgradient portion of the site, where TCE concentrations exceed the MCL of 5 µg/L (Air Force, 2018b).

At Area A (Figure 2-9), the interim remedial actions implemented between 2000 and 2002 included the components listed below.

- Removing drums and filling the shallow disposal trenches.
- Rerouting Best Slough north of Area A.
- Installing a slurry wall around Area A to contain the primary source area of groundwater contamination.
- Installing pump-and-treat and phytoremediation systems within the slurry wall area to maintain a lowered groundwater table.
- Adding an air stripper to the GTS to remove VOCs from groundwater before discharge.
- Using LUCs to restrict access to groundwater and prevent disturbance to the slurry wall, so the potential exposure pathway to contaminants would remain incomplete.

At Area B (Figure 2-9), the interim remedial actions implemented in 2007 included the components listed below.

- Containing groundwater with TCE concentrations exceeding 500 µg/L within a slurry wall.
- Installing a 90-foot-long, 2-foot-thick zero-valent iron PRB along the southern (downgradient) edge of Area B.
- Using LUCs to restrict access to groundwater and prevent disturbance to the slurry wall and PRB so the potential exposure pathway to contaminants would remain incomplete.

The COCs identified in the Final ROD for CG041 (Air Force, 2018b) include carbon tetrachloride, cis-1,2-DCE, chloroform, 1,2-dichloroethane (DCA), 1,1-DCE, 1,1,2-TCA, methylene chloride, PCE, 1,1,2,2-tetrachloroethane (TeCA), TCE (primary), trans-1,2-DCE, and vinyl chloride. The selected remedy in the Final ROD for CG041 (Air Force, 2018b) to address COCs in groundwater at CG041-017 includes the components listed below.

- Continued containment using existing slurry walls.
- Hotspot treatment with ERD and PRB with in-situ chemical reduction (hotspot generally defined by residual TCE concentrations exceeding 10,000 µg/L inside the slurry wall and 500 µg/L outside the slurry wall).
- EA monitoring of COCs.
- LUCs prohibiting groundwater use and activities that would adversely affect implementation of the selected remedy until COC concentrations in groundwater allow for UU/UE.
- Until soil vapor sampling demonstrates that VI risks are acceptable, LUCs prohibiting residential and industrial land uses in areas where VOC concentrations pose unacceptable risk via VI.

The status of remedy implementation is summarized below.

- The Plume CG041-017 Remedial Action Work Plan describes installing a supplemental PRB of zero-valent iron and sand within the southwestern portion of the Area A (primary) slurry wall, modifying the existing pump-and-treat system to allow recirculation of EVO and groundwater into injection wells and 2 bioreactors, installing 30 injection wells, constructing 2 bioreactor trenches and plumbing both trenches to the pump-and-treat system, and performance and compliance monitoring to evaluate remedial progress and monitor potential adverse secondary water quality effects associated with ERD (CH2M, 2018c).
- Implementation of the final remedy for CG041-017 was scheduled to occur during summer 2018. Following an inspection by a contractor for the California Department of Transportation, the maximum loads for the bridges across Dry Creek on Gavin Mandery Drive were reduced to 6 tons. The bridges must be used to obtain site access, and a 6-ton load limit was insufficient to mobilize the construction equipment needed to implement the remedy. At a minimum, an approximate 25- to 30-ton load limit would be required. Replacement of the existing bridges across Dry Creek was ongoing in 2022 and was completed in 2023. As a result, the remedy implementation was delayed. Implementation of the selected remedy (hotspot treatment) to address COCs in groundwater at Plume CG041-017 began in August 2023. This remedy includes hotspot treatment with ERD and PRB with in-situ chemical reduction (hotspot generally defined by residual TCE concentrations greater than 10,000 µg/L inside the slurry walls and 500 µg/L outside the slurry walls). Portions of the remedy construction, including construction of the PRB and two bioreactors, have been completed. Full remedy construction is expected to be completed in 2024.
- GTS operations due to the delay in remedy implementation are summarized below.
  - The GTS that was installed as a part of the interim remedy is equipped with two granular activated carbon (GAC) vessels in series that remove VOCs from extracted groundwater. Additional long-term operation and maintenance (O&M) of the groundwater extraction and treatment system (interim remedy) was conducted from May 2021 to April 2022 due to the delay in implementing the final remedy.
  - The reduced load limit for the bridges across Dry Creek was also insufficient to mobilize equipment needed to complete periodic replacement of the GAC in each vessel. In March 2019, VOC contamination broke through the lag GAC vessel. Although the pump-and-treat system includes an air stripper after the GAC vessels, the system was not designed to operate with only the air stripper. GAC treatment is required to ensure that VOC concentrations are less than the MCLs prior to discharging groundwater to the Base sanitary sewer.
  - During January 2020, the Air Force installed two additional GAC vessels in series to remove residual VOCs from the air stripper effluent before discharge to the sewer. The Plume CG041-017 Groundwater Extraction and Treatment System Modification Technical Memorandum (CH2M, 2020f) documents installation of the two new GAC vessels.
  - On 18 April 2022, per direction from the Base Restoration Program Manager, the system operator shut down the pump-and-treat system because concentrations of cis-1,2-DCE and vinyl chloride in the treatment system effluent were increasing. Because of the bridge replacement work on Gavin Mandery Drive, the site could not be accessed by heavy equipment to replace the spent GAC. The Long-Term O&M Calendar Year 2022 Semiannual

Report provides additional details on the plant shutdown and future GAC replacement in the carbon vessels (Brice, 2022d).

At Site CG041-017, LUCs required by the Final ROD for CG041 (Air Force, 2018b) are implemented in accordance with the LUCIP (Brice, 2021a). On a semiannual basis, the Air Force monitors and inspects LUCs at CG041-017 to assess the LUCs specified in the Final ROD for CG041 (Air Force, 2018b). The annual LUC inspection reports document the findings of the LUC inspections (CH2M, 2017b, 2018e, 2019a, and 2020a; Brice, 2020, 2021b, and 2022e). LUC inspection findings indicated that LUCs are being implemented at plume site CG041-017 as intended by the Final ROD. No residences or water supply wells exist within the LUC boundary at CG041-017 and site access continues to be restricted. The Work Clearance Request process followed by the Operation Flight of the Civil Engineering Office has been effective in preventing groundwater use and activities that would adversely affect implementation of the selected remedy until COC concentrations in groundwater allow for UU/UE.

2.6.3.1. Systems Operations and Operation and Maintenance

The GTS includes a two-stage liquid-phase GAC system consisting of two 1,500-pound-capacity vessels operating in series (Brice, 2022g). The GAC in the 1,500-pound-capacity lead carbon vessel became spent and was replaced in August 2016 (CH2M, 2017a). The GAC in the 1,500-pound-capacity lead and lag vessels became spent in May 2018 and February 2020, respectively (CH2M, 2019c, Brice, 2021e). Replacement of the GAC in the 1,500-pound-capacity lead and lag vessels was postponed because load limits were insufficient on the bridge connecting the site to Gavin Mandery Drive. In November 2020, the seal between the lead 1,500-pound-capacity GAC vessel and its lid deteriorated and was no longer watertight. The lids of the lead and lag 1,500-pound-capacity vessels were replaced in March 2021 (Brice, 2021e).

In January 2020, Beale AFB installed a second two-stage liquid GAC system consisting of two 2,000-pound-capacity vessels operating in series. The GAC in the lead 2,000-pound-capacity vessel became spent in October 2021 (Brice, 2022g). VOC contamination began to break through the lag 2,000-pound-capacity GAC vessel in January 2022, causing the GTS to shut down on 18 April 2022 (Brice, 2022d). As described in Section 2.6.3, heavy equipment could not access the site to replace the spent GAC due to access limitations as a result of bridge construction. While the GTS was shut down, remedy protectiveness in the short-term is maintained by implementing LUCs. Implementation of the final remedy, which began in August 2023 and is expected to be completed in 2024, is expected to address the long-term protectiveness of the remedy for Plume CG041-017. Quarterly inspections and periodic repairs and maintenance of the GTS were conducted, as necessary, until it was shut down in April 2022.

2.6.4. Plume CG041-018

Groundwater beneath Site ST018 is included as part of Site CG041 and is identified as CG041-018. As described in Section 2.4, Site ST018, the Bulk Fuel Storage Facility, is located in the southwestern portion of Beale AFB, northeast of the intersection of Gavin Mandery Drive and J Street (Figures 1-2, 2-6, and 2-10).

Data characterizing soil, sediment, soil vapor, surface water, and groundwater at ST018 and CG041-018 have been collected since 1985 (Air Force, 2018b). Sources of soil and groundwater contamination include a leaking JP-TS pipeline discovered in 1988, a leaking pipeline replaced with a threaded pipe that also leaked until it was replaced in 1996, and an unknown release of TCE that may have occurred in the area east of the former MOGAS Facility (Air Force, 2018b).

As discussed in Section 2.4, the Air Force has conducted several interim remedial actions, including bioventing, soil excavation, and SVE, to address soil contamination at Site ST018. Light nonaqueous-phase liquid (LNAPL) recovery (passive skimmer), evaluation monitoring, and LUCs for the petroleum plume and continued SVE, evaluation monitoring, and LUCs for the TCE plume were identified as interim remedies in the Site 18 IROD (Air Force, 2011a). LNAPL has been monitored and manually recovered from wells 18U007BMW and 18U008BMW since December 2008 and August 2014, respectively (Brice, 2022b). Passive free product skimmers were installed in these wells in 2011 and 2014, respectively.

The Final ROD for CG041 identified benzene and TCE as the COCs in groundwater at CG041-018 (Air Force, 2018b). The selected remedy in the Final ROD to address benzene at CG041-018 includes the components listed below (Air Force, 2018b).

- Hotspot treatment with bioremediation (hotspot generally defined by residual benzene concentrations exceeding 3 µg/L).
- Continued LNAPL recovery from wells 18U007BMW and 18U008BMW.
- EA monitoring of COCs.
- LUCs prohibiting residential use unless VI risks from groundwater at the proposed construction location are determined to be acceptable or appropriate engineering controls are implemented to mitigate VI.
- LUCs prohibiting groundwater use and activities that would adversely affect implementation of the selected remedy until COC concentrations in groundwater allow for UU/UE.

Additionally, the selected remedy in the Final ROD to address TCE at CG041-018 includes the components listed below (Air Force, 2018b).

- Hotspot treatment with ERD (hotspot generally defined by residual TCE concentrations exceeding 300 µg/L).
- EA monitoring of COCs.
- LUCs prohibiting residential use unless VI risks from groundwater at the proposed construction location are determined to be acceptable or appropriate engineering controls are implemented to mitigate VI.
- LUCs prohibiting groundwater use and activities that would adversely affect implementation of the selected remedy until COC concentrations in groundwater allow for UU/UE.

Five EVO injection wells were installed and developed from 20 August to 16 October 2018, and EVO injections were completed from 29 October to 06 December 2018. Eight biosparge wells were installed and developed from 21 August to 19 October 2018. Construction of the biosparge system was completed in August 2019. Startup testing of the biosparge system occurred from 29 August through 06 September 2019 and is documented in the Plume CG041-018 Remedial Action-Construction Completion Report (CH2M, 2020b). In August 2021, passive free product skimmers were redeployed in wells 18U007BMW and 18U008BMW to remove LNAPL while the biosparge system was shut down for a 1-year rebound period.

At Site CG041-018, LUCs required by the Final ROD for CG041 (Air Force, 2018b) are implemented in accordance with the LUCIP (Brice, 2021a). On a semiannual basis, the Air Force monitors and inspects LUCs at CG041-018 (Air Force, 2018b). The annual LUC inspection reports document the findings from the LUC inspections (CH2M, 2017b, 2018e, 2019a, and 2020a; Brice, 2020, 2021b, and 2022e). LUCs are being implemented as intended by the ROD. No residences or groundwater use exist within the LUC boundary at CG041-018. There were no activities that would adversely affect implementation of the selected remedy. The Work Clearance Request process followed by the Operation Flight of the Civil Engineering Office has been effective in preventing groundwater use and activities that would adversely affect implementation of the selected remedy until concentrations in groundwater allow for UU/UE.

2.6.4.1. Systems Operations and Operation and Maintenance

This section summarizes the free product removal activities and the biosparge systems in operation at CG041-018.

Free Product Removal

- In March 2019, the Hydro-Skimmer passive free product skimmer in well 18U007BMW was replaced with a Geotech Environmental Equipment, Inc. Product Recover Canister passive skimmer (Brice, 2022b).
- In August 2021, the passive skimmers in wells 18U007BMW and 18U008BMW were redeployed while the biosparge system was shut down (Brice, 2022b).
- Cumulatively from 2007 through second quarter 2022, 0.012 gallons, 19.9 gallons, and 10.6 gallons of LNAPL were removed from wells 18U007AMW, 18U007BMW, and 18U008BMW, respectively. The remaining LNAPL is likely trapped below the water table and with groundwater elevations likely affect the presence of LNAPL (Brice, 2022b). Routine maintenance continues as necessary.

Biosparge System

From September 2020 through July 2021, the system has operated using the four deep biosparge wells to remediate the benzene source area at CG041-018. Liquid waste (condensate) generated from the biosparge system is containerized in portable tanks within the treatment system and sampled (Brice, 2022b). On 02 August 2021, the biosparge system was shut down to begin a 1-year rebound evaluation period.

Groundwater elevations have decreased in all four performance monitoring wells from March 2021 through February 2022 by an average of 5.51 feet and was likely due to the drought and off-Base pumping (Brice, 2022b). Periodic maintenance of the biosparge system continues to be conducted as necessary.

2.6.5. Plume CG041-029

Groundwater at Site FT029 is managed under CG041-029. Site FT029 and CG041-029 are located in the central portion of Beale AFB, north of Gavin Mandery Drive between A Street and C Street (Figures 1-2 and 2-11). Site FT029 is a former unlined burn pit (approximately 400 feet by 50 feet) and was used for fire-fighting training exercises reportedly conducted in the late 1950s or early 1960s (Air Force, 2018b). Waste oil, solvents, and other flammable materials were ignited and extinguished in the burn pit. Site FT029 is currently an unused open space zoned for industrial use (Air Force, 2018b).

In 1997, an SVE system was installed as an interim remedial action to address VOCs (primarily TCE) in soil and soil vapor at the burn pit (Air Force, 2018b). In October 2001, Beale AFB received regulatory approval to decommission the system (Air Force, 2018b). The SVE system operated until December 2001. COCs identified in the Final ROD for CG041 (Air Force, 2018b) included carbon tetrachloride, cis-1,2-DCE, and TCE. The selected final remedy in the Final ROD for CG041 (Air Force, 2018b) to address COCs in groundwater at CG041-029 includes the components listed below.

- EA monitoring of COCs.
- LUCs prohibiting groundwater use and activities that would adversely affect implementation of the selected remedy until COC concentrations in groundwater allow for UU/UE.

EA monitoring is ongoing. LUCs required by the Final ROD for CG041 (Air Force, 2018b) are implemented in accordance with the LUCIP (Brice, 2021a). On a semiannual basis, the Air Force monitors and inspects LUCs at CG041-029 to assess the LUCs specified in the Final ROD for CG041 (Air Force, 2018b). The annual LUC inspection reports document the findings from the LUC inspections (CH2M, 2017b, 2018e, 2019a, and 2020a; Brice, 2020, 2021b, and 2022e). LUCs are being implemented as intended by the ROD. No residences or water supply wells exist within the LUC boundary at CG041-029, and site access continues to be restricted. The Work Clearance Request process followed by the Operation Flight of the Civil Engineering Office has been effective in preventing groundwater use and activities that would adversely affect implementation of the selected remedy until concentrations in groundwater allow for UU/UE.

2.6.6. Plume CG041-035

CG041-035 is a plume at Site SS035, which is a munitions storage area in the northern part of Beale AFB, approximately 2,700 feet south of the northern Base boundary (Figures 1-2, 2-6, and 2-12). The site is fenced, with a restricted access area, and access is well controlled with locked gates and a guard. Access requires an escort from the 9th Munitions Squadron. Small ephemeral drainages and seasonal creeks pass

through Site SS035 and surrounding areas. Surface water runoff drains seasonally from the site through the drainages and creeks and eventually flows into Reeds Creek to the north.

Currently, the site is used for munitions storage, training, equipment maintenance, and office space. It is approximately 95 percent unpaved, with the unpaved areas consisting mainly of annual grass (Air Force, 2018b). Paved areas consist of asphalt and gravel roadways, buildings and surrounding concrete aprons, and four concrete foundations of former sheds.

A treatability study was implemented in October 2010 to evaluate the effectiveness of an in-situ bioreactor to treat groundwater contamination at Site SS035. Source area soil was excavated and disposed of at an offsite facility during construction of the in-situ bioreactor (Air Force, 2018b). The bioreactor (approximately 41 feet long, 25 feet wide, and 25 feet deep) was constructed within the excavation pit using a mixture of gravel, tree mulch, vegetable oil, and molasses. In 2013, the bioreactor was turned off and an SVE system was installed.

The ROD for Site SS035 selected continued operation of the SVE system, soil vapor monitoring, LUCs, an SVE termination or optimization process (STOP) evaluation, and excavation as the final remedy for soil (Air Force, 2017b). The in-situ bioreactor was shut down from May 2013 until December 2019 during startup of the SVE system at Site SS035. The SVE system operated from 2013 through 2016, until it was decommissioned in 2018.

The Final ROD for CG041 (Air Force, 2018b) identified carbon tetrachloride, 1,1-DCE, PCE, and TCE as the COCs in groundwater at plume CG041-035. The selected final remedy in the Final ROD to address COCs in groundwater at CG041-035 includes the components listed below.

- Hotspot treatment with ERD (hotspot generally defined by residual TCE concentrations exceeding 300 µg/L).
- EA monitoring of COCs.
- LUCs prohibiting groundwater use and activities that would adversely affect implementation of the selected remedy until COC concentrations in groundwater allow for UU/UE.
- Until soil vapor sampling demonstrates that VI risks are acceptable, LUCs prohibiting future residential and industrial land uses in areas where VOC concentrations pose unacceptable risk via VI unless appropriate engineering controls are implemented (current use of Building 1322 is acceptable).

The Plume CG041-035 Remedial Action-Construction Completion Report documents implementation of the remedial action at plume site CG041-035 (CH2M, 2020d). In September and October 2018, two injection wells were constructed. In January and February 2019, approximately 1,200 gallons of concentrated EVO was distributed into the injection wells and the bioreactor well.

On 02 March 2022, the Air Force proposed terminating operation of the bioreactor, as documented in the Plume CG041-035 Bioreactor Termination Technical Memorandum (Brice, 2022a), because the bioreactor and subsequent actions (SVE and EVO injections) had successfully reduced site-wide TCE concentrations to less than the target treatment concentration of 300 µg/L and had reduced the estimated mass of TCE in the treatment zone by approximately 97 percent. The Draft Final Plume CG041-035 Bioreactor Decommissioning Technical Memorandum (Brice, 2022c), submitted on 13 September 2022, documents the decommissioning of the bioreactor. Groundwater monitoring will continue under the BGMP and until the RAOs are met.

LUCs restrict access to groundwater by prohibiting water supply wells until COC concentrations allow for UU/UE. LUCs required by the Final ROD for CG041 (Air Force, 2018b) are implemented in accordance with the LUCIP (Brice, 2021a). On a semiannual basis, the Air Force monitors and inspects LUCs at CG041-035 to assess the LUCs specified in the Final ROD for CG041 (Air Force, 2018b). The annual LUC inspection reports document the findings from the LUC inspections (CH2M, 2017b, 2018e, 2019a, and 2020a; Brice, 2020, 2021b, and 2022e). LUCs are being implemented as intended by the Final ROD. The Work Clearance Request process followed by the Operation Flight of the Civil Engineering Office has been effective in preventing groundwater use and activities that would adversely affect implementation of the selected remedy until COC concentrations in groundwater allow for UU/UE.

2.6.6.1. Systems Operations and Operation and Maintenance

During operation of the SVE system at CG041-035, liquid waste (condensate) generated from the system was pumped into an onsite 500-gallon tank, then transported to the CG044-013 treatment system where it was filtered through the GAC, and then containerized in portable tanks and sampled (CH2M, 2019a). Depending on the representative sample results, the waste was either treated via air strippers or transported to an appropriate offsite facility and properly documented on a waste tracking log. In August 2016, the in-situ bioreactor at CG041-035, which has not been operational since 2013 due to ongoing operation of the SVE system, was drained to improve the performance of the SVE system (CH2M, 2017b). Monthly routine maintenance of the SVE system continued until it was shut off in 2018 for decommissioning in 2019.

2.6.7. Plume CG041-039

Groundwater associated with Site SS039 is managed under plume site CG041-039. Site SS039 is located in the eastern portion of the Cantonment Area (Figures 1-2, 2-6, and 2-13). Site SS039 encompasses approximately 720 acres (Air Force, 2018b). Site SS039 (formerly designated as AOC 72) originally consisted of Building 2145, several closed USTs formerly located near the building, and portions of the associated sanitary sewer system. In 2003, AOC 72 was designated as Site SS039; and, in 2004, the investigation boundary for Site SS039 was expanded to include groundwater contamination beneath Site DP019, Site SS036, and developed portions of the Cantonment Area extending north to Doolittle Drive (Air Force, 2018b).

Building 2145 consists of the Air Combat Command Center and the Beale AFB photography laboratory. The building also contains a photochemical recovery area, a paint booth, powerhouse, transformer areas, three ASTs, an air conditioner maintenance shop, a field shop, a fenced storage area, and administrative support offices (Air Force, 2018b). The associated sanitary and storm sewer system originates upgradient and to the east and northeast of Building 2145. Developed portions of Site SS039 are currently used for mixed land uses, including administration, industrial, community service, housing, a movie theater, and open space (Air Force, 2018b).

The first VOC source area within SS039, Source Area 1, is in the northern Cantonment Area to the north of the movie theater, approximately 400 feet west of A Street and 140 feet south of 26th Street (Brice, 2022b). Source Area 1 is believed to have resulted from a previously undocumented surface release of chlorinated VOCs near monitoring well pair 39C045AMW/39C045BMW (Brice, 2022b). The second source area, Source Area 2, is located north of Building 2145 in the south-central portion of the Cantonment Area (Brice, 2022b). Contamination at Source Area 2 is suspected to result from past disposal of TCE and PCE into sanitary sewer or storm drain lines that run adjacent to one another in an east-west direction, approximately 75 feet north of the northeastern corner of Building 2145 (Brice, 2022b). It is not known if a study was conducted to check for leaks in the sanitary and storm drains, and if additional actions such as flushing of lines and repair of the lines were taken to address the source.

The interim remedy identified in the Final IROD for the Cantonment Area included continued ERD, EA, and LUCs (Air Force, 2011b). In 2007, an ERD treatability study was initiated in Source Area 2, where TCE concentrations in groundwater exceeded 500 µg/L, to evaluate the effectiveness of ERD on VOCs in groundwater (Air Force, 2018b). A mixture of EVO concentrate and potable water was injected. In 2009, a second ERD treatability study was initiated near the movie theater in Source Area 1 in the northern portion of the site, where TCE concentrations were greater than 1,000 µg/L (Air Force, 2018b). Site SS039 was decoupled in 2013, and groundwater is addressed as plume CG041-039 within CG041.

In 2014, an SVE system was installed at Source Area 2 as part of a treatability study (CH2M, 2015b). The SVE system began operating in August 2014 and was shut down in March 2015 to begin an extended rebound period.

The selected remedy in the Final ROD for Site SS039 (Air Force, 2016b) included continued operation of the SVE system, a STOP evaluation, LUCs, soil vapor monitoring, and excavation as the final remedy for Source Area 2 soil. The STOP evaluation concluded that continued operation of the SVE system was neither technically nor economically feasible. As a result, the SVE system was decommissioned in 2016.

The Final ROD for CG041 identified carbon tetrachloride, cis-1,2-DCE, 1,1-DCE, PCE, TCE, and vinyl chloride as the COCs for plume site CG041-039 (Air Force, 2018b). The selected remedy in the Final ROD to address COCs in groundwater at CG041-039 includes the components listed below.

- Hotspot treatment with ERD (hotspot generally defined by residual TCE concentrations exceeding 300 µg/L).
- EA monitoring of COCs.
- LUCs prohibiting residential use unless VI risks from groundwater at the proposed construction location are determined to be acceptable or appropriate engineering controls are implemented to mitigate VI.
- LUCs prohibiting future buildings for industrial/commercial land use over a portion of the plume (Figure 2-13) unless VI risks from groundwater at the proposed construction location are determined to be acceptable or appropriate engineering controls are implemented to mitigate VI.
- LUCs prohibiting groundwater use and activities that would adversely affect implementation of the selected remedy until COC concentrations in groundwater allow for UU/UE.

As a part of ERD implementation, three EVO injection wells were installed and developed from 01 to 25 October 2018, and EVO injections occurred from 20 February to 09 May 2019. The Plume CG041-039 Remedial Action-Construction Completion Report documents well installation and EVO injection activities (CH2M, 2020c). In total, 19,000 pounds of EVO was injected. Groundwater monitoring will continue under the BGMP until the RAOs are met.

On a semiannual basis, the Air Force monitors and inspects LUCs at CG041-039 to assess the LUCs specified in the Final ROD for CG041 (Air Force, 2018b). The annual LUC inspection reports document the findings from the LUC inspections (CH2M, 2017b, 2018e, 2019a, and 2020a; Brice, 2020, 2021b, and 2022e). LUCs are being implemented as intended by the Final ROD. The Work Clearance Request process followed by the Operation Flight of the Civil Engineering Office has been effective in preventing groundwater use and activities that would adversely affect implementation of the selected remedy until COC concentrations in groundwater allow for UU/UE.

2.7. Site CG044 – Western Groundwater Plumes

The Air Force established Site CG044 in 2017. Site CG044 consists of five plumes (CG044-003, CG044-013, CG044-031, CG044-032, and CG044-040) located in the western area of the Base (Figure 2-14) that have been impacted by off-Base pumping. Site CG044 groundwater has been affected by releases of VOCs to soil that migrated to underlying groundwater, with TCE as the primary COC. Table 2-9 presents each Site CG044 plume and the overlying site name.

Table 2-9. Site CG044 – Groundwater Plume Names and Overlying Site Names

Plume Name	Overlying Site(s) Name(s)
CG044-003	Site FT003 (Fire Protection Training Area)
CG044-013	Site LF013 (Former Landfill No. 1 and Photographic Wastewater Treatment Plant)
CG044-031	Site SD031 (Former Building T-896)
CG044-032	Sites SD001 (Westside Drainage Ditch), SD011 (Aerospace Ground Equipment Maintenance Area), ST021 (Jet Propellant, Grade 7 Aboveground Storage Tanks), and SD032 (Building 1086)
CG044-040	Site CG040 (Formerly Area of Concern 73)

Sections 2.7.1 through 2.7.5 summarize the site background and pre-ROD activities for each CG044 plume sites. CERCLA preliminary assessments, site assessments, RIs, response actions, and groundwater monitoring were conducted between 1984 and 2001 for the overlying sites, including underlying groundwater (Air Force, 2023). Interim actions, such as in-situ treatment, tank removal, excavation, installation of treatment systems, and implementation of LUCs were conducted between 1984 and present to accelerate site cleanup and provide protection to human health and the environment until final remedies are selected (Air Force, 2023). The site-specific interim RAOs and remedial actions for each CG044 plume site vary and are discussed in Sections 2.7.1 through 2.7.5.

A focused feasibility study (FFS)[1] for CG044 was completed in August 2020 to support the selection of a final remedy for CG044 (CH2M, 2020g). The RAOs for Site CG044 as stated in the Final FFS are listed below.

1. Reduce and/or monitor reduction in concentrations of COCs in groundwater to support restoration of groundwater to designated beneficial uses (domestic, municipal, agricultural, and industrial supply).
2. Restrict potential exposure to COCs in groundwater until concentrations are at such levels to allow for UU/UE.
3. Eliminate or reduce the potential for further migration of the identified existing TCE plumes in the groundwater.

These RAOs were used, along with site-specific ARARs, to select cleanup standards for groundwater. Cleanup levels for restoring designated beneficial uses of groundwater are based on the lowest of the federal or state primary MCLs (Air Force, 2023). Risk-based groundwater concentrations protective of the indoor air pathway at Site CG044 were calculated and were found to be higher than the MCLs; therefore, restoring

[1] A Final Proposed Plan for Site CG044 was released in April 2023 (Air Force, 2023). The ROD for CG044 is forthcoming.

groundwater to the MCLs will be protective of the VI pathway (Air Force, 2023). Table 2-10 presents the preliminary cleanup levels to be achieved by the selected remedies.

Table 2-10. Site CG044 – Groundwater Cleanup Levels

Chemical of Concern	Preliminary Cleanup Level (µg/L)	Basis for Preliminary Cleanup Level
Carbon tetrachloride	0.5	California Primary MCL
1,2-Dichloroethane	0.5	California Primary MCL
1,1-Dichloroethene	6	California Primary MCL
cis-1,2-Dichloroethene	6	California Primary MCL
trans-1,2-Dichloroethene	10	California Primary MCL
1,1,1,2-Tetrachloroethane	N/A	N/A
1,1,2,2-Tetrachloroethane	1	California Primary MCL
Tetrachloroethene	5	Federal Primary MCL
1,1,2-Trichloroethane	5	Federal Primary MCL
Trichloroethene	5	Federal Primary MCL
Vinyl chloride	0.5	California Primary MCL

Notes:
MCL = maximum contaminant level
N/A = not applicable
µg/L = micrograms per liter

Sections 2.7.1 through 2.7.5 summarize the response actions for the five CG044 groundwater plume sites.

2.7.1. Plume CG044-003

FT003 is a 116-acre tract of land formerly used for firefighter training (Brice, 2022b). The site is near the intersection of J Street and Doolittle Drive, just east of the southern end of the flightline, in the central portion of the Base (Figures 2-14 and 2-15). Groundwater associated with this site is managed under CG044 as CG044-003. Historically, before 1942, FT003 consisted of undeveloped pastureland. The Camp Beale Hospital complex occupied the site between 1942 and 1952 (Brice, 2022b). While the hospital complex was in operation, heating oil was stored in numerous USTs located throughout the site.

Starting in 1952, FT003 was used as a fire protection training area (FPTA) (Brice, 2022b). Historically, training exercises were conducted at FPTA Nos. 1 through 4, which have been identified as sources of TCE groundwater contamination at the site. A TCE source area was discovered near a dry well located in the western portion of FT003 (Brice, 2022b).

CG044-003 was collocated with soil site FT003, until FT003 was deemed suitable for UU/UE closure in 2014 (Air Force, 2014).

The Site 3 Action Memorandum for Time-Critical Removal Action (CH2M, 2011a) identified the RAOs listed below for the protection of groundwater beneath Site FT003.

- Reduce concentrations of COCs (carbon tetrachloride, 1,2-DCA, PCE, TCE, and TPH as gasoline-range organics [TPH-G]) in underlying groundwater to support designated beneficial uses of groundwater (i.e., domestic, municipal, agricultural, and industrial supply), if feasible.
- Restrict potential exposure to COCs in groundwater until concentrations are at levels that allow UU/UE.

The removal action selected in the action memorandum consisted of in-situ chemical oxidation (ISCO), EA monitoring, and LUCs. The FT003 SVE system was in operation from 1997 to 2009 until it was terminated in 2010 and later decommissioned in 2014 (Brice, 2022e). In 2011, ISCO was performed in CG044-003's western source area, which distributed potassium permanganate solution through six injection wells near the former dry well. In 2018, a data gaps investigation was conducted at CG044-003 to evaluate the extent of VOCs, primarily TCE, in groundwater in the flightline area. The data gaps investigation also included collection of soil gas samples above the groundwater plume downgradient of the source area to assess the risk from VI. The results of the data gaps investigation at CG044-003 indicate that the downgradient VOC plumes have been defined to their respective PSLs (Brice, 2022b). In late 2018/early 2019, another injection of sodium permanganate at the six injection wells was conducted (Brice, 2022e).

LUCs are implemented in accordance with the LUCIP (Brice, 2021a). The annual LUC inspection reports document the findings from the LUC inspections (CH2M, 2017b, 2018e, 2019a, and 2020a; Brice, 2020, 2021b, and 2022e). The Work Clearance Request process followed by the Operation Flight of the Civil Engineering Office has been effective in preventing groundwater use and activities that would adversely affect implementation of the selected remedy until COC concentrations in groundwater allow for UU/UE.

An FFS for CG044 was completed in August 2020 to support selection of a final remedy for CG044-003 (CH2M, 2020g). The preferred remedial alternatives in the FFS for Site CG044 included EA monitoring and LUCs to address COCs in groundwater at CG044-003 and to achieve the RAOs for Site CG044.

2.7.2. Plume CG044-013

CG044-013 is the groundwater plume underlying Site LF013. As described in Section 2.1, Site LF013 is in an inactive, unlined landfill used from late 1930s to the mid-1950s. CG044-013 is located in the southwestern portion of Beale AFB, adjacent to the Base boundary near the Wheatland Gate and west of J Street (Figures 2-14 and 2-16). Open fields and grazing land surround the site, and Hutchinson Creek flows along its southern and western boundaries. Waste disposal associated with LF013 has resulted in CVOCs, primarily TCE, being released to groundwater (Air Force, 2010a). In 1994, a GTS was installed at CG044-013 to treat groundwater contamination and augmented in 2007. In 2010, an in-situ bioreactor was constructed and was expanded in July and August 2011.

The interim remedy for CG044-013 in the Final IROD for Site 13 consists of groundwater extraction and treatment (Air Force, 2010a). This remedy component includes extraction of groundwater via pumping followed by ex-situ air stripping and on-Base discharge or reuse of treated groundwater (i.e., known as the GTS). The system components include 109 wells, 14 of which are currently configured as extraction wells, and piping, pumps, control panels, a control house, and 2 air strippers (Brice, 2022g). The air strippers operate in parallel. The effluent was formerly discharged to the base sanitary sewer system. In April 2021, CVWB issued a Notice of Applicability authorizing Beale AFB to discharge treated groundwater effluent from the GTS to Hutchinson Creek, which allows the GTS to operate at higher flow rates to increase TCE mass removal (CVWB, 2021). Discharge of GTS effluent to Hutchinson Creek began on 1 September 2021. Photograph C-21 in Appendix C shows the location of the effluent discharge point. An in-situ bioreactor was also installed to treat groundwater in the source area.

The interim remedy objectives at CG044-013 are to restore groundwater quality to meet the interim cleanup goals and to protect downgradient groundwater from further contamination. The interim remedy for CG044-013 includes the components listed below.

- Continuing treatment of VOCs in groundwater in the source area to accelerate groundwater cleanup and restore groundwater to interim cleanup goals (i.e., MCLs). This remedy component includes extraction of groundwater via pumping followed by ex-situ air stripping and on-Base discharge or reuse of treated groundwater (i.e., known as the GTS). An in-situ bioreactor was also installed to treat groundwater in the source area.
- Implementing LUCs to restrict use of and access to contaminated groundwater until RAOs have been achieved.

The LUC boundary (Figure 2-16) identified in the LF013 IROD (Air Force, 2010a) will remain in place for CG044-013 until the forthcoming ROD for Site CG044 is signed and a new LUC boundary limited to Beale AFB is established. As discussed in Section 2.1, the LF013 ROD (Air Force, 2016a) established new LUC boundaries for soil that are limited to former Landfill No. 1, the former WP002 unlined sludge ponds, and the three pipeline soil covers (Figure 2-1).

The in-situ bioreactor was expanded in 2011. The bioreactor backfill is constructed of 60 percent composted mulch and 40 percent gravel mixed with soybean oil. In 2014, 250 gallons of concentrated EVO was injected into both zones of the bioreactor.

LUCs are implemented in accordance with the LUCIP (Brice, 2021a). The annual LUC inspection reports document the findings from the LUC inspections (CH2M, 2017b, 2018e, 2019a, and 2020a; Brice, 2020, 2021b, and 2022e). The Work Clearance Request process followed by the Operation Flight of the Civil Engineering Office has been effective in preventing groundwater use and activities that would adversely affect implementation of the selected remedy until COC concentrations in groundwater allow for UU/UE.

The Site CG044 Data Gap Investigation Summary Report describes the investigation activities that were completed to evaluate the extent and potential for migration of the distal portion of CG044-013 in response to off-Base pumping (CH2M, 2019e). The results of the data gaps investigation indicated that the downgradient VOC plumes have been defined to their respective PSLs (Brice, 2022b). During 2020, an FFS was completed to evaluate remedial options for CG044, including CG044-013 (CH2M, 2020g). The FFS identifies EA monitoring and LUCs as the preferred remedial alternatives to address COCs in groundwater at CG044-013 and achieve the RAOs. The ROD for CG044 is forthcoming.

2.7.2.1. Systems Operations and Operation and Maintenance

This section summarizes O&M of the GTS and in-situ bioreactor at CG044-013.

Groundwater Treatment System

The maintenance and repair activities at the GTS system that occurred from 2016 to 2022 are summarized below.

- On 13 July 2016, a base power outage occurred that caused the GTS's uninterruptible power supply for the master programmable logic controller to fail, discharging partially treated water that escaped the secondary containment berm (CH2M, 2017b). A new uninterruptible power supply was installed and tested, and additional alarms were added to the system to prevent the problem from recurring.
- In July 2017, the GTS was shut down due to a leak in the conveyance pipeline near EW13L004EW until it was repaired in October 2017 (CH2M, 2018a).
- In May 2019, the GTS experienced a control system failure that resulted in a release of partially treated groundwater to the grounds surrounding the GTS air strippers (CH2M, 2020d).
- In 2020, the Supervisory Control and Data Acquisition system was replaced, and all programmable logic controllers were upgraded (Brice, 2021e).
- In June 2020, a leak in the conveyance pipeline at IV-3 caused water discharge to the ground (Brice, 2021e). Sections of the conveyance pipe were repaired in September 2021 (Brice, 2022g).
- In August 2021, a leak was discovered at the discharge pipe at the effluent pump P-22, and the discharge pipe was replaced in February 2022 (Brice, 2022d).
- The Notice of Applicability issued by the CVWB requires Beale AFB to monitor water temperatures in Hutchinson Creek upstream and downstream of the outfall where CG044-013 GTS effluent discharges to the creek. On 02 December 2022, the CVWB sent a letter to Beale AFB titled "Self-Monitoring Report Review and Notice of Violation, Department of the Air Force, Plume CG044-013 Groundwater Treatment System, Yuba County" (CVWB, 2022). The letter states that the GTS discharge violated receiving water limitations contained in the applicable waste discharge requirements (WDR). Specifically, the water temperature increased by more than 5°F between the upstream and downstream monitoring locations on 08 March and 06 April 2022. Beale AFB Natural Resources staff concluded that the receiving water temperature would have insignificant impacts on aquatic life in Hutchinson Creek and were not a cause for concern. Hutchinson Creek is a seasonal creek, dead-ending on Beale AFB, and is not spawning

water for sensitive species. The GTS discharge is ecologically beneficial due to the continued source of water downstream of the outfall during non-rain-season months. In response to CVWB's letter, Beale AFB will collect additional data in 2023 to improve its understanding of the impact of the GTS discharge on receiving water temperature in Hutchinson Creek.

The system uptimes in 2021, 2020, 2019, 2018, 2017, and 2016 were approximately 68 percent, 86 percent, 39 percent, 80 percent, 53 percent, and 96 percent, respectively (Brice, 2022g and 2021e; CH2M, 2020d, 2019c, 2018a, and 2017a). The relatively low GTS uptime in 2019 (39 percent) was caused by an extended weather-related shutdown from December 2018 through May 2019 and extended downtime from May through July 2019 related to the instrumentation and controls issues (CH2M, 2020d). The relatively low system uptime in 2017 (53 percent) was largely due to a leaking conveyance pipe, which caused the GTS to be shut down from July through September 2017 (CH2M, 2018a). During the first and second quarters 2022, the overall GTS uptime was 92 percent, which was limited by the above repairs, replacements, and failures (Brice, 2022d). Periodic maintenance continues at the GTS as needed.

In-Situ Bioreactor

On 20 January 2022, an equipment failure at extraction well 13C083EW resulted in a discharge of water to the drainage ditch above the northern zone of the in-situ bioreactor, which caused the bioreactor to be shut down until February 2022. The excessive pump run-time and discharge from extraction well 13C083MW on 19 January 2022 resulted in ponded water in the ditch measuring approximately 15 feet long, varying in width from approximately 1 to 7 feet, and with an average depth of 4 inches. The volume of water was estimated to be 1,871 gallons. The ponded water was sampled, and results indicated TCE was detected at concentrations ranging from 5.7 to 5.8 µg/L, which slightly exceeded the MCL (5 µg/L). The maximum total mass of TCE contained in the ponded water is estimated to be 0.000010 pound. The estimated maximum total mass of TCE discharged is significantly less than the federal reportable quantity of TCE (100 pounds). There is no state-specific reportable quantity for TCE. The flow of water in the ditch stopped at more than 200 feet from the outfall. None of the water from the bioreactor discharged into the creek (Brice, 2022d).

Since February 2022, extraction well 13083MW has been manually operated for short durations to periodically recirculate water to the bioreactor (Brice, 2022d). Periodic maintenance of the in-situ bioreactor continues as needed.

2.7.3. Plume CG044-031

Site CG044-031 is a groundwater plume underlying Site SD031 (former Building 896), located in the south-central portion of Beale AFB, at the southwestern corner of the intersection of 9th and K Streets (Figures 2-14 and 2-17). The land surface above the plume is surrounded by open grazing and rangeland to the west and south, by a contractor staging area to the north, and by the Bulk Fuel Storage Area (ST018 and CG041-018) to the east. SD031 was listed as "LDY 20" on the 1944 Completion Map for Camp Beale (Brice, 2022b). No other documentation has been found regarding the former use of Building 896. However,

"LDY" may be an abbreviation for "laundry"; the 1944 map shows several steam pipelines entering the building (Brice, 2022b).

From 1990 to 1992, the Air Force used the Building T-896 foundation as a holding area for soil contaminated with petroleum hydrocarbons. A soil bioremediation cell was built over the building foundation in 1995, which was decommissioned in fall 2001.

In 1996, an SVE system was installed to remediate TCE-contaminated soil beneath the bioremediation cell and was operational until the system was shut down in March 2004 after the soil gas cleanup goal was met (Brice, 2022b). TCE and vinyl chloride were identified as COCs in groundwater at plume CG044-031. The IROD for Site 31, Former Building 896 (Air Force, 2007b) identified the selected interim remedies for groundwater, as follows: EISB, groundwater performance monitoring, and LUCs. To prevent exposure to groundwater containing COCs at concentrations exceeding the MCLs, LUCs are implemented to restrict access to groundwater, so the potential exposure pathway to contaminants is incomplete.

In 2007, an EISB system was installed at CG044-031 as an interim remedy to reductively dechlorinate TCE in groundwater using sodium lactate as an electron donor. The EISB treatment system installed in 2007 consisted of 10 extraction wells and 12 injection wells and was designed to provide sufficient amounts of sodium lactate to stimulate reductive dechlorination of chlorinated ethenes in groundwater within the groundwater source area. The groundwater source area was defined as groundwater with TCE concentrations exceeding 1,000 µg/L (Brice, 2022b). This objective was achieved except in one hotspot by 2010. The EISB system operated at CG044-031 from September 2007 until the end of March 2010, when it was shut down for a rebound assessment. Following shutdown of the EISB treatment system, EVO was injected into 14 existing groundwater wells in summer 2010. In 2011 and 2018, additional EVO injections were performed at two groundwater wells and three wells, respectively, at CG044-031. The EISB system was decommissioned in September 2015.

The data gaps investigation at CG044-031 was completed in 2018. TCE concentrations greater than 1,000 µg/L in wells 31C042AMW/BMW and 31C043MW suggested that a TCE source was still present within the source area near existing well 31U001AMW (Brice, 2022b).

In 2021, the Air Force installed additional wells to delineate the source area to the east of wells 31C042AMW and 31C042BMW and the cross-gradient extent of the TCE plume southwest of well 31C044MW. This work was completed as part of the CG044 Pre-ROD Investigation (Brice, 2022b).

An FFS for CG044 was completed in August 2020 to support the selection of a final remedy for CG044-031 (CH2M, 2020g). The Site CG044 Data Gap Investigation Summary Report describes the investigation activities that were completed to refine the extent of the TCE source area in groundwater and evaluate the extent of TCE in the distal portion of the plume, off-Base plume migration, and VI above the distal portion of the plume (CH2M, 2019e).

LUCs are implemented in accordance with the LUCIP (Brice, 2021a). The annual LUC inspection reports document the findings from the LUC inspections (CH2M, 2017b, 2018e, 2019a, and 2020a; Brice, 2020, 2021b, and 2022e). The Work Clearance Request process followed by the Operation Flight of the Civil Engineering Office has been effective in preventing groundwater use and activities that would adversely affect implementation of the selected remedy until COC concentrations in groundwater allow for UU/UE.

The FFS identified the preferred remedial alternatives as EA monitoring and LUCs to meet the RAOs for Site CG044. Final remedial strategies, cleanup goals, and RAOs will be identified and presented in the forthcoming ROD for CG044.

2.7.4. Plume CG044-032

Plume CG044-032 is the flightline groundwater investigation area, which is in the northwestern portion of Beale AFB (Figures 2-14 and 2-18). Historically, the flightline area comprised multiple ERP sites. The Air Force has closed Sites SD001, WP004, SD005, SD011, ST021, ST025, and SS037 with concurrence from the State of California (Brice, 2022b). SD032 (Building 1086) is still an active site, and Section 2.3 discusses the soil component of SD032 covered under the Final ROD for SD032 (Air Force, 2017c). Plume CG044-032 originated from sources at Sites SD001, SD011, and SD032. Groundwater contamination originating from the sites has merged and underlies a large area from east of the runways to the western Base boundary. The general direction of groundwater flow across the flightline area is from northeast to southwest. West of the flight line, the flow direction curves toward the south. The Site 32/1 RI Report provides additional site details, including the description and history of historical flightline area sites (CH2M, 2004).

Cis-1,2-DCE and TCE are the COCs in groundwater at CG044-032. The interim remedy for CG044-032 included the components listed below (Air Force, 2007a).

- Perform ISCO to treat VOCs in groundwater in areas with the highest known concentrations.
- Establish and enforce LUCs to restrict groundwater use by prohibiting water supply well installation where contaminants remain in groundwater at concentrations exceeding interim cleanup goals.
- Collect additional groundwater data during interim remedy implementation to further define the extent of contamination and to assess the need for additional remedial actions beyond the scope of this interim action.

Two SVE systems operated at SD032 from 1998 to 2009, and a biovent system operated at AOC 39 from 1997 to 2011 to remediate contaminated soil. All three systems were shut down after cleanup goals protective of groundwater were met. Post-SVE sampling at SD032 indicated that VOCs remained in soil vapor near location SD32VE4D at concentrations that may pose a VI risk to hypothetical future residential receptors.

ISCO was implemented in two separate source areas at CG044-032. Potassium permanganate was injected into the southern source area as part of an ISCO pilot study in 2005. In 2007, potassium permanganate was injected into the northern source area at CG044-032 (Brice, 2022e). The objective of ISCO was to decrease the TCE mass in the groundwater source areas so the plume would stabilize. ISCO performance monitoring was conducted to demonstrate plume stability and reduction of the residual TCE over time. A TEFA was conducted in 2011 and concluded that no significant rebound of VOC concentrations in groundwater had been detected since ISCO treatment was implemented at CG044-032 in early 2007. The TEFA further concluded that the treatment area had been remediated to the technically and economically feasible extent using ISCO (Brice, 2022e).

In the CG044-032 off-Base area, TCE has been detected at concentrations below the CalEPA Office of Environmental Health Hazard Assessment (OEHHA) public health goal (PHG) (1.7 µg/L) in groundwater at three off-Base residential water supply wells (OBL004AW, OBL005AW, and OBL008AW) (Brice, 2021d). Two residential wellhead treatment systems (OBL004AW and OBL005AW) were constructed in 2000. A third residential wellhead system (OBL008AW) was constructed in 2001. In 2004, an irrigation system was constructed at OBL005AW to allow property irrigation and it is maintained by the resident (Brice, 2022d). The irrigation system includes two 5,000-gallon water storage tanks, an aboveground pump, piping, valves, level switches, and a foundation for the tanks. The irrigation system is maintained by the resident at OBL005AW and not by the Air Force. No irrigation well is associated with the system. Well OBL005AW is a typical residential well that draws water in the range of approximately 5 to 6 gallons per minute.

Since 1999, Beale AFB has supplied bottled water to the residents. During the 5-year period from 2016 through 2020, TCE concentrations did not exceed the PHG (1.7 µg/L). Therefore, on 04 March 2021, the Air Force notified all three residences via letter that bottled water delivery would be discontinued (Brice, 2021d). Starting in April 2021, Beale AFB discontinued bottled delivery to the three residences.

LUCs are implemented in accordance with the LUCIP (Brice, 2021a). The annual LUC inspection reports document the findings from the LUC inspections (CH2M, 2017b, 2018e, 2019a, and 2020a; Brice, 2020, 2021b, and 2022e). The Work Clearance Request process followed by the Operation Flight of the Civil Engineering Office has been effective in preventing groundwater use and activities that would adversely affect implementation of the selected remedy until COC concentrations in groundwater allow for UU/UE.

In 2019, a data gaps investigation was completed at CG044-032 (CH2M, 2019e). An FFS for CG044 was completed in August 2020 to support the selection of a final remedy for CG044-032 (CH2M, 2020g). The "Revised Final Site CG044 Pre-Record of Decision Investigation Data Summary, Beale Air Force Base, California" (Brice, 2022f) documents that TCE concentrations exceeding the PSLs have migrated and impacted off-Base wells. The investigation concluded that decreases in groundwater elevations of up to 21.45 feet observed in wells near the Base boundary between March and August 2021 indicate that pumping of groundwater at the off-Base agricultural wells for irrigation purposes is impacting remediation of the

CG044-032 plume (Brice, 2022b; CH2M, 2020g). Triple-completion off-Base wells 32C087MW(A/B/C) were proposed to define the downgradient extent of the off-Base TCE plume, south of North Beale Road (Brice, 2022f). However, the wells could not be installed because a right-of-entry (ROE) agreement between the Base and the property owner could not be obtained. An additional well that is needed to delineate the off-Base CG044-032 plume to the OEHHA's PHG will be installed post-ROD when the ROE agreement becomes available (Brice, 2022f).

The FFS for CG044 identifies wellhead treatment, EA monitoring, and LUCs as the preferred remedial alternative to address the COC plume at CG044-032 and meet the RAOs. Groundwater monitoring is ongoing at CG044-032. The LUCs will remain in place until future data and risk assessments indicate that the risk posed to human health is acceptable. The ROD for CG044 is forthcoming.

2.7.4.1. Systems Operations and Operation and Maintenance

Periodic maintenance of the off-Base residential wellhead treatment systems continues as necessary. In March 2016, the water supply pump in OBL005AW failed and was replaced by the resident. In 2018, the pressure switch and pressure tanks at OBL008AW failed. The resident replaced the pressure switch, and the Air Force replaced the existing pressure tanks with a single new pressure tank in 2018 that was replaced again in March 2020 and July 2021 (Brice, 2022b). In May 2022, the GAC in the lead vessel at the OBL005AW wellhead of the treatment system became spent and was scheduled to be replaced in the third quarter 2022 (Brice, 2022b).

2.7.5. Plume CG044-040

Plume CG044-040 is located in the central portion of Beale AFB beneath the eastern portion of Site CG040, a former soil site (Figures 2-14 and 2-19). Site CG040 is located to the west of Site SS039 in the Cantonment Area and extends westward toward the Base boundary (Figure 2-19). CG040 consists primarily of flat, open annual grassland with few trees and few paved roads.

Investigations associated with Site CG040 discovered a previously unknown VOC source to groundwater at new Site SS043, which is located to the south and west of Site CG040 (CH2M, 2020e). Following the establishment of Site SS043, the Site CG040 boundary was shifted to the LUC boundary (which is also the site investigation boundary) shown on Figure 2-19. Prior to the establishment of Site SS043, Site CG040 was divided into eastern (Site CG040 East), and western (Site CG040 West) portions based on potential source areas for VOCs in groundwater (CH2M, 2020e). The eastern portion includes the area from approximately C Street to the J Street Gas Station, running parallel to Warren Shingle Road (Figure 2-19). The western portion encompassed the area west from the J Street Gas Station to the Base boundary, and south from the flightline to approximately 12th Street. Following the establishment of Site SS043, the Site CG040 boundary was revised as shown on Figure 2-19 (CH2M, 2020e).

PCE and TCE were identified as the COCs in groundwater at CG044-040. The selected interim remedy for CG044-040 in the Cantonment Area IROD (Air Force, 2011b) consisted of ERD, EA monitoring, and LUCs. The selected remedy was intended to meet the RAOs listed below.

- Reduce concentrations of VOCs (carbon tetrachloride, cis-1,2-DCE, 1,1-DCE, PCE, TCE, and vinyl chloride) in underlying groundwater originating at Sites 39 and 40, and TPH-D and TPH-G in underlying groundwater originating at Site 39 to support designated beneficial uses of groundwater (i.e., domestic, municipal, agricultural, and industrial supply).
- Restrict potential exposure to COCs in groundwater until concentrations are at such levels to allow UU/UE.

In 2011, an ERD treatability study was conducted to treat CVOCs (primarily TCE) in groundwater downgradient from well 40C017MW. The treatability study included installation of four injection wells (40C040IW through 40C043IW) at the intersection of Warren Shingle Road and N Street (Figure 2-19) and subsequent injections of EVO to form a biobarrier (CH2M, 2011b). In 2018, additional EVO was injected to maintain treatment via the biobarrier.

LUCs are implemented in accordance with the LUCIP (Brice, 2021a). The annual LUC inspection reports document the findings from the LUC inspections (CH2M, 2017b, 2018e, 2019a, and 2020a; Brice, 2020, 2021b, and 2022e). The Work Clearance Request process followed by the Operation Flight of the Civil Engineering Office has been effective in preventing groundwater use and activities that would adversely affect implementation of the selected remedy until COC concentrations in groundwater allow for UU/UE.

The FFS (identified EA monitoring and LUCs as the preferred remedial alternative to address the COC plume at CG044-040 and to meet the RAOs.

3. Progress Since the Last Review

This section includes the protectiveness determinations and statements and recommendations from the last FYR, as well as the implementation status of those recommendations. The Final FYR Corrective Action Report (CH2M, 2019d) provided follow-up corrective action recommendations for the issues identified in the Second FYR Report for the ERP sites. The implementation status updates presented in the following sections are in part based on this report.

3.1. LF013 – Former Landfill No. 1

The protectiveness statement for Site LF013 in the Second FYR Report (AECOM, 2018) states:

> *The remedy at Site LF013 is protective of human health and the environment under current and anticipated future land uses. If these conditions change and, for example, buildings are constructed, the implications to human health risk may need to be re-evaluated.*

There were no issues identified for Site LF013 in the Second FYR Report (AECOM, 2018).

3.2. OT017 – Best Slough

The protectiveness statement for Site OT017 in the Second FYR Report (AECOM, 2018) states:

> *The remedy at Site OT017 is protective of human health and the environment under current and anticipated future land uses. If these conditions change and, for example, buildings are constructed, the implications to human health risk may need to be re-evaluated.*

Table 3-1 shows the status of the issues and recommendations presented in the Second FYR Report.

Table 3-1. Status of Recommendations from the Second Five-Year Review, Site OT017

Issue	Recommendation	Current Status	Current Implementation Status Description
A final decision document is needed that addresses Site OT017 media (except for groundwater).	Prepare a final decision document, selecting no further action for soil and soil vapor. Existing LUCs should remain in effect because they provide protection from exposure to soil vapor.	Completed	The U.S. Air Force and regulatory agencies signed a final ROD for Site OT017 in May 2018 (Air Force, 2018a). The selected final remedy for soil is LUCs.

Issue	Recommendation	Current Status	Current Implementation Status Description
Active remediation of soil is not likely to achieve unrestricted use levels until groundwater remediation is complete; therefore, LUCs still are needed to prevent exposure to soil vapor.	Ensure that established LUCs continue to be monitored on a semiannual basis, as required, and that results are provided to state regulatory agencies in annual monitoring reports.	Ongoing	The final LUCs continue to be the interim remedy for all non-groundwater media. LUCs continue to be monitored on a semiannual basis, and the results are reported annually in the LUC Inspection Report

Notes:
LUC = land use control
ROD = Record of Decision

3.3. SD032 – Building 1086

The protectiveness statement for Site SD032 in the Second FYR Report (AECOM, 2018) states:

> *The interim remedy for Site SD032 is considered protective of human health and the environment because it has remediated soil and soil vapor contamination to levels acceptable for restricted use in accordance with LUCs established in the Site SD032 IROD. LUCs continue to be implemented and will limit disturbances to the site until UU/UE is approved. To further ensure protectiveness, a final decision document must be completed.*

Table 3-2 shows the status of the issues and recommendations presented in the Second FYR Report.

Table 3-2. Status of Recommendations from the Second Five-Year Review, Site SD032

Issue	Recommendation	Current Status	Current Implementation Status Description
A final decision document is needed for Site SD032.	Develop and finalize a decision document specifying no further action for soil at Site SD032.	Completed	The U.S. Air Force and regulatory agencies signed a final ROD for Site SD032 in January 2018 (U.S. Air Force, 2017c). The selected final remedy for soil is LUCs.

Notes:
LUC = land use control
ROD = Record of Decision

3.4. ST018 – Bulk Fuel Storage Facility

The protectiveness statement for Site ST018 in the Second FYR Report (AECOM, 2018) states:

> *Site conditions are protective of human health and ecological receptors based on current and anticipated future use of Site ST018 as a bulk fuel storage facility.*

Table 3-3 shows the status of the issues and recommendations presented in the Second FYR Report.

Table 3-3. Status of Recommendations from the Second Five-Year Review, Site ST018

Issue	Recommendation	Current Status	Current Implementation Status Description
A decision document establishing NFA for Site ST018 has not been finalized yet.	Finalize the ROD for ST018, which selects NFA as the preferred remedial alternative.	Completed	The U.S. Air Force and regulatory agencies signed a final ROD for Site ST018 in March 2017 (U.S. Air Force, 2017a). The selected final remedy for soil is LUCs.

Notes:
NFA = no further action
LUC = land use control
ROD = Record of Decision

3.5. TU509 – Clinic Underground Storage Tanks

The protectiveness statement for Site TU509 in the Second FYR Report (AECOM, 2018) states:

> *The remedy at Site TU509 is protective of human health and the environment.*

There were no issues identified for Site TU509 in the Second FYR Report.

3.6. CG041 – Basewide Groundwater

The protectiveness statement for Site CG041 in the Second FYR report (AECOM, 2018) states:

> *The interim remedies for Site CG041 are protective of human health and the environment because LUCs established in interim decision documents remain in place to prevent potential exposures through the vapor intrusion or direct contact pathways. LUCs and groundwater monitoring and evaluation should be a part of any final remedy selected until such time as RAOs are achieved and the site is suitable for UU/UE.*

Table 3-4 shows the status of the issues and recommendations presented in the Second FYR Report.

Table 3-4. Status of Recommendations from the Second Five-Year Review, Site CG041

Issue	Recommendation	Current Status	Current Implementation Status Description
Groundwater cleanup goals based on aquatic ecological toxicity criteria have not been established for sites where surface discharge of groundwater is occurring.	For sites where surface discharge of groundwater is occurring, cleanup goals protective of aquatic ecological receptors should be established; sampling should include upstream and downstream sampling for hardness to support the comparison.	Completed	For sites where surface discharge of groundwater is occurring, the second FYR recommendations to establish cleanup goals protective of aquatic ecological receptors and upstream and downstream sampling for hardness to support the comparison were not implemented, considering that ecological risk for surface water was evaluated and was found to be not a concern per the signed ROD (Air Force, 2018b). In addition, surface water was not identified as a medium of concern for any of the sites where groundwater discharges to surface water; cleanup goals were established to be protective of potential receptors at the site; and RAOs were not established that include protection of surface water receptors. An ARARs memo from 2015 documents the process for establishing cleanup goals for groundwater (CH2M, 2019d). This process includes using MCLs, then evaluating the feasibility of achieving lower water quality objectives.
A decision document needs to be prepared that establishes the final RAOs, COCs, cleanup goals, and remedies for Site CG041.	Complete and finalize the ROD for Site CG041.	Completed for CG041	The Air Force and regulatory agencies signed the Final ROD for Site CG041 (Plumes CG041-010, CG041-016, CG041-017, CG041-018, CG041-029, CG041-035, and CG041-039), which addressed the final RAOs for each plume, cleanup goals, and selected remedies, in April 2018 (Air Force, 2018b).
		Ongoing for CG044	Groundwater at Plumes CG041-003, CG041-013, CG041-031, CG041-032, and CG041-040 were transferred to Western Plumes Site CG044 in 2017. Those plumes are now referred to as CG044-003, CG044-013, CG044-031, CG044-032, and CG044-040. The CG044 Final Proposed Plan was released in April 2023 (Air Force, 2023). The ROD for CG044 is forthcoming.

Notes:

Air Force = U.S. Air Force

ARARs = applicable or relevant and appropriate requirements

CH2M = CH2M Hill

COCs = chemicals of concern

MCLs = maximum contaminant levels

RAOs = remedial action objectives

ROD = Record of Decision

4. Five-Year Review Process

4.1. Community Notification and Involvement

Involving members of the community and notifying them that an FYR is underway are important parts of the FYR process. Publishing a public notice in a local newspaper was determined to be the best way to share information with the community about FYR activities at Beale AFB. In support of this, a public notice was published in the *Appeal-Democrat* on 09 February 2023 (Appendix A). The notice announced the start of the FYR process and provided an overview of the FYR process. It also shared resources for more information, including a link to the AFCEC Administrative Record (https://ar.afcec-cloud.af.mil/). In addition, contact information was provided for the Beale AFB Public Affairs Office for community members to ask questions about the environmental cleanup program at the base. The Final Third FYR Report for Beale AFB will be available to the public on the AFCEC website (https://ar.afcec-cloud.af.mil/).

4.2. Site Interviews

As part of the third FYR process, interviews were conducted to evaluate opinions and concerns regarding environmental restoration activities at Beale AFB. The interview process included three components: interviews with community members, interviews with regulatory agency representatives, and interviews with O&M contractors for Beale AFB.

Seven Restoration Advisory Board members were contacted to represent members of the community. Of those, two Restoration Advisory Board members participated in the FYR interview process. Interviewees reported a positive overall impression of the remedies selected at Beale AFB and indicated they were well informed about the environmental restoration activities being conducted at Beale AFB. Interviewees noted no community concerns, complaints, violations, or other incidents requiring a response from local authorities. One participant shared "[the remedies selected for Beale AFB are] impressive, well researched and effective" and "the local community has greatly benefited from the communication on site operations." Appendix B includes the community representative interview response forms.

Two O&M contractors (Brice and Jacobs Engineering Group, Inc. [Jacobs]) were contacted for an interview. Representatives from both companies participated by returning a detailed summary of ERP activities. Both contractors noted impacts from off-Base pumping as the single greatest concern regarding the ongoing performance of remedies at Beale AFB. Additional contractor concerns included increased materials costs and difficulties procuring materials, specifically vegetable oil. Appendix B includes the interview response summary forms that were completed by Brice and Jacobs representatives.

Regulatory agency participation in the Third FYR for Beale AFB included responses from CVWB and DTSC in their roles as state regulatory agencies. The CVWB response describes routine review and comment on ERP plans and reports and collection of split groundwater samples with the Air Force from off-Base domestic supply wells. Issues described in the regulatory response included concerns about leaks

from Beale AFB's GTS, citing two spills on which the agency worked with Air Force staff to gather and review data and develop corrective actions. DTSC stated "the ERP program at Beale appears well managed" and noted that unexpected delays in conducting work are typically short-lived. The response describes availability of Air Force staff to meet with agencies in meetings, site visits, and one-on-one discussions. DTSC noted that as fieldwork increases, more frequent updates would be welcomed. Appendix B includes the interview record forms.

The responses to the third FYR interviews will be considered as Beale AFB moves forward with the public outreach program and continues its environmental restoration activities.

4.3. Site Inspection

Beale AFB ERP, Bayside, and ERRG personnel inspected the third FYR sites on 03 April 2023 and 18 May 2023. Except where prohibited because of Air Force security restrictions, photographs were taken at all sites. Appendix C includes the site photographic log. Site inspection observations and notes were combined on the inspection form to reduce redundancy. Appendix C includes the inspection form. No significant issues were identified at any of the sites.

4.4. Data Review

As discussed in Sections 2.1 through 2.5, LUCs form the primary remedial components for Sites LF013, OT017, SD032, ST018, and TU509 for media other than groundwater. Accordingly, this section focuses on a review of the data collected at seven CG041 plume sites and four CG044 plume sites.

The collected groundwater monitoring data at the CG041 and CG044 sites support ongoing investigations and facilitate the evaluation of the effectiveness of the selected groundwater remedies (Brice, 2022b). The data collected between 2016 and 2021 are presented in the respective annual BGMP reports (CH2M, 2017c, 2018d, 2019f, and 2020f; Brice, 2021c and 2022b). The reports include a detailed discussion of groundwater flow, comprehensive analysis of contaminant trends, the impact of remedial actions, and conclusions drawn from the annual data. The 2021 BGMP annual report (2021 annual report) includes the most current groundwater data available for evaluation during this FYR (Brice, 2022b). Section 4.4.1 briefly summarizes the groundwater elevation trends based on groundwater data collected during the 2021 BGMP and the discussion presented in the 2021 annual report (Brice, 2022b). Section 4.4.1 is followed by a discussion of the groundwater concentration trends and COC mass removals for Site CG041 (Section 4.4.2) and Site CG044 (Section 4.4.3). The COC mass removal percentages and the estimated quantities of COC mass remaining presented in the following sections were based on the 2021 annual report (Brice, 2022b).

4.4.1. Groundwater Elevation Trends

The effect of off-Base pumping on Beale AFB groundwater elevations and groundwater elevation trends based on 2021 BGMP data are summarized below. The summary is based on the 2021 annual report (Brice, 2022b).

- The primary discharge point for groundwater at Beale AFB has been to a large cone of depression created by historical agricultural pumping west and southwest of the Base.
- The rise and fall in groundwater elevations at Beale AFB resulting from hydrologic conditions in the local groundwater subbasin are particularly notable in monitoring wells located along the western Base boundary (CG044-003, CG044-013, CG044-031, CG044-032, and CG044-040) (Brice, 2022b).
- Starting in 2007, the Yuba County Water Agency (YCWA) initiated a water transfer program to have local farmers pump groundwater from selected irrigation wells and discharge the pumped water to the canal system or have the local farmers use the pumped water for irrigation in lieu of taking water from the canal system. The excess water is conveyed downstream and sold to other water districts through a water transfer agreement.
- Brophy Water District (located along the western Base boundary) in the South Yuba Groundwater Subbasin participated in water transfers in 2008, 2009, 2010, 2013, 2014, 2018, and 2020 as part of the YCWA groundwater substitution transfer program (Brice, 2022b). During 2020, a total of 28,517 acre-feet of water was transferred, the largest recorded by Brophy Water District in 1 calendar year (Brice, 2022b).
- Significant drops in water levels of 15 to 40 feet were observed in the annual 2020 event at several subsites including CG041-010, CG044-013, CG044-031, and CG044-032. The largest drop of approximately 40 feet in water level was encountered at CG044-013 well 13L023MW (Brice, 2022b).
- While no water transfer took place in Water Year 2021, Brophy Water District pumped 34,748 acre-feet of supplemental groundwater, via YCWA's deficiency pumping agreement, due to below average rainfall (35.1 percent of average) and insufficient surface water deliveries (Brice, 2022b). The combination of below average rainfall and increased groundwater pumping near the western Base boundary has resulted in decreased groundwater elevations, particularly at CG044-013 and CG044-032.
- Groundwater elevations in several wells near the Base boundary at CG044-013 decreased by as much as 46 feet between the semiannual BGMP events in 2021.
- At CG044-032, groundwater elevations in wells along the Base boundary dropped by as much as 21 feet. Since 2019, the horizontal gradient measured near these CG044-032 wells has doubled from approximately 0.001 to 0.002 foot per foot. The increased horizontal gradient results in higher groundwater flow velocity and the potential for downgradient plume migration.

4.4.2. CG041 – Basewide Groundwater Concentration Trends

As discussed in Section 2.6, seven groundwater plume sites are combined under CG041, the basewide groundwater site. Sections 4.4.2.1 through 4.4.2.7 discuss the data review for each plume site. Tables 4-1 through 4-14, which are presented after Section 9 and the figures, summarize the TCE time-series plot trends and 2021 annual groundwater results for TCE and other COCs.

4.4.2.1. CG041-010

As discussed in Section 2.6.1, the COCs for CG041-010 are cis-1,2-DCE, PCE, TCE, trans-1,2-DCE, and vinyl chloride. Cis-1,2-DCE, TCE, and vinyl chloride were detected at concentrations exceeding their respective PSLs (6, 5, and 0.5 µg/L) during the 2021 annual sampling event (Brice, 2022b). Table 4-1 summarizes the TCE (indicator COC) time-series plot trends and 2021 annual groundwater results for TCE, cis-1,2-DCE and vinyl chloride. Figure 4-1 shows the 2021 CG041-010 plume with site features and the 2021 annual TCE concentrations. Figure 4-2 shows the comparison of 2016, 2019, and 2021 TCE isocontours. The concentration trends and plume aerial extent comparisons are summarized below.

- TCE concentrations at Monitoring and Reporting Program (MRP) source area wells (treatment zone and transition zone wells) are decreasing or show no trend. TCE concentrations in those areas have significantly decreased as a result of the 2018 EVO injection at wells 10C044RW and 10C048MW, as can be seen between the 2016 and 2019 TCE isocontours (Figures 4-1 and 4-2). Decreased TCE concentrations in groundwater samples collected from wells 10C044RW and 10C048MW in 2019 through 2021 indicate minimal rebounding following the 2018 EVO injection (Brice, 2022b).
- Multiple compliance zone wells (10C006MW, 10C029MW, 10R003MW) show increasing TCE concentrations, indicating the plume may be migrating downgradient of the treatment zone (Brice, 2022b).
- TCE concentrations increased in MRP compliance well 10C028MW from 2007 to 2014 but have recently begun to decrease, demonstrating migration of the historical TCE plume to the southeast has begun to stabilize (Brice, 2022b).
- In most downgradient monitoring wells, TCE has either been not detected or exhibited trace concentrations. At downgradient well 10R004MW, TCE was detected at a concentration of 8.1 µg/L, which slightly exceeds the PSL of 5 µg/L. Cis-1,2-DCE was detected at a concentration less than the PSL at well 10R004MW, and vinyl chloride was not detected.
- In downgradient well l0R005MW, TCE was detected at a concentration of 0.24 J µg/L, which is less the PSL, and TCE was non-detect in samples from all remaining downgradient wells. No other site COCs were detected at any of the downgradient wells.
- The presence of TCE in wells 10R004MW and 10R005MW indicates the CG041-010 plume may be migrating downgradient (Brice, 2022b).
- Following the 2018 EVO injection, cis-1,2-DCE and vinyl chloride concentrations significantly decreased, indicating complete reductive dechlorination of TCE.
- The calculated areas of the inferred 5-µg/L TCE isocontour based on 2016, 2019, and 2021 annual groundwater sampling results are approximately 19 acres, 25 acres, and 24 acres, respectively. The 100-µg/L TCE isocontour was greatly diminished between 2016 and 2019 and was not present based on 2021 TCE analytical results (Figure 4-2). Based on the MRP, the beneficial uses of groundwater outside the CG041-010 treatment areas have not been adversely affected (Brice, 2022b).

Figure 4-3 presents the groundwater TCE mass removal. The TCE mass within the baseline 100-µg/L TCE plume was estimated to be 322 pounds prior to the start of bioremediation activities (Brice, 2022b). Based on the 2021 annual sampling results, the TCE mass in groundwater calculated from groundwater samples collected during the 2021 annual sampling event was 16 pounds, equating to a 95-percent reduction in TCE mass within the baseline of 100 µg/L (Brice, 2022b). Following the 2018 EVO injections, CG041-010 achieved a 100-percent reduction in total TCE mass within the baseline of 500 µg/L (Brice, 2022b).

4.4.2.2. CG041-016

Groundwater samples were collected during the 2021 annual event to define the perchlorate plume at CG041-016, but the data were deemed unusable (Brice, 2022b). For the purposes of this FYR, 2021 semiannual event and 2020 annual event data were considered for the isocontour comparison and historical concentrations trends. Figure 4-4 shows the 2020 perchlorate plume along with additional site features. Figure 4-5 shows a visual comparison of the perchlorate plume location by years 2016, 2019, and 2020.

- The decreasing trend in perchlorate concentrations in downgradient wells 16C015MW and 16C013AMW is evidenced by the plume receding from the southwest direction, as can be seen between the 2016 and 2020 perchlorate isocontours (Figure 4-5).
- From 2014 to 2019, the perchlorate mass in the vadose zone may have contributed to the increasing concentration in plume well 16L002MW, although concentrations have been decreasing in 2020, as can be seen between the 2019 and 2020 perchlorate isocontours (Figure 4-5).
- Surface water samples were collected from 5 of 13 sample stations in 2020, and the perchlorate concentrations were either not detected or were less than the PSL (Brice, 2021c). Perchlorate was not detected in the three surface water locations during the 2021 semiannual event (Brice, 2021d).
- The calculated areas of the inferred 6-µg/L perchlorate isocontour based on 2016, 2019, and 2020 annual groundwater sampling results are approximately 21 acres, 16 acres, and 15 acres, respectively (Figure 4-5). The southwest portion of the plume has receded from 2016 to 2019 and has remained stable as of the 2020 annual sampling event.
- CG041-016 plume perchlorate concentrations from the 2020 annual event were generally stable or decreasing, indicating the perchlorate plume is stable.

4.4.2.3. CG041-017

The COCs for CG041-017 are 1,1,2,2-TeCA, 1,1,2-TCA, 1,1-DCE, 1,2-DCA, carbon tetrachloride, chloroform, cis-1,2-DCE, PCE, TCE, trans-1,2-DCE, and methylene chloride. All COCs were detected during the 2021 annual event and exceeded their respective PSLs, except for methylene chloride (Brice, 2022e). Table 4-2 summarizes the 2021 semiannual and 2021 annual CG041-017 TCE concentration results and the time-series plot trends. Figure 4-6 shows the 2021 TCE plume, groundwater monitoring well locations, and correlating TCE concentration. Figure 4-7 shows the comparison of 2016, 2019, and 2021 TCE isocontours. TCE is the primary site contaminant and is the most widespread. As a result, the discussion below focuses on the TCE concentration trends and plume areal extent comparisons.

- During the 2021 annual sampling event, all 10 source wells had TCE concentrations that exceeded the PSL, with concentrations exceeding 10,000 µg/L at four wells. The chemical time-series sample data for Primary and Secondary Source Area samples (Table 4-2) continue to have elevated TCE concentrations with variable trends, which is expected and indicates that the TCE plume is moving within the slurry walls (Brice, 2022b).
- TCE was detected at concentrations exceeding the PSL at 8 of 12 plume wells, with increasing trends at wells 17C165BMW, 17C166MW, and 17H16BMW. Well 17C165BMW is about 100 feet southeast and downgradient of the PRB. Well 17C166MW is located about 260 feet southwest and downgradient of the PRB. Plume well 17H16BMW is located farther downgradient, approximately 750 feet south of the PRB. TCE outside the slurry walls at the time of construction (2007) is apparently migrating (Brice, 2022b). TCE contamination located outside the slurry walls may have migrated south to these locations since the PRB was constructed (Brice, 2022b). The EA monitoring and the groundwater LUCs component of the remedy will be used to address the increasing TCE concentration trends. Results from the ongoing groundwater monitoring will be used to continue to assess the performance of the slurry wall.
- Decreasing trends in wells 17C156MW and 17C157MW indicate the PRB has remained effective in lowering TCE concentrations in this area (Table 4-2).
- An inward hydraulic gradient outside the Primary Source Area wall was maintained, except for short periods in 2008, 2017, and 2019 (Brice, 2022b).
- Since 2007, plume well 17V012MW has exhibited extremely variable TCE concentrations, indicating that a local source of TCE may exist outside the wall near well 17V012MW (Brice, 2022b).
- The 2021 TCE concentrations in wells 17H15AMW, 17H15BMW, 17H17BMW, 17H18AMW, and 17H18BMW indicate no migration is occurring toward Best Slough (Brice, 2022b).
- The surface water sample collected from location 17L008SW in Best Slough had no detections of any COC.
- The calculated areas of the inferred 5-µg/L TCE isocontour based on 2016, 2019, and 2021 annual groundwater sampling results are approximately 31.4 acres, 25.3 acres, and 18.2 acres, respectively (Figure 4-7). A comparison of annual sampling results for 2019 and 2021 indicate that the 5-µg/L TCE isocontour has receded in the eastern and western directions at the downgradient wells.
- Overall, as shown on Figure 4-7 and based on the 2021 analytical data from the downgradient wells, the southern portion of the plume has retracted approximately 1,100 feet over the last 15 years, the western portion of the plume is not migrating and has retracted, and the isolated residual plume is no longer present and the contamination is not migrating (Brice, 2022b).

The GTS has removed a total of 2,055 pounds of VOCs from groundwater since 2009, with approximately 20.4 pounds of VOCs removed during the first and second quarters of 2022 (Brice, 2022b).

4.4.2.4. CG041-018

TCE and benzene are the primary contaminants for CG041-018. Compliance triggers for CG041-018 include dissolved iron, total dissolved solids (TDS), and vinyl chloride, and none of those chemicals exceeded their respective trigger concentrations. Therefore, CG041-018 is in compliance with the existing MRP (Brice, 2022e). Tables 4-3 and 4-4 summarize the 2021 semiannual and 2021 annual CG041-018 concentration results and the time-series plot trends for TCE and TPH-D, respectively. Figure 4-8 shows the TCE and TPH-D plumes at CG041-018 in 2021. Figure 4-9 provides a visual comparison of the groundwater contaminant plumes in 2016, 2019, and 2021 for TCE and TPH-D. The TCE and TPH-D concentration trends and plume areal extent comparisons are summarized below.

TCE

- TCE concentrations exceeded the PSL of 5 µg/L at all eight TCE source areas and plume wells. EVO injections were performed in October and December 2018 between wells 18C023MW and 18C020MW, which may have contributed to the decreasing TCE concentration trends in all source area wells and most plume wells, as can be seen between the 2019 and 2021 100-µg/L isocontours (Figure 4-9). Only plume well 18C021BMW (Figure 4-8) exhibited an increasing trend. The decreases in TCE concentrations may also be the result of regional drought conditions (Brice, 2022b).
- The calculated areas of the inferred 5-µg/L TCE isocontour based on 2016, 2019, and 2021 annual groundwater sampling results are approximately 3.5 acres, 4.3 acres, and 4.2 acres, respectively (Figure 4-9).
- TCE concentrations for the 2021 annual event generally decreased, indicating the TCE plume seems to be contained to the site and is not migrating (Brice, 2022b). TCE detections in the upgradient wells may be from the migrating TCE plume in CG041-039 (Brice, 2022b).

Figure 4-10 presents the TCE mass removal. Prior to beginning of bioremediation activities in 2018, the TCE mass within the target treatment area was estimated to be 42.8 pounds; the TCE groundwater mass in the target treatment area calculated during the 2021 annual event was approximately 10.1 pounds (Figure 4-10; Brice, 2022b). The decrease in mass indicates a 76-percent total TCE mass reduction within the saturated zone in the target treatment area (Brice, 2022b)

TPH-D

As discussed in Section 2.6.4, petroleum contamination was found in the northern portion of CG041-018, near a leak from the JP-TS pipeline east of the Jet Fuel Tank Farm. When the pipeline leak occurred, the water table was situated at about 90 feet bgs. TPH-D contamination originates from a zone that is submerged about 40 feet below the water table, which was approximately 50 feet bgs in August 2021 (Brice, 2022b). As the water table has risen over the years, petroleum contamination has remained trapped below the water table.

TPH-D is not a COC at CG041-018 but it is monitored to provide contaminant concentration trends to support future closure of the benzene plume (Brice, 2022b). High TPH-D concentrations at source area wells 18U007AMW and 18U008BMW may be from LNAPL trapped below the water table (Brice, 2022b). Benzene was detected in three wells, all located west of the former JP-TS pipeline leak, but at concentrations less than the PSL of 1 µg/L. The TPH-D plume has been relatively stable from 2016 to 2021 (Figure 4-9).

4.4.2.5. CG041-029

The COCs in groundwater at CG041-029 are carbon tetrachloride, cis-1,2-DCE, and TCE. TCE was the only site contaminant exceeding its PSL during the 2021 annual sampling event (Brice, 2022b). Table 4-5 summarizes the 2021 annual groundwater results for TCE at CG041-029, with the chemical time-series plot trends. Figure 4-11 shows the 2021 TCE plume at CG041-029. Figure 4-12 provides a visual comparison of the TCE groundwater contaminant plume location by years 2016, 2019, and 2021.

Higher fluctuating TCE concentration trends at plume well 29C008BMW and only trace TCE detections in plume well 29C008AMW suggest that TCE contamination is predominantly within the deeper part of the alluvial unit (Brice, 2022b). The calculated areas of the inferred 5-µg/L deep TCE isocontour based on 2016, 2019, and 2021 annual groundwater sampling results are approximately 17.5 acres, 17.6 acres, and 15.2 acres, respectively. Based on the annual sampling results from 2019 to 2021, the northeastern portion of the plume has receded and the shallow TCE zone isocontour interpreted during 2019 was not present based on 2021 analytical results for TCE. TCE concentrations during the 2021 annual event indicate the plume is stable and not migrating beyond the current boundary (Figure 4-12).

4.4.2.6. CG041-035

The COCs in groundwater at CG041-035 are TCE, PCE, 1,1-DCE, and carbon tetrachloride. During the 2021 annual sampling event, dissolved iron, TDS, and vinyl chloride concentrations were less than trigger concentrations in the MRP wells; therefore, CG041-035 is in compliance with the existing MRP (Brice, 2022b). Table 4-6 summarizes the 2021 semiannual and 2021 annual TCE concentration results and the time-series plot trends for CG041-035. Figure 4-13 shows the annual 2021 TCE plume. Figure 4-14 provides a visual comparison of the TCE groundwater contaminant plume location in 2016, 2019, and 2021. TCE continues to be the most widespread groundwater COC at CG041-035 based on the annual 2021 groundwater monitoring results. The TCE concentrations trends and plume areal extent comparisons are summarized below.

- TCE was detected at a concentration of 9.7 µg/L at MRP compliance well 35C014MW during the 2021 annual event; however, the long-term trend is decreasing, indicating the TCE plume is not migrating northward from the source area (Brice, 2022b).
- The 2016 SVE and 2019 EVO injections, in addition to the in-situ bioreactor, greatly reduced TCE concentrations (Figure 4-14).

- As shown on Figure 4-14, the TCE concentrations in groundwater at CG041-35 are decreasing overall, indicating the CG041-035 plume is stable. The calculated areas of the inferred 5-µg/L TCE isocontour based on 2016, 2019, and 2021 annual groundwater sampling results are approximately 0.43 acre, 0.64 acre, and 0.68 acre, respectively (Figure 4-14). Previously, many TCE concentrations in monitoring wells at CG041-035 were extremely high. However, TCE concentrations in all wells at CG041-035 were less than 100 µg/L during the 2021 annual sampling event. The 100-µg/L isocontours inferred based on the 2016 annual sampling results were not present during 2019 and 2021 (Figure 4-14).

Figure 4-15 presents the groundwater TCE mass removal. The TCE mass within the target treatment area was estimated to be 29 pounds prior to the start of remediation activities (Brice, 2022b). The groundwater TCE mass calculated from groundwater samples collected during the 2021 annual event was 1.0 pound, indicating an approximately 97-percent reduction in mass (Brice, 2022b).

4.4.2.7. CG041-039

The COCs in groundwater at CG041-039 are carbon tetrachloride, cis-1,2-DCE, 1,1-DCE, PCE, vinyl chloride, and TCE. During the 2021 annual sampling event, vinyl chloride was not detected and dissolved manganese and TDS concentrations were less than the respective trigger concentrations at all three compliance wells; therefore, CG041-039 is in compliance with the existing MRP (Brice, 2022b). Figure 4-16 shows the 2021 TCE plume. Figure 4-17 provides a visual comparison of the TCE groundwater contaminant plume location for years 2016, 2019, and 2021.

The calculated areas of the inferred 5-µg/L TCE isocontour based on 2016, 2019, and 2021 annual groundwater sampling results are approximately 127 acres, 120.5 acres, and 120 acres, respectively, indicating the plume has remained relatively stable. The 100-µg/L isocontour was greatly diminished between years 2016 and 2019 and has remained stable as of the 2021 annual sampling event (Figure 4-17). TCE is the indicator groundwater chemical with the widest distribution of groundwater contamination. The TCE concentration trends and mass removal rates for Source Area 1 and Source Area 2 are summarized below.

Source Area 1

Table 4-7 summarizes the 2021 TCE results and the time-series plot trends for Source Area 1 at CG041-039. The concentration trends for Source Area 1 are summarized below.

- Following the 2019 EVO injections, the TCE plume has reduced significantly at and downgradient of the injection locations and no concentration rebound has been observed.
- TCE concentrations at source wells 39C017AMW and 39C017BMW, which are upgradient of the injection locations, remain high at 1,200 µg/L and 860 µg/L, respectively.
- Two of the upgradient wells (39C023MW and 39C025MW) have elevated TCE concentrations, indicating the Source Area 1 plume is commingling with the upgradient TCE source area at SS023 (Brice, 2022b).

- The cross-gradient wells have had low to non-detect TCE concentrations, demonstrating the plume is not migrating away from the main source area (Brice, 2022b; Figure 4-17).

Based on the 2021 annual event results, the TCE mass has decreased within the Source Area 1 treatment zone by approximately 94 percent since ERD treatment began in 2009 (Figure 4-18; Brice, 2022b). This value has increased more than 10 percent since EVO injections were conducted in 2019 (Brice, 2022b).

Source Area 2

Table 4-8 summarizes the 2021 TCE results and the time-series plot trends for Source Area 2 at CG041-039. The concentration trends for Source Area 2 are summarized below.

- The 2021 annual report data shows the TCE plume is stable in the area west of Source Area 2.
- Increasing TCE concentrations in shallow and deep wells A72U003AMW, A72U003BMW, and A72U003CMW suggest that contamination may be migrating to the southwest of Source Area 2 (Brice, 2022b; Figure 4-17).
- The source of elevated TCE concentrations at monitoring well 39C013BMW is considered to be a result of the TCE plume migrating from Source Area 1 (Brice, 2022b).
- Most of the monitoring wells at the distal end of the TCE plume in the Cantonment Area show stable or decreasing trends, indicating the distal plume boundary is generally stable (Brice, 2022b).

Based on the 2021 annual event results, the TCE mass has decreased within the Source Area 2 treatment zone by approximately 99 percent since ERD treatment began in 2009 (Figure 4-19; Brice, 2022b). This reduction has been largely unchanged since 2011 and reflects that the mass removal has reached an asymptotic level, with most of the mass having been consumed (Brice, 2022b).

4.4.3. CG044 – Western Groundwater Plumes

Five groundwater plume sites are combined under Site CG044, Western Groundwater Plumes. Sections 4.4.3.1 through 4.4.3.5 discuss the data review for each plume site at CG044.

4.4.3.1. CG044-003

The COCs in groundwater at CG044-003 are carbon tetrachloride, 1,2-DCA, PCE, and TCE. All MRP wells were sampled as specified in the revised MRP for chromium, manganese, TDS, and permanganate. Sample results indicated that the ISCO treatment complied with the MRP provisions established by the WDR. Table 4-9 summarizes the 2021 semiannual and 2021 annual TCE results and time-series plot trends for CG044-003. Figure 4-20 shows the 2021 TCE plume at CG044-003. Figure 4-21 provides a visual comparison of the TCE groundwater contaminant plume location in 2016, 2019, and 2021. TCE continues to be the most widespread contaminant at CG044-003. The TCE concentration trends and distribution are summarized below.

- FPTA Nos. 1, 2, 3 and 4 have been identified as sources of TCE groundwater contamination. The eastern source area includes the FPTA Nos. 1 and 2 groundwater plumes. The western source area comprises FPTA Nos. 3 and 4 and the former dry well area and concrete pad contamination. Groundwater contamination at FPTA Nos. 3 and 4 appears to have merged with the TCE plume associated with the dry well (Brice, 2022b).
- In 2018, an ISCO injection event was performed that included distributing sodium permanganate solution through six injection wells and results indicated TCE concentrations decreased in all MRP treatment wells, except for well 03C051IW, as can be seen between the 2016 and 2019 TCE isocontours (Figure 4-21; Brice, 2022b). During the 2021 annual event, TCE concentrations were less than the ISCO treatment action level of 350 µg/L.
- Variable or increasing TCE concentrations in a MRP transition well (03C045AMW), plume wells (03C048MW and 03C049MW), and MRP compliance wells (03C015AMW and 03C015BMW) indicate the TCE plume is migrating (Brice, 2022b). The increasing concentrations of TCE and carbon tetrachloride in various downgradient wells and MRP compliance wells near the eastern edge of the taxiway, as well as the TCE detection in 03C059MW, confirm that TCE has migrated beneath the taxiway (Brice, 2022b). The downgradient wells that monitor the distal portion of the plume show increasing trends for TCE and carbon tetrachloride, indicating the VOC plumes are also migrating in this area (Brice, 2022b).
- The calculated areas of the inferred 5-µg/L TCE isocontour based on 2016, 2019, and 2021 annual groundwater sampling results are approximately 22.1 acres, 30.4 acres, and 34.7 acres, respectively. Since the 2019 sampling event, the southwestern portion of the inferred 5-µg/L isocontour has expanded past the LUC boundary, likely as a result of off-Base pumping (Figure 4-21).

As of August 2021, approximately 85 percent of the TCE mass has been removed in the target treatment area, as shown in the TCE mass removal graph (Figure 4-22). The baseline TCE plume was estimated to be 9.2 pounds prior to the start of ISCO activities, and the TCE mass calculated during the 2021 annual sampling events was 1.4 pounds, equating to approximately 7.7 pounds removed (Brice, 2022b).

4.4.3.2. CG044-013

The COCs in groundwater at CG044-013 are 1,1,1,2-TeCA, 1,1,2,2-TeCA, 1,1,2-TCA, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, TCE, and PCE. During the 2021 sampling event, TCE and 1,1,2,2-TeCA were the only COCs detected at concentrations exceeding their respective PSLs. Table 4-10 summarizes the TCE results and long-term trends for the 2021 semiannual and annual groundwater events at CG044-013. Figure 4-23 shows the 2021 TCE plume, including site features, CG044-013. Figure 4-24 provides a visual comparison of the TCE groundwater contaminant plume location by years 2016, 2019, and 2021. TCE was the most widespread COC at CG044-013 and is the focus of the discussion below.

- TCE was not detected at a concentration greater than the source area treatment target concentration of 100 µg/L in any wells; however, it was detected at concentrations exceeding the PSL of 5 µg/L in 18 wells. The maximum TCE concentration detected was 40 µg/L at plume well 13L006MW.

- Overall, time-series plots indicate decreasing trends in approximately two-thirds (57 of 66) of the source area and plume wells (Brice, 2022e).

- Off-Base:

  - During the BGMP Annual 2021 sampling event, TCE was not detected at concentrations exceeding the PSL in any off-Base downgradient wells, indicating the contaminant plume is being effectively confined to this area.
  - Since 2014, TCE concentrations in off-Base well 13C045MW (Figure 4-23) have slowly increased until 2019, when concentrations peaked and then began to decline (Brice, 2022b). This well is in the northern portion of the site and is located about 600 feet west of the Base boundary. Concentration trends in the area appear to reflect migration of a slug of contamination, first through well 13L029MW between 2008 and 2014 and then through well 13C045MW between 2016 and 2019 (Brice, 2022b). TCE contamination appears to be migrating toward the west in this area (Brice, 2022b). During the semiannual and annual 2021 events, TCE was detected at concentrations of 2.9 and 3.2 µg/L, which were less than the PSL (5 µg/L).
  - Well 13C054MW is located approximately 2,000 feet downgradient of well 13C045MW. During the 2017 semiannual event, TCE was detected at a concentration of 5.2 µg/L, which exceeded the PSL for the first time in a sample from this well. TCE concentrations also exceeded the PSL during the 2018, 2019, and the 2020 semiannual events. TCE was detected at a concentration (1.9 µg/L) less than the PSL during the 2020 annual event. TCE remained at concentrations (3.7 and 2.6 µg/L) less than the PSL during the 2021 semiannual and annual events, respectively.

    Increases in TCE concentrations in samples from wells 13C045MW and 13C054MW may be related to off-Base pumping (Brice, 2022b).

During the first and second quarters of 2022, approximately 3.38 pounds and 2.89 pounds of VOC and TCE mass were removed from the GTS, respectively (Brice, 2022b). Since the GTS started in 1994, approximately 824 pounds of TCE has been removed from groundwater.

In 2010, the TCE mass within the target treatment zone of the 100-µg/L plume was estimated to be 18 pounds; and, as of July 2021, the TCE mass was estimated to be 2.4 pounds, equating to a decrease of 87 percent. In 2010, the TCE mass within the target treatment zone of the 5-µg/L plume was estimated to be 135 pounds; as of July 2021, the TCE mass was estimated to be 33 pounds, equating to a 76-percent reduction (Brice, 2022b).

4.4.3.3. CG044-031

TCE and vinyl chloride are the COCs in groundwater at CG044-031. Table 4-11 summarizes the 2021 TCE results and long-term TCE trends for groundwater at CG044-031. Figure 4-25 shows the 2021 TCE plume at CG044-031. Figure 4-26 provides a visual comparison of the TCE isoconcentrations for the years 2016, 2019, and 2021. TCE continues to be the most widespread COC and is the focus of the discussion below.

- As can be seen between the 2019 and 2021 TCE isocontours, most TCE concentrations in the performance zone wells at the source area have greatly decreased following implementation of EISB and EVO injections.
- TCE was detected at concentrations exceeding the PSL of 5 µg/L in 10 of 15 plume wells, with TCE concentrations exceeding 1,000 µg/L in three wells (1,500 µg/L at 31C042AMW, 9,100 µg/L at 31C042BMW, and 5,200 µg/L at 31C043MW).
- The calculated areas of the inferred 5-µg/L TCE isocontour based on 2016, 2019, and 2021 annual groundwater sampling results are approximately 14.7 acres, 24.4 acres, and 31.5 acres, respectively. Since the 2019 sampling event, the western and south/southeastern portions of the inferred 5-µg/L isocontour have expanded past the LUC boundary, likely as a result of off-Base pumping (Figure 4-26).
- The TCE plume continues to migrate west (Figure 4-26), with TCE contamination being detected at greater depths (Brice, 2022b). None of the downgradient wells exhibited TCE concentrations exceeding the PSL, indicating TCE is contained to the site. Based on the 2021 annual data, the TCE mass has been reduced by 92 percent in the target treatment area (Brice, 2022b).

Figure 4-27 provides the TCE mass removal graph. Prior to the start of the bioremediation activities, the TCE mass within the target treatment area was estimated to be 1,646 pounds (Brice, 2022b). The TCE mass that was calculated from the groundwater samples collected during the 2021 annual sampling event was approximately 50 pounds, which is an overall 92-percent reduction of TCE mass since bioremediation began (Brice, 2022b).

4.4.3.4. CG044-032

The COCs in groundwater at CG044-032 are cis-1,2-DCE and TCE. TCE continues to be the most widespread contaminant. As discussed in Section 2.7.4, ISCO treatments were implemented in 2007 to decrease the TCE groundwater mass in the source areas at CG044-032. Table 4-12 summarizes the 2021 semiannual and 2021 annual TCE results and the time-series plot trends for CG044-032. Figure 4-28 shows the 2021 plume, with additional site features, at CG044-032. Figure 4-29 provides a visual comparison of the groundwater TCE isocontours for 2016, 2019, and 2021. TCE concentration trends and distribution are summarized below.

- The TCE concentrations in MRP compliance wells 32C026IW, 32C027EW, and 05R002MW exceeded the PSL during the 2021 annual event. Based on the 2021 annual results, TCE concentrations tend to increase with depth in the deeper screened wells and may represent the merging of TCE plumes from both the northern and southern source areas at CG044-032 (Brice, 2022b).
- MRP treatment wells 32M001MW and 32048MW exhibited high TCE concentrations (170 µg/L and 28 µg/L, respectively), indicating contamination has rebounded in this area (Brice, 2022b).
- High TCE concentrations in various wells (05R002MW, 05R003MW, 32C027EW) suggest the westerly plume is continuing to migrate beneath the flight line (Brice, 2022b). The distal portion

of the plume at CG044-032 has migrated to the flightline source areas, indicating it is one continuous TCE plume, as can be seen in 2019 and 2021 isocontours (Figure 4-29).

- Off-Base:
  - The TCE plume has migrated beyond the Base boundary, south of well pair 32C083A/BMW (Figure 4-28). In 2021, TCE was detected at concentrations of 8.7 µg/L and 7.1 µg/L, which exceeded the PSL (PHG of 1.7 µg/L), in deep well 32C083AMW (Brice, 2022b). The chemical time-series plot for well 32C083AMW indicates an increasing trend in TCE concentrations.
  - The TCE plume is not currently bound to the south of well 32C083AMW (Brice, 2022b). As part of the Pre-ROD investigation at CG044-032, groundwater samples were collected in August 2021 from two existing off-Base agricultural wells (15N05E29C002M and BRO-106; Brice, 2022f). Appendix F includes Figures 4-7 and 4-8 from the "Revised Final Site CG044 Pre-Record of Decision Investigation Data Summary" (Brice, 2022f) showing the TCE concentrations in the off-Base agricultural wells and their relation to CG044-032. The screen depths for the wells are unknown (Brice, 2022b and 2022f). These wells are located approximately 1,350 southeast and 1,200 feet southwest of well cluster 32C083A/BMW.
  - TCE was not detected in well 15N05E029C002M. At well BRO-106M, TCE was detected at a concentration of 1.9 µg/L, which exceeded the PSL.
  - Between March and August 2021, groundwater elevations decreased across all 35 wells, ranging from a 5.90-foot decrease at 01C009CMW (located approximately 2,500 feet north of the Base boundary) to a maximum 21.45-foot decrease at 01C006BMW (located close to the off-Base agricultural wells), with an average decrease of 14.59 feet (Brice, 2022f). The large decrease in groundwater elevations is likely a result of the continual pumping of groundwater at the off-Base agricultural wells for irrigation purposes to offset the drought, resulting in the downgradient plume migrating south toward the off-Base pasture fields while the hydraulic gradient is to the west-southwest or southwest (Brice, 2022f).
  - As described in the "Revised Final Site CG044 Pre-Record of Decision Investigation Data Summary Report," dated August 2022, the proposed triple-completion off-Base wells 32C087MW(A/B/C) were to be installed to define the downgradient extent of the off-Base TCE plume, south of North Beale Road. However, the wells could not be installed because a ROE agreement between the Base and the property owner could not be obtained.
  - An additional well that is needed downgradient of well BRO-106 to delineate the off-Base CG044-032 plume to the OEHHA's PHG will be installed post-ROD when the ROE agreement becomes available (Brice, 2022f).
- TCE was not detected at concentrations exceeding the PSL in 19 of 24 downgradient wells. Detections at well 32C081MW confirm that the plume from the flight line extends to wells 01C008A/B/CMW near the Base boundary (Brice, 2022b).
- Downgradient wells 01C007AMW, 01C007BMW, 01C007CMW, 01C011AMW, 01C011BMW, 01C011CMW, 01L002MW, and 01L003MW are designated as guard wells for the Base water supply. During the 2021 event, TCE was not detected at concentrations exceeding the PSL in the wells, indicating the plume is stable in this area and is not migrating toward the Base water supply.

- During the 2021 sampling event, well 01L009MW exhibited a high TCE concentration of 5.8 µg/L, where a separate TCE source is near the storm sewer outfall (Brice, 2022b).
- Off-Base residential wells are sampled semiannually for VOCs. Over the years, TCE has continually been detected at the same three off-Base wells. The wells are equipped with wellhead treatment systems (Brice, 2022b). During the 2021 semiannual and annual events, TCE concentrations (0.52 J and 0.31 J µg/L and 0.26 J and 0.32 J µg/L) in two of three wells (OBL004AW and OBL005AW) were less than the PSL. In addition, TCE was detected in well OBL006AW during the 2021 semiannual event (0.18 µg/L) and in well OBL023AW during both 2021 sampling events (0.31 J µg/L and 0.25 J µg/L).

Prior to the start of remediation activities in October 2006, the TCE mass within the target treatment area was estimated at 551 pounds. The TCE mass that was calculated from the groundwater samples collected during the 2021 annual sampling event was approximately 19 pounds, as shown in the TCE mass removal graph (Figure 4-30; Brice, 2022b). The decrease reflects a 97-percent reduction in total TCE mass within the target treatment area at CG044-032 (Brice, 2022b).

4.4.3.5. CG044-040

The COCs in groundwater at CG044-040 are TCE, PCE, cis-1,2-DCE, vinyl chloride, 1,1-DCE, and carbon tetrachloride. As of 2021, the VOC plumes at CG044-040 and SS043 continue to merge near the biobarrier in the vicinity of Warren Shingle Road and N Street and continue to migrate toward the west (Brice, 2022b). The plume at CG044-040 originates near wells 40C009MWA/B/C, and the plume at SS043 originates approximately 700 feet south of Building 469. Tables 4-13 and 4-14 summarize the 2021 annual TCE results and the time-series plot trends in the eastern and western parts of CG044-040. Figure 4-31 shows the 2021 TCE plume, with additional site features, at CG044-040. Figure 4-32 provides a visual comparison of the TCE groundwater contaminant plume location in 2016, 2019, and 2021. COC concentration trends are summarized below.

- In 2021, only TCE, PCE, and 1,1-DCE were detected at concentrations exceeding their respective PSLs in the eastern part of CG044-040.
- TCE concentrations increased with depth away from the source area, indicating the TCE plume is migrating within coarser-grained sediments in the lower part of the alluvial sequence (Brice, 2022b).
- The decreasing trends in wells 40C009AMW and UBL002MW indicate the original source in the eastern portion of the plume is being reduced (Brice, 2022b).
- The 2021 annual TCE results were overall stable or decreasing, indicating the TCE plume is stable (Brice, 2022b).
- In 2021, only TCE, PCE, 1,1-DCE, cis-1,2-DCE, and vinyl chloride were detected at concentrations exceeding their respective PSLs in the western wells of CG044-040.
- Recently increasing TCE concentration trends in MRP treatment well 40C039MW indicate that TCE is migrating around the biobarrier to the south (Brice, 2022b). Elevated TCE concentrations

at depth indicate TCE may also be migrating beneath the biobarrier (Brice, 2022b). MRP compliance wells 40C034AMW/BMW show decreasing TCE concentrations, indicating the biobarrier is still treating TCE contamination in groundwater. Daughter products cis-1,2-DCE and vinyl chloride were detected in well 40C34AMW, further implying the biobarrier is successfully treating groundwater. Evidence exists that TCE is migrating to the south of the biobarrier from the upgradient source at SS043, south of Warren Shingle Road (Brice, 2022b).

- TCE concentrations trends are increasing in western plume wells 40C022MW and 40C023MW, implying TCE contamination is migrating from upgradient SS043. Well 40C037BMW exhibited a high TCE concentration, indicating the TCE plume is gradually becoming deeper as it moves to the west (Brice, 2022b). Well 40C044MW, located near the western Base boundary, has an increasing TCE trend, indicating the TCE plume may be migrating off the Base. RI data for Site SS043 confirm that TCE has migrated to the Base boundary, and a data gaps investigation will be performed prior to the SS043 FS to evaluate the extent of TCE that has migrated to the west of the Base boundary (Brice, 2022b). Off-base plume migration will be addressed as a part of Site SS043.

Prior to injecting EVO in July 2011, the baseline mass flux of TCE through the biobarrier was estimated at 0.002 pound per square foot per day (Brice, 2022b). Since 2018, the mass flux of TCE through the biobarrier is minimal. The reduction in mass flux is greater than 90 percent.

4.5. Climate Change and Environmental Justice

Potential site impacts from climate change have been assessed (National Oceanic and Atmospheric Administration, 2023; NEMAC, 2023), and performance of the remedies are currently not at risk due to the expected effects of climate change in the region and near the ERP sites. Appendix D includes the full climate change assessment.

In September 2022, EPA finalized an Environmental Justice Action Plan (EPA, 2022), which was developed to provide direction to federal agencies to promote and work toward proactively achieving environmental justice. Environmental justice considerations were reviewed, and no applicable elements were discovered.

Based on the existing terrain, climatic patterns, and indigenous fauna, wildfires pose a moderate to very high risk according to the State of California's Fire and Resource Assessment Program Map developed by the California Department of Forestry and Fire Protection. According to the National Oceanic and Atmospheric Administration, the risk of wildfires at Beale AFB over time is moderate but may increase during the summer seasons. Historically, as a part of the LUC remedies, brush removal and landscape maintenance have occurred in various areas as needed. Brush removal and general land maintenance will continue to be implemented as a LUC to mitigate any risks of wildfire. Routine inspections and landscape maintenance will continue to be performed. The performance of the remedies is currently not at risk because the expected landscape maintenance efforts would reduce the chances of wildfires near the ERP sites in the future. Appendix D includes a detailed discussion of the climate change assessment.

5. Technical Assessment

5.1. LF013 – Former Landfill No. 1

5.1.1. Question A – Is the Remedy Functioning as Intended by the Decision Documents?

Yes, the Site LF013 remedy is functioning as intended by the Final ROD for Site LF013 (Air Force, 2016a). The Air Force implemented the LUCs selected as the final remedy to:

- restrict land use (i.e., no residential land use), and
- restrict invasive activities to minimize the potential for exposure and maintain the integrity of the soil covers over the former landfill and portions of the former PWTP wastewater pipeline.

LUCs were inspected semiannually. LUC inspection results were documented in the annual LUC inspection reports. As stated in the Final ROD (Air Force, 2016a), LUCs will remain in perpetuity. LUCs will continue to be inspected semiannually and reported in the annual LUC inspection reports. No outstanding issues are associated with the LUC requirements at Site LF013.

5.1.2. Question B – Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and RAOs Used at the Time of the Remedy Selection Still Valid?

Yes. The RAO for soil was to prevent exposure to COCs that would result in an unacceptable risk to onsite residents and/or workers and ecological receptors. Per the Final ROD (Air Force, 2016a), this RAO is achieved using LUCs and maintenance of soil covers. The exposure setting at Site LF013 has not changed since implementation of the remedy. The COCs in soil were limited to metals (primarily lead), dioxins, and furans. To minimize the potential for exposure, a 4-foot-thick soil cover was installed over the footprint of the former landfill and over areas of soil containing dioxins and furans that remain along the former PWTP pipeline. The soil cover reduces exposure for both human and ecological receptors and protects water quality.

No COCs were identified in sediment or surface water of Hutchinson Creek. No numeric cleanup levels were identified for soil because the selected remedial alternative includes LUCs and maintenance of soil covers. Therefore, there is no interaction between receptors and contaminant concentrations and an assessment of toxicity criteria is not applicable.

No buildings are present at Site LF013. The nearest structure to Site LF013 are those associated with the GTS, which is more than 300 feet east of the Site LF013 western border and outside the 100-foot initial lateral inclusion zone for VI screening (EPA, 2015). However, to assess the potential VI pathway, soil vapor samples were collected during a 2013 data gaps investigation and a screening-level VI assessment was conducted to evaluate the risk levels in recently remediated areas of Site LF013 and the migration of VOCs from soil to indoor air. The Data Gap Investigation Summary Report identified TCE, 1,1,2,2-TeCA, 1,1,2-TCA, and PCE as COCs in soil vapor for Site LF013 (CH2M, 2014).

The soil-vapor-to-indoor-air risks under future residential and industrial scenarios presented in the data gap report were calculated based on the exposure equations and assumptions used to develop the EPA's 2013 regional screening levels (RSLs) for indoor air and the CalEPA's 2013 soil vapor contaminant source to indoor air attenuation factors of 0.0005 and 0.001 for commercial/industrial and residential exposure scenarios, respectively. The more stringent CalEPA or EPA toxicity values were used for screening data. The Data Gap Investigation Summary Report indicated risk estimates for VOCs in soil vapor ranged from 4×10^{-9} to 5×10^{-7} for the commercial/industrial exposure scenario, which is below the acceptable risk threshold of 1×10^{-6} (de minimis). For the hypothetical residential scenario, risk estimates ranged from 4×10^{-8} to 5×10^{-6}.

Although the toxicity criteria for the soil vapor COCs have not changed (except for the reference concentration for 1,1,2,2-tetrachloroethene), the standard exposure factors used to calculate the screening levels have marginally changed. These changes have resulted in the revisions to current indoor air screening levels. The table below compares the 2013 and the current indoor air screening levels established by DTSC (2022) and EPA (2023b).

2013 Indoor Air Screening Values (µg/m^3)				
Chemical of Concern	**Residential Screening Level**		**Industrial Screening Level**	
	Cancer	**Noncancer**	**Cancer**	**Noncancer**
1,1,2,2-Tetrachloroethane	0.04	NE	0.21*	NE
Tetrachloroethene	0.41	37	2.1	153
Trichloroethene	0.43	2.0	3.0*	8.8*
2023 Indoor Air Screening Values (µg/m^3)				
Chemical of Concern	**Residential Screening Level**		**Industrial Screening Level**	
	Cancer	**Noncancer**	**Cancer**	**Noncancer**
1,1,2,2-Tetrachloroethane	0.048	*83*	0.21	*350*
Tetrachloroethene	0.46	42	2	180
Trichloroethene	0.48**	2.1**	3.0**	8.8**

Notes:

Italics indicate changes to screening values.

1,1,2-Trichloroethane was not detected during the data gaps investigation.

* = screening levels from EPA 2013 RSLs
** = screening Levels from EPA 2023RSLs

EPA = U.S. Environmental Protection Agency

RSLs = regional screening levels

NE = not evaluated for noncancer effects

µg/m^3 = micrograms per cubic meter

In 2015, the EPA published the "OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air" (EPA, 2015). In the 2015 guidance, EPA

recommends using a soil gas attenuation factor of 0.03, rather than the values of 0.001 and 0.0005 used in 2014. This factor would increase risk estimates by over an order of magnitude.

Using the current attenuation factor of 0.03, the revised indoor air risks can be recalculated as presented in the table below.

Soil Vapor Chemical of Concern	Maximum Concentration in ppbv (µg/m^3)	2023 Residential Risks		2023 Industrial Risks	
		Cancer	Noncancer	Cancer	Noncancer
1,1,2,2-Tetrachloroethane	20 (137)	9×10^{-5}	0.05	2×10^{-5}	0.01
Benzene*	2 (5)	2×10^{-6}	0.05	4×10^{-7}	0.01
Tetrachloroethene	7 (50)	3×10^{-6}	0.04	7×10^{-7}	0.008
Trichloroethene	93 (500)	3×10^{-5}	7	5×10^{-6}	1.70
Vinyl Chloride*	15 (62)	2×10^{-4}	0.01	1×10^{-5}	0.003

Notes:

* = Not a soil vapor chemical of concern but contributes to risk under the revised attenuation factor assumptions. Concentration detected at 13C070VEWSV49 (19 to 34 feet below ground surface) during the 2014 data gaps investigation (CH2M HILL, 2014).

ppbv = parts per billion by volume

µg/m^3 = micrograms per cubic meter

Using the more conservative attenuation factor, predicted health risks are higher than previously calculated but generally within the EPA's generally acceptable risk management range of 10^{-6} to 10^{-4} as discussed in the NCP (Title 40 CFR § 300.430), with a risk level of 10^{-6} used as a point of departure for determining remedial goals when ARARs are not available or are not sufficiently protective. These results further substantiate the need for continuing to implement LUCs at Site LF013.

ARARs established in the Final ROD for Site LF013 (Air Force, 2016a) were evaluated. No major changes to the ARARs listed in the Final ROD were identified. In summary, as discussed above, the exposure assumptions, toxicity data, cleanup levels, and RAOs have not changed in a way that could affect the protectiveness of the remedy at Site LF013.

5.1.3. Question C – Has Any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

No other information has come to light that could call into question the protectiveness of the remedy at Site LF013. As discussed in Section 2.7.2, groundwater beneath and downgradient from Site LF013 is managed as CG044-013 under Site CG044 (Western Groundwater Plumes). Section 5.7 presents the review of the protectiveness of the groundwater remedy for Site CG044.

5.2. OT017 – Best Slough

5.2.1. Question A – Is the Remedy Functioning as Intended by the Decision Documents?

Yes, the remedy is functioning as intended by the Final ROD for Site OT017 (Air Force, 2018a). The Air Force continues to implement LUCs as the final remedy by limiting access to site soil and preventing exposure to COCs in soil vapor.

5.2.2. Question B – Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and RAOs Used at the Time of the Remedy Selection Still Valid?

Yes, the site-specific RAO for soil at Site OT017 is to protect human health by preventing exposure to COCs in soil vapor that would result in an unacceptable risk to onsite residents, recreationalists, and/or workers. Per the Site OT017 Final ROD (Air Force, 2018a), this RAO is achieved using LUCs which consist of a prohibition on residential land use and industrial land use (unless appropriate engineering controls are implemented, such as vapor barriers) and restrictions on activities during which workers could be exposed to soil vapor (e.g., workers entering excavations or vaults). The exposure conditions at OT017 have not changed. Beale AFB is expected to remain an active military installation into the foreseeable future. Current land use at the site is reasonably anticipated to continue indefinitely to support the mission of the facility (Air Force, 2018a).

The VI pathway was evaluated in 2015 (CH2M, 2015c) and summarized in the ROD (Air Force, 2018a). Cancer risk and noncancer hazard estimates were calculated for exposure of Base workers and residents to soil vapor via VI. Cancer risk and noncancer hazard estimates were derived by using the risk ratio method. As stated in the Site OT017 Final ROD (Air Force, 2018a), risk-based screening levels for soil vapor were calculated using the soil vapor-to-indoor air attenuation factor of 0.001 and risk-based indoor air screening levels from DTSC's Human Health Risk Assessment (HHRA) Note 3. The EPA's January 2015 RSLs for indoor air under Base workers and residential scenarios were used for VOCs without risk-based screening levels from HHRA Note 3 (Air Force, 2018a). The VI risk assessment identified 1,1,2,2-TeCA, TCE, 1,1,2-TCA, and vinyl chloride as the risk drivers for the hypothetical future resident and 1,1,2,2-TeCA and TCE for the hypothetical industrial scenario. The table below presents the results of the 2015 VI risk assessment.

Chemical of Concern	Concentration in ppbv (µg/m^3)	2015 Residential Risks		2015 Industrial Risks	
		Cancer	Noncancer	Cancer	Noncancer
1,1,2,2-Tetrachloroethane	5,370 (36,865)	8×10^{-4}	0.5	9×10^{-5}	0.06
Trichloroethene	3,840 (20,635)	4×10^{-5}	10	4×10^{-6}	1.21
1,1,2-Trichloroethane	84 (458)	3×10^{-6}	2	3×10^{-7}	0.3
Vinyl Chloride	253 (647)	4×10^{-6}	0.007	1×10^{-7}	0.001

Notes:
ppbv = parts per billion by volume
µg/m^3 = micrograms per cubic meter

Based on the results, the Air Force selected LUCs as the final soil remedy to address VOCs in soil vapor and maintain future protectiveness of human health and the environment at Site OT017. The LUCs will remain in place until the groundwater remedy under CG041 is complete, or soil vapor concentrations allow for UU/UE (based on future soil vapor sampling and a VI risk assessment) at Site OT017.

In 2015, the EPA published the "OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air" (EPA, 2015). In the 2015 guidance, EPA recommends using a soil gas attenuation factor of 0.03, rather than the value of 0.001 used in 2015. This factor would increase risk estimates by an order of magnitude. The indoor air screening levels used in 2015 were compared to current values in the following table. The values used in the 2015 risk assessment were primarily from DTSC HHRA Note 3, dated 14 July 2014, and supplemented by EPA's January 2015 RSLs. Current DTSC values are from HHRA Note 3, dated May 2022, and EPA's May 2023 RSLs (EPA, 2023b).

2015 Indoor Air Screening Values (µg/m^3)				
Chemical of Concern	**Residential Screening Level**		**Industrial Screening Level**	
	Cancer*	**Noncancer**	**Cancer**	**Noncancer**
1,1,2,2-Tetrachloroethane	0.048	120	0.21*	480
1,1,2-Trichloroethane	0.18*	0.21*	0.77*	0.88*
Trichloroethene	0.48*	2.1*	3.0*	8.8*
Vinyl Chloride	0.031	100*	0.16	440*
2022 and 2023 Indoor Air Screening Values (µg/m^3)				
Chemical of Concern	**Residential Screening Level**		**Industrial Screening Level**	
	Cancer	**Noncancer**	**Cancer**	**Noncancer**
1,1,2,2-Tetrachloroethane	0.048	*83*	0.21	*350*
1,1,2-Trichloroethene	0.18**	0.21**	0.77**	*0.88***
Trichloroethene	0.48**	2.1**	3.0**	8.8**
Vinyl Chloride	*0.0095*	100*	0.16	440**

Notes:

Italics indicate changes to screening values.

* = Screening levels from EPA RSLs January 2015

** = Screening Levels from EPA RSLs May 2023

EPA = U.S. Environmental Protection Agency

RSLs = regional screening levels

µg/m^3 = micrograms per cubic meter

Using the current attenuation factor of 0.03 and the revised indoor air screening levels, indoor air risks were recalculated as summarized in the table below.

Chemical of Concern	2023 Residential Risks		2023 Industrial Risks	
	Cancer*	Noncancer	Cancer	Noncancer
1,1,2,2-Tetrachloroethane	2×10^{-2}	13	5×10^{-3}	3
1,1,2-Trichloroethane	8×10^{-5}	66	2×10^{-5}	16
Trichloroethene	1×10^{-3}	295	2×10^{-4}	70
Vinyl Chloride	2×10^{-3}	0.2	1×10^{-4}	0.04

Using the more conservative attenuation factor, predicted health risks are higher than previously calculated. The results further substantiate the need to continue to implement LUCs to prevent the construction of enclosed structures at Site OT017 and to further address groundwater contamination under the CG041 Basewide Groundwater Program. While the potential risks to human health due to VI would be above acceptable risk thresholds, there are no enclosed structures present at Site OT017 as required under the LUCs and therefore risks from VI are nonexistent.

An evaluation of the ARARs established in the Final ROD for Site OT017 (Air Force, 2018a) indicated that there were no major changes to the ARARs listed in the Final ROD. In summary, as discussed above, the exposure assumptions, toxicity data, cleanup levels, and RAOs have not changed in a way that could affect the protectiveness of the remedy for Site OT017.

5.2.3. Question C – Has Any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

No other information has come to light that could call into question the protectiveness of the remedy. As discussed in Section 2.6, groundwater at Site OT017 is managed under Site CG041. Section 5.6 presents the review of the protectiveness of the groundwater remedy at Site CG041.

5.3. SD032 – Building 1086

5.3.1. Question A – Is the Remedy Functioning as Intended by the Decision Documents?

Yes, the remedy is functioning as intended by the Final ROD for Site SD032 (Air Force, 2017c). The Air Force has implemented and continues to implement LUCs selected as the final remedy by prohibiting residential land use, including housing, daycare centers, and schools over an approximately 0.3-acre area around well VE-4 (Figure 2-3).

5.3.2. Question B – Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and RAOs Used at the Time of the Remedy Selection Still Valid?

Yes. The RAO for Site SD032 is to protect human health by preventing exposure of hypothetical future residents to TCE in soil vapor (via VI to indoor air). This RAO is achieved using LUCs that prohibit residential land use, including housing, daycare centers, and schools over an approximately 0.3-acre area around well VE-4. The Site SD032 ROD identified TCE as the risk driver in soil vapor at Site SD032 (Air Force, 2017c). Exposure conditions at SD032 have not changed. Beale AFB is expected to remain an

active military installation into the foreseeable future. Current land use at the site is reasonably anticipated to continue indefinitely to support the mission of the facility (Air Force, 2017c).

The most recent risks were presented in the Data Gap Investigation Summary Report (CH2M, 2014) and were estimated using risk-based screening levels for indoor air and site-specific soil-gas-to-indoor-air attenuation factors using the Johnson and Ettinger model.

For the soil-vapor-to-indoor-air pathway, the maximum excess lifetime cancer risk (ELCR) for the onsite Base worker exposure scenario, based on the maximum concentration of TCE in the depth-discrete samples collected from location 32080SB, was 1×10^{-5} and the hazard index (HI) was 2. For the hypothetical future resident, the maximum ELCR was 5×10^{-5} and the HI was 9, which exceeds the threshold of 1. TCE was the risk driver but was limited to soil vapor in one small area near vapor well VE-4 at a depth between 15 and 40 feet bgs. Because the HI for the hypothetical future resident exceeded 1, the ROD for Site SD032 stipulated that LUCs were warranted to eliminate the exposure pathway (Air Force, 2017c).

Although the toxicity criteria for TCE have not changed, the standard exposure factors used to calculate the screening levels have marginally changed (EPA, 2014). When recalculated, the residential screening level (cancer risks) used in the 2014 assessment changes from 0.43 micrograms per cubic meter ($\mu g/m^3$) to 0.48 $\mu g/m^3$ and the industrial screening level changes from 2 $\mu g/m^3$ to 3 $\mu g/m^3$ (based on a cancer risk of 10^{-6}).

In 2015, EPA published the "OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air" (EPA, 2015). In the 2015 guidance, EPA recommends using a soil gas attenuation factor of 0.03. In 2014, the maximum residential risk was estimated based on an attenuation factor of 0.00063 and a TCE concentration of 5,100 parts per billion by volume (ppbv; 27.407 $\mu g/m^3$ at 15 feet bgs). For industrial risks the 2014 assessment used an attenuation factor of 0.05 and a TCE concentration of 0.56 ppbv (1.5 feet bgs) were used.

Using the current attenuation factor of 0.03 and the revised indoor air risks were recalculated as presented in the table below.

Exposure Scenario (depth of contamination)	TCE Maximum Concentration in ppbv ($\mu g/m^3$)	2014 Estimated TCE Risks		2023 Estimated TCE Risks	
		Cancer	Noncancer	Cancer	Noncancer
Residential	5,100 (27,407)	5×10^{-5}	9	2×10^{-3}	391
Industrial		8×10^{-8}	2	3×10^{-4}	93

Notes:
bgs = below ground surface
ppbv = parts per billion by volume
TCE = trichloroethene
$\mu g/m^3$ = micrograms per cubic meter

For both the residential and industrial scenarios, risk estimates from TCE are two orders of magnitude greater when comparing the 2014 to 2023 estimated TCE risks. While the potential risks to human health due to VI would be above acceptable risk thresholds at the location of the elevated TCE in well VE-4, there are no enclosed structures present within the vicinity of the well as required under the LUCs and therefore risks from VI are nonexistent. The results, however, further substantiate the need for continuing implementation of LUCs restricting residential use in this area and continuing remediation of the groundwater under CG044 Western Groundwater Plumes; therefore, the current remedy is protective and valid.

ARARs established in the Final ROD for Site SD032 (Air Force, 2017c) were evaluated. No major changes to the ARARs listed in the Final ROD were identified. In summary, as discussed above, the exposure assumptions, toxicity data, cleanup levels, and RAOs have not changed in a way that could affect the protectiveness of the remedy for Site SD032.

5.3.3. Question C – Has Any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

No other information has come to light that could call into question the protectiveness of the remedy. As discussed in Section 2.7, groundwater at Site SD032 is managed under Site CG044. Section 5.7 presents the review of the protectiveness of the groundwater remedy at Site CG044.

5.4. ST018 – Bulk Fuel Storage Facility

5.4.1. Question A – Is the Remedy Functioning as Intended by the Decision Documents?

Yes, the remedy is functioning as intended by the Site ST018 Final ROD (Air Force, 2017a). The Air Force implemented and continues to implement LUCs by prohibiting residential land use, including housing, daycare centers, and schools, at Site ST018.

5.4.2. Question B – Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and RAOs Used at the Time of the Remedy Selection Still Valid?

Yes. The site-specific RAO for soil at Site ST018 is to protect human health by preventing exposure of hypothetical future onsite residents to PAHs in soil that could pose an unacceptable risk. Therefore, LUCs were implemented to prevent exposure of future onsite residents to PAHs in soil. The selected final remedy prohibits residential land use (including housing, daycare centers, and schools). Exposure conditions at ST018 have not changed. Beale AFB is expected to remain an active military installation into the foreseeable future. Current land use at the site is reasonably anticipated to continue indefinitely to support the mission of the facility (Air Force, 2017a).

PAHs were identified as the risk drivers in soil at Site ST018, although overall risks were estimated to be within the risk management range. Because of the uncertainty associated with characterization of PAHs (i.e., they have not been fully characterized within the active tank farm and in the southeast portion of the

site), the Air Force and the regulatory agencies agreed that further action was warranted (Air Force, 2017a). The PSL for carcinogenic PAHs was identified as 0.12 milligrams per kilogram, which was derived using the EPA RSL calculator (EPA, 2023a) for the residential exposure scenario. A review of the derivation of the residential PSL for PAHs indicated that the current toxicity data and exposure factors have not changed since the PSL was calculated (EPA, 2023a). The ROD for Site ST018 did not identify COCs in sediment or surface water (Air Force, 2017a), and no actions are required for those media.

TCE in soil vapor was considered a COC; however, the Site ST018 Soil Vapor Extraction System Shutdown Report (CH2M, 2013) concluded the remaining TCE mass was submerged below the water table and TCE concentrations detected in soil vapor following termination of the SVE system were related to off-gassing from groundwater. Groundwater impacts are evaluated as part of CG041 (see Section 5.6).

An evaluation of the ARARs established in the Final ROD for Site ST018 (Air Force, 2017a) indicated that there were no major changes to the ARARs listed in the Final ROD. In summary, the exposure assumptions, toxicity data, cleanup levels, and RAOs have not changed in a way that could affect the protectiveness of the remedy at Site ST018.

5.4.3. Question C – Has Any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

No other information has come to light that could call into question the protectiveness of the remedy. As discussed in Section 2.6, groundwater at Site ST018 is managed under Site CG041. Section 5.6 presents the review of the protectiveness of the groundwater remedy at Site CG041.

5.5. TU509 – Clinic Underground Storage Tanks

5.5.1. Question A – Is the Remedy Functioning as Intended by the Decision Documents?

Yes. LUCs are being implemented at Site TU509 and are inspected semiannually. LUCs prevent groundwater use and potential exposure of humans to COCs in soil from groundwater. The remedy for soil is considered protective of human health and the environment.

5.5.2. Question B – Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and RAOs Used at the Time of the Remedy Selection Still Valid?

Yes. LUCs are implemented at this site to prevent residential exposure to petroleum contamination in soil through direct contact and potential exposure to contaminants through VI. Specifically, the LUCs prevent construction of residential buildings within the site boundaries. At TU509, soil cleanup levels for TPH-d and naphthalene were established based on the SWRCB's Low Threat Closure Policy (SWRCB, 2012), which is current and valid. The TU509 CAP Addendum added a soil LUC to the selected corrective action alternative to prevent residential exposure to contaminants in soil through the direct contact pathway and to contaminants potentially migrating from soil into indoor air through the VI pathway (CH2M, 2016). Exposure conditions at TU509 have not changed. Beale AFB is expected to remain an active military

installation into the foreseeable future. Current land use at the site is reasonably anticipated to continue indefinitely to support the mission of the facility.

As part of the CAP (CH2M, 2015a), the VI pathway was evaluated and no COCs were identified based on a comparison of detected chemical concentrations against their respective PSLs. The PSLs for soil vapor were based on screening levels for residential indoor air and a soil-gas-to-indoor-air attenuation factor of 0.001 (CH2M, 2015a). The CAP specifically evaluated benzene and ethylbenzene because they are typically the primary risk drivers at fuel release sites. Currently, the Regional Water Quality Control Board (RWQCB) uses environmental screening levels (ESLs) to assess soil vapor concentrations and that integrate current toxicity information (which are unchanged from 2015 for benzene and ethylbenzene) and soil-gas-to-indoor-air attenuation factor assumptions, which RWQCB currently assumes is 0.03 (RWQCB, 2019). The current ESLs were compared to the 2015 PSLs in the table below.

Volatile Organic Compound	Maximum Detected Concentration (ppbv)	2015 PSL (ppbv)	2019 ESL (ppbv)
Benzene	1.6	26.6	1
Ethylbenzene	1.0	253	8.5

Notes:
ppbv = parts per billion by volume
ESL = environmental screening level
PSL = project screening level

The ESL for benzene is based on a cancer risk level of 1×10^{-6}; therefore, the maximum detected concentration of 1.6 ppbv equates to a risk estimate of 2×10^{-6}, which is within the EPA's generally acceptable risk management range of 10^{-6} to 10^{-4} as discussed in the NCP (Title 40 CFR § 300.430), with a risk level of 10^{-6} used as a point of departure for determining remedial goals when ARARs are not available or are not sufficiently protective.

In summary, the exposure assumptions used at the time the TU 509 corrective action was selected are still valid. There have been no changes in regulatory standards, exposure pathways, contaminant toxicity, or risk assessment protocols that call into question the current protectiveness of the Site TU509 corrective action.

5.5.3. Question C – Has Any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

5.6. CG041 – Basewide Groundwater

5.6.1. Question A – Is the Remedy Functioning as Intended by the Decision Documents?

Yes. Prior to signing the Final ROD for CG041 in April 2018, the interim remedies in place for the CG041 plume sites were implemented per the respective IRODs to achieve the interim RAOs. After the Final ROD was signed and as discussed in Section 2.6, remedial actions were implemented at plume sites CG041-010, CG041-016, CG041-018, CG041-029, CG041-035, and CG041-039 and are functioning as intended. The remedy components at CG041-017 were also implemented and are functioning as intended by the Final ROD, except for one remedial component (i.e., hotspot treatment with ERD and PRB with in-situ chemical reduction), as discussed in Section 2.6.3. The hotspot treatment and PRB remedial components of the remedy implementation were delayed due to the replacement of the existing bridges across Dry Creek, which was ongoing in 2022 and was completed in 2023. Implementation of the selected remedy (hotspot treatment) to address COCs in groundwater at Plume CG041-017 began in August 2023. This remedy includes hotspot treatment with ERD and PRB with in-situ chemical reduction (hotspot generally defined by residual TCE concentrations greater than 10,000 µg/L inside the slurry walls and 500 µg/L outside the slurry walls). Portions of the remedy construction, including construction of the PRB and two bioreactors, have been completed. Full remedy construction is expected to be completed in 2024. The observed long-term increasing TCE trends at wells 17C165BMW, 17C166MW, and 17H16BMW are likely a result of TCE present outside the slurry walls at the time of construction in 2007 (Brice, 2022b). Groundwater gradients measured in June 2021 in wells along the slurry wall in the Primary Source Area (outside of the Secondary Source Area) indicated that the groundwater gradient is inward, and the containment system is operating as designed (Brice, 2022b). Based on the observed hydraulic performance of the slurry wall, implementation of the final remedy (which is in progress), the CG041-017 remedy is protective in the short-term. For the Site CG041 remedy to be fully protective, the ongoing implementation of the final remedy for Plume CG041-017 will need to be completed.

The conclusions summarized below are based on the response action and data review summaries presented in Sections 2.6 and 4.4.2, respectively.

- Based on the 2021 annual groundwater monitoring results, the remedies implemented at CG041 plume sites CG041-010, CG041-029, CG041-035, and CG041-039 have reduced TCE by more than 90 percent in the target treatment area. At CG041-018, TCE was reduced by more than 75 percent in the target treatment area. The reduction in mass is associated with all remedies implemented to date and not just those implemented since the CG041 ROD.
- Decreasing long-term concentration trends at several of the CG041 plume sites were observed, as discussed in Section 4.4.2.
- Concentrations of one or more COCs continue to exceed the PSLs at all CG041 sites. As the remedies continue to progress, further reductions in contaminant mass and concentrations are expected.

- For the CG041 plume sites with a remedial treatment component such as ERD, additional treatment will be evaluated to address rebound and/or increase in COC concentrations.
- While the remedial actions at each site vary, long-term EA monitoring and LUCs are components of every remedy selected (Table 2-8) and are being implemented at all CG041 plume sites.
- Long-term EA monitoring effectively provides advanced identification of potential threats to downgradient receptors before exposure can occur. Long-term EA monitoring has also been effective in monitoring the performance of the remedial actions and compliance with WDRs. Optimization of the EA monitoring program is ongoing.
- LUCs have effectively restricted access to groundwater by prohibiting the installation of water supply wells, thus preventing human consumption of COC-laden groundwater. Semiannual LUC inspections indicated that LUCs are being implemented per the CG041 Final ROD (Air Force, 2018b).

In summary, the remedies are currently in place and are being implemented at six of the seven CG041 plume sites. At plume site CG041-017, four of five remedial components are in place and are being implemented. Implementation of the selected remedy to address the COCs in groundwater at Plume CG041-017 began in August 2023. Portions of the remedy construction, including construction of the PRB and two bioreactors, have been completed. The full remedy construction is expected to be completed in 2024. Site inspections, document reviews, data reviews, and interviews indicate the remedy is functioning as intended. No new site conditions were identified that impact RAOs and remedy protectiveness. While the timelines for restoring groundwater to UU/UE vary, progress is being made toward reducing groundwater COC concentrations to each site's respective cleanup goals and/or reaching asymptotic conditions, as stated in CG041 ROD (Air Force, 2018b). Overall, the implemented remedies for CG041 plume sites are functioning as intended by the Final ROD (Air Force, 2018b) and are protective of human health and the environment as of the date of this FYR. The remedies will continue to be implemented and monitored.

5.6.2. Question B – Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and RAOs Used at the Time of the Remedy Selection Still Valid?

Yes, exposure conditions have not changed, and LUCs are in place to protect public health. The existing and planned future land use for the site is industrial (Air Force, 2018b). Beale AFB is expected to remain an active military installation into the foreseeable future. Current land use at the site is reasonably anticipated to continue indefinitely to support the mission of the facility (Air Force, 2018b). The groundwater cleanup levels for COCs identified in the Final ROD for CG041 (Air Force, 2018b) were based on established state or federal MCLs, which remain current and valid. Because cleanup levels were based on MCLs, an evaluation of changes in toxicity data was not necessary.

The MCLs are intended to support restoration of groundwater to designated beneficial uses; however, when VOCs are present in groundwater, the potential for the VI pathway to indoor air may be of interest. That is, vapors from groundwater may migrate through diffusive and convective properties and ultimately impact indoor air quality. During historical investigations, many VI risk assessments have been prepared. As

identified in the Final ROD (Air Force, 2018b), the toxicity values for TCE were updated in EPA's Integrated Risk Information System (https://www.epa.gov/iris) in 2011. As part of the Final ROD, existing risk assessments for the Site CG041 plumes were reviewed, and it was concluded that the evaluation of VI risks for plume sites CG041-017, CG041-035, and CG041-039 either did not consider the updated TCE toxicity value or uncertainty exists in the data used to characterize VI risks based on the future potential for short-term exposure to TCE at a concentration that may potentially exceed response action levels for TCE. Therefore, to protect human health until RAOs have been met, LUCs were implemented at Site CG041 that prohibit groundwater use in areas where COC concentrations exceed MCLs and that prohibit residential land uses (including housing, daycare facilities, and schools) and industrial land uses in areas where VOC concentrations in groundwater pose unacceptable risk via VI (Air Force, 2018b). With respect to the VI pathway, the ROD specifies the LUCs listed below by plume site.

- CG041-010: LUCs prohibiting residential use unless VI risks from groundwater at the proposed construction location are determined to be acceptable or appropriate engineering controls are implemented to mitigate VI.
- CG041-017: Until soil vapor sampling demonstrates that VI risks are acceptable, LUCs prohibit residential and industrial land uses in areas where VOC concentrations pose unacceptable risk via VI.
- CG041-018: LUCs prohibiting residential use unless VI risks from groundwater at the proposed construction location are determined to be acceptable or appropriate engineering controls are implemented to mitigate VI.
- CG041-035: Until soil vapor sampling demonstrates that VI risks are acceptable, LUCs prohibit future residential and industrial land uses in areas where VOC concentrations pose unacceptable risk via VI.
- CG041-039: LUCs prohibiting residential use unless VI risks from groundwater at the proposed construction location are determined to be acceptable or appropriate engineering controls are implemented to mitigate VI. Also, LUCs prohibiting future buildings for industrial/commercial land use over a portion of the plume unless VI risks from groundwater at the proposed construction location are determined to be acceptable or appropriate engineering controls are implemented to mitigate VI.

To assess the protectiveness of the MCLs with respect to the groundwater-to-indoor air VI pathway, MCL concentrations were evaluated using the methods in the EPA's "OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air" (EPA, 2015). In the 2015 guidance, the concentration of a vapor-forming chemical (VFC) migrating into indoor air through VI can be predicted using the groundwater concentration in two steps, as described below.

1. The VFC concentration in groundwater is used in the partitioning equation below to predict the equilibrium vapor concentration.

$$C_{vapor-GW} = C_{GW} \times H' \times \left(\frac{1{,}000L}{m^3}\right)$$

where:

$C_{Vapor-GW}$	Vapor concentration in equilibrium with groundwater in µg/m^3
C_{GW}	Groundwater concentration in µg/L
H'	Chemical-specific Henry's Law constant (unitless)

2. The equilibrium vapor concentration is multiplied by EPA's groundwater-to-indoor air attenuation factor (0.001) to predict the indoor air concentration after vapors have migrated through the capillary fringe and vadose zone into a building, as shown below.

$$C_{IA} = C_{vapor-GW} \times AF_{GW}$$

where:

C_{IA}	Indoor air concentration in µg/m^3
$C_{Vapor-GW}$	Vapor concentration in equilibrium with water in µg/m^3
AF_{GW}	Generic groundwater to indoor air attenuation factor of 0.001

Estimated risks were then calculated using the modeled indoor air concentrations and the more health protective of either the DTSC indoor air screening levels (DTSC, 2022) or EPA indoor air RSLs (EPA, 2023b). Both the DTSC screening levels and EPA RSLs incorporate current toxicity and exposure factor information and are used to calculate risks and hazard, as follows:

$$Cancer\ Risk = \frac{C_{IA} \times (1 \times 10^{-6})}{Indoor\ Air\ Screening\ Level, Cancer\ (DTSC\ SL\ or\ EPA\ RSL)}$$

$$Noncancer\ Hazard = \frac{C_{IA}}{Indoor\ Air\ Screening\ Level, Noncancer\ (DTSC\ SL\ or\ EPA\ RSL)}$$

Appendix E, Table E-1, presents the calculations of estimated risk and hazards resulting from the groundwater-to-indoor air VI pathway, under both residential and industrial scenarios. A review of the results indicates that all health risks are either less than or within EPA's generally acceptable risk management range of 10^{-6} to 10^{-4} as discussed in the NCP (Title 40 CFR § 300.430), with a risk level of 10^{-6} used as a point of departure for determining remedial goals when ARARs are not available or are not sufficiently protective. The highest risk estimate is attributed to chloroform, which is within the acceptable risk range.

ARARs established in the Final ROD for Site CG041 (Air Force, 2018b) were evaluated. No major changes to the ARARs listed in the Final ROD were identified. The exposure assumptions, toxicity data, cleanup levels, and RAOs have not changed in a way that could affect the protectiveness of the remedy at Site CG041.

5.6.3. Question C – Has Any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

As noted in the interview record forms received from the O&M contractor, cost inflation and decreased availability of some materials, such as emulsified vegetable oil, have occurred recently. Those issues are not expected to impact the long-term protectiveness of the remedy considering that LUCs are being implemented and groundwater is not in use. In summary, there is no new information that would call into question the protectiveness of the remedy.

5.7. CG044 – Western Groundwater Plumes

5.7.1. Question A – Is the Remedy Functioning as Intended by the Decision Documents?

For the CG044 plume sites, interim remedies are being implemented per the Action Memorandum (CG044-003) and the respective IRODs as discussed in Section 2.7. An FFS for CG044 was completed in August 2020 to support the selection of a final remedy for CG044 (CH2M, 2020g).

The conclusions summarized below are based on the response action and data review summaries presented in Sections 2.7, 4.4.1, and 4.4.3, respectively.

- At CG044-003, as of August 2021, approximately 85 percent of the TCE mass was removed in the target treatment area, largely due to the implementation of ISCO as an interim remedy.
- Since the GTS began operation in 1994 at CG044-013, approximately 824 pounds of TCE have been removed from groundwater as of the second quarter of 2022.
- At CG044-031, based on the annual 2021 groundwater monitoring data, the bioremediation component of the interim remedy has resulted in an overall 92-percent reduction in total TCE mass in the target treatment area.
- Based on the annual 2021 groundwater monitoring data, the ISCO component of the interim remedy at CG044-032 has resulted in an overall 92-percent reduction in total TCE mass in the target treatment area. As stated in Section 4.4.3.4, the TCE plume has migrated beyond the Base boundary, south of well pair 32C083A/BMW (Figure 4-28), with an increasing trend in TCE concentrations. The TCE plume is not currently bound south of well 32C083AMW. In August 2021, sampling results for the two off-Base agricultural wells, 15N05E029C002M and BRO-106 (Appendix F), that had unknown screen depths and were located approximately 1,350 southeast and 1,200 feet southwest of well cluster 32C083A/BMW (Appendix E) indicated that TCE was not detected in well 15N05E029C002M. At well BRO-106, TCE was detected at a concentration of 1.9 µg/L, which exceeded the PSL (PHG of 1.7 µg/L; Brice, 2022b and 2022f). An additional well that is needed downgradient of well BRO-106 to delineate the off-Base CG044-032 plume to the OEHHA's PHG will be installed post-ROD when the ROE agreement becomes available (Brice, 2022f).
- At CG044-040, prior to injecting EVO during July 2011, the baseline mass flux of TCE through the biobarrier was estimated at 0.002 pound per square foot per day (Brice, 2022b). Since 2018, the mass flux of TCE through the biobarrier was noted to be minimal (Brice, 2022b). The reduction in mass flux is greater than 90 percent.

- Concentrations of one or more COCs continue to exceed PSLs at all CG044 plume sites. As the interim remedies continue to progress and the final remedies are implemented, further reductions in contaminant mass and concentrations are expected.
- Off-Base agricultural pumping and drought conditions during the third FYR period impacted plume migration and increases in COC concentrations.
- For the CG044 plume sites with a remedial treatment component, additional treatment will be evaluated to address rebound and/or increase in COC concentrations.
- While the remedial actions at each site vary, long-term monitoring and LUCs are components of each remedy, as discussed in Section 2.7, and are being implemented at all CG044 plume sites.
- Long-term monitoring has effectively provided advanced identification of potential threats to downgradient receptors before exposure can occur. Long-term monitoring has also been effective in monitoring the performance of the remedial actions and compliance with WDRs. The monitoring program is optimized on a regular basis.
- LUCs have effectively restricted access to groundwater on-Base by prohibiting the installation of water supply wells, thus preventing human consumption of COC-laden groundwater. At some CG044 plume sites, due to off-Base pumping, groundwater contamination has been observed to extend past the LUC boundaries.
- Three off-Base residential wellhead treatment systems were constructed. Since 1999, Beale AFB supplied bottled water to the residents. Starting in April 2021, Beale AFB discontinued bottled delivery because TCE concentrations have been less than the MCL for the last 5 years. Off-Base residential wells are sampled semiannually and analyzed for VOCs.

In summary, the interim remedies for the CG044 plume sites are in place. Site inspections, document reviews, data review, and interviews indicated the interim remedies are functioning as intended. As discussed above, due to off-Base pumping, groundwater contamination has been observed to extend past the LUC boundaries at some plume sites. During the interim, the protectiveness is maintained considering that groundwater is not in use and that the Work Clearance Request process has been effective in preventing groundwater use on-Base. Off-Base wellhead treatment systems are in place that effectively prevent exposure to contaminants. An additional well that is needed to delineate the off-Base CG044-032 plume downgradient of agricultural well BRO-106 will be installed post-ROD when the ROE agreement becomes available (Brice, 2022f). While the timelines for restoring groundwater to UU/UE vary, progress is being made toward achieving that goal. Overall, the implemented remedies for the CG044 plume sites are functioning as intended by the respective interim decision documents and are protective of human health and the environment in the short-term as of the date of this FYR. The remedies will continue to be implemented and monitored.

5.7.2. Question B – Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and RAOs Used at the Time of the Remedy Selection Still Valid?

As discussed in Sections 4.4.1 and 4.4.3.4, the combination of below average rainfall and increased off-Base groundwater pumping for agricultural purposes near the western Base boundary has resulted in

decreased groundwater elevations. This has resulted in an increase in horizontal gradient and groundwater flow velocity and downgradient plume migration. At some CG044 plume sites, groundwater contamination has been observed to extend past the LUC boundaries; however, exposure conditions on-Base are similar to those within the LUC boundaries. During the interim, the protectiveness is maintained on-Base considering that groundwater is not in use for the area within the LUC boundary and for the area outside the LUC boundary. The Work Clearance Request process followed by the Operation Flight of the Civil Engineering Office has been effective in preventing on-Base groundwater use and activities that would adversely affect implementation of the selected remedy until COC concentrations in groundwater allow for UU/UE. Wellhead treatment systems are in place at three off-Base residential wells. The remedy for CG044 is short-term protective, which is consistent with the definition of short-term protectiveness. Human and ecological risks are currently under control, and no unacceptable risks are occurring. However, the data indicate that future protectiveness or remedy performance may not be sufficient, but the remedy is currently protective.

Except for 1,1,1,2-TeCA, the interim cleanup levels established for COCs in the respective IRODs for the CG044 plume sites were based on the established state or federal MCLs (CH2M, 2007a, 2007b, and 2010). The MCLs remain current and valid. Because cleanup levels for all COCs except for 1,1,1,2-TeCA were based on MCLs, an evaluation of changes in toxicity data was not necessary.

The VOC 1,1,1,2-TeCA was identified as a COC in groundwater in the Site 13 IROD but no cleanup goal was selected because no MCL has been established for 1,1,1,2-TeCA. The annual 2021 groundwater monitoring data for CG044 plume sites indicated that 1,1,2-TeCA was not reported at or above the reporting limit.

Currently, groundwater at Site CG044 is contaminated with COCs at concentrations exceeding MCLs. In addition, VOCs migrating from groundwater to indoor air currently pose a potential unacceptable risk to future hypothetical residents and, in some localized areas within plume sites CG044-003, CG044-013, and CG044-031 to onsite Base workers.

To assess the protectiveness of the MCLs with respect to the groundwater-to-indoor air VI pathway, MCL concentrations were evaluated using the methods in the EPA's "OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air" (EPA, 2015). In the 2015 guidance, the concentration of a VFC migrating into indoor air through VI can be predicted using the groundwater concentration in two steps, as described below.

1. The VFC concentration in groundwater is used in the partitioning equation below to predict the equilibrium vapor concentration.

$$C_{vapor-GW} = C_{GW} \times H' \times \left(\frac{1{,}000L}{m^3}\right)$$

where:

$C_{Vapor-GW}$	Vapor concentration in equilibrium with groundwater in µg/m^3
C_{GW}	Groundwater concentration in µg/L
H'	Chemical-specific Henry's Law constant (unitless)

2. The equilibrium vapor concentration is multiplied by EPA's groundwater-to-indoor air attenuation factor (0.001) to predict the indoor air concentration after vapors have migrated through the capillary fringe and vadose zone into a building, as shown below.

$$C_{IA} = C_{vapor-GW} \times AF_{GW}$$

where:

C_{IA}	Indoor air concentration in µg/m^3
$C_{Vapor-GW}$	Vapor concentration in equilibrium with water in µg/m^3
AF_{GW}	Generic groundwater to indoor air attenuation factor of 0.001

Estimated risks were then calculated using the modeled indoor air concentrations and the more health protective of either the DTSC indoor air screening levels (DTSC, 2022) or EPA indoor air RSLs (EPA, 2023b). Both the DTSC screening levels and EPA RSLs incorporate current toxicity and exposure factor information and are used to calculate risks and hazard, as follows:

$$Cancer\ Risk = \frac{C_{IA} \times (1 \times 10^{-6})}{Indoor\ Air\ Screening\ Level, Cancer\ (DTSC\ SL\ or\ EPA\ RSL)}$$

$$Noncancer\ Hazard = \frac{C_{IA}}{Indoor\ Air\ Screening\ Level, Noncancer\ (DTSC\ SL\ or\ EPA\ RSL)}$$

Appendix E, Table E-1, presents the calculations of estimated risk and hazards resulting from the groundwater-to-indoor-air VI pathway, under both residential and industrial scenarios. A review of the results indicates that all health risks are either less than or within the EPA's generally acceptable risk management range of 10^{-6} to 10^{-4} as discussed in the NCP (Title 40 CFR § 300.430), with a risk level of 10^{-6} used as a point of departure for determining remedial goals when ARARs are not available or are not sufficiently protective.

Because no MCL has been established for 1,1,1,2-TeCA, groundwater concentrations protective of the indoor air pathway were calculated using the EPA VI Screening Model (Appendix E) and are shown in the table below.

VOC in Groundwater	Residential Target Concentration	Industrial Target Concentration
1,1,1,2-Tetrachloroethane	3.71 µg/L	16.2 µg/L

Notes:
VOC = volatile organic compound
µg/L = micrograms per liter

Although cleanup levels have not changed, no current interim cleanup goal was established for 1,1,1,2-TeCA in groundwater. Although identified as a COC, as discussed above, recent groundwater data (Annual 2021) indicated that 1,1,1,2-TeCA was not reported at or above the reporting limit (Brice, 2022e).

An evaluation of the ARARs established in the interim decision documents for the CG044 plume sites indicated that there were no major changes to the ARARs listed in the interim decision documents. In summary, the exposure assumptions, toxicity data, cleanup levels, and RAOs have not changed in a way that could affect the protectiveness of the remedy for Site CG044.

5.7.3. Question C – Has Any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

There are no apparent site changes or site vulnerabilities related to climate change that would compromise the long-term protectiveness of the remedy. The off-Base pumping and drought conditions are regional issues that increase or decrease based on variables that are outside the purview of this FYR, not just specific to the site (e.g., off-Base water demand, off-Base agricultural pumping, and annual rainfall amounts).

As noted in the interview record forms received from the O&M contractor (Appendix B), cost inflation and decreased availability of some materials, such as EVO, have occurred recently. Those issues are not expected to impact the long-term protectiveness of the remedy considering that LUCs are being implemented and groundwater is not in use.

Potential impacts associated with off-Base pumping and drought conditions can be addressed by the interim remedies and the remedies identified in the Final Proposed Plan and the forthcoming ROD for CG044 without affecting the long-term protectiveness of the remedy.

6. Issues/Recommendations

The table below presents issues, recommendations, and follow-up actions for the Third FYR sites at the Beale AFB.

Issues/Recommendations
Sites with Issues/Recommendations Identified in the Third Five-Year Review:
No issues or recommendations were identified for Sites LF013, OT017, SD032, ST018, and TU509.
The following issue was identified in the technical assessment for Site CG041: ▪ *At plume site CG041-017, implementation of one of the remedial components (hotspot treatment with ERD and PRB with in-situ chemical reduction) was delayed due to limitations associated with access for heavy equipment (Beale AFB bridge construction). Implementation is expected to begin in August 2023 and is expected to be completed in 2024.* *The intent of the following recommendation is to address the issue identified during the technical assessment for Site CG041:* ▪ *Per the CG041 Final ROD (Air Force, 2018b), implement hotspot treatment with ERD and PRB with in-situ chemical reduction at plume site CG041-017 by 2024.*
The following issues were identified in the technical assessment for Site CG044: ▪ *For CG044 plume sites CG044-003, CG044-031, and CG044-32 off-Base pumping has resulted in plume migration beyond the LUC boundaries established in the interim remedies.* ▪ *PFAS in groundwater at CG044-013 should be characterized to assess how the presence of PFAS in groundwater affects the effectiveness of the remedy.* ▪ *The combination of below average rainfall and increased off-Base groundwater pumping for agricultural purposes near the western Base boundary has likely caused the downgradient plume to migrate toward the off-Base pasture fields at CG044-032. The off-Base CG044-032 TCE plume needs to be delineated.* ▪ *A decision document establishing the final RAOs, COCs, cleanup levels, and remedies needs to be prepared for Site CG044.* *The intent of the following recommendations are to address the issue identified during the technical assessment for Site CG044:* ▪ *Reevaluate and establish appropriate LUC boundaries on-Base for CG044 plume sites CG044-003, CG044-031, and CG044-32 in the forthcoming CG044 ROD. Currently, groundwater at these sites is not in use. For the on-Base plume areas that are outside the LUC boundaries, continue to verify that groundwater will not be used. For CG-44-032 off-base plume areas, a contingency action to address future plume expansion should be included in the decision document that includes implementing wellhead treatment on residential drinking water wells that do not currently have a wellhead treatment system.*

- *Characterize PFAS in groundwater at CG044-013 to assess how the presence of PFAS in groundwater affects the effectiveness of the remedy.*
- *When the ROE agreement becomes available (post-ROD), an additional well should be installed downgradient of agricultural well BRO-106 to delineate the off-Base CG044-032 plume by 2025.*
- *Prepare and finalize the ROD for Site CG044 by 2025.*

6.1. Other Findings for CG041 and CG044

The following sections discuss other findings for CG041 and CG044 based on a review of available information.

6.1.1. Per- and Polyfluoroalkyl Substances

Over the last few years, a new class of chemicals of potential concern (PFAS) has received increased scrutiny as emerging contaminants. PFAS is not currently regulated under CERCLA; however, this section has been added in anticipation of EPA's plan to designate two PFAS compounds (perfluorooctane sulfonic acid [PFOS] and perfluorooctanoic acid [PFOA]) as hazardous substances under CERCLA. The Air Force has taken proactive steps to determine whether PFOS and PFOA were used on Air Force facilities in aqueous film forming foam (AFFF) formulations for fighting petroleum fires. The Air Force released the "Interim Air Force Guidance on Sampling and Response Actions for Perfluorinated Compounds at Active and Base Realignment and Closure Installations" that presents a systematic response to the potential PFAS impacts (Air Force, 2012). While the guidance focuses on the presence or absence of PFAS at fire training areas, PFAS may be present at other Air Force areas resulting from activities related to storage, handling, or use of AFFF.

The Air Force is investigating the extent of PFAS contamination and conducting treatability studies in a parallel effort to other environmental restoration activities at Beale AFB. All current investigations and actions will continue to move forward and not be delayed, changed, or influenced by the PFAS investigations. Due to the emerging contaminant status of PFAS and the associated unknowns, the Air Force will continue other environmental restoration investigations and efforts in order to make timely decisions regarding other contaminants. The Air Force is committed to conducting required PFAS investigations and actions. For those sites with PFAS impacts, the CERCLA process, including submission and review of documents, will be used to address the impacts.

6.1.2. 1,4-Dioxane and 1,2,3-Trichloropropane

Groundwater sampling activities for 1,4-dioxane and 1,2,3-trichloropropane (TCP) were completed in February and March 2022 at multiple solvent plume sites at Beale AFB (Brice, 2023), including various plume sites at CG041 and CG044.

1,4-Dioxane is a solvent that has been widely used as a stabilizer for the transport of other solvents. No federal or California MCL has been established for 1,4-dioxane. However, the California Division of Drinking Water has established a drinking water notification level of 1 µg/L (Brice, 2023). 1,2,3-TCP is a VOC that has been used historically as a solvent/degreaser. No federal MCL has been established for 1,2,3-TCP. However, in December 2017, SWRCB promulgated a California MCL for 1,2,3-TCP of 0.005 µg/L (Brice, 2023).

The findings based on the 2022 groundwater results are summarized below (Brice, 2023).

- 1,4-Dioxane is not present in groundwater at concentrations exceeding the California drinking water notification level in solvent plumes at Beale AFB.
- 1,2,3-TCP is present in groundwater at concentrations exceeding the California MCL in solvent plumes CG041-017, CG041-039, CG041-508, CG044-031, SS023, and SS507 at Beale AFB, including at well 17L008MW.

The need for follow-on groundwater sampling for 1,2,3-TCP will be evaluated further as a part of the Tier I regulatory partnering process (Brice, 2023).

7. Protectiveness Statement

This section provides the protectiveness statements for the Beale AFB Third FYR sites.

For CERCLA sites that require a FYR, a separate protectiveness statement is required for each operable unit where the remedial action is currently underway or remedial construction is complete. The EPA's "Comprehensive Five-Year Review Guidance" defines five protectiveness categories: protective, short-term protective, will be protective, protectiveness deferred, and not protective (EPA, 2001).

Protective

A protectives determination of "protective" is typically used when the answers to Questions A, B, and C (see Section 5) provide sufficient data and documentation to conclude that the remedy is functioning as intended and all human and ecological risks are currently under control and are anticipated to be under control in the future.

Short-Term Protective

A protective determination of "short-term protective" is typically used when the answers to Questions A, B, and C provide sufficient data and documentation to conclude that human and ecological risks are currently under control and no unacceptable risks are occurring. However, the data and/or documentation review also raises issues that could impact future protectiveness or remedy performance but not current protectiveness.

Will be Protective

A protective determination of "will be protective" is typically used when the answers to Questions A, B, and C provide sufficient data and documentation to conclude that human and ecological exposures are currently under control and no unacceptable risks are occurring in those areas. In addition, answers to Questions A, B, and C also indicate that the remedy under construction is anticipated to be protective upon completion and no remedy implementation or performance issues have been identified.

Protectiveness Deferred

This protective determination is generally used when the available information to answer Questions A, B, and C does not provide sufficient data and documentation to conclude that all human and ecological exposures are currently under control and no unacceptable risks are occurring.

Not Protective

A protectiveness determination of "not protective" is generally used when the answers to Questions A, B, and C provide adequate data and documentation to conclude that human and/or ecological risks are not currently under control (EPA, 2012).

7.1. Sites LF013, OT017, SD032, ST018, and TU509

Protectiveness Statement(s)	
S*ites: LF013, OT017, SD032, ST018, TU509*	*Protectiveness Determination:* Protective
Protectiveness Statement: The remedies implemented at these sites are protective of human health and the environment under current and anticipated future land use and based on the continued implementation of LUCs. If those conditions change, the risks posed to human health and the environment may need to be reevaluated.	

7.2. Groundwater Sites CG041 and CG044

Protectiveness Statement(s)	
S*ites: CG041*	*Protectiveness Determination:* Short-term Protective
Protectiveness Statement: The remedies for Site CG041 currently protect human health and the environment because LUCs and a majority of the other remedies established in the CG041 Final ROD have been implemented. LUCs remain in place to prevent potential exposures through VI or direct contact pathways. In addition, the implemented remedies are functioning as intended by the CG041 ROD. Groundwater is not in use. However, for the Site CG041 remedy to be fully protective, the ongoing implementation of the final remedy for Plume CG041-017 will need to be completed. LUCs and groundwater monitoring and evaluation for Site CG041should be continued until such time as RAOs are achieved and the site is suitable for UU/UE.	
S*ites: CG044*	*Protectiveness Determination:* Short-term Protective
Protectiveness Statement: The interim remedies for Site CG044 currently protect human health and the environment because LUCs established in interim Decision Documents remain in place on-Base to prevent potential exposures through the VI or direct contact pathways. In addition, on-Base groundwater sources are sampled quarterly and are not impacted by CG044 COCs. For the CG044 plume sites with on-Base groundwater contamination extending past the LUC boundaries due to off-Base pumping, protectiveness is currently maintained because groundwater is not in use and the Work Clearance Request process has been effective in preventing groundwater use within the Base boundaries. For Plume CG044-032 with the TCE plume extending off-Base, wellhead treatment systems are in place for three residential wells. However, in order for the Site CG044 remedy to be protective in the long-term, the CG044 ROD will need to be finalized and the remedies will need to be implemented; the off-Base CG044-032 plume will need to be delineated; and, to address future plume expansion of CG044-032 off-Base plume areas, a contingency action should be included in the Decision Document that includes implementing wellhead treatment on residential drinking water wells that do not currently have a wellhead treatment system. In addition, PFAS in groundwater at CG044-013 will need to be characterized to assess how the presence of PFAS in groundwater affects the effectiveness of the remedy. LUCs and groundwater monitoring and evaluation should be a part of any final remedy selected until such time as the RAOs are achieved and the site is suitable for UU/UE.	

8. Next Review

The next FYR (fourth) for Sites CG041, CG044, LF013, OT017, SD032, ST018, and TU509 is required 5 years from the completion date of this review.

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Figures

Service Layer Credits: World Imagery : Earthstar Geographics

Reeds Creek

Wellman Creek

Vineyard Creek

Dry Creek

Hutchinson Creek

Grasshopper Slough

Hammonton-Smartsville Rd

North Beale Rd

South Beale Rd

Plume CG041-0035 (Weapons Storage Area)

Bldg 1086

Plume CG041-0010 (Former J-58 Test Cell)

SITE SD032 (BLDG 1086) AND PLUME CG044-032

CG041-016 (Explosive Ordnance Disposal Area)

Plume CG044-003 (Fire Protection Training Areas)

Plume CG044-040 (Former AOC 73)

TU509 Beale Air Force Base Clinic

Plume CG041-039 (Building 2145 Area)

Bldg 2145

Plume CG044-031

Site OT-017 (Best Slough) / Plume CG041-17

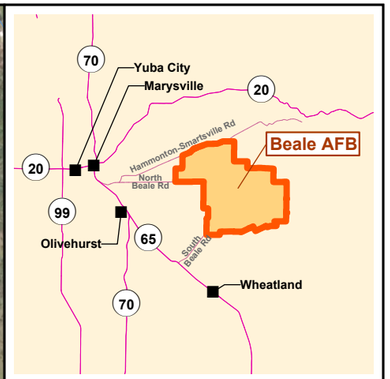
Plume CG041-018

ST018 Bulk Fuel Storage Area

Plume CG041-029 (Burn Pit / Former AOC 9 Area)

Plume CG044-013

LF013 Landfill No. 1



LEGEND

- CG041 - Basewide Groundwater
- CG044 - Basewide Groundwater - Agricultural Pumping
- Perchlorate Isocontour in µg/L (2020)
- TCE 5 µg/L Isocontour (2021)
- OT017 - Best Slough
- ST018 - Bulk Fuel Storage Facility
- LF013 - Former Landfill No. 1
- TU509 - Beale AFB Clinic
- Lakes and Streams
- Streams
- Ditch or Aqueduct
- Buildings
- Major Roads
- Local Roads
- Airfield Surface
- Beale Air Force Base

TCE Trichloroethene
µg/L micrograms per liter

Source: Brice, 2022b, 2022e

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Feet

THIRD FIVE-YEAR REVIEW SITES

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
ES-1

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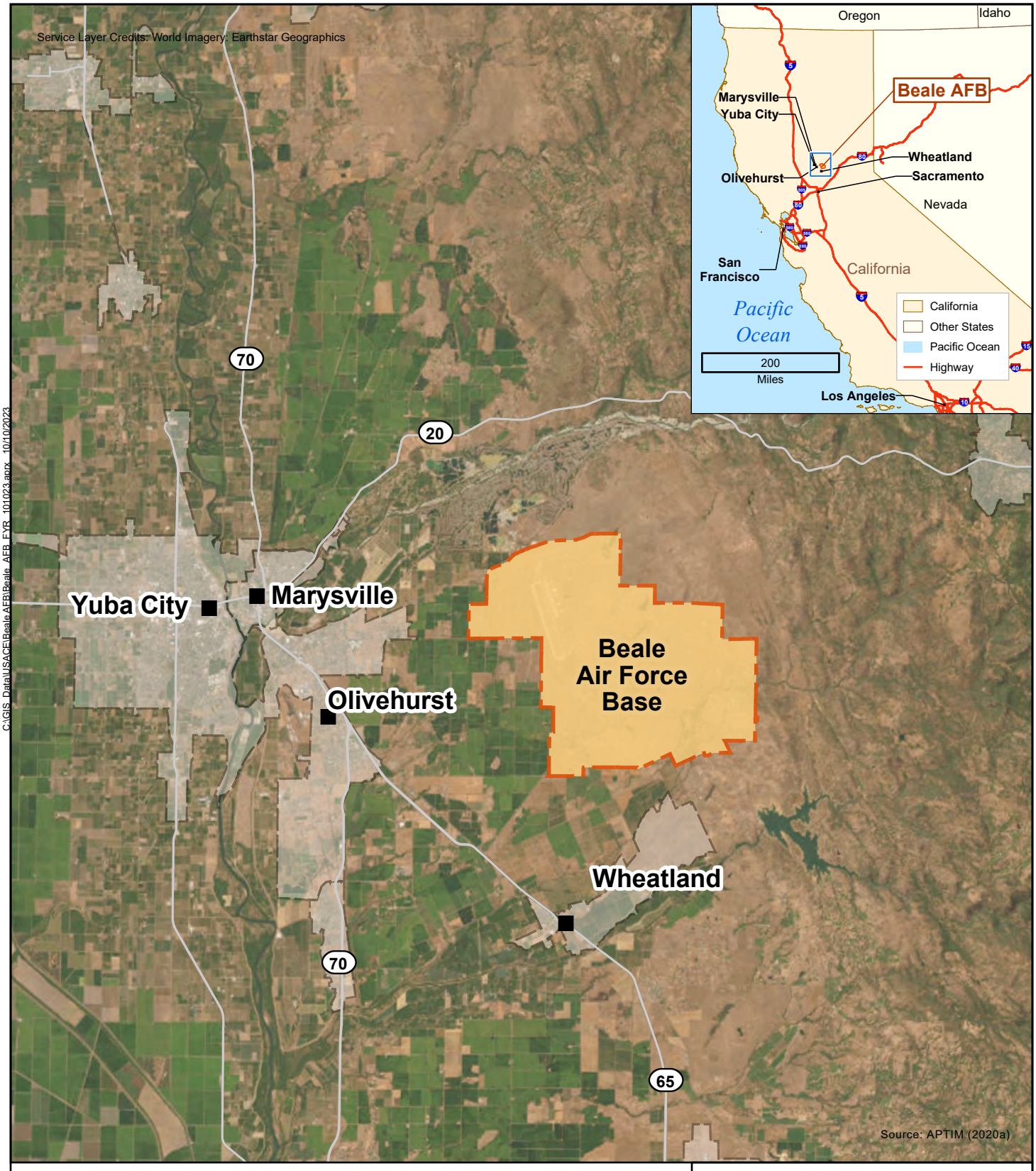

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LEGEND

- Beale Air Force Base
- Major Roads
- City
- City Limits

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0 3 6

Miles

REGIONAL SITE LOCATION MAP:
BEALE AIR FORCE BASE

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
1-1

Service Layer Credits: World Imagery : Earthstar Geographics

Reeds Creek

Wellman Creek

Vineyard Creek

Dry Creek

Hutchinson Creek

Hammonton-Smartsville Rd

North Beale Rd

South Beale Rd

Plume CG041-0035 (Weapons Storage Area)

Bldg 1086

Plume CG041-0010 (Former J-58 Test Cell)

SITE SD032 (BLDG 1086) AND PLUME CG044-032

CG041-016 (Explosive Ordnance Disposal Area)

Plume CG044-003 (Fire Protection Training Areas)

Plume CG044-040 (Former AOC 73)

TU509 Beale Air Force Base Clinic

Plume CG041-039 (Building 2145 Area)

Bldg 2145

Plume CG044-031

Site OT-017 (Best Slough) / Plume CG041-17

Plume CG041-018

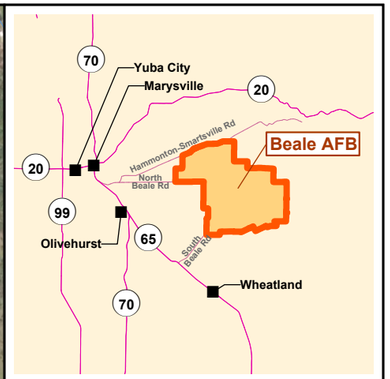
ST018 Bulk Fuel Storage Area

Plume CG041-029 (Burn Pit / Former AOC 9 Area)

Plume CG044-013

LF013 Landfill No. 1

Grasshopper Slough



LEGEND

- CG041 - Basewide Groundwater
- CG044 - Basewide Groundwater - Agricultural Pumping
- Perchlorate Isocontour in µg/L (2020)
- TCE 5 µg/L Isocontour (2021)
- OT017 - Best Slough
- ST018 - Bulk Fuel Storage Facility
- LF013 - Former Landfill No. 1
- TU509 - Beale AFB Clinic
- Lakes and Streams
- Streams
- Ditch or Aqueduct
- Buildings
- Major Roads
- Local Roads
- Airfield Surface
- Beale Air Force Base

TCE Trichloroethene
µg/L micrograms per liter

Source: Brice, 2022b, 2022e

N

0 4,000 8,000
Feet

THIRD FIVE-YEAR REVIEW SITES

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
1-2

G:\GIS Data\USAF\Beale AFB\Beale AFB_FYR.mxd 11/1/2023

Service Layer Credits: World Imagery : Maxar

Hutchinson Creek

SITE WP002
UNLINED
GREASE PIT

SITE WP002
FORMER UNLINED
SLUDGE PONDS

AIR
STRIPPERS

FORMER
LANDFILL NO. 1

unnamed road

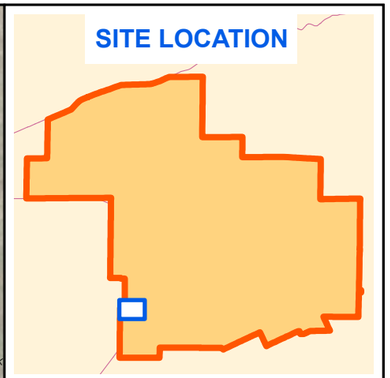
SLUDGE
DRYING
BEDS

AERATION
POND

J Street

WASTEWATER
LAGOON

SITE LOCATION



LEGEND

- Approximate Location of Fill Containing Debris
- M-5 Ointment Tube Disposal Cell
- Bioreactor
- Wastewater Treatment Plant
- Former GTS Photographic Wastewater Pipeline
- Wastewater Lagoon
- Stream
- Local Road
- Fenceline
- Land Use Control Boundary (Soil)
- Beale Air Force Base Boundary

GTS groundwater treatment system

Source: Brice, 2022e

N

0 250 500
Feet

SITE LF013 FEATURES AND
LAND USE CONTROL BOUNDARY

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
2-1

C:\GIS_Data\USAF\Beale_AFB\Beale_AFB_FYR_10\2023.mxx 10/10/2023

Service Layer Credits: World Imagery : Maxar

Gavin Mandery Drive

GROUNDWATER TREATMENT SYSTEM

Best Slough

unnamed road*

Dry Creek

Bonanza Court

Parks Lake

SITE LOCATION

C:\GIS_Data\USACE\Beale AFB\Beale_AFB_FYR.aprx 12/12/2023

LEGEND

- OT017 Water Treatment Plant
- Location of Former Disposal Trench
- Area A - Slurry Wall (Primary Source Area)
- Permeable Reactive Barrier
- Area B - Slurry Wall (Secondary Source Area)
- Area C - Dissolved trichloroethene plume
- Best Slough (Original Alignment)
- Land Use Control Boundary (Soil Gas)
- Building
- Beale Air Force Base Boundary
- Lake
- Vernal Pool or Wetland
- Stream
- Ditch or Aqueduct
- Fenceline
- Local Road

Source: Brice, 2022b, 2022e

N

0 500 1,000

Feet

SITE OT017 FEATURES AND LAND USE CONTROL BOUNDARY

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE 2-2

Service Layer Credits: World Imagery : Maxar, Microsoft

Bldg. 1086

1092
1082
1703
1088
1079
1071
1083
11606
1076
11604
1074
1072
1077
11603
11600
1075
1069
1073
11589

Greasman Avenue

Doolittle Drive

Fairchild Street

C:\GIS_Data\USACE\Beale AFB\Beale AFB_EYR.aprx 11/15/2023

SITE LOCATION

LEGEND

- Land Use Control Boundary (Soil)
- Oil-Water Separator
- Wash Rack Location
- Local Road
- Fenceline
- Airfield Surface
- Beale Air Force Base Boundary

Source: Brice, 2022e

N

0 200 400

Feet

SITE SD032 FEATURES AND LAND USE CONTROL BOUNDARY

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE 2-3

Service Layer Credits: World Imagery : Maxar, Microsoft

Liquid Fuels Pump Stations

POL Administration Building

JPTS Pump House

POL Control Building

Liquid Fuels Pump Station

CG041-018

10th Street
9th Street
8th Street
7th Street
Gavin Mandery Drive
K Street
H Street
G Street
F Street
E Street
J Street
L Street

C:\GIS_Data\USACE\Beale AFB\Beale_AFB.aprx 6/26/2023

SITE LOCATION

LEGEND

- Biosparge Well
- BioSparge Conveyance
- JPTS Pipeline
- Building
- Local Road
- Fenceline
- Land Use Control Boundary (Soil)
- Beale Air Force Base Boundary
- Railroad

JPTS Jet Propellant Thermally Stable
POL Petroleum, Oil, and Lubricants

N

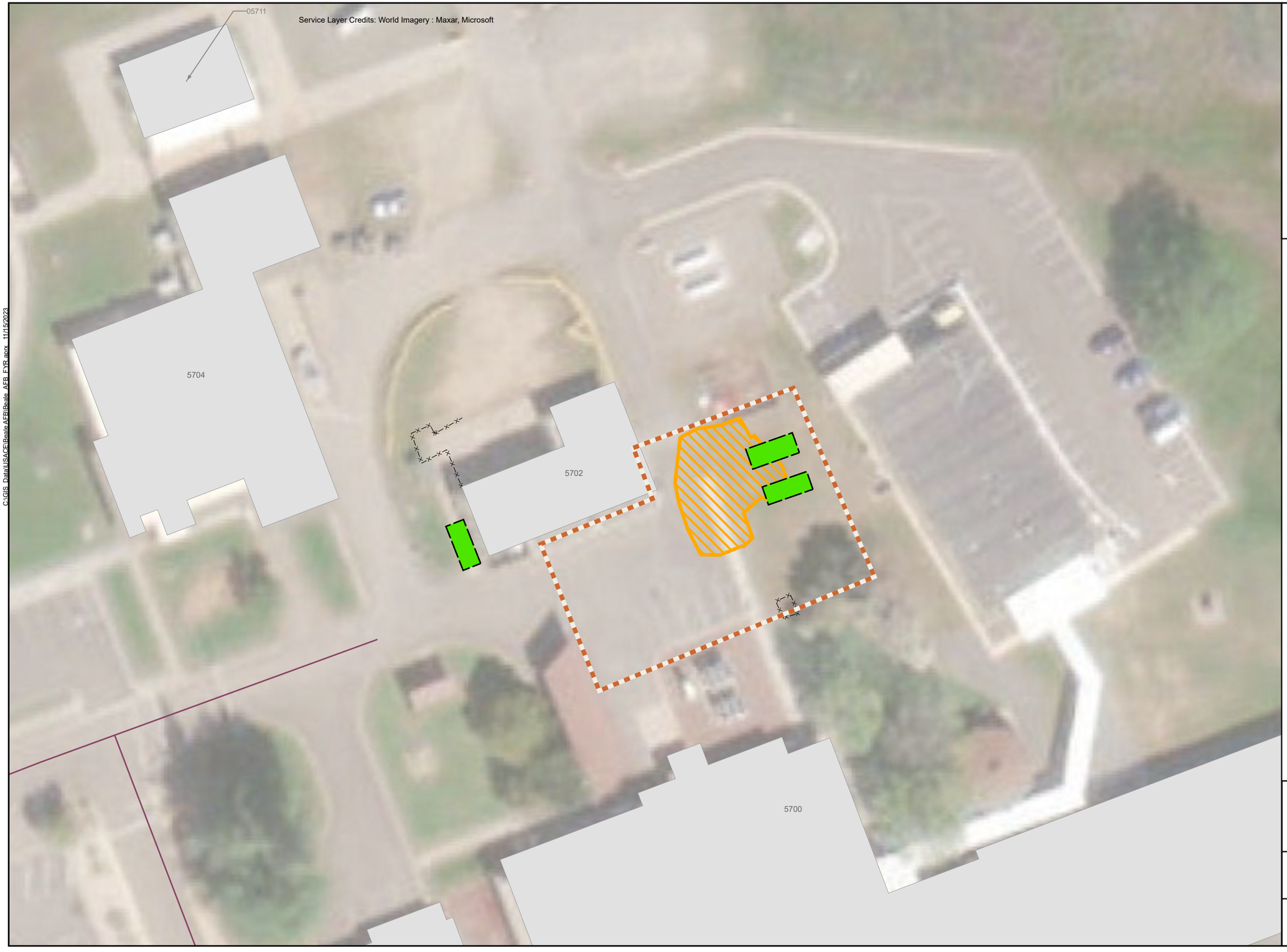
Source: Brice, 2022e

0 250 500
Feet

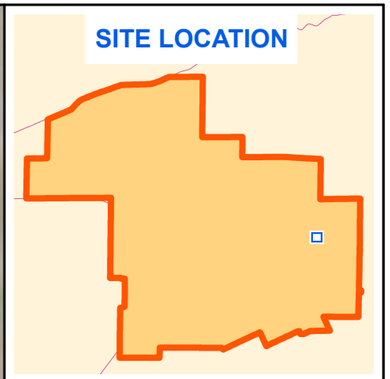
SITE ST018 FEATURES AND LAND USE CONTROL BOUNDARY

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
2-4



SITE LOCATION



LEGEND

- Former Underground Storage Tank
- Excavation Area
- Local Road
- Fenceline
- Land Use Control Boundary (Soil)
- Beale Air Force Base Boundary

Source: Brice, 2022e

N

0 40 80

Feet

SITE TU509 FEATURES AND LAND USE CONTROL BOUNDARY

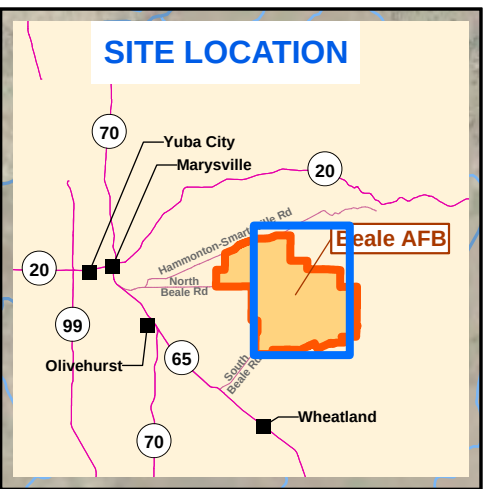
BEALE AIR FORCE BASE, CALIFORNIA

FIGURE 2-5

Service Layer Credits: World Terrain Base: Esri Community Maps Contributors, California State Parks, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA
World Imagery : Maxar
World Hillshade: Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

C:\GIS_Data\USACE\Beale AFB\Beale_AFB.aprx 6/23/2023

SITE LOCATION



CG041-035
Buildings 1322 and 1319
Weapons Storage Area

Bldg. 1086

CG041-010
J-58 Test Cell

CG041-016
Explosive Ordnance
Disposal Area

Civil Engineering
Equipment Yard

CG041-039
Building 2145

CG041-517
Beale Air Force Base
Clinic PCE Plume
(Out of Scope)

CG041-018
Bulk Fuel
Storage Area

Bldg. 2145

CG041-029
Burn Pit
(Former AOC 9)

CG041-017
Best Slough

Hammonton-Smartville Road
Reeds Creek
Alert Drive
Grumman Avenue
Arnold Avenue
Firehouse Road
North Erle Road
South Erle Road
Erle Rd
Boxwood Way
Wellman Creek
B Street
32nd Street
27th Street
Doolittle Drive
N Street
F Street
C Street
A Street
26th Street
Warren Shingle Road
Spencer Paul Drive
Grass Valley Road
Dry Creek
Gavin Mandery Drive
Delta Drive
Hutchinson Creek
J Street
Ostrom Rd
Best Slough
Camp Far West Rd
Monarch Tr
Grasshopper Slough
Camp Beale Highway
Kapaka Ln

LEGEND

- Extent of TCE Exceeding 5 µg/L
- Beale Air Force Base Boundary
- Land Use Control Boundary (Groundwater)
- Building
- Airfield Surface
- Local Road
- Surface Water or Wetland Area (Best Slough Vicinity)
- Wetland
- Lake
- Stream
- Ditch or Aqueduct

AOC	Area of Concern
PCE	tetrachloroethene
TCE	trichloroethene
µg/L	micrograms per liter

Source: Brice, 2022b, 2022e

0 2,500 5,000
Feet

N

SITE CG041
(BASEWIDE GROUNDWATER)
PLUME SITES

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
2-6

Service Layer Credits: World Terrain Base: Esri Community Maps Contributors, California State Parks, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA
World Imagery : Maxar
World Hillshade: Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

C:\GIS_Data\USACE\Beale AFB\Beale_AFB.aprx 6/23/2023

Doolittle Drive
Creasman Avenue
Grumman Avenue
Doolittle Drive
North Street
Mcgregor Street
Lockheed Street
Arnold Avenue
Firehouse Road
Camp Beale Highway*
CG041-010
1149
1150
11600
11603
1152
1153
1154
1032
1050
1029
1025
01034
1023
11103

SITE LOCATION

LEGEND

- Land Use Control Boundary (Groundwater)
- Wetland
- Ditch or Aqueduct
- Building
- Local Road *Road label reflects nearest contiguous named road.
- Beale Air Force Base Boundary

0 400 800
Feet

N

Source: Brice, 2022b, 2022e

PLUME CG041-010
SITE MAP – SITE SD010
FORMER J-58 TEST STAND

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
2-7

Service Layer Credits: World Imagery : Maxar

CG041-016

North Erle Road

intermittent ponds

unnamed road

Upper Blackwelder Lake

Hutchinson Creek

C:\GIS_Data\USAF\Beale AFB\Beale AFB_EYR_10\1\23.mxx 10/10/2023

SITE LOCATION

LEGEND

- Land Use Control Boundary (Groundwater)
- Former Disposal Trench
- Former Ordnance Burning Bunker
- Lake
- Intermittent Pond
- Vernal Pool or Wetland
- Stream
- Local Road
- Recreation Trail
- Fenceline
- Beale Air Force Base Boundary

GTS groundwater treatment system

Source: Brice, 2022b, 2022e

N

0 300 600

Feet

PLUME CG041-016
SITE MAP – SITE WP016
EXPLOSIVE ORDNANCE
DISPOSAL AREA

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
2-8

Service Layer Credits: World Terrain Base: Esri Community Maps Contributors, California State Parks, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA
World Imagery : Maxar
World Hillshade: Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

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Gavin Mandery Drive

GROUNDWATER TREATMENT SYSTEM

Best Slough

Gavin Mandery Drive

West Gold Court

Bonanza Court

West Lo

Flume Court

Dry Creek

unnamed road*

unnamed road*

SITE LOCATION

LEGEND

- OT017 Water Treatment Plant
- Location of Former Disposal Trench
- Area A - Slurry Wall (Primary Source Area)
- Permeable Reactive Barrier
- Area B - Slurry Wall (Secondary Source Area)
- Area C - Dissolved trichloroethene plume
- Best Slough (Original Alignment)
- Land Use Control Boundary (Groundwater)
- Surface Water or Wetland Area (Best Slough Vicinity)
- Stream
- Ditch or Aqueduct
- Building
- Fenceline
- Local Road *Road name not listed in available sources.
- Beale Air Force Base Boundary

Source: Brice, 2022b, 2022e

N

0 590 1,180
Feet

PLUME CG041-017
SITE MAP – SITE OT017
BEST SLOUGH

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
2-9

Service Layer Credits: World Terrain Base: Esri Community Maps Contributors, California State Parks, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA
World Hillshade: Esri, NASA, NGA, USGS, FEMA
World Imagery : Maxar
World Hillshade: Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

M Street
K Street
H Street
G Street
F Street
J Street
E Street
9th Street
10th Street
8th Street
7th Street
L Street
Gavin Mandery Drive
Gavin Mandery Drive
J Street
F Street
CG041-018

Liquid Fuels Pump Stations
POL Administration Building
JPTS Pump House
POL Control Building
Liquid Fuels Pump Station

SITE LOCATION

LEGEND

- Land Use Control Boundary (Groundwater)
- ST018 - Bulk Fuel Storage Facility
- Biosparge Well
- BioSparge Conveyance
- JPTS Pipeline
- Building
- Wetland
- Ditch or Aqueduct
- Local Road
- Railroad
- Fenceline
- Beale Air Force Base Boundary

JPTS Jet Propellant Thermally Stable
POL Petroleum, Oil, and Lubricants

N

Source: Brice, 2022b, 2022e

0 300 600
Feet

PLUME CG041-018
SITE MAP – SITE ST018
BULK FUEL STORAGE AREA

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
2-10

G:\GIS_Data\USACE\Beale_AFB\Beale_AFB.aprx 6/24/2023

Service Layer Credits: World Terrain Base: Esri Community Maps Contributors, California State Parks, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA
World Hillshade: Esri, NASA, NGA, USGS, FEMA
World Imagery : Maxar
World Hillshade: Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

10th Street
9th Street
8th Street
7th Street
C Street
B Street
A Street
Hutchinson Creek
Gavin Mandery Drive
South Earle Drive

SITE LOCATION

LEGEND

- Land Use Control Boundary (Groundwater)
- Former Unlined Burn Pit
- CG041-029 Trench
- Building
- Wetland
- Stream
- Local Road
- Fenceline
- Beale Air Force Base Boundary

Source: Brice, 2022b, 2022e

N

0 300 600
Feet

PLUME CG041-029
SITE MAP – SITE FT029
FORMER UNLINED BURN PIT

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
2-11

C:\GIS_Data\USACE\Beale_AFB\Beale_AFB.aprx 6/21/2023

Service Layer Credits: World Imagery : Maxar, Microsoft
World Terrain Base: Esri Community Maps Contributors, California State Parks, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA
World Hillshade: Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

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1324
1325
1322
Shed
AREA A
AREA B
AREA C
Alert Drive
Alert Drive
1318

SITE LOCATION

LEGEND

- SS035 Bioreactor
- SS035 Soil Excavation
- Soil Vapor Extraction System Trailer
- Vapor Phase Granular Activated Carbon Vessel
- Land Use Control Boundary (Groundwater)
- Wetland
- Ditch or Aqueduct
- Building
- Fenceline
- Local Road
- Beale Air Force Base Boundary

0 80 160
Feet

N

Source: Brice, 2022b, 2022e

PLUME CG041-035
SITE MAP – SITE SS035
WEAPONS STORAGE AREA

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
2-12

Service Layer Credits: World Imagery : Maxar

SITE SSO39
SOURCE AREA 1

SITE SSO39
SOURCE AREA 2

Bldg. 2145

Hutchinson Creek

Warren Shingle Road

Gavin Mandery Drive

Robert Nicoletti Way

Doolittle Drive

Armory Lane

South Earle Drive

24th Street
23rd Street
22nd Street
21st Street
16th Street
15th Street
13th Street
12th Street
11th Street
10th Street
8th Street
7th Street
4th Street
25th Street
26th Street
29th Street
28th Street
30th Street
16th Street
13th Street
11th Street
10th Street
9th Street
8th Street
7th Street

C Street
B Street
A Street
D Street
E Street
Peckham St
Sycamore
Acacia
Chestnut
Pine
Manzanita

CG041-039

SITE LOCATION

LEGEND

- Industrial/Commercial Land Use Control Boundary
- Land Use Control Boundary (Groundwater)
- Building
- Beale Air Force Base Boundary
- Wetland
- Stream
- Ditch or Aqueduct
- Fenceline
- Local Road

0 800 1,600
Feet

N

Source: Brice, 2022b, 2022e

PLUME CG041-039
SITE MAP – SITE SS039
BUILDING 2145

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
2-13

C:\GIS_Data\USACE\Beale AFB\Beale_AFB.aprx 6/27/2023

Service Layer Credits: World Imagery : Maxar

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CG044-032
Building 1086

Bldg. 1086

CG044-003
Fire Protection
Areas No. 1 & 2 aka
Fire Training Areas

CG044-040
Former
AOC 73

CG044-031
Site SD031
(Building T-896)

CG044-013
Landfill
No. 1

Hammonton-Smartville Rd
Reeds Creek
Alert Drive
Road 103
Hammonton Rd
Patrol Road
Grumman Avenue
Arnold Avenue
Firehouse Road
Camp Beale Highway
North Erle Road
Boxwood Way
Wellman Creek
unnamed road*
B Street
North Beale Road
A Rd
Blair Way
27th Street
Doolittle Drive
A Street
N Street
C Street
26th Street
Robert Nicoletti Way
Warren Shingle Road
F Street
10th Street
8th Street
Gavin Mandery Drive
South Earle Drive
Erle Rd
Hutchinson Creek
unnamed road
J Street
South Beale Rd
Jasper Ln
Ostrom Rd
Bradshaw Rd

SITE LOCATION

LEGEND

- Shallow or Deep TCE Isocontour in µg/L (2021)
- Land Use Control Boundary (Groundwater)
- CG044 - Basewide Groundwater - Agricultural Pumping
- Airfield Surface
- Building
- Beale Air Force Base Boundary
- Lake
- Stream
- Ditch or Aqueduct
- Local Road

0 2,500 5,000
Feet

N

Source: Brice, 2022b, 2022e

SITE CG044
(WESTERN GROUNDWATER PLUMES)
PLUME SITES

BEALE AIR FORCE BASE, CALIFORNIA

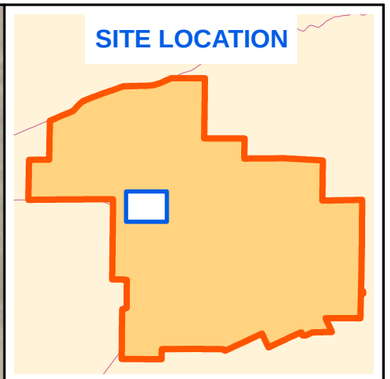
FIGURE
2-14

Service Layer Credits: World Imagery : Maxar

32nd Street
31st Street
30th Street
29th Street
27th Street
M Street
J Street
Doolittle Drive
G Street
F Street
CG044-003
FPTA No. 4
FPTA No. 3
FPTA No. 2
FPTA No.. 1
Former UST Area
11025
539
11538
0538
847

G:\GIS_Data\USAF\Beale AFB\Beale AFB.aprx 6/27/2023

SITE LOCATION



LEGEND

- Land Use Control Boundary (Groundwater)
- Recycling Pad
- Earthen Berm
- Former UST
- Drainage Ditch
- Former Presumed Dry Well
- Building
- Airfield Surface
- Wetland
- Local Road
- Fenceline
- Beale Air Force Base Boundary

FPTA Fire Protection Training Area
UST underground storage tank

Source: Brice, 2022b, 2022e

N

0 400 800
Feet

PLUME CG044-003
SITE MAP – SITE FT003
FIRE PROTECTION TRAINING AREA

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
2-15

Service Layer Credits: World Terrain Base: Esri Community Maps Contributors, California State Parks, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA
World Hillshade: Esri, NASA, NGA, USGS, FEMA
World Imagery : Maxar
World Hillshade: Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

C:\GIS_Data\USAGE\Beale AFB\Beale_AFB.aprx 6/25/2023

CG044-013

Hutchinson Creek

SITE WP020 UNLINED GREASE PIT

SITE WP020 FORMER UNLINED SLUDGE PONDS

AIR STRIPPERS

FORMER LANDFILL NO. 1

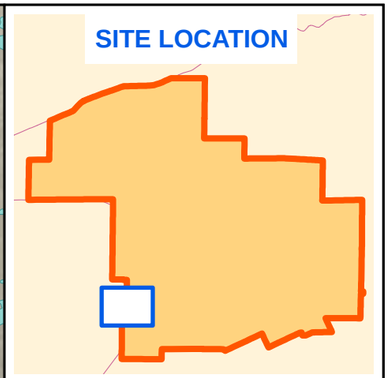
SLUDGE DRYING BEDS

AERATION POND

WASTEWATER LAGOON

J Street

SITE LOCATION



LEGEND

- Land Use Control Boundary (Groundwater)
- Wastewater Treatment Plant
- Former GTS Photographic Wastewater Pipeline
- Approximate Location of Fill Containing Debris
- M-5 Ointment Tube Disposal Cell
- Bioreactor
- Wastewater Lagoon
- Building
- Wetland
- Stream
- Local Road
- Railroad
- Fenceline
- Beale Air Force Base Boundary

N

Source: Brice, 2022b, 2022e

0 500 1,000
Feet

PLUME CG044-013
SITE MAP – SITE LF013
LANDFILL NO. 1

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
2-16

Service Layer Credits: World Terrain Base: Esri Community Maps Contributors, California State Parks, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA
World Hillshade: Esri, NASA, NGA, USGS, FEMA
World Imagery : Maxar
World Hillshade Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

12th Street
11th Street
10th Street
L Street
N Street
M Street
K Street
J Street

Site SD031
Building 896
Foundation

C:\GIS_Data\USACE\Beale AFB\Beale_AFB.aprx 6/25/2023

SITE LOCATION

LEGEND

- Land Use Control Boundary (Groundwater)
- Building 896 Foundation
- Building
- Wetland
- Ditch or Aqueduct
- Local Road
- Railroad
- Fenceline
- Beale Air Force Base Boundary

Source: Brice, 2022b, 2022e

N

0 300 600
Feet

PLUME CG044-031
SITE MAP – SITE SD031
FORMER BUILDING 896

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
2-17

Service Layer Credits: World_Terrain_Base: Esri Community Maps Contributors, California State Parks, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA
World Hillshade: Esri, NASA, NGA, USGS, FEMA
World Imagery : Maxar
World Hillshade: Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

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Reeds Creek

Henderson Drive

Henderson Drive

Doolittle Drive

Alex Drive

Curtis Street

Douglas Street

Bensing Avenue

Creesham Avenue

Fairchild Street

Kings Way

Grumman Avenue

North Street

Olds Way

Mcgregor Street

Lockheed Street

Arnold Avenue

Doolittle Drive

Firehouse Road

Patrol Road

32nd Street

Bldg. 1086

CG041-010

SITE LOCATION

LEGEND

- Land Use Control Boundary (Groundwater)
- Oil-Water Separator
- Wash Rack Location
- Building
- Airfield Surface
- Wetland
- Stream
- Ditch or Aqueduct
- Local Road
- Fenceline
- Beale Air Force Base Boundary

Source: Brice, 2022b, 2022e

N

0 975 1,950

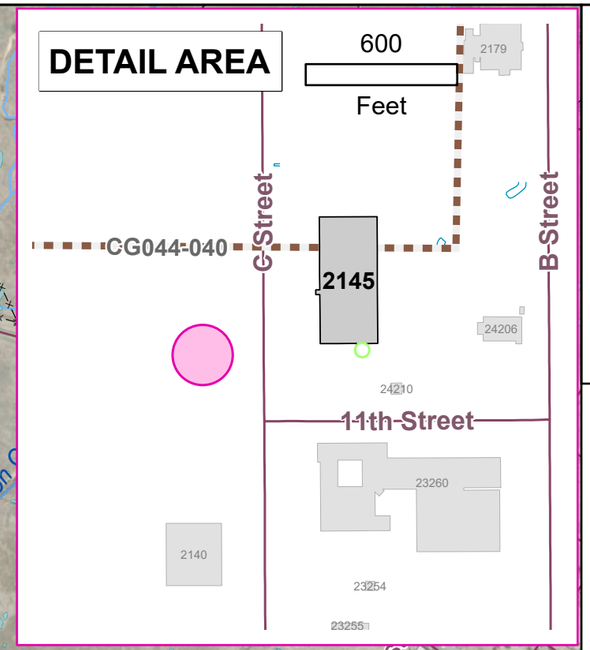
Feet

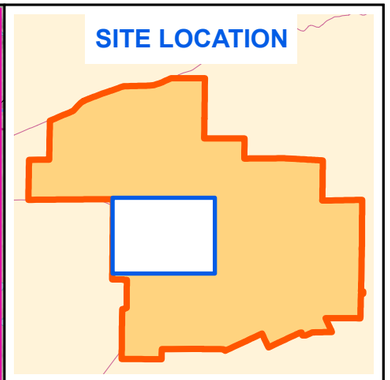
PLUME CG044-032
SITE MAP – FLIGHTLINE AREA

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
2-18

Service Layer Credits: World Imagery : Maxar





LEGEND

- Land Use Control Boundary (Groundwater)
- Site SS043 Investigation Boundary (Pending)
- Former Emergency Holding Basin
- Sump
- Building
- Airfield Surface
- Vernal Pool or Wetland
- Stream
- Ditch or Aqueduct
- Local Road
- Railroad
- Fenceline
- Beale Air Force Base Boundary

GTS groundwater treatment system

Source: Brice, 2022b, 2022e

N

0 1,000 2,000
Feet

PLUME CG044-040
SITE MAP – SITE CG040
FORMER AOC 73

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
2-19

C:\GIS_Data\USAF\Beale AFB\Beale_AFB_EVR.mxd 12/12/2023

Service Layer Credits: World Terrain Base: Esri Community Maps Contributors, California State Parks, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA
World Imagery : Maxar
World Hillshade: Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

1086

10C045RW
28

10C041RW
ND

10C035RW
105.05
23

10M004MW
105.51
1

10C054RW
105.7
8.8

10C002AMW

10C028MW
104.3
34

10C027MW
104.31
92 J

10C050RW
104.45
0.47 J

10C006MW
10R002MW

10C017AMW

10R003MW
102.7
27

10C021AMW
10C021BMW

10C009MW
88.62
62

10C029MW
102.66
91

10C071MW

10R005MW
85.28
0.24 J

10R006MW

CG041-010

10C018AMW
10C018BMW

10C007MW

10R004MW
84
8.1

10C019BMW
90.48
ND

10C019AMW

5

DETAIL AREA

300
Feet

Grumman-Avenue

10C003MW 105.72 1.3
10C049MW 106.34
SD10NVEW2
10C052RW
10C031RW
10M004MW 105.51 1
10C037RW 105.37
10M005MW 106.45
10C040RW 105.61 11
10C025MW 105.15
10C030RW
10C036RW 104.97
10C026MW 105.17
10C047MW 105.18
10C048MW 105.49 0.31 J
10C001MW 104.05
10C033RW 104.4
10C044RW ND
10C028MW 104.3 34
10C041Rw ND
10C062RW
10C063RW 105.21
10C053RW
10C059RW 105.05
10C055RW 104.89 0.7 J
10C035RW 105.28 23
10M006MW
10C034RW 105.09
10C065RW 104.79
10C054RW 105.7 8.8
10C050RW 104.45 0.47 J
10C027MW 104.31 92 J
10C051RW 105.09 0.6 J
10C070RW 103.26
10M007MW-R 103.87 15
10R003MW 102.7 27
10C029MW 102.66 91

SITE LOCATION

LEGEND

- Land Use Control Boundary (Groundwater)
- TCE Isocontour in µg/L (2021)
- Deep Groundwater Monitoring Well
- Shallow Groundwater Monitoring Well
- Former EISB Groundwater Extraction Well
- Former EISB Groundwater Injection Well
- Ditch or Aqueduct
- Beale Air Force Base Boundary

10C050RW Location ID
104.45 Groundwater Elevation
0.47 J TCE Concentration in µg/L

EISB enhanced in-situ bioremediation
J The analyte was positively identified, but the quantitation is an estimate.
ND The analyte was not detected
TCE trichloroethene
µg/L micrograms per liter

Source: Brice, 2022b, 2022e

Elevations are in feet above NAVD88*

*North American Vertical Datum of 1988 Mean Sea Level may be a few feet above or below this fixed level depending on local conditions in coastal areas.

Gray text in data label indicates elevation not used in contouring.

N

0 510 1,020
Feet

PLUME CG041-010
ANNUAL 2021 GROUNDWATER TCE CONCENTRATIONS

BEALE AIR FORCE BASE, CALIFORNIA

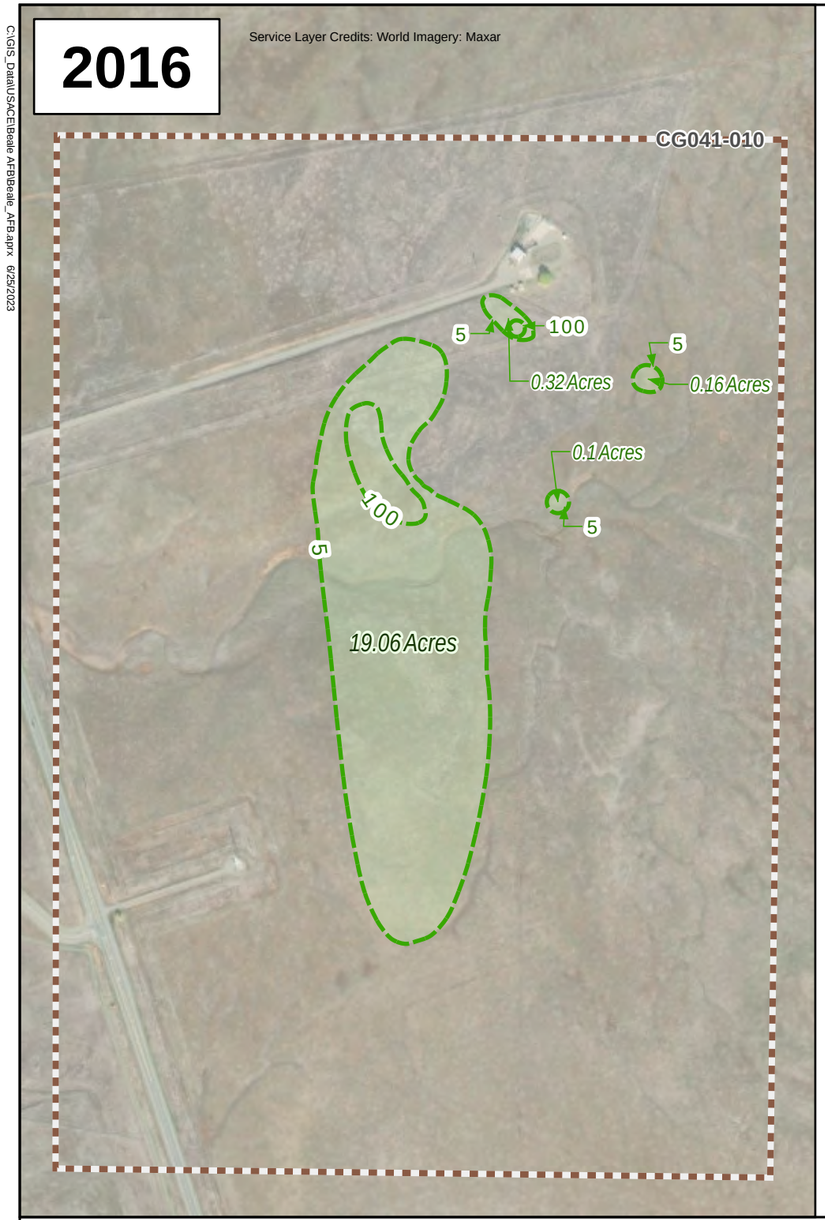
FIGURE
4-1

C:\GIS_Data\USACE\Beale AFB\Beale_AFB.aprx 6/25/2023

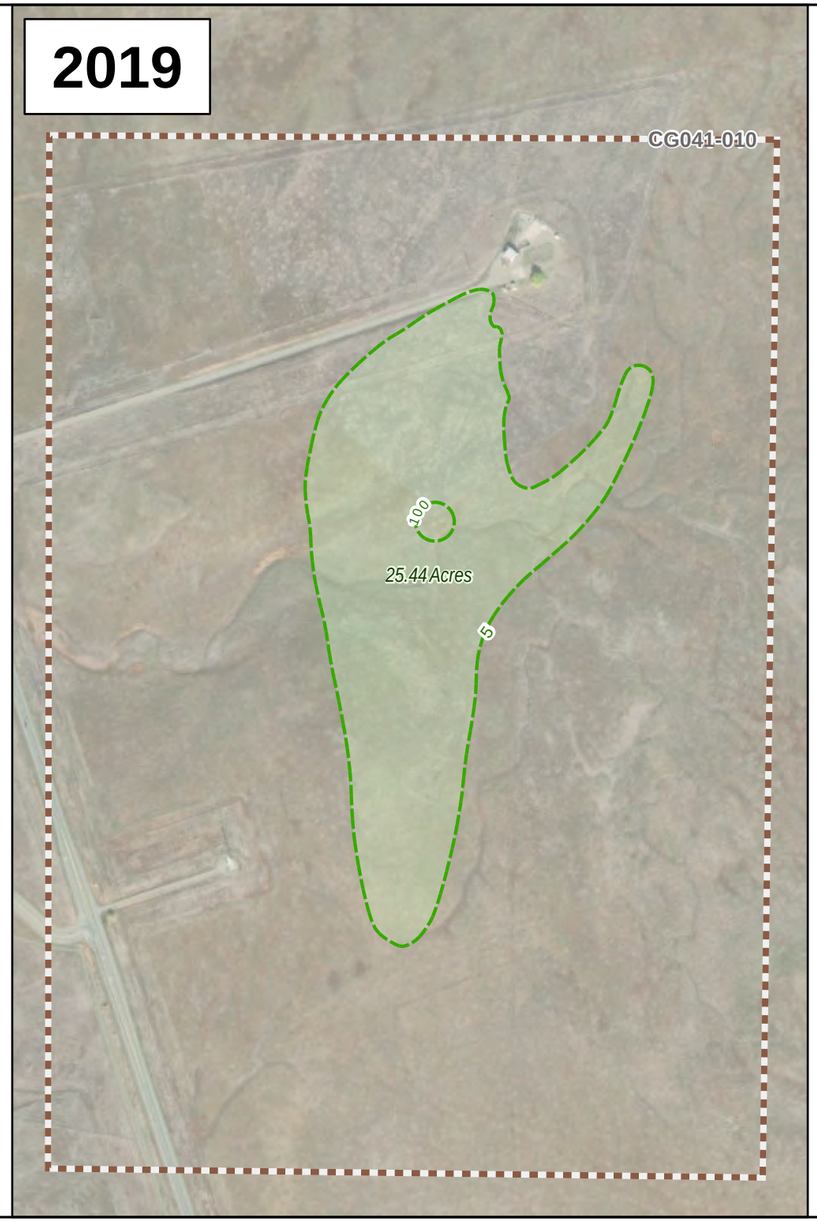
C:\GIS_Data\USACE\Beale AFB\Beale_AFB.aprx 6/25/2023

2016

Service Layer Credits: World Imagery: Maxar



2019



2021

Land Use Control Boundary (Groundwater)

Shallow TCE Isocontour in µg/L

TCE trichloroethene
µg/L micrograms per liter

N

0 500 1,000

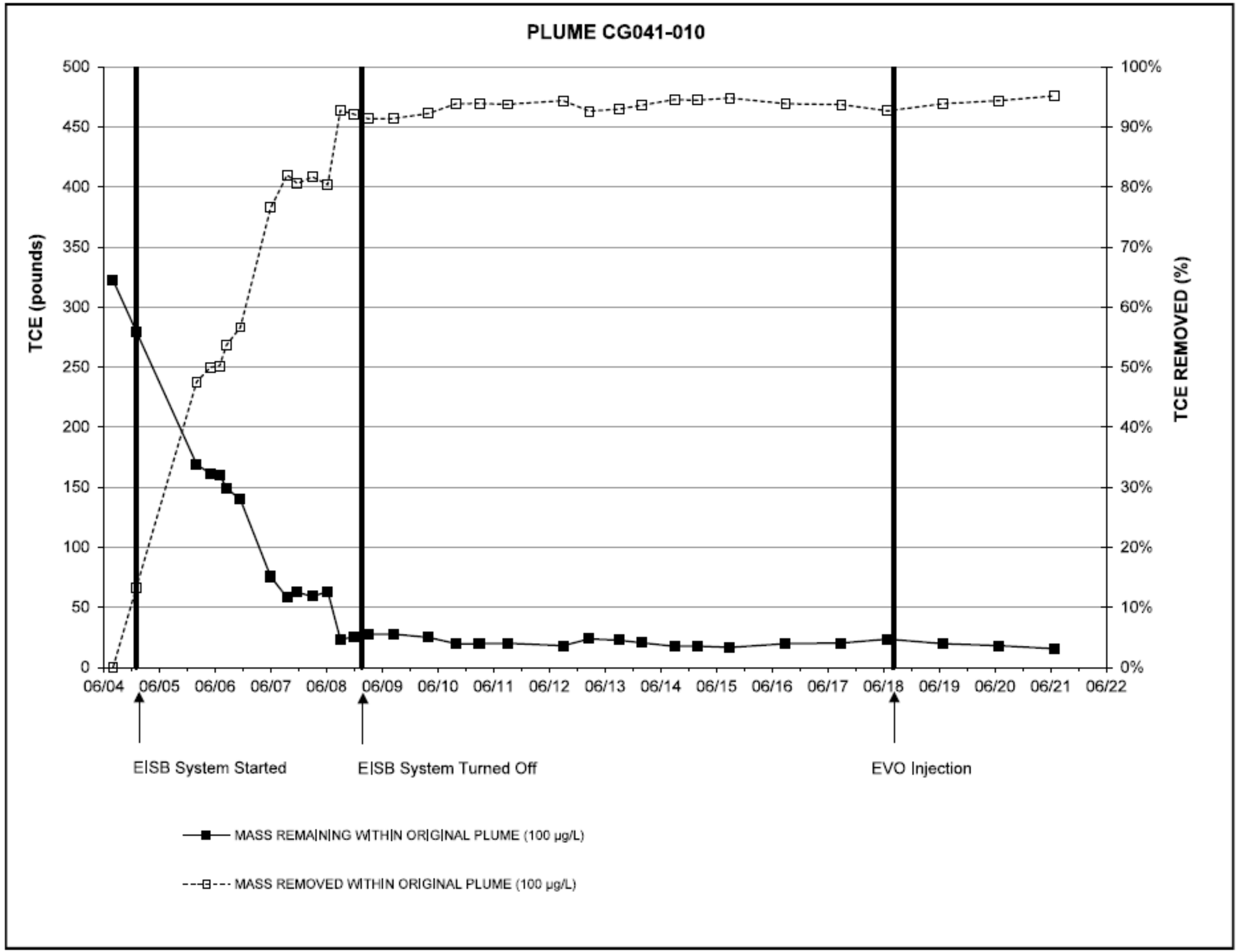
Feet

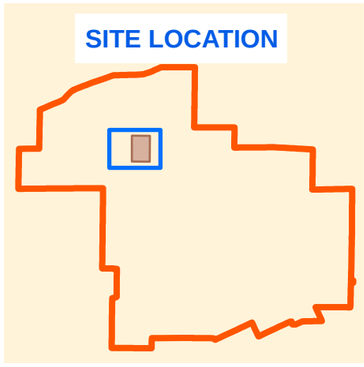
Source: Brice, 2022b, 2022e

PLUME CG041-010 GROUNDWATER TCE ISOCONTOURS (2016, 2019, AND 2021)

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
4-2





EISB enhanced in-situ bioremediation

EVO emulsified vegetable oil

TCE trichloroethene

Source: Brice, 2022b

PLUME CG041-010
GROUNDWATER TCE
MASS REMOVAL

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
4-3

C:\GIS_Data\US\CER\Beale AFB\Beale_AFB.aprx - 6/29/2023

Service Layer Credits: World Terrain Base: Esri Community Maps Contributors, California State Parks, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA
World Imagery : Maxar
World Hillshade: Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

16C011AMW
16C011BMW
16C031MW
CG041-016
16C018MW
16C012AMW
16C012BMW
16C001MW
16L003MW
16L001MW
16C013AMW
16C013BMW
25
6
16L002MW
16L004MW
16C002MW
16C014AMW
16C014BMW
16C003MW
16C015MW
16C016AMW
16C016BMW
16C032MW
16C033MW
16C017AMW
16C017BMW
North Erle Road
unnamed road*

SITE LOCATION

LEGEND
- Land Use Control Boundary (Groundwater)
- Perchlorate Isocontour in µg/L (2020)
- Groundwater Monitoring Well
- Lake
- Stream
- Local Road
- Beale Air Force Base Boundary

Note: sampling data for individual wells not available at this site.

*Road name not listed in available sources.

µg/L micrograms per liter

Source: Brice, 2022b, 2022e

N

0 300 600
Feet

PLUME CG041-016
ANNUAL 2020 GROUNDWATER
PERCHLORATE CONCENTRATIONS

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
4-4

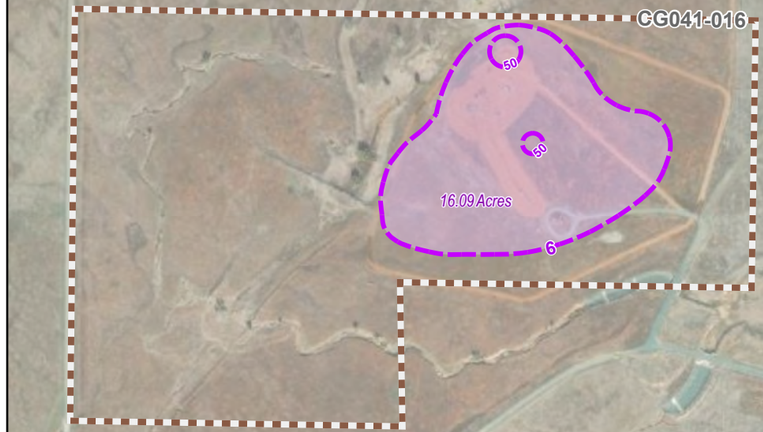
G:\GIS_Data\USACE\Beale AFB\Beale_AFB.aprx, 6/25/2023

C:\GIS_Data\USACE\Beale AFB\Beale_AFB_FYR_101023.aprx 10/10/2023

2016

Service Layer Credits: World Imagery: Maxar

2019



2020

Land Use Control Boundary (Groundwater)

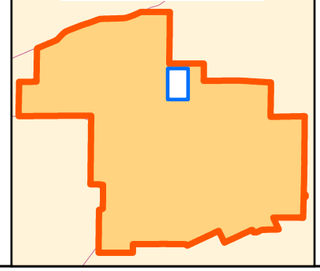
Beale Air Force Base

Perchlorate Isocontour in µg/L

µg/L micrograms per liter

Source: Brice, 2022b, 2022e

SITE LOCATION



N

0 600 1,200

Feet

PLUME CG041-016
GROUNDWATER
PERCHLORATE
ISOCONTOURS
(2016, 2019, AND 2020)

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
4-5

Service Layer Credits: World Imagery : Maxar

CG041-017

GROUNDWATER TREATMENT SYSTEM

17H13MW 142.31

17L001MW 143.72

17L002MW 143.91

SG1

17L010MW 140.49 ND

17L008SW

UCL001MW 128.19 ND

17C009MW 124.13 1.1

UCL001PZ 142.72

17H17AMW 136.46

17H17BMW 136.12 ND

100

5

17C010MW 119.92 1

17C001PZ 139.57

17H18AMW 139.71 ND

17H18BMW 139.70 1.1

UCL002MW 139.95

17C001MW 132.19 ND

17H15AMW 139.31

17H16AMW 139.47

17H15BMW 139.13 ND

17H16BMW 139.48 79

17C167MW 138.77

17C168MW 138.59 0.16 J

17C169MW 138.39 ND

17C002MW 138.74

UCL002PZ 136.39

17C011MW 135.44 ND

17C003MW 136.62

17C012MW 135.84

SWPARKS

17C004MW

Parks Lake

UCL003MW 118.95

17009SW

17C008MW

17008SW

17C006MW

17C005MW

17C013MW

17C007MW

DETAIL AREA

300

Feet

17V004MW 141.05

17L003MW 140.53

17V003MW 145.18

17L006MW 141.28 240000

17V006MW 140.93

17L004MW

17L005MW 140.60 39000

17C163MW 142.36

17U11AMW 140.62

17U11BMW 140.28

17U12AMW 140.86

17U12BMW 140.71

17V005MW 140.38

17V007MW 140.93

17C019MW 141.50 6.6

17V002MW 140.15 1100

17H20AMW 140.72

17V008MW 140.67

17V001MW 140.86 0.15 J

17H20BMW 140.86

17V009MW 141.26

17L008MW 141.50 160000

17C164MW 142.04 0.24 J

17V010MW 140.18

17C017MW 141.46

17C018MW 139.57 48000

17L009MW 140.64

17L008SW ND

17V011MW 140.14 20

17C016AMW 141.28

17C016BMW 142.36

17C161MW 141.43 5

17V012MW 140.65 47

17C015AMW 140.64 80

17C015BMW 137.12 ND

17C160MW 141.02 58

17C162MW 141.46 16

17C159MW 140.31 95

17C003PZ

17C156MW 140.50 17

17C157MW 140.29 39

17C002PZ 139.99

17C165AMW 140.55

17C165BMW 137.54 140

17H18BMW 140.43 ND

17H14AMW 140.80

17C166MW 139.96 190

17H19MW 140.13

17L007MW 143.11

SITE LOCATION

LEGEND

- Land Use Control Boundary (Groundwater)
- Land Use Control Boundary (Soil Gas)
- Shallow TCE Isocontour in µg/L (2021)
- OT017 Water Treatment Plant
- Area A - Slurry Wall (Primary Source Area)
- Permeable Reactive Barrier
- Area B - Slurry Wall (Secondary Source Area)
- Area C - Dissolved trichloroethene plume
- Location of Former Disposal Trench
- Best Slough (Original Alignment)
- Groundwater Monitoring Well
- Surface Water Sampling Location
- Stream
- Ditch or Aqueduct
- Local Road
- Lake
- Vernal Pool or Wetland
- Beale Air Force Base Boundary

J The analyte was positively identified, but the quantitation is an estimate.
ND The analyte was not detected
TCE trichloroethene
µg/L micrograms per liter
Source: Brice, 2022b, 2022e

N

0 500 1,000
Feet

10C050RW Location ID
104.45 Groundwater Elevation (2021)
0.47 J TCE Concentration in µg/L

Elevations are in feet above NAVD88*
*North American Vertical Datum of 1988
Mean Sea Level may be a few feet above or below this fixed level depending on local conditions in coastal areas.
Gray text in data label indicates elevation not used in contouring.

PLUME CG041-017 ANNUAL 2021 GROUNDWATER TCE CONCENTRATIONS

BEALE AIR FORCE BASE, CALIFORNIA

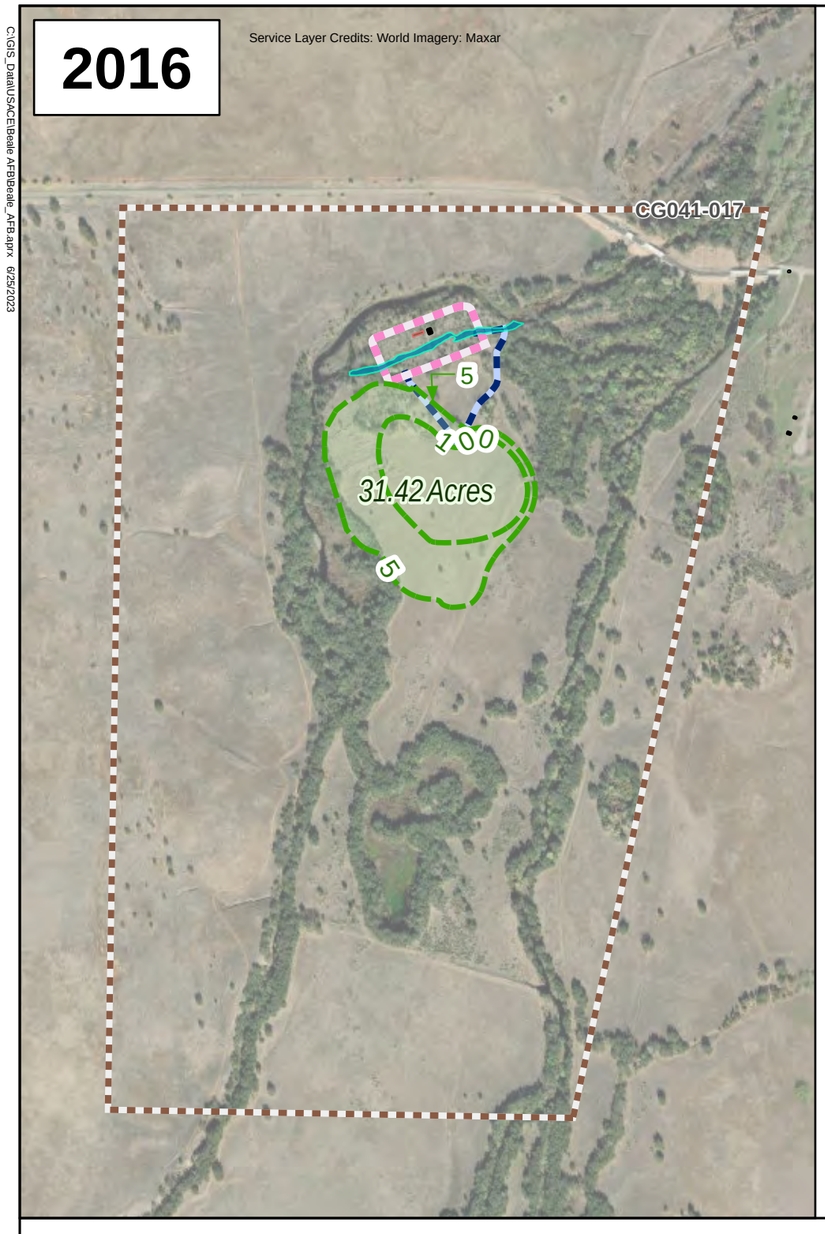
FIGURE 4-6

C:\GIS_Data\USACE\Beale AFB\Beale_AFB_FYR.aprx 2/21/2024

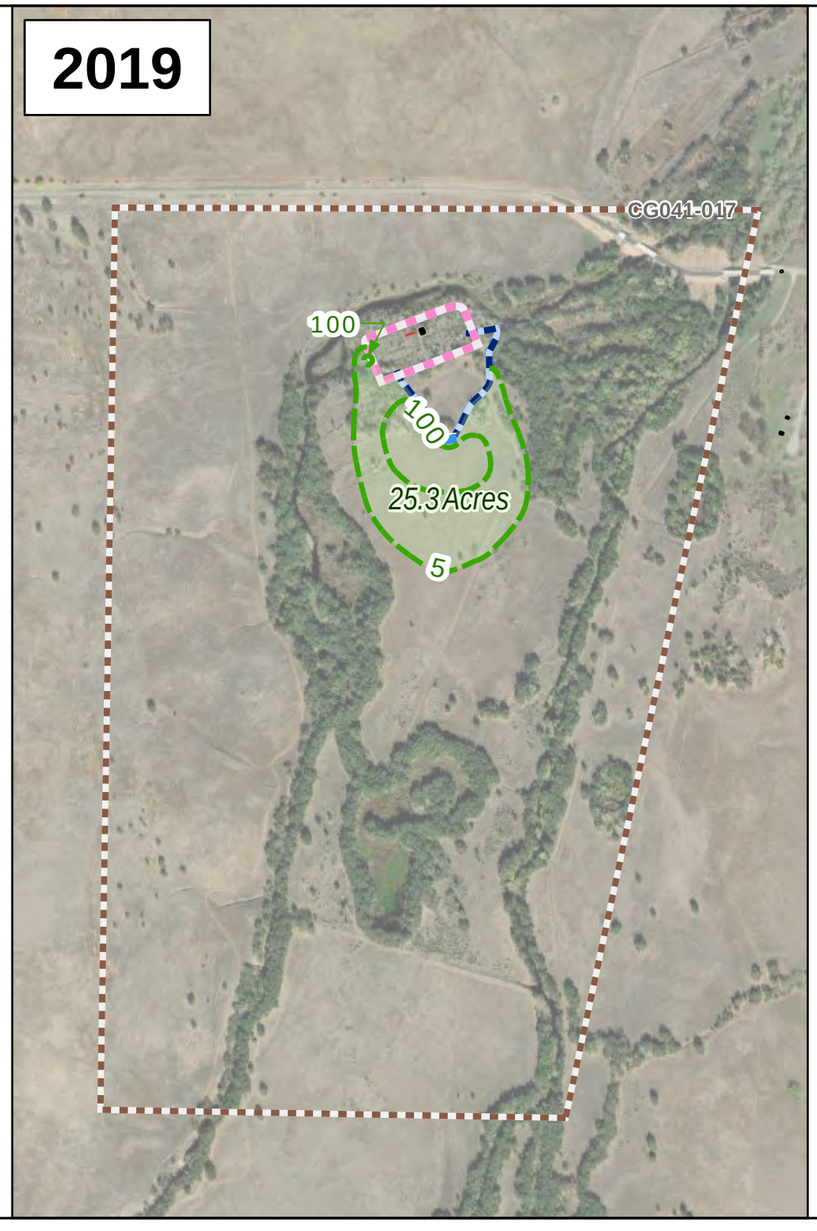
C:\GIS_Data\USACE\Beale AFB\Beale_AFB.aprx 6/25/2023

2016

Service Layer Credits: World Imagery: Maxar



2019



2021

Land Use Control Boundary (Groundwater)
Best Slough (Original Alignment)
Location of Former Disposal Trench
OT017 Water Treatment Plant
Shallow TCE Isocontour in µg/L

Area A - Slurry Wall (Primary Source Area)
Permeable Reactive Barrier
Area B - Slurry Wall (Secondary Source Area)
Area C - Dissolved trichloroethene plume (2021)

TCE trichloroethene
µg/L micrograms per liter

Source: Brice, 2022b, 2022e

N

0 1,000 2,000
Feet

PLUME CG041-017 GROUNDWATER TCE ISOCONTOURS (2016, 2019, AND 2021)

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
4-7

Service Layer Credits: World Terrain Base: Esri Community Maps Contributors, California State Parks, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA
World Imagery : Maxar
World Hillshade: Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

O:\GIS_Data\USACE\Beale AFB\Beale_AFB.aprx, 6/25/2023

M Street
K Street
J Street
H Street
G Street
F Street
L Street
9th Street
10th Street
8th Street
7th Street
E Street
CG041-018
Gavin Mandery Drive

18L004MW 65.18
18L001MW 64.16 0.17 J
18C053MW 49.24 0.35 J
18L002MW 60.34 2.7
18U005MW 64.77 ND
18U008AMW TPH-D: 890
18U008BMW TPH-D: 130000
18U007AMW TPH-D: 13000 J
18U007BMW TPH-D: 5400 J
18C019AMW 64.83 ND
18C019BMW 64.07 ND
18U008AMW 67.83 ND
18U008BMW 62.27 ND
18U008CMW 62.52 1
18U007AMW 67.97 ND
18U007BMW 62.59 ND
18U006AMW 62.30 1.2
18U006BMW 57.55 ND
18U006CMW 58.80 ND
18C002MW 60.28
18U002AMW
18U002BMW 63.25
18U002CMW 62.63
18L005MW 69.66 0.4 J
18C022MW 66.32 33
18C045MW 65.68 0.93
18C021AMW 66.10 0.39 J
18C021BMW 65.81 10
18C028MW 66.51 79
18C052MW 69.32 4
18C001MW 58.14
18C023MW 120
18U004MW 64.67 2.5
18U001AMW 65.96
18U001BMW
18C058IW
18C056IW
18C043MW 65.31 ND
18C020MW 68.28 37
18C024MW 66.26 41
18C046MW 67.75 1.1
18C044MW 66.48 6.1
18C057IW
18C055IW
18C054IW
18C048MW 68.35
18C047MW 68.14 0.26 J
18U003AMW 67.06
18U003BMW 66.91
18U003CMW 58.69

4.18 Acres
100
100
5

SITE LOCATION

LEGEND

- Land Use Control Boundary (Groundwater)
- TCE Isocontour in µg/L (2021)
- TPH-D Isocontour -- 100 µg/L (2021)
- Jet Propellant Thermally Stable Pipeline
- ST018 Biosparge Well
- Biosparge Conveyance Pipe
- Shallow Groundwater Monitoring Well
- Groundwater Injection Well
- Ditch or Aqueduct
- Local Road
- Beale Air Force Base Boundary

10C050RW **Location ID**
104.45 **Groundwater Elevation**
0.47 J **TCE Concentration in µg/L**
TPH-D: 790 **TPH-D Concentration in µg/L**

J The analyte was positively identified, but the quantitation is an estimate.
ND The analyte was not detected
TCE trichloroethene
TPH-D total petroleum hydrocarbons as diesel-range organics
µg/L micrograms per liter

Source: Brice, 2022b, 2022e

N

0 300 600
Feet

PLUME CG041-018
ANNUAL 2021 GROUNDWATER
TCE AND TPH-D CONCENTRATIONS

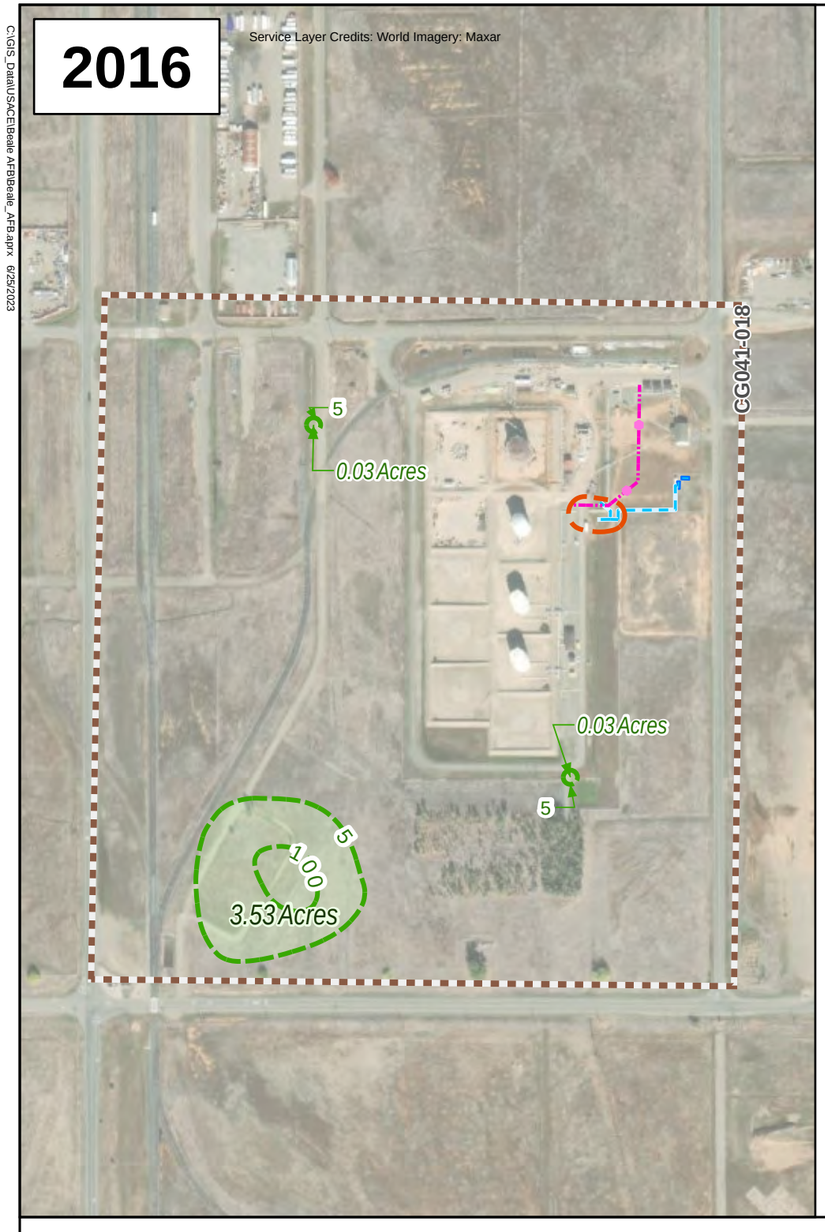
BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
4-8

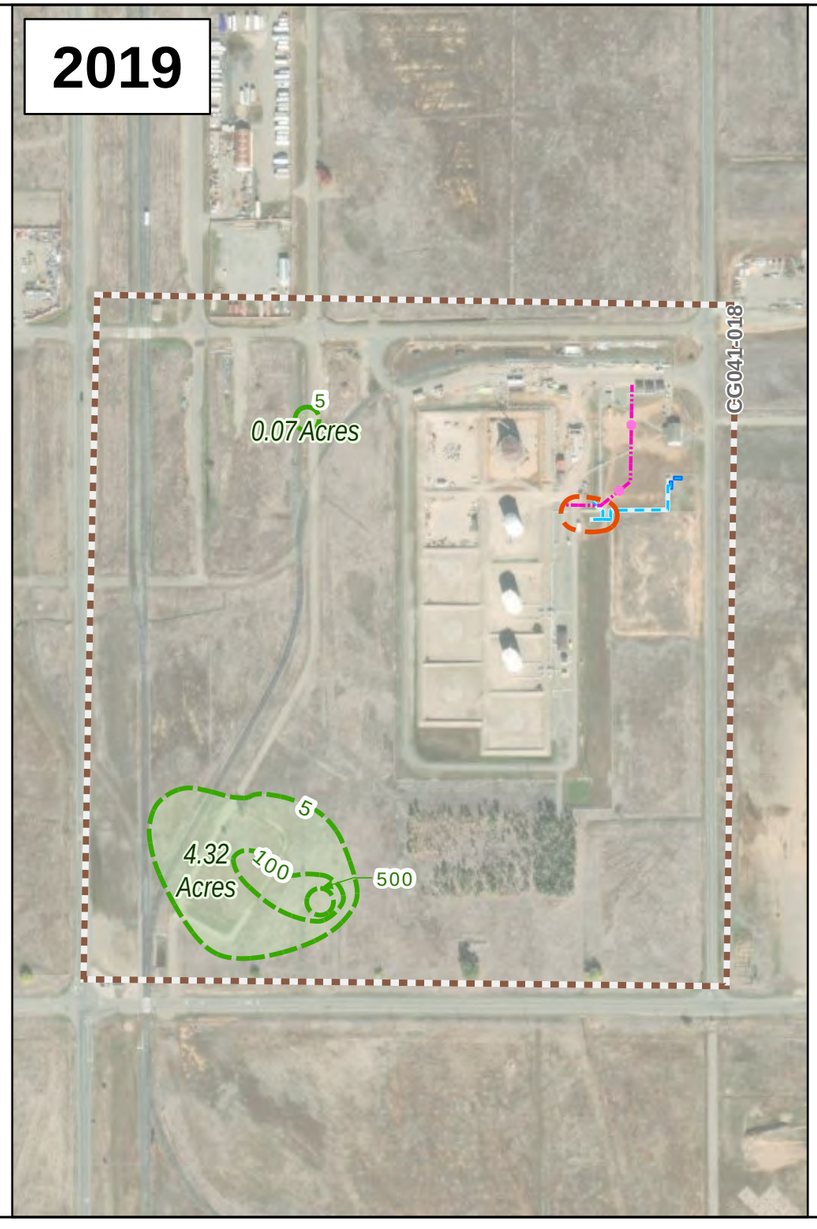
C:\GIS_Data\USACE\Beale AFB\Beale_AFB.aprx 6/25/2023

2016

Service Layer Credits: World Imagery: Maxar



2019



2021

Land Use Control Boundary (Groundwater)
TPH-D Isocontour -- 100 µg/L
Shallow TCE Isocontour in µg/L

ST018 Biosparge Well
Biosparge Conveyance Pipe
Jet Propellant Thermally Stable Pipeline

N

0 400 800
Feet

TCE trichloroethene
µg/L micrograms per liter

TPH-D total petroleum hydrocarbons as diesel-range organics

Source: Brice, 2022b, 2022e

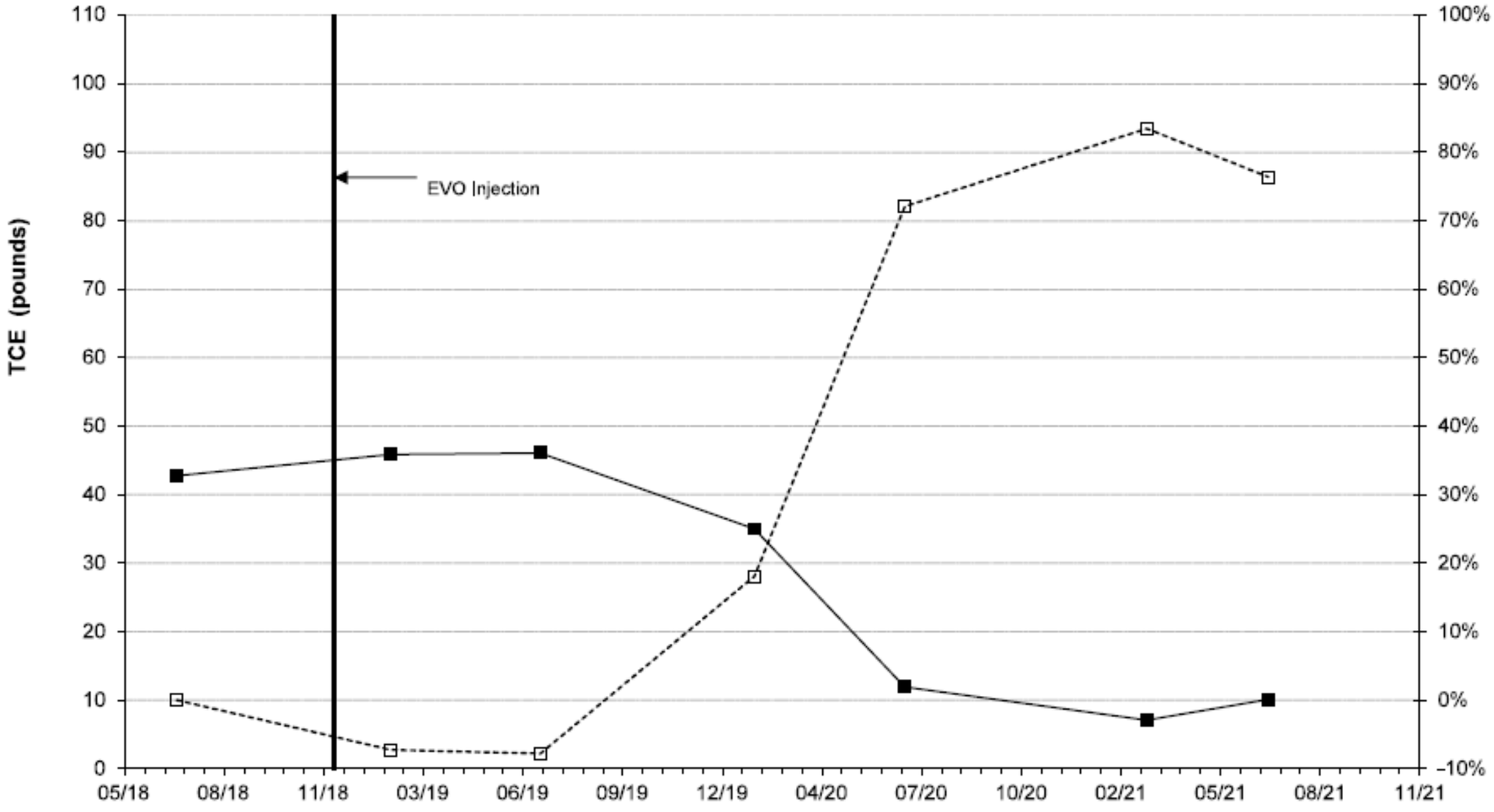
CG041-018
GROUNDWATER TCE AND TPH-D ISOCONTOURS (2016, 2019, AND 2021)

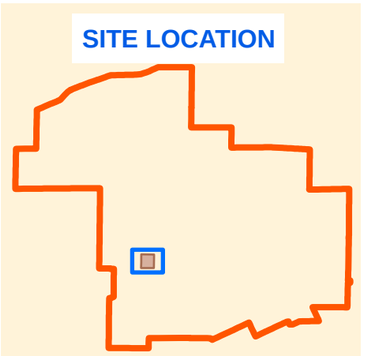
BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
4-9

C:\GIS_Data\USAGE\Beale AFB\Beale_AFB.aprx - 6/23/2023

PLUME CG041-018





EVO emulsified vegetable oil

TCE trichloroethene

Source: Brice, 2022b

PLUME CG041-018
GROUNDWATER TCE
MASS REMOVAL

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
4-10

Service Layer Credits: World Terrain Base: Esri Community Maps Contributors, California State Parks, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA
World Imagery : Maxar
World Hillshade: Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

C:\GIS_Data\USAF\Beale AFB\Beale_AFB.aprx, 6/25/2023

10th Street
9th Street
8th Street
7th Street
B Street
C Street
A Street
A-Street
Gavin Mandery Drive
South Earle Drive
CG041-029

29C010AMW
94.54
1.1

29C010BMW
84.98

29C008AMW
93.72
0.24 J

29C008BMW
84.63
14

29C009AMW
91.88

29C009BMW
91.71
0.59

29C038AMW
90.59
0.57

29C038BMW
79.94
5.2

29C040AMW
77.92
5.2

29C040BMW
77.79
1.6

29C037AMW
93.02
ND

29C037BMW
86.24
2.5

29L003MW
86.37

29L002MW
87.74

29VW004
94.53
1.1

29VW005
93.96

29C006MW
94.28

29L001MW
94.06

29L004MW
83.05
9.8

15.15 Acres

5

SITE LOCATION

LEGEND

- Land Use Control Boundary (Groundwater)
- Deep TCE Isocontour in µg/L (2021)
- CG041-029 Trench
- Groundwater Monitoring Well
- Stream
- Local Road
- Beale Air Force Base Boundary

10C050RW — Location ID
104.45 — Groundwater Elevation
0.47 J — TCE Concentration in µg/L

J — The analyte was positively identified, but the quantitation is an estimate.
ND — The analyte was not detected
TCE — trichloroethene
µg/L — micrograms per liter

Source: Brice, 2022b, 2022e

N

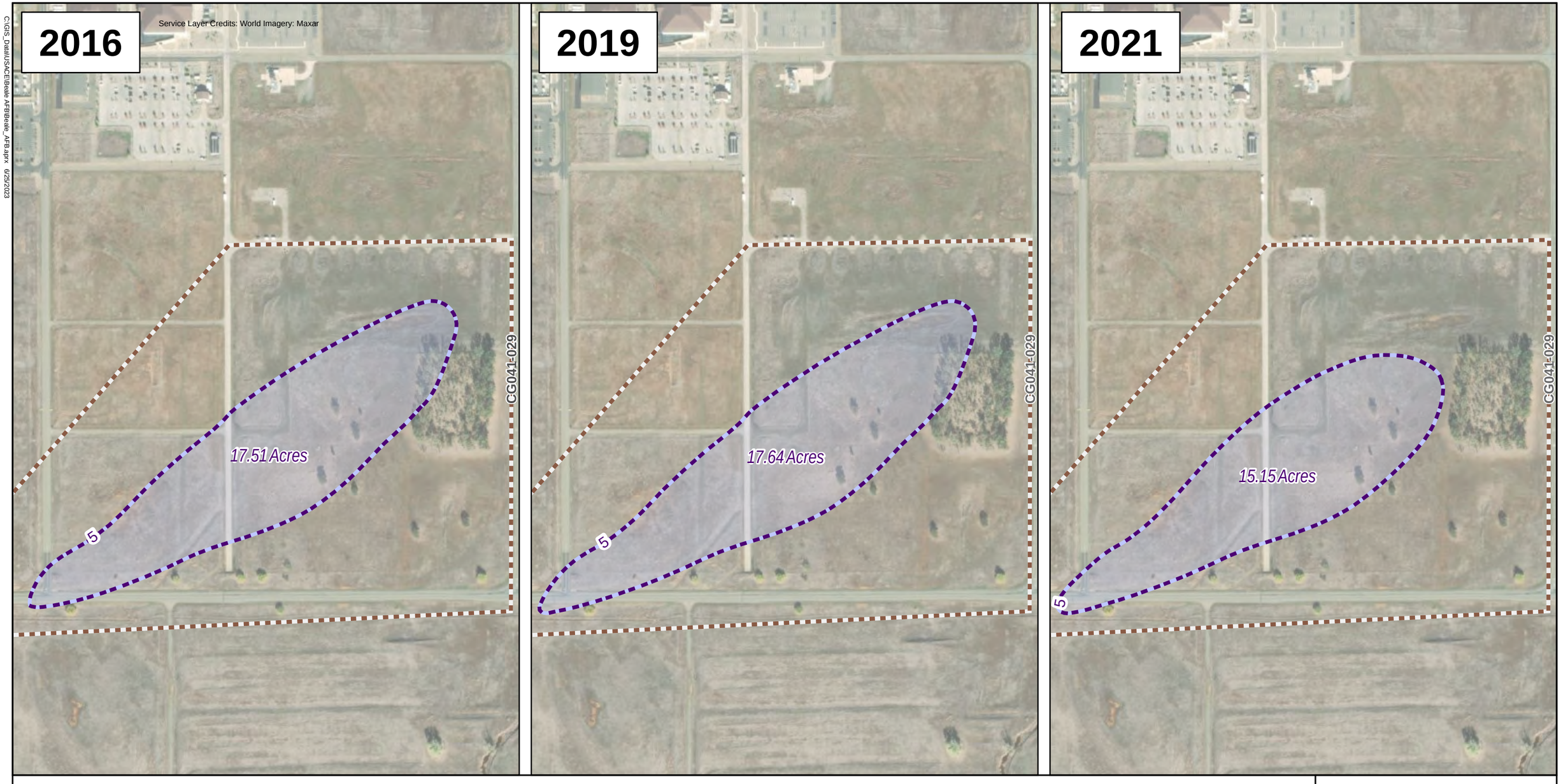
0 300 600
Feet

PLUME CG041-029
ANNUAL 2021 GROUNDWATER
TCE CONCENTRATIONS

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
4-11

C:\GIS_Data\USACE\Beale AFB\Beale_AFB.aprx 6/25/2023



Land Use Control Boundary (Groundwater)

Deep TCE Isocontour in µg/L

TCE trichloroethene
µg/L micrograms per liter

N

0 400 800

Feet

Source: Brice, 2022b, 2022e

PLUME CG041-029
GROUNDWATER TCE
ISOCONTOURS
(2016, 2019, AND 2021)

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
4-12

Service Layer Credits: World Terrain Base: Esri Community Maps Contributors, California State Parks, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA
World Imagery : Maxar
World Hillshade: Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

BGC001MW
89.36

35C014MW
93.77
9.7

35C056MW
91.65
ND

35C066MW
92.65
ND

35C042MW

35C010MW
93.94
2.1

35C041AMW
96.43

35C041BMW

35C082MW
94.91
0.3 J

35C037MW
96.48

35C081MW
96.60
0.14 J

35C021MW
80.85

0.68
Acres

5

35C005MW
96.38
1.2

35C059MW
96.60
3.5

35C058MW
97.05
3.6

35C084IW

35C067MW
96.55
41

35C083IW

35C065EW

35C064MW
97.86
14

35C017MW
96.64
91

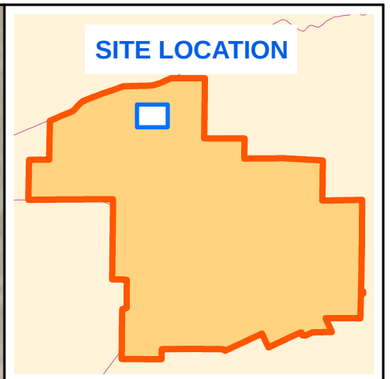
35C063MW
ND

Alert Drive

BWL001PZ
96.91

C:\GIS_Data\USACE\Beale AFB\Beale_AFB.aprx 6/25/2023

SITE LOCATION



LEGEND

- Land Use Control Boundary (Groundwater)
- TCE Isocontour in µg/L (2021)
- Shallow Groundwater Monitoring Well
- Groundwater Extraction Well
- Groundwater Injection Well
- Ditch or Aqueduct
- Local Road
- Beale Air Force Base Boundary

10C050RW	Location ID
104.45	Groundwater Elevation
0.47 J	TCE Concentration in µg/L

J	The analyte was positively identified, but the quantitation is an estimate.
ND	The analyte was not detected
TCE	trichloroethene
µg/L	micrograms per liter

Source: Brice, 2022b, 2022e

N

0 300 600
Feet

PLUME CG041-035
ANNUAL 2021 GROUNDWATER
TCE CONCENTRATIONS

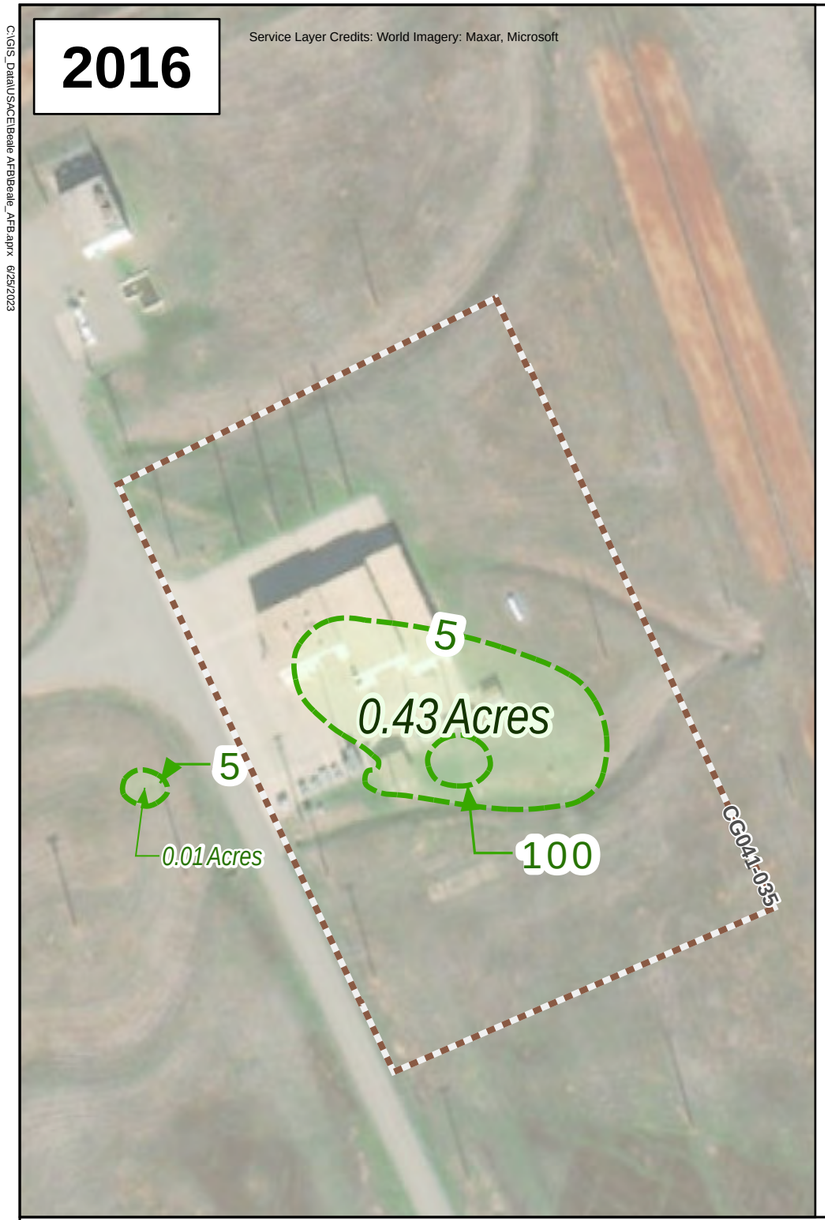
BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
4-13

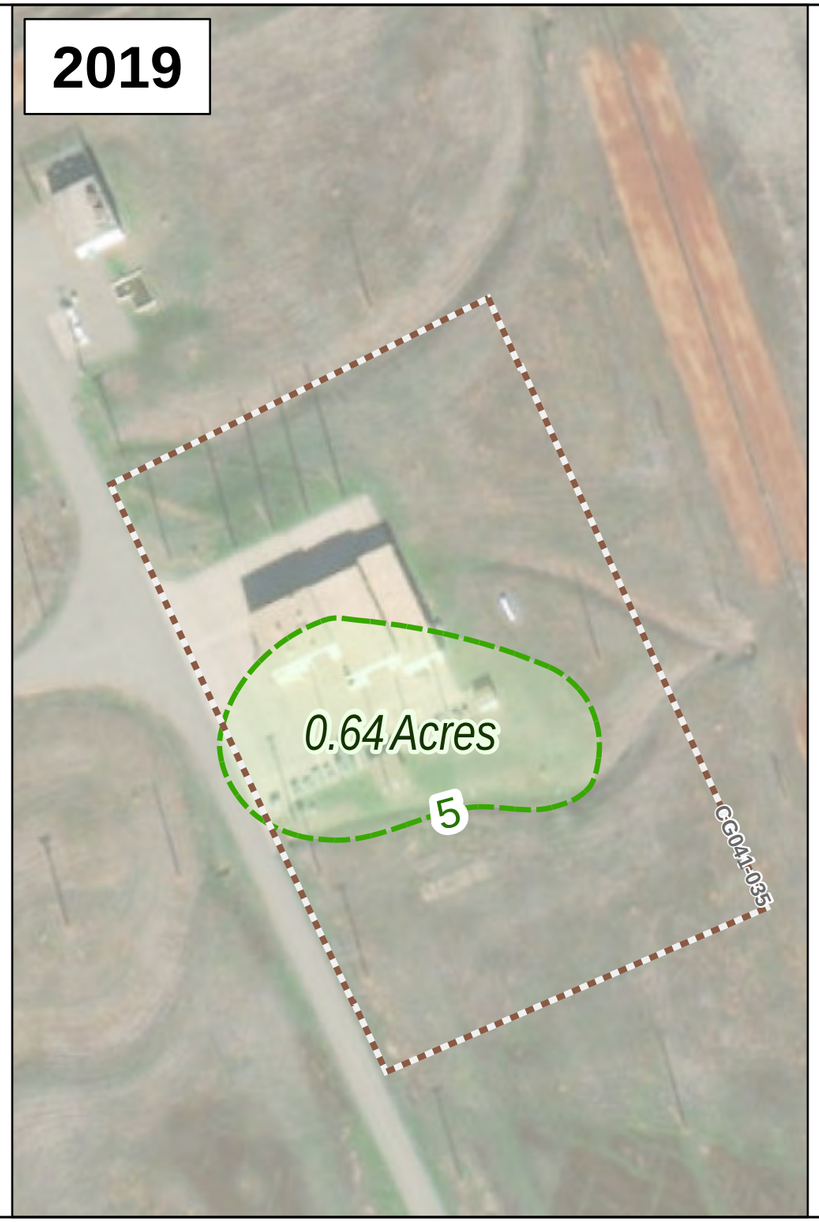
C:\GIS_Data\USACE\Beale AFB\Beale_AFB.aprx 6/25/2023

2016

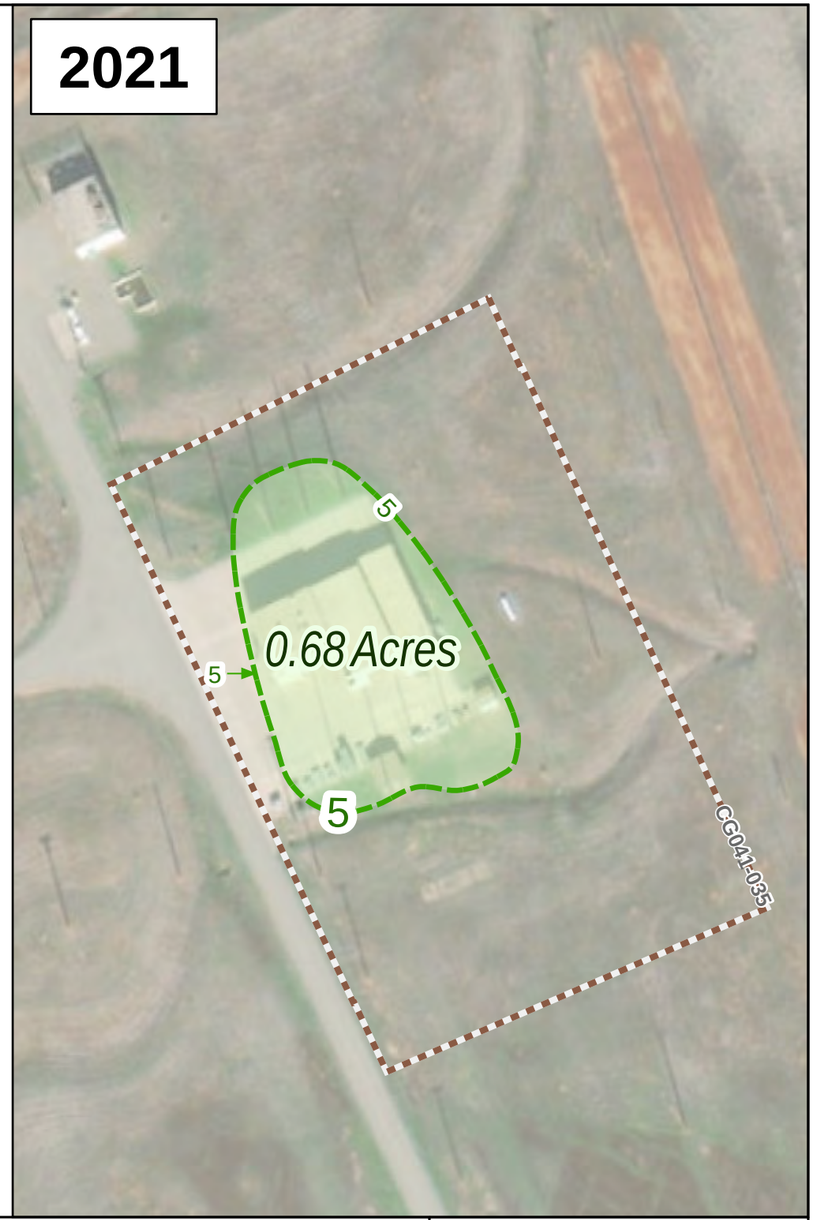
Service Layer Credits: World Imagery: Maxar, Microsoft



2019



2021



Land Use Control Boundary (Groundwater)

Shallow TCE Isocontour in µg/L

TCE trichloroethene
µg/L micrograms per liter

N

0 100 200

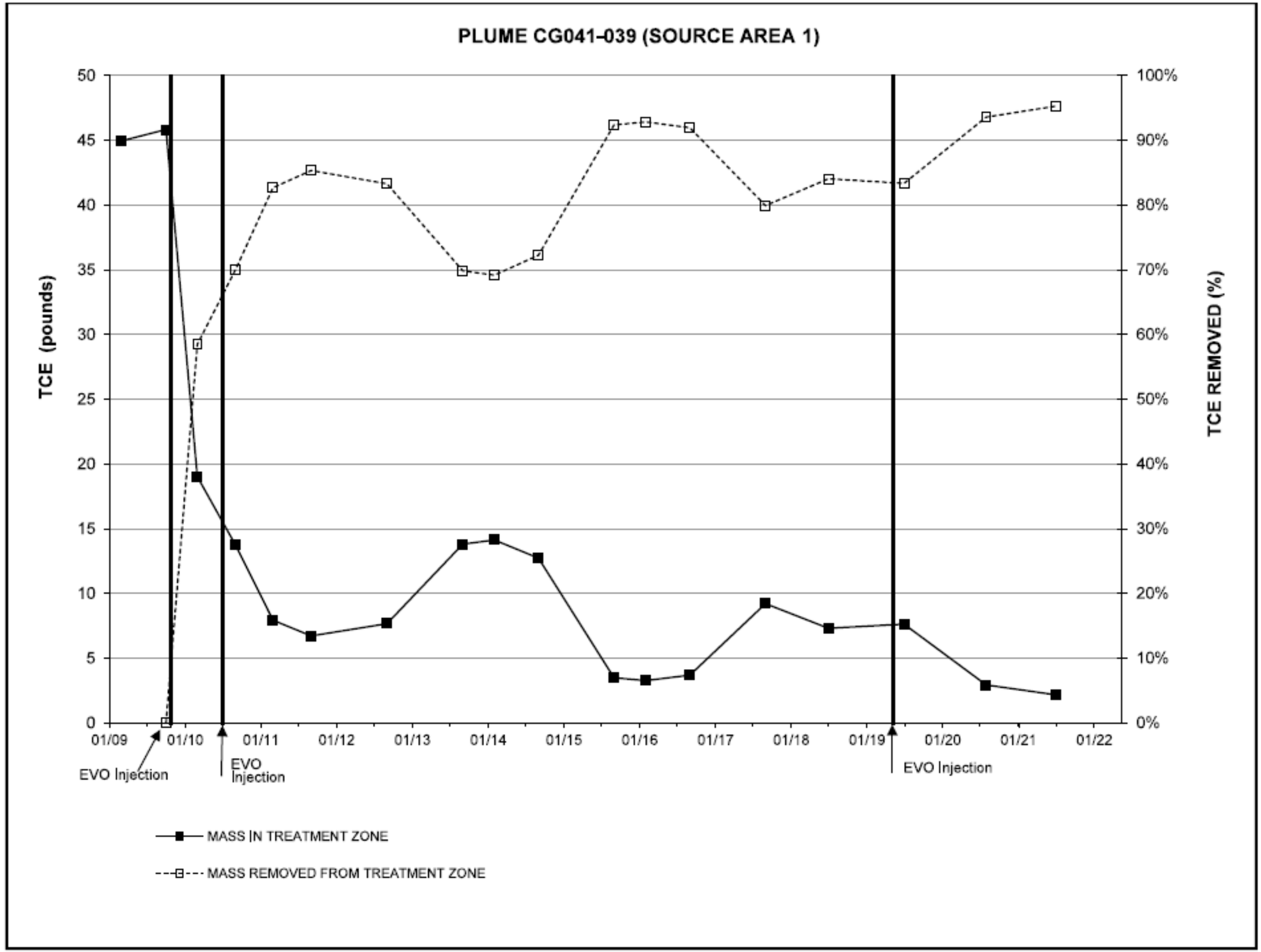
Feet

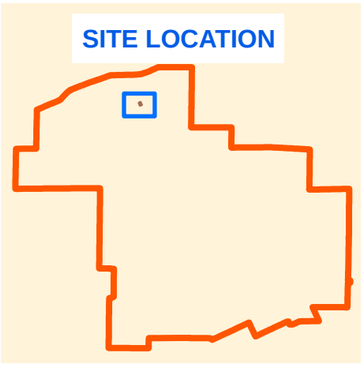
Source: Brice, 2022b, 2022e

PLUME CG041-035
GROUNDWATER TCE
ISOCONTOURS
(2016, 2019, AND 2021)

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
4-14





EVO emulsified vegetable oil
SVE soil vapor extraction
TCE trichloroethene

Source: Brice, 2022b

PLUME CG041-035
GROUNDWATER TCE
MASS REMOVAL

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
4-15

Service Layer Credits: World Imagery : Maxar

NORTHERN CANTONMENT AREA

SOUTHERN CANTONMENT AREA

SITE SS039 SOURCE AREA 1

SITE SS039 SOURCE AREA 2

INDUSTRIAL/COMMERCIAL LAND USE CONTROL BOUNDARY

Bldg. 2145

C Street
29th Street
30th Street
Acacia
Chestnut
Manzanita
Peckham Street
28th Street
A Street
26th Street
B Street
25th Street
Doolittle Drive
24th Street
CG041-039
16th Street
Armory Lane
Warren Shingle Road
Robert Nicoletti Way
13th Street
11th Street
10th Street
9th Street

5
100
1000

DETAIL AREA

200 Feet

SITE LOCATION

LEGEND

- Land Use Control Boundary (Groundwater)
- Shallow TCE Isocontour in µg/L (2021)
- Groundwater Monitoring Well
- Groundwater Injection Well
- Surface Water Sampling Location
- Building
- Approximate direction of groundwater flow (2021)
- Vernal Pool or Wetland
- Stream
- Ditch or Aqueduct
- Local Road
- Industrial/Commercial Land Use Control Boundary
- Beale Air Force Base Boundary

10C050RW **Location ID**
104.45 **Groundwater Elevation (2021)**
0.47 J **TCE Concentration in µg/L**

J The analyte was positively identified, but the quantitation is an estimate.
ND The analyte was not detected
TCE trichloroethene
µg/L micrograms per liter

Source: Brice, 2022b, 2022e

Elevations are in feet above NAVD88*

*North American Vertical Datum of 1988
Mean Sea Level may be a few feet above or below this fixed level depending on local conditions in coastal areas.

Gray text in data label indicates elevation not used in contouring.

N

0 700 1,400
Feet

PLUME CG041-039 ANNUAL 2021 GROUNDWATER TCE CONCENTRATIONS

BEALE AIR FORCE BASE, CALIFORNIA

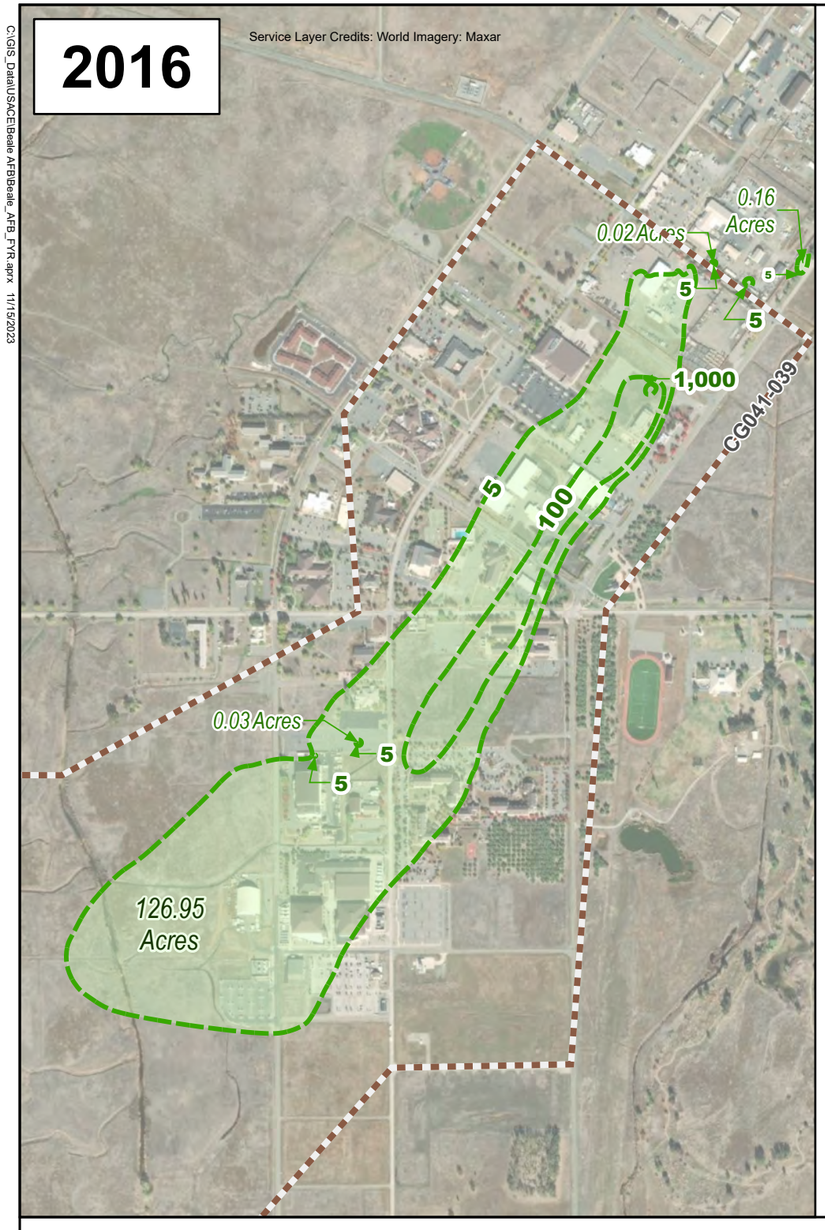
FIGURE 4-16

C:\GIS_Data\USACE\Beale_AFB\Beale_AFB_FYR_10\023.aprx 10/13/2023

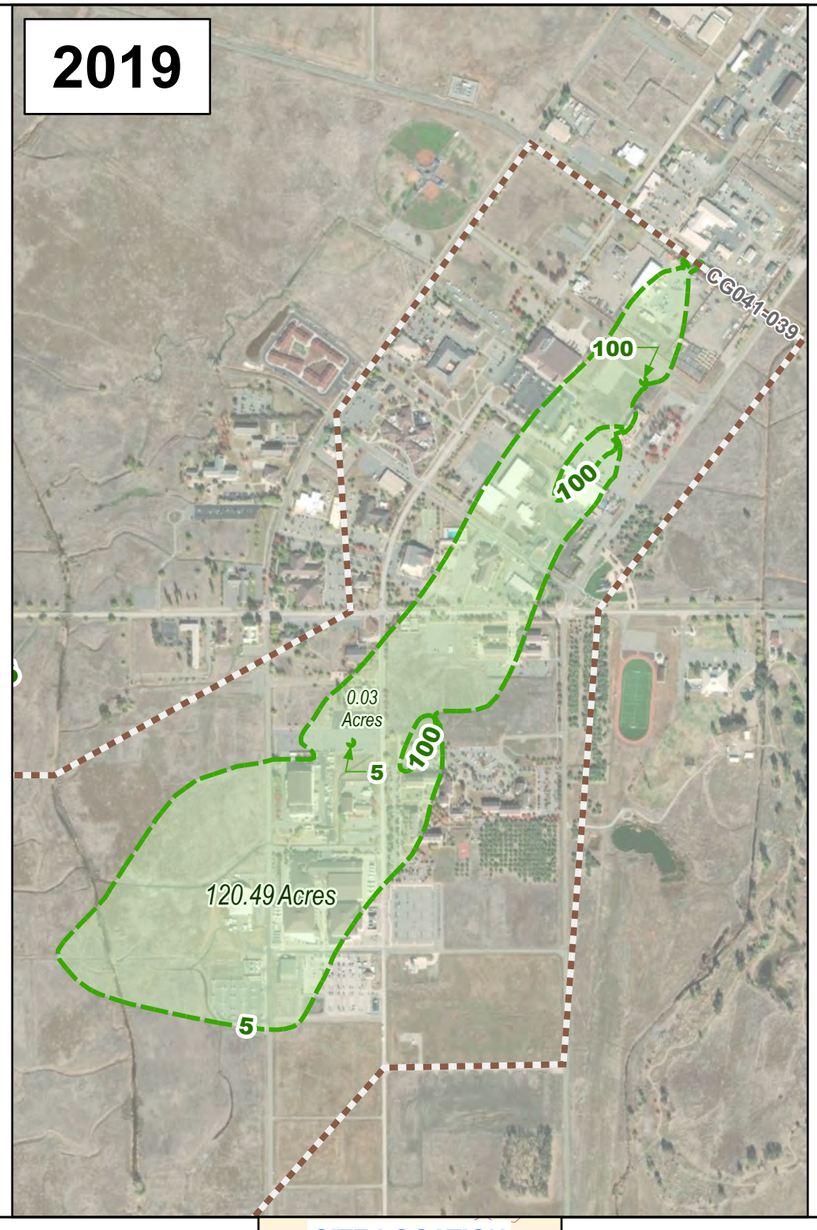
C:\GIS_Data\USACE\Beale AFB\Beale_AFB_FYR.aprx 11/15/2023

2016

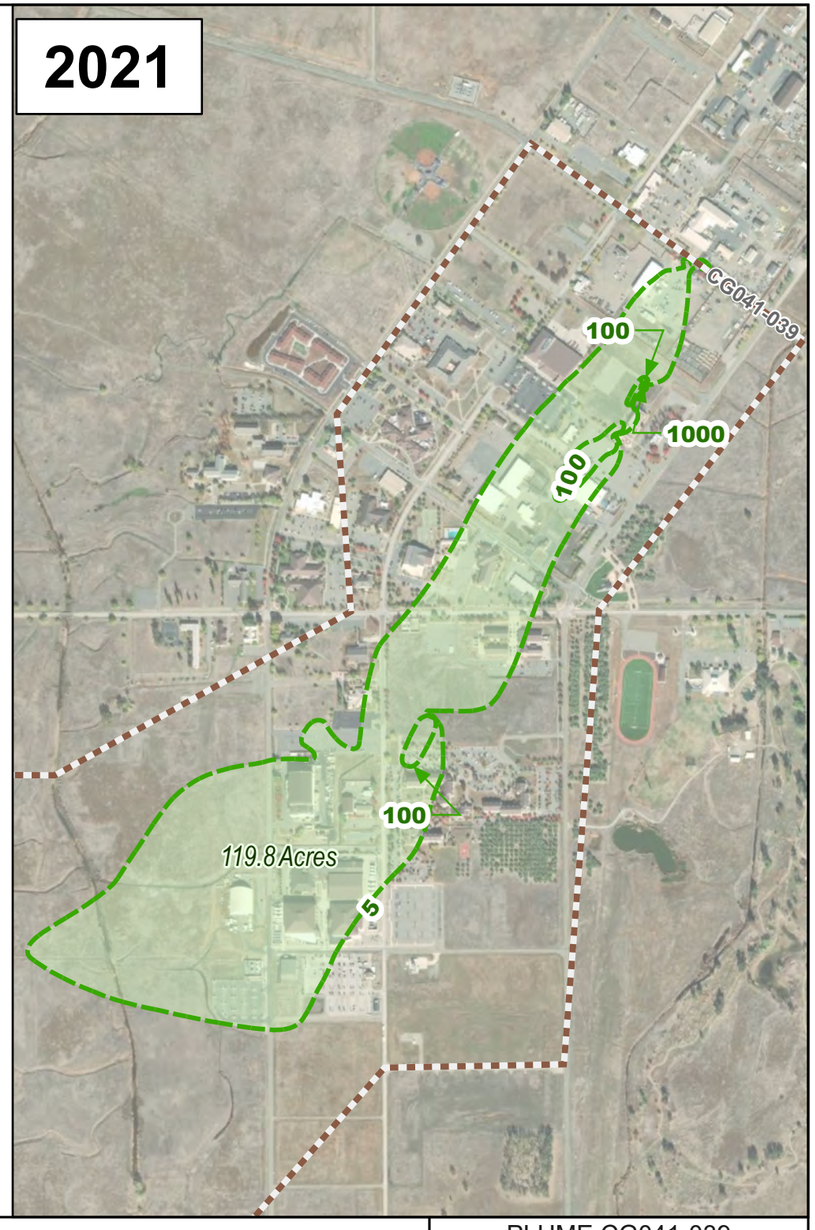
Service Layer Credits: World Imagery: Maxar



2019



2021



Shallow TCE Isocontour in µg/L

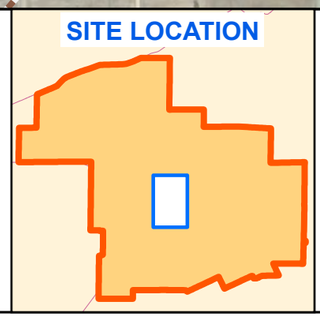
Land Use Control Boundary (Groundwater)

Beale Air Force Base

TCE trichloroethene
µg/L micrograms per liter

Source: Brice, 2022b, 2022e

SITE LOCATION



N

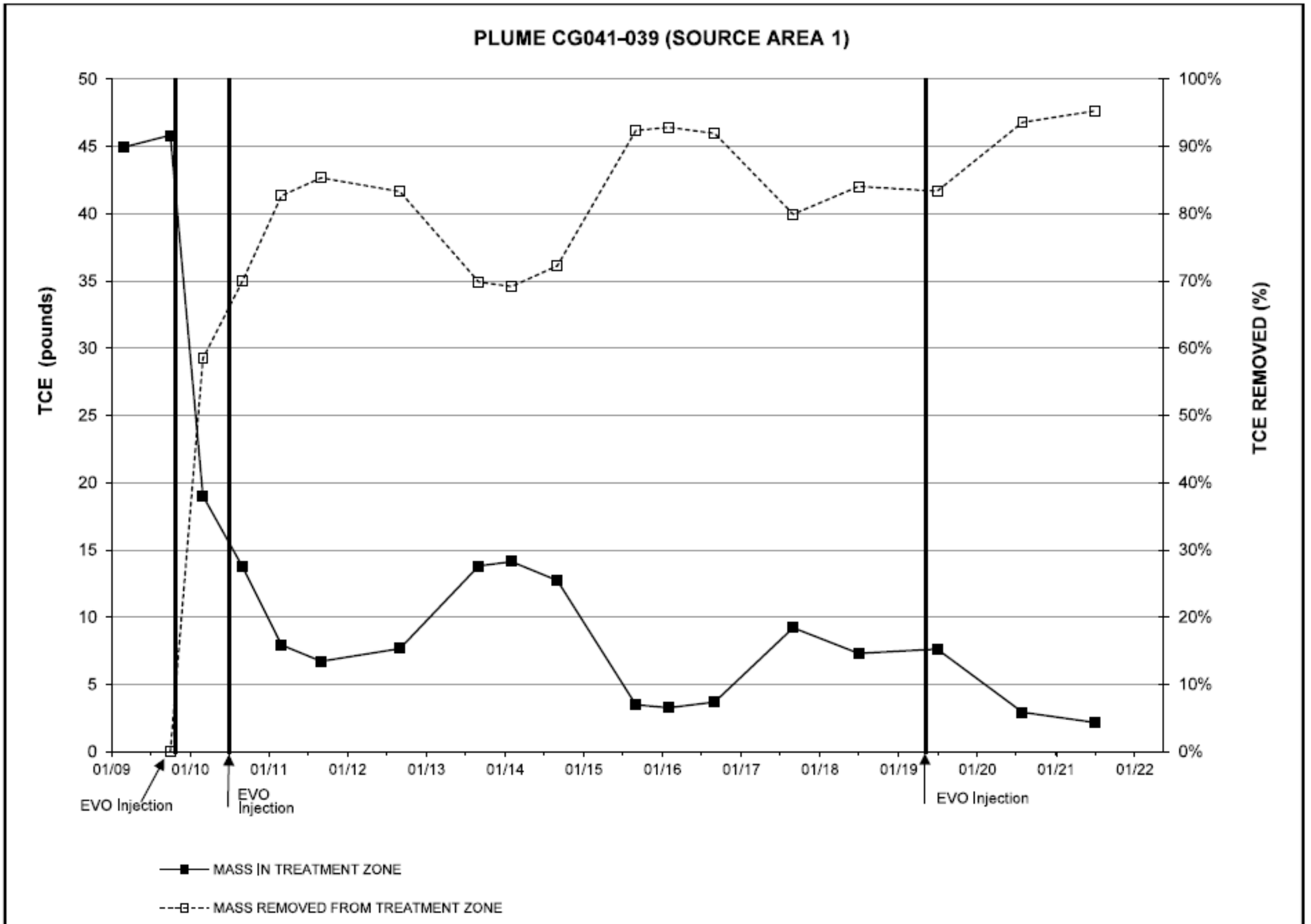
0 720 1,440

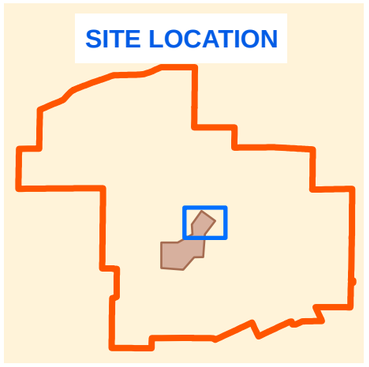
Feet

PLUME CG041-039
GROUNDWATER TCE
ISOCONTOURS
(2016, 2019, AND 2021)

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
4-17





EVO emulsified vegetable oil
SVE soil vapor extraction
TCE trichloroethene

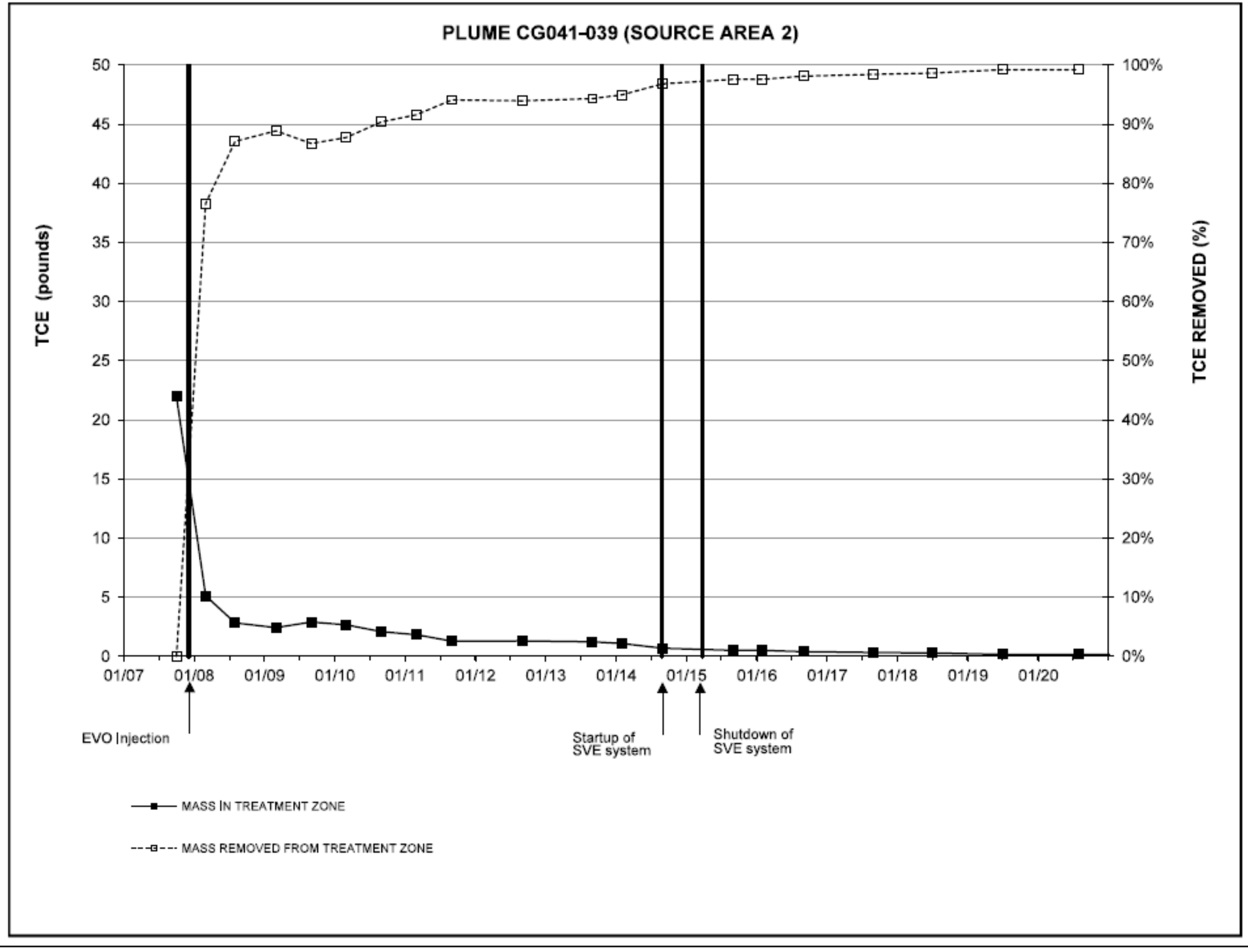
Source: Brice, 2022b

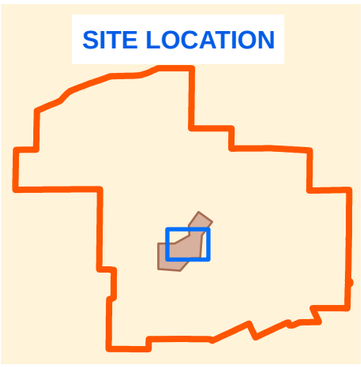
PLUME CG041-039
(SOURCE AREA 1)
GROUNDWATER TCE
MASS REMOVAL

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
4-18

C:\GIS_Data\US\CE\Beale AFB\Beale_AFB.aprx, 6/23/2023





EVO emulsified vegetable oil
SVE soil vapor extraction
TCE trichloroethene

Source: Brice, 2022b

PLUME CG041-039
(SOURCE AREA 2)
GROUNDWATER TCE
MASS REMOVAL

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
4-19

C:\GIS_Data\USACE\Beale AFB\Beale_AFB.aprx - 6/23/2023

Service Layer Credits: World Imagery : Maxar

C:\GIS_Data\USAGE\Beale AFB\Beale AFB_FYR.aprx 2/22/2024

32nd Street
31st Street
30th Street
29th Street
27th Street
M Street
J Street
G Street
Doolittle Drive
CG044-003
FPTA No. 1
FPTA No. 2
FPTA No. 3
FPTA No. 4
DRY WELL

03C061MW 58.91 ND
03C012AMW 58.04 0.32 J
03C012BMW 57.71 ND
03R011MW 58.02 ND
03C058MW 56.49 ND
03C015AMW 58.02 15
03C015BMW 57.71 3.4
03R002MW 58.27 3.6
03R003MW 57.36 19
03C011MW[a] 58.38 0.37 J
03C059MW 55.77 17
03C060MW 57.32 2.2
03R009MW 57.79
03R001MW 57.59 3.5
03L001MW 58.11 4.9
03L002MW 58.70
03L003MW 59.34
03R005MW 58.19
03V003MW 58.54
03C001MW 59.45
FT03PEW4 28
FT03VW1D
FT03VW5D
FT03VW7D 12
FT03VW8D
FT03VW11D
03R006MW 59.32
03V002MW 59.37
03R007MW 60.03
03U001MW 61.66
03L004MW 60.45
03R008MW 61.36
03R010MW 61.99
22V9080VE001
03R004MW 59.85
03V001MW 59.88
100
5

UAL003PZ 51.50
UAL003MW 51.43
UAL004PZ 51.65
UAL005PZS 51.22 ND
UAL005PZD 51.09

DETAIL AREA

300 Feet

03C061MW 58.91 ND
03C046AMW 59.17 32
03C046BMW 58.69 0.16 J
03C013AMW 58.73 54
03C013BMW 58.23 ND
03C021MW 58.66 160
03C030MW 58.47 140
03C015BMW 57.71 3.4
03C019AMW 58.54 13
03C019BMW 58.56 0.11 J
03C057MW 58.34 50
03C056MW 58.32 0.32 J
03C050IW ND
03C052IW ND
03C054IW ND
03C055IW ND
03C053IW 71
03C051IW 26
03C018MW 58.73 180
03C032MW[b] 58.78 25
03C031MW 58.93 65
03C045AMW 59.29 150
03C045BMW 58.96 1.7
03C048MW 59.16 86
03C049MW 59.21 20
100
5
M-Street

SITE LOCATION

LEGEND

- Land Use Control Boundary (Groundwater)
- TCE Isocontour in µg/L (2021)
- Earthen Berm
- Former UST
- Recycling Pad
- Drainage Ditch
- Groundwater Monitoring Well
- Groundwater Injection Well
- Former Presumed Dry Well
- Approximate direction of groundwater flow (2021)
- Vernal Pool or Wetland
- Local Road
- Beale Air Force Base Boundary

10C050RW Location ID
104.45 Groundwater Elevation (2021)
0.47 J TCE Concentration in µg/L

FPTA	Fire Protection Training Area
J	The analyte was positively identified, but the quantitation is an estimate.
ND	The analyte was not detected
TCE	trichloroethene
µg/L	micrograms per liter

Source: Brice, 2022b, 2022e

Elevations are in feet above NAVD88*

*North American Vertical Datum of 1988 Mean Sea Level may be a few feet above or below this fixed level depending on local conditions in coastal areas.

Gray text in data label indicates elevation not used in contouring.

N

0 500 1,000 Feet

PLUME CG044-003 ANNUAL 2021 GROUNDWATER TCE CONCENTRATIONS

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE 4-20

2016

Service Layer Credits: World Imagery: Maxar

0.22 Acres
100
5
100
100
22.12 Acres
5
CG044-003

2019

100
30.39 Acres
5
CG044-003

2021

100
100
5
34.65 Acres
5
2.07 Acres
CG044-003

C:\GIS_Data\USACE\Beale AFB\Beale_AFB.aprx 6/26/2023

LEGEND

- Shallow TCE Isocontour in µg/L
- Land Use Control Boundary (Groundwater)
- Beale Air Force Base

TCE trichloroethene
µg/L micrograms per liter

SITE LOCATION

N

0 700 1,400
Feet

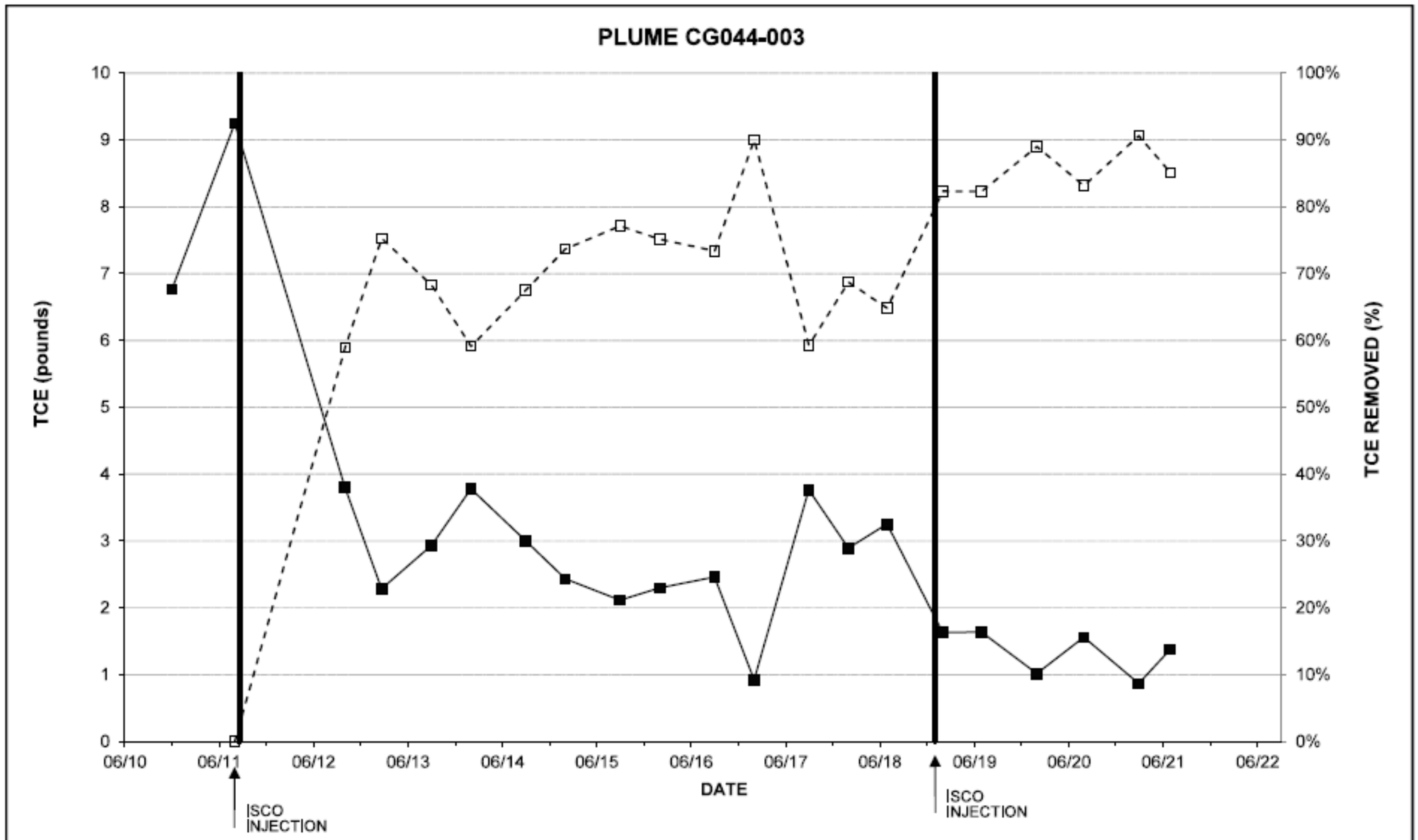
Source: Brice, 2022b, 2022e

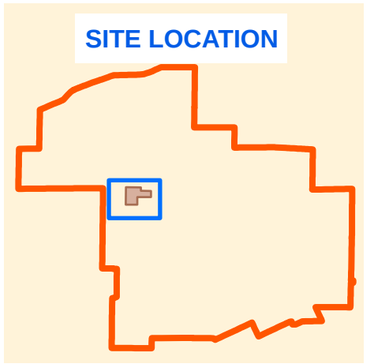
PLUME CG044-003 GROUNDWATER TCE ISOCONTOURS (2016, 2019, AND 2021)

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
4-21

C:\GIS_Data\USACE\Beale AFB\Beale_AFB.aprx - 6/23/2023





ISCO in-situ chemical oxidation

TCE trichloroethene

Source: Brice, 2022b

PLUME CG044-003
GROUNDWATER TCE
MASS REMOVAL

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
4-22

Service Layer Credits: World Imagery : Maxar

C:\GIS_Data\US\CA\Beale AFB\Beale_AFB.aprx - 6/26/2023

DETAIL AREA

300 Feet

13C084MW 57.05 8.5
13C091MW ND
13C085MW 11
13C086MW 57.67 3.9
13C083MW 8.6
13L005MW
13L011MW 7.7
13C001MW 9.2
13L018MW
13C088MW ND
13L019AMW
13C079VEW 55.01 0.18 J
LF13WVW4
13L025MW
13C070VEW 56.02 0.36 J
13C063IW 57.39
13C080VEW
13C064IW 7.3
13C081EW 3.9
13C077VEW 55.90 13
13C078VEW
13C065IW 57.16
13C075VEW
13C087VEW
5
1.43 Acres
5.07 Acres
3.45 Acres
3.45 Acres
5

13C046MW 31.90 0.5
13C089AMW 43.54 ND
13C089BMW 41.46 0.24 J
13C052MW 41.47
13C053MW 21.34
13L029MW 41.29 2.8
13C104MW 34.98 ND
13C045MW 34.80 3.2
13C044MW 31.58 ND
13C043MW 29.55 ND
13C090AMW 44.16 0.21 J
13C090BMW 42.50 5.1
13L010MW 41.17 8.9
13C048PZS 44.57
13C048PZUM 44.65
13C048PZLM 44.55
13O033MW 36.03 ND
13C082MW 50.72
13L028MW 40.94 ND
13L031MW 35.51 1.2
13C103MW 39.85 ND
13O005EW 3.7
13L015MW 19.25
13C006MW 9.1
13C071MW 49.61
13L014MW
13C039MW 43.22 ND
13L007MW 54.44
13L004MW 28
13C054MW 28.61 2.6
13C055MW 28.44 1.2
13L030MW 30.10 2.8
13O035MW 34.09 ND
13O034MW 34.35 ND
13C049MW
13C010EW ND
13C038MW 43.74 ND
13L001EW 4.8
13L002EW 44.26 4.4
02R002MW 62.77
SITE WP020 FORMER UNLINED SLUDGE PONDS
SITE WP062 UNLINED GREASE PIT
13C056MW 41.64 ND
13C040MW 42.79
13L026MW 47.05
13L017MW 21.37
13C051EW 26
02R001MW 62.60
02R003MW 65.18
13O036MW 33.72 ND
13L016MW 22.27
13L027MW 5.1
AIR STRIPPERS
13L001MW 57.78 16
02R004MW 63.52
13L032MW 32.46 0.2 J
13L012MW 52.60
13L006MW 43.73 40
13L003EW 47.29 5.8
13C042MW 27.53 ND
13C011EW 1.4
13O009EW 0.23 J
13O007EW 1.9
13A001MW 57.61
13L013MW 57.12
13L003MW 52.16
13L004EW 1.3
13A002MW 57.10
13C005MW 60.76
13C050EW 1.2
13O037MW 31.37 5.4
13L022MW 41.21 3.4
FORMER 13C002MW LANDFILL NO.4 44.79
13C004MW 57.57 0.5 J
13L024MW 44.93
13L002MW 63.57
13L009MW 42.22
13L023MW 18.73
13C003MW 22.79
13L020MW 22.79
13L021MW 22.38
13C057BMW 31.66
13C057AMW 42.63
SLUDGE DRYING BEDS
AERATION POND
unnamed road
J Street
13C041PZS 35.69 ND
13C041PZM 34.03 ND
13C041PZD 26.41 ND
13C058MW 22.70 1.2
13C105MW 27.87 ND
13L008MW 51.35
WASTEWATER LAGOON

SITE LOCATION

LEGEND

- Land Use Control Boundary (Groundwater)
- HSU-1, 2A, 2B TCE Isocontour in µg/L (2021)
- HSU-2C TCE Isocontour in µg/L (2021)
- Bioreactor
- Shallow Groundwater Monitoring Well
- Extraction Well
- Former EISB GroundwaterExtraction Well
- Stream
- Local Road
- Beale Air Force Base Boundary

10C050RW **Location ID**
104.45 **Groundwater Elevation**
0.47 J **TCE Concentration in µg/L**

EISB	enhanced in-situ bioremediation
FTPA	Fire Protection Training Area
J	The analyte was positively identified, but the quantitation is an estimate.
ND	The analyte was not detected
TCE	trichloroethene
µg/L	micrograms per liter

Source: Brice, 2022b, 2022e

Elevations are in feet above NAVD88*

*North American Vertical Datum of 1988 Mean Sea Level may be a few feet above or below this fixed level depending on local conditions in coastal areas.

Gray text in data label indicates elevation not used in contouring.

N

0 500 1,000 Feet

PLUME CG044-013 ANNUAL 2021 GROUNDWATER TCE CONCENTRATIONS

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE 4-23

C:\GIS_Data\USACE\Beale AFB\Beale_AFB.aprx 6/26/2023

2016

Service Layer Credits: World Imagery: Maxar

CG044-013

7.91 Acres

7.91 Acres

3.78 Acres

5

5

2019

CG044-013

0.98 Acres

5

3.60 Acres

Single Well Result
0.029 Acre

3.42 Acres

5

5

5

5

Single Well Result
approx. 6-foot radius

2021

CG044-013

5

1.43 Acres

5

5.07 Acres

3.45 Acres

5

5

5

Single Well Result
approx. 6-foot radius

HSU-1, 2A, 2B TCE Isocontour in µg/L

HSU-2C TCE Isocontour in µg/L

Land Use Control Boundary (Groundwater)

Beale Air Force Base

TCE trichloroethene
µg/L micrograms per liter

Source: Brice, 2022b, 2022e

SITE LOCATION

N

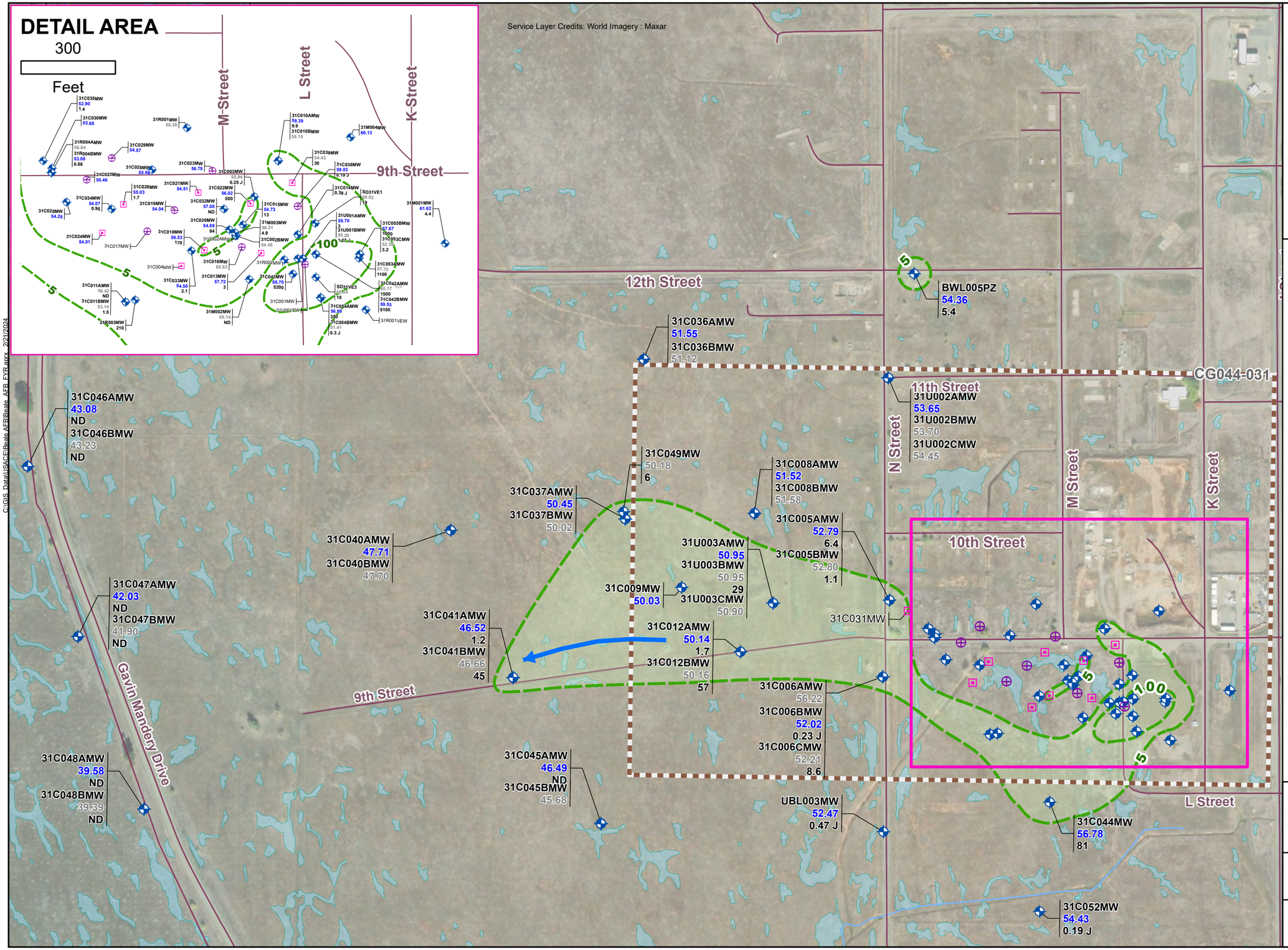
0 300 600

Feet

PLUME CG044-013
GROUNDWATER TCE
ISOCONTOURS
(2016, 2019, AND 2021)

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
4-24



SITE LOCATION

LEGEND

- Land Use Control Boundary (Groundwater)
- Shallow TCE Isocontour in µg/L (2021)
- Groundwater Monitoring Well
- Former EISB Groundwater Extraction Well
- Former EISB Groundwater Injection Well
- Approximate direction of groundwater flow (2021)
- Building
- Unnamed Streams
- Vernal Pool or Wetland
- Local Road
- Beale Air Force Base Boundary

10C050RW **Location ID**
104.45 **Groundwater Elevation (2021)**
0.47 J **TCE Concentration in µg/L**

EISB	enhanced in-situ bioremediation
J	The analyte was positively identified, but the quantitation is an estimate.
ND	The analyte was not detected
TCE	trichloroethene
µg/L	micrograms per liter

Source: Brice, 2022b, 2022e
Elevations are in feet above NAVD88*
*North American Vertical Datum of 1988
Mean Sea Level may be a few feet above or below this fixed level depending on local conditions in coastal areas.
Gray text in data label indicates elevation not used in contouring.

N

0 400 800
Feet

PLUME CG044-031 ANNUAL 2021 GROUNDWATER TCE CONCENTRATIONS

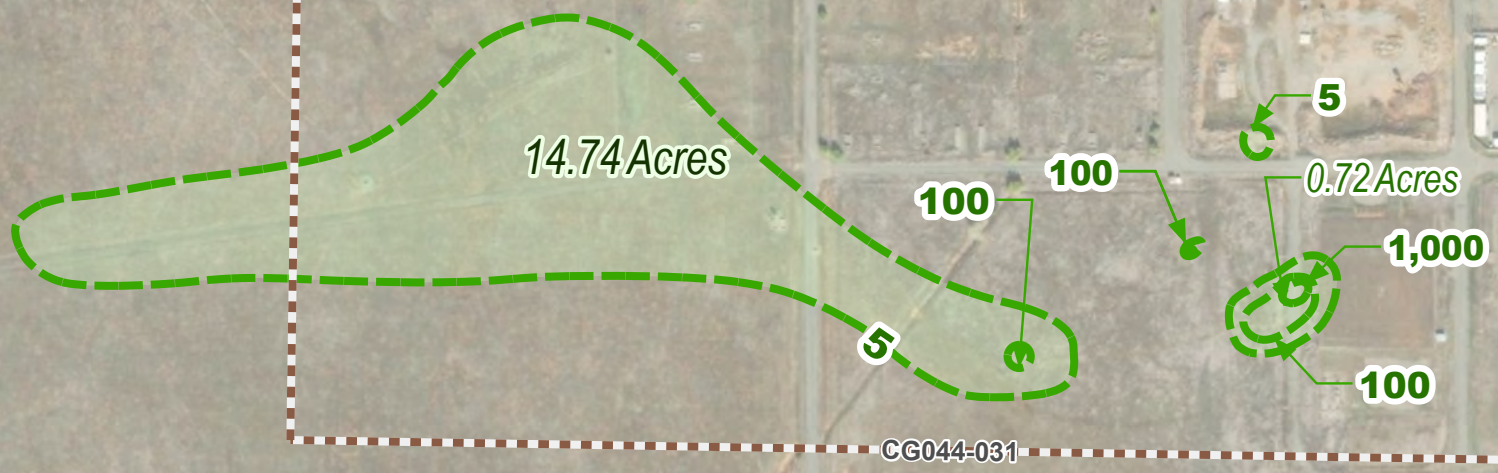
BEALE AIR FORCE BASE, CALIFORNIA

FIGURE 4-25

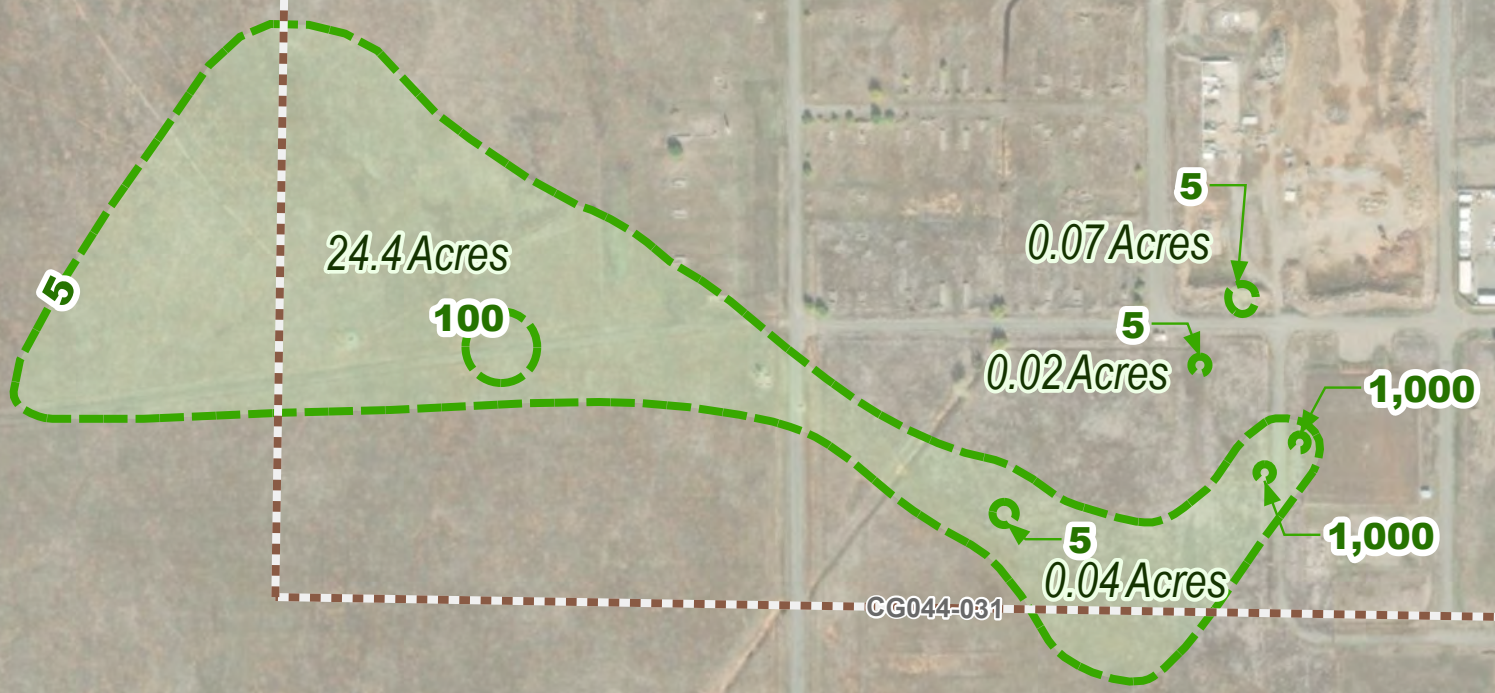
C:\GIS_Data\USAGE\Beale AFB\Beale AFB_FYR.aprx 2/21/2024

2016

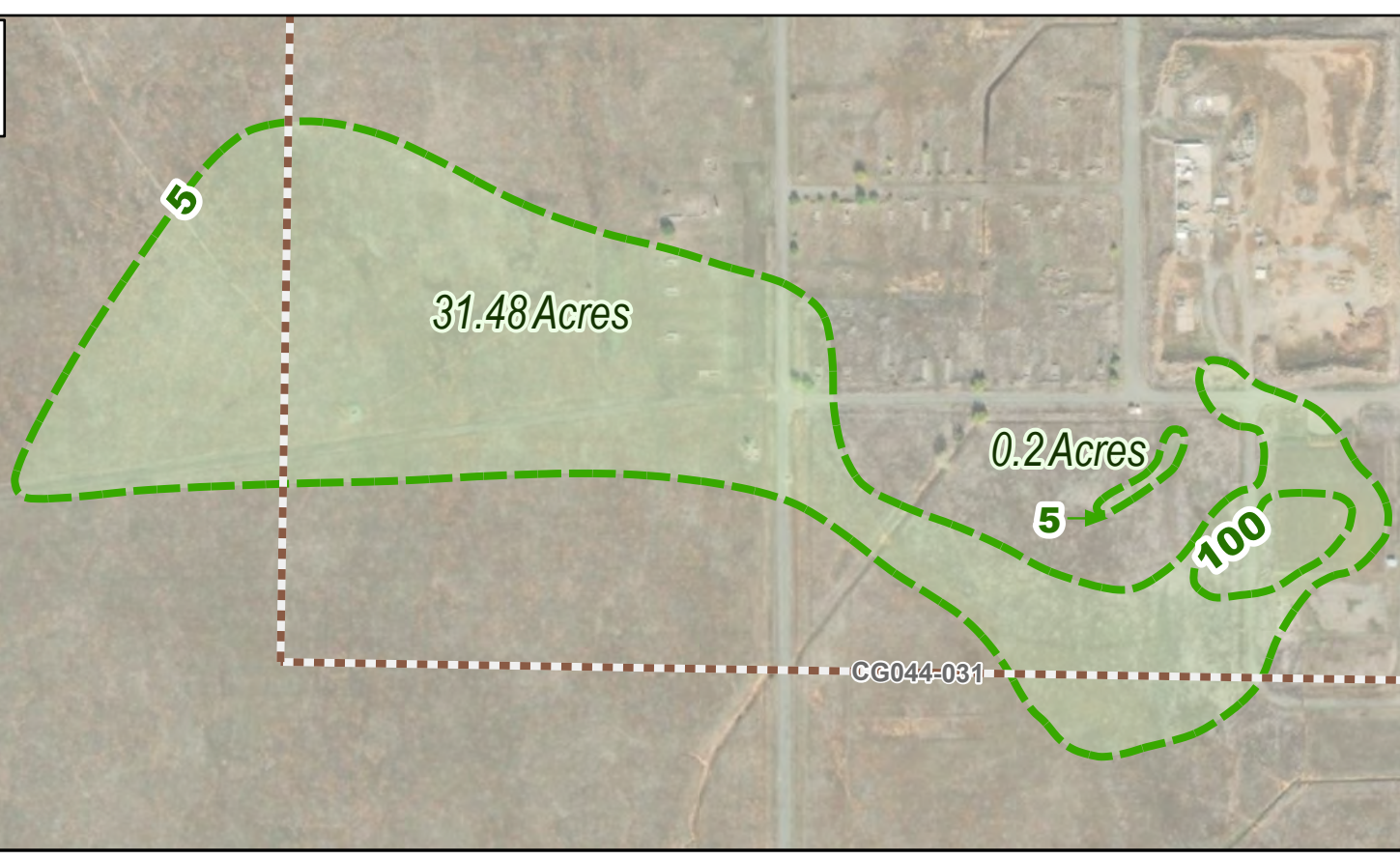
Service Layer Credits: World Imagery: Maxar



2019



2021

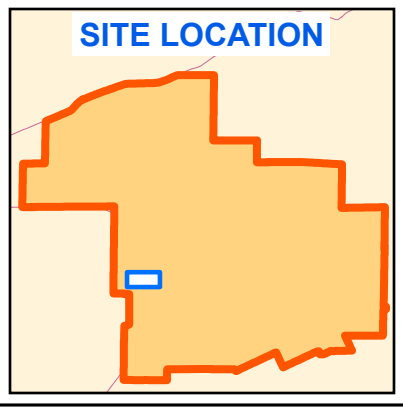


C:\GIS_Data\USACE\Beale AFB\Beale_AFB_FYR.aprx 12/11/2023

LEGEND

- Shallow TCE Isocontour in µg/L
- Land Use Control Boundary (Groundwater)
- Beale Air Force Base

TCE trichloroethene
µg/L micrograms per liter



N

0 400 800

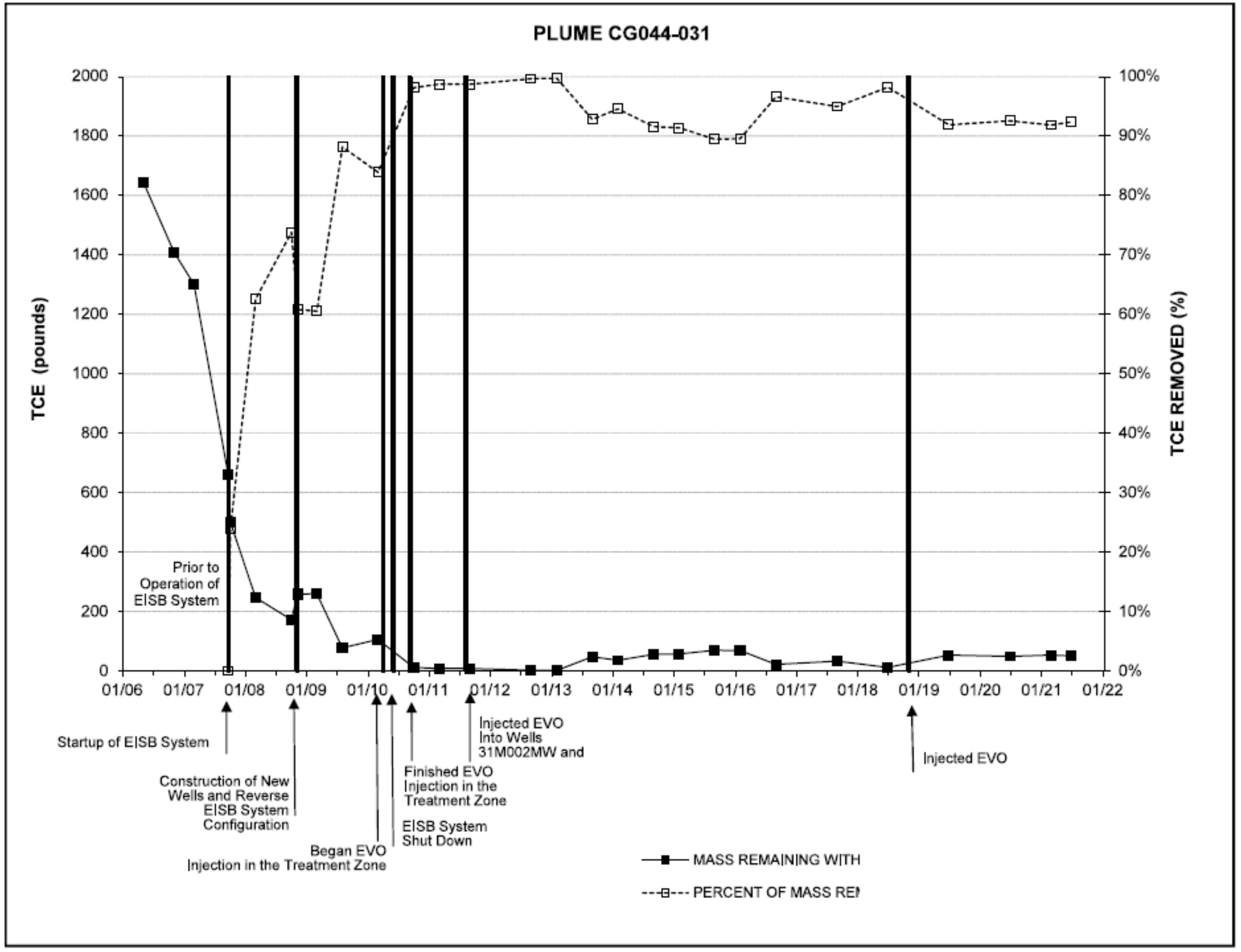
Feet

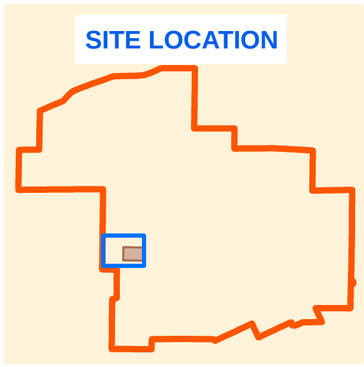
Source: Brice, 2022b, 2022e

PLUME CG044-031 GROUNDWATER TCE ISOCONTOURS (2016, 2019, AND 2021)

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE 4-26





EISB enhanced in-situ bioremediation

EVO emulsified vegetable oil

TCE trichloroethene

Source: Brice, 2022b

PLUME CG044-031
GROUNDWATER TCE
MASS REMOVAL

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE
4-27

G:\GIS_Data\US\CER\Beale AFB\Beale_AFB.aprx, 6/29/2023

Service Layer Credits: World Imagery : Maxar

DETAIL AREA

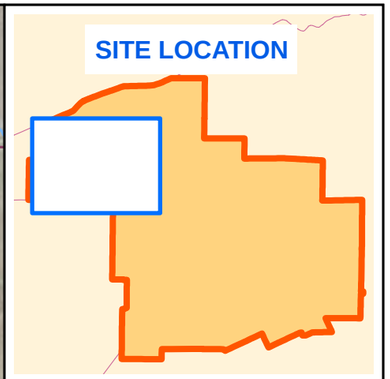
300 Feet

1086
32C048MW 59.60 28
SD32VE-3
32C035MW
32M002MW 59.63 24
32C049MW 59.67
04L001MW 60.30
32M001MW 59.64 170
32C036MW 59.53
32C047MW 59.49
32C051MW 59.47
32C059MW 59.34
32C050MW
32C060MW
SD32VE-4S
32C046MW 59.38
32C039MW 59.34 4.9
SD32VE-4D 63.98 0.96 J
32C061MW
32C052MW 59.28
32C062MW 59.45
32C063MW 59.58
32C064MW 59.27
32M003MW 58.91 1

1079 1071 1088 1083 1076 1072 1074

Edison Avenue
Arnold Avenue
100
5

SITE LOCATION



LEGEND

- Land Use Control Boundary (Groundwater)
- Shallow TCE Isocontour in µg/L (2021)
- Deep TCE Isocontour in µg/L (2021)
- Shallow Groundwater Monitoring Well
- Deep Groundwater Monitoring Well
- Building
- Stream
- Ditch or Aqueduct
- Local Road
- Beale Air Force Base Boundary

10C050RW Location ID
104.45 Groundwater Elevation
0.47 J TCE Concentration in µg/L

J	The analyte was positively identified, but the quantitation is an estimate.
ND	The analyte was not detected
TCE	trichloroethene
µg/L	micrograms per liter

Source: Brice, 2022b, 2022e

Elevations are in feet above NAVD88*

*North American Vertical Datum of 1988 Mean Sea Level may be a few feet above or below this fixed level depending on local conditions in coastal areas.

Gray text in data label indicates elevation not used in contouring.

N

0 1,000 2,000 Feet

PLUME CG044-032 ANNUAL 2021 GROUNDWATER TCE CONCENTRATIONS

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE 4-28

G:\GIS_Data\USACE\Beale AFB\Beale_AFB.aprx 6/26/2023

C:\GIS_Data\USACE\Beale AFB\Beale_AFB.aprx 6/26/2023

Service Layer Credits: World Imagery: Maxar

2016

1.83 Acres
1.83 Acres
1.83 Acres
0.80 Acres
2.94 Acres
2.94 Acres
2.94 Acres
89.76 Acres
47.88 Acres
47.88 Acres
3.39 Acres

2019

2.19 Acres
2.19 Acres
0.81 Acres
0.81 Acres
0.81 Acres
119.04 Acres
119.04 Acres
159.92 Acres

2021

4.45 Acres
0.8 Acres
0.8 Acres
53.4 Acres
189.74 Acres

Shallow TCE Isocontour in µg/L
Deep TCE Isocontour in µg/L
Land Use Control Boundary (Groundwater)
Beale Air Force Base

TCE trichloroethene
µg/L micrograms per liter

Source: Brice, 2022b, 2022e

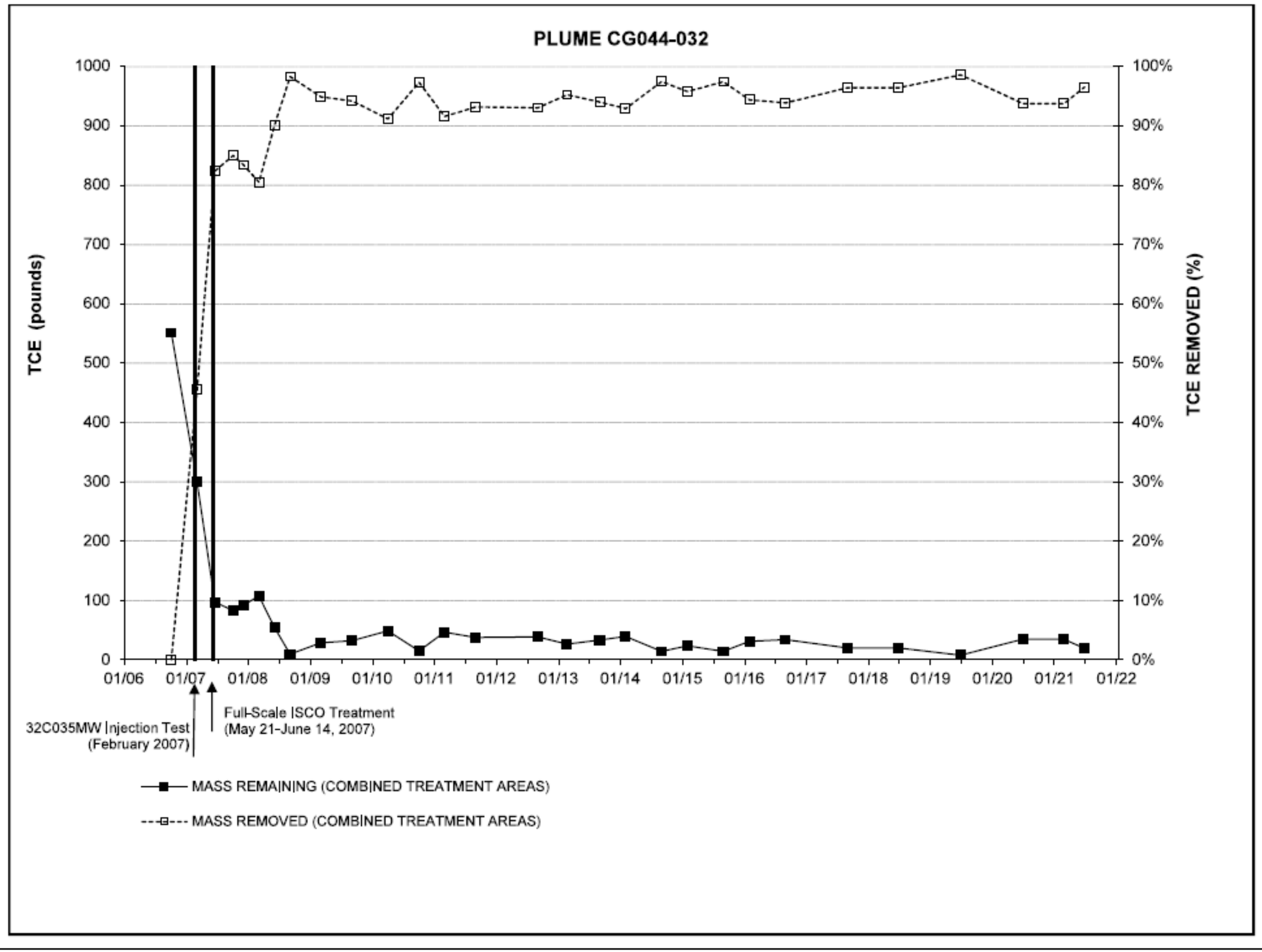
N

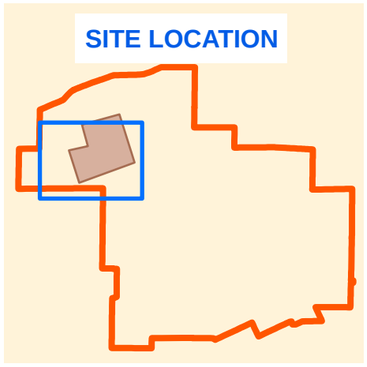
0 1,000 2,000
Feet

PLUME CG044-032 GROUNDWATER TCE ISOCONTOURS (2016, 2019, AND 2021)

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE 4-29





ISCO in-situ chemical oxidation

TCE trichloroethene

Source: Brice, 2022b

PLUME CG044-032
GROUNDWATER TCE
MASS REMOVAL

BEALE AIR FORCE BASE, CALIFORNIA

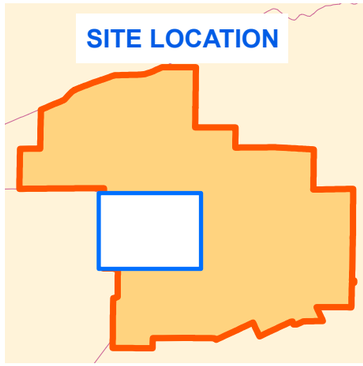
FIGURE
4-30

C:\GIS_Data\USACE\Beale AFB\Beale_AFB.aprx - 6/23/2023

Service Layer Credits: World Imagery : Maxar

G:\GIS_Data\USAGE\Beale AFB\Beale AFB_FYR.aprx 12/10/2023

SITE LOCATION



LEGEND

- Land Use Control Boundary (Groundwater)
- TCE Isocontour in µg/L (2021)
- Former EISB Groundwater Injection Well
- Groundwater Monitoring Well
- Approximate direction of groundwater flow (2021)
- Vernal Pool or Wetland
- Stream
- Ditch or Aqueduct
- Local Road
- Beale Air Force Base Boundary

10C050RW Location ID
104.45 Groundwater Elevation (2021)
0.47 J TCE Concentration in µg/L

EISB	enhanced in-situ bioremediation
J	The analyte was positively identified, but the quantitation is an estimate.
ND	The analyte was not detected
TCE	trichloroethene
µg/L	micrograms per liter

Source: Brice, 2022b, 2022e

Elevations are in feet above NAVD88*

*North American Vertical Datum of 1988 Mean Sea Level may be a few feet above or below this fixed level depending on local conditions in coastal areas.

Gray text in data label indicates elevation not used in contouring.

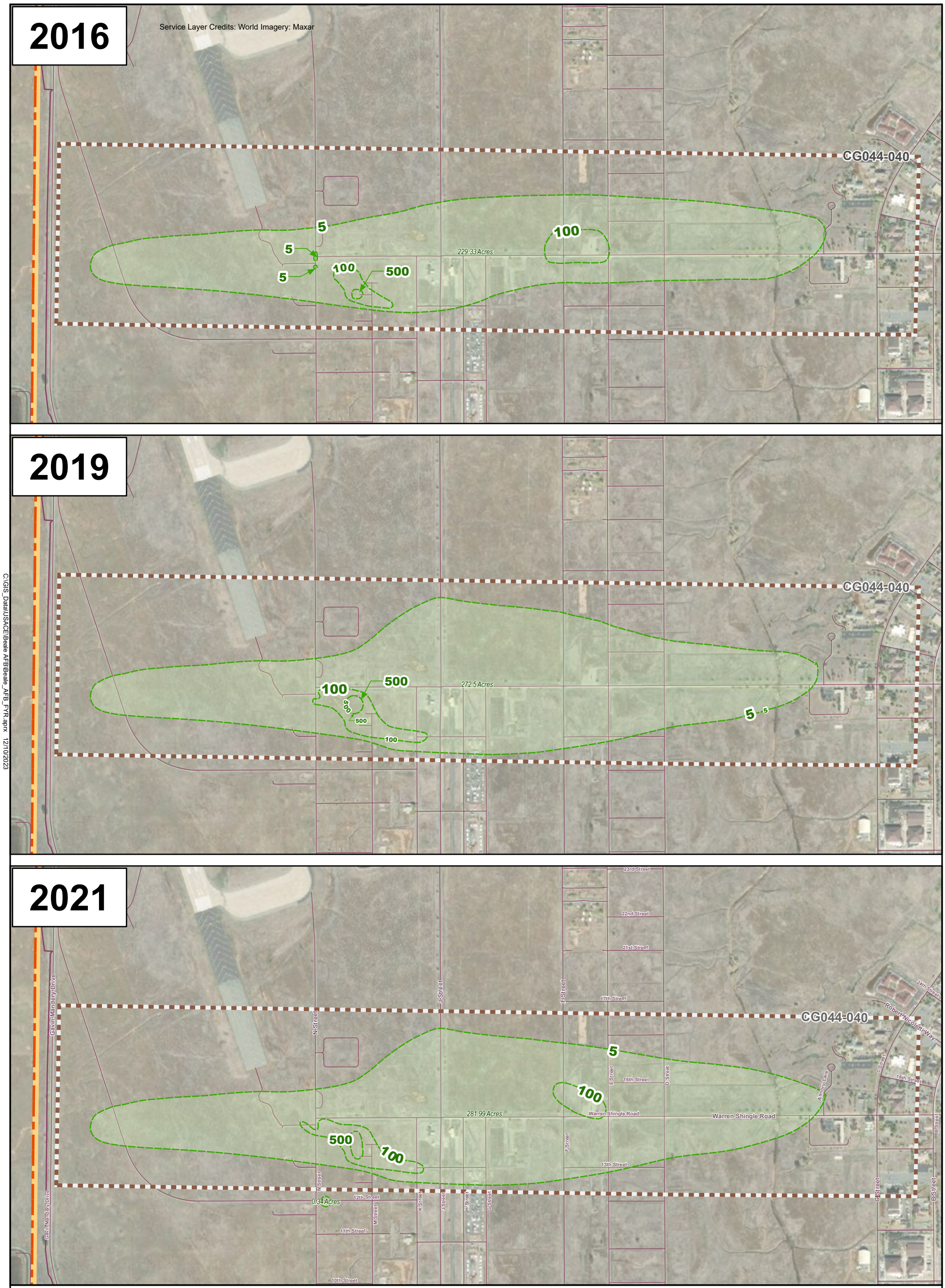
N

0 1,000 2,000
Feet

PLUME CG044-040 ANNUAL 2021 GROUNDWATER TCE CONCENTRATIONS

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE 4-31



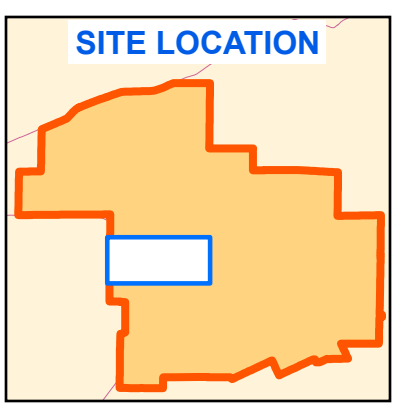
C:\GIS_Data\USACE\Beale AFB\Beale_AFB_FYR.aprx 12/10/2023

LEGEND

- Shallow TCE Isocontour in µg/L
- Land Use Control Boundary (Groundwater)
- Beale Air Force Base

TCE trichloroethene
µg/L micrograms per liter

SITE LOCATION



N

0 1,000 2,000

Feet

Source: Brice, 2022b, 2022e

PLUME CG044-040 GROUNDWATER TCE ISOCONTOURS (2016, 2019, AND 2021)

BEALE AIR FORCE BASE, CALIFORNIA

FIGURE 4-32

Tables

Table 4-1. Summary of TCE, cis-1,2-DCE, and Vinyl Chloride Concentrations and Long-Term TCE Trends — Plume CG041-010

Well ID No.	Type	2021 Annual TCE (µg/L)	2021 Annual cis-1,2-DCE (µg/L)	2021 Annual Vinyl Chloride (µg/L)	TCE Time-Series Plot Trend**
		Project Screening Levels			
		5	6	0.5	
10C035RW	MRP treatment	**23**	1.7	ND	Decreasing
10C044RW	MRP treatment	ND	3	ND	Recently decreasing
10C048MW	MRP treatment	0.31 J	1.9	**2.8**	No trend
10M004MW	MRP treatment	1	**20**	**32**	No trend
10C027MW	MRP transition	**92 J**	**12**	ND	Decreasing
10C050RW	MRP transition	0.47 J	1.2	0.43 J	No trend
10C051RW	MRP transition	0.6 J	**10**	**10**	No trend
10C054RW	MRP transition	**8.8**	**66**	**77**	No trend
10C003MW	MRP compliance	1.3	ND	ND	No trend
10C006MW	MRP compliance	4.3	ND	ND	**Increasing**
10C009MW	MRP compliance	**62**	**8.1**	ND	Variable
10C028MW	MRP compliance	**34**	**28**	0.18 J	Decreasing
10C029MW	MRP compliance	**91**	**33**	0.33 J	**Increasing**
10M007MW-R*	MRP compliance	**15**	**9.6**	ND	No trend
10R003MW	MRP compliance	**27**	0.59 J	ND	**Increasing**
10C040RW	Plume	**11**	**7.8**	ND	Variable
10C041RW	Plume	ND	0.2 J	**3.6**	No trend
10C045RW	Plume	**28**	**6.2**	ND	Decreasing
10C055RW	Plume	0.7 J	**7.8**	**11**	No trend
10C007MW	Downgradient	ND	ND	ND	No trend
10C017AMW	Downgradient	ND	ND	ND	No trend
10C017BMW	Downgradient	ND	ND	ND	No trend
10C019AMW	Downgradient	ND	ND	ND	No trend
10C019BMW	Downgradient	ND	ND	ND	No trend
10C021BMW	Downgradient	ND	ND	ND	No trend
10R004MW	Downgradient	**8.1**	0.9 J	ND	Variable
10R005MW	Downgradient	0.24 J	ND	ND	No trend

Notes:

* = 10M007MW-R is a replacement well for 10M007MW.

**Source: Brice, 2022b ("Basewide Groundwater Monitoring Program 2021 Annual Report, Beale Air Force Base, California," July).

Bold = exceeds project screening levels or shows an increasing trend

DCE = dichloroethene

MRP = Monitoring and Reporting Program

J = estimated quantity

ND = not detected

TCE = trichloroethene

µg/L = micograms per liter

Table 4-2. Summary of TCE Concentrations and Long-Term TCE Trends — Plume CG041-017

Well ID No.	Type	2021 Semiannual TCE (µg/L)	2021 Annual TCE (µg/L)	TCE Time-Series Plot Trend*
		Project Screening Level		
		5		
17C018MW	Secondary source area	NS	**48,000**	**Increasing**
17C019MW	Secondary source area	NS	**8.6**	No trend
17C156MW	Secondary source area	NS	**17**	Decreasing
17C160MW	Secondary source area	NS	**58**	Decreasing
17C161MW	Secondary source area	NS	**5**	Variable
17L008MW	Secondary source area	NS	**160,000**	Variable
17L005MW	Primary source area	NS	**69,000**	Decreasing
17L006MW	Primary source area	NS	**240,000**	Variable
17V002MW	Primary source area	NS	**1,100**	**Increasing**
17V011MW	Primary source area	NS	**20**	No trend
17C015AMW	Plume	2.7	**80**	Variable
17C015BMW	Plume	0.46 J	ND	No trend
17C157MW	Plume	NS	**39**	Decreasing
17C159MW	Plume	NS	**95**	Decreasing
17C162MW	Plume	NS	**16**	Variable
17C164MW	Plume	NS	0.24 J	Variable
17C165BMW	Plume	**180**	**140**	**Increasing**
17C166MW	Plume	**220**	**190**	**Increasing**
17H16BMW	Plume	**91**	**79**	**Increasing**
17L010MW	Plume	ND	ND	No trend
17V001MW	Plume	ND	0.15 J	No trend
17V012MW	Plume	**9.7**	**47**	Variable
17C001MW	Downgradient	NS	ND	No trend
17C009MW	Downgradient	NS	1.1	No trend
17C010MW	Downgradient	NS	1	No trend
17C011MW	Downgradient	NS	ND	No trend
17C168MW	Downgradient	NS	0.16 J	Decreasing
17C169MW	Downgradient	NS	ND	No trend
17H15AMW	Downgradient	0.11 J	NS	No trend
17H15BMW	Downgradient	NS	ND	No trend
17H17BMW	Downgradient	NS	ND	No trend
17H18AMW	Downgradient	NS	ND	No trend
17H18BMW	Downgradient	NS	1.1	No trend

Notes:

*Source: Brice, 2022b ("Basewide Groundwater Monitoring Program 2021 Annual Report, Beale Air Force Base, California," July).

Bold = exceeds project screening level of 5 µg/L or shows an increasing trend

J = estimated quantity

ND = not detected

NS = not sampled

TCE = trichloroethene

µg/L = micograms per liter

Table 4-3. Summary of TCE Concentrations and Long-Term TCE Trends — Plume CG041-018

Well ID No.	Type	2021 Semiannual TCE (µg/L)	2021 Annual TCE (µg/L)	TCE Time-Series Plot Trend*
		Project Screening Level		
		5		
18C046MW	Upgradient	0.84 J	1.1	Decreasing
18C047MW	Upgradient	NS	0.26 J	Decreasing
18C052MW	Upgradient	NS	4	Variable
18L005MW	Upgradient	NS	0.4 J	No trend
18C020MW	Source	**21**	**37**	Variable
18C023MW	Source	**81**	**120**	Decreasing
18C028MW	Source	**88**	**79**	Decreasing
18C021AMW	Plume	**11**	0.39 J	Recently decreasing
18C021BMW	Plume	**8**	**10**	**Increasing**
18C022MW	Plume	**37**	**33**	Recently decreasing
18C024MW	Plume	**16**	**41**	Variable
18C044MW	Plume	NS	**6.1**	Decreasing
18C043MW	Downgradient	NS	ND	No trend
18C045MW	Downgradient	1.1	0.93	Recently decreasing
18U004MW	Downgradient	2.3	2.5	**Increasing**
18U006AMW	Downgradient	NS	1.2	Recently decreasing
18U006BMW	Downgradient	NS	ND	No trend
18U006CMW	Downgradient	NS	ND	No trend
18C053MW	Other Site Well	NS	0.35 J	No trend
18L002MW	Other Site Well	NS	2.7	Decreasing
18U005MW	Other Site Well	NS	ND	No trend
18U007AMW	Other Site Well	ND	ND	No trend
18U007BMW	Other Site Well	ND	ND	No trend
18U008AMW	Other Site Well	ND	ND	No trend
18U008BMW	Other Site Well	ND	ND	No trend
18U008CMW	Other Site Well	1	1	**Increasing**

Notes:

*Source: Brice, 2022b ("Basewide Groundwater Monitoring Program 2021 Annual Report, Beale Air Force Base, California," July).

Bold = exceeds project screening level of 5 µg/L or shows an increasing trend

J = estimated quantity

ND = not detected

NS = not sampled

TCE = trichloroethene

µg/L = micograms per liter

Table 4-4. Summary of TPH-D Concentrations and Long-Term TPH-D Trends – Plume CG041-018

Well ID No.	Type	2021 Annual TCE (µg/L)	2021 Annual TPH-D (µg/L)	TPH-D Time-Series Plot Trend*
		Project Screening Levels		
		5	100	
18U007AMW	Source	**19,000**	**13,000 J**	Decreasing
18U007BMW	Source	**29,000**	**5,400 J**	Variable
18U008AMW	Source	ND J	890	No trend
18U008BMW	Source	**28,000**	**130,000**	**Recently increasing**
18L002MW	Downgradient	NS	ND	No trend
18U005MW	Downgradient	NS	32 J	No trend

Notes:

*Source: Brice, 2022b ("Basewide Groundwater Monitoring Program 2021 Annual Report, Beale Air Force Base, California," July).

Bold = exceeds project screening level of 100 µg/L or shows an increasing trend

J = estimated quantity

ND = not detected

NS = not sampled

TPH-D = total petroleum hydrocarbons as diesel-range organics

µg/L = micograms per liter

Table 4-5. Summary of TCE Concentrations and Long-Term TCE Trends — Plume CG041-029

Well ID No.	Type	2021 Annual TCE (µg/L) Project Screening Level 5	TCE Time-Series Plot Trend*
29C008AMW	Plume	0.24 J	Variable
29C008BMW	Plume	**14**	Variable
29C009BMW	Plume	0.59	Decreasing
29C038AMW	Plume	0.57	No trend
29C038BMW	Plume	**5.2**	No trend
29L004MW	Plume	**9.8**	**Increasing**
29VW004	Plume	1.1	Decreasing
29C040AMW	Downgradient	**5.2**	Variable
29C040BMW	Downgradient	1.6	No trend
29C010AMW	Crossgradient	1.1	No trend
29C037AMW	Crossgradient	ND	No trend
29C037BMW	Crossgradient	2.5	Variable

Notes:

*Source: Brice, 2022b ("Basewide Groundwater Monitoring Program 2021 Annual Report, Beale Air Force Base, California," July).

Bold = exceeds project screening level of 5 µg/L or shows an increasing trend

J = estimated quantity

ND = not detected

NS = not sampled

TCE = trichloroethene

µg/L = micograms per liter

Table 4-6. Summary of TCE Concentrations and Long-Term TCE Trends — Plume CG041-035

Well ID No.	Type	2021 Semiannual TCE (µg/L)	2021 Annual TCE (µg/L)	TCE Time-Series Plot Trend*
		Project Screening Level		
		5		
35C005MW	MRP background compliance	1	1.2	**Increasing**
35C014MW	MRP compliance	**5.3**	**9.7**	Decreasing
35C059MW	MRP compliance	**5.1**	3.5	Recently decreasing
35C082MW	MRP compliance	0.23 J	0.3 J	No trend
35C017MW	MRP performance	**35**	**91**	No trend
35C063MW	MRP performance	ND	ND	No trend
35C064MW	MRP performance	**23**	**14**	No trend
35C058MW	Source, MRP performance	**5.7**	3.6	Decreasing
35C065EW	Source	NS	**31**	No trend
35C010MW	Downgradient	NS	2.1	**Increasing**
35C056MW	Downgradient	NS	ND	No trend
35C066MW	Downgradient	NS	ND	No trend
35C067MW	Plume	**33**	**41**	Variable
35C081MW	Crossgradient	NS	0.14 J	No trend

Notes:

*Source: Brice, 2022b ("Basewide Groundwater Monitoring Program 2021 Annual Report, Beale Air Force Base, California," July).

Bold = exceeds project screening level of 5 µg/L or shows an increasing trend

J = estimated quantity

MRP = Monitoring and Reporting Program

ND = not detected

NS = not sampled

TCE = trichloroethene

µg/L = micograms per liter

Table 4-7. Summary of TCE, cis-1,2-DCE, and Vinyl Chloride Concentrations and Long-Term TCE Trends — Plume CG041-039 Source Area 1

Well ID No.	Type	2021 Annual TCE (µg/L) Project Screening Level 5	TCE Time-Series Plot Trend*
39C017AMW	Source	**1,200**	Variable
39C017BMW	Source	**860**	Variable
39C045BMW	Source	**30**	Decreasing
39C045AMW	Source, MRP performance	**16**	Recently decreasing
39C051IW	Source, MRP performance	0.17 J	Decreasing
39C057IW	Source, MRP performance	0.12 J	No trend
39C087IW	Source, MRP performance	0.21 J	Decreasing
39C015AMW	Plume	**70**	Variable
39C047MW	Plume	**130**	Decreasing
39C048AMW	Plume	**55**	Decreasing
39C088MW	Plume	**97**	Variable
39U006AMW	Plume	**24**	Decreasing
39U006BMW	Plume	0.26 J	No trend
39U007AMW	Plume	3	No trend
39U007BMW	Plume	**51**	No trend
39U007CMW	Plume	**20**	Decreasing
39U008APZ	Plume	**32**	**Increasing**
39U008BPZ	Plume	**130**	Variable
A72U001AMW	Plume	4.6	No trend
A72U001BMW	Plume	0.29 J	No trend
A72U002AMW	Plume	ND	No trend
A72U002BMW	Plume	**47**	**Increasing**
A72U002CMW	Plume	**31**	Variable
39C044MW	Plume, MRP performance	**210**	Decreasing
39C046MW	Plume, MRP performance	**63**	Recently decreasing
39C048BMW	Plume, MRP performance	**200**	Decreasing
39C089IW	Plume, MRP performance	2	Decreasing
39C090IW	Plume, MRP performance	0.32	Decreasing
39C015BMW	Plume, MRP compliance	**44**	Decreasing
39C023MW	Upgradient, MRP compliance	**36**	**Increasing**
39C025MW	Upgradient	**42**	**Increasing**
39C019AMW	Upgradient	ND	No trend
39C019BMW	Upgradient	ND	No trend
36U001MW	Cross gradient	ND	No trend
39U005AMW	Cross gradient	0.76	No trend
39U005BMW	Cross gradient	0.42 J	Decreasing
39U007APZ	Cross gradient	ND	No trend
39U007BPZ	Cross gradient	0.27 J	No trend

Notes:

*Source: Brice, 2022b ("Basewide Groundwater Monitoring Program 2021 Annual Report, Beale Air Force Base, California," July).

Bold = exceeds project screening level of 5 µg/L or shows an increasing trend

J = estimated quantity

MRP = Monitoring and Reporting Program

ND = not detected

TCE = trichloroethene

µg/L = micograms per liter

Table 4-8. Summary of TCE, cis-1,2-DCE, and Vinyl Chloride Concentrations and Long-Term TCE Trends — Plume CG041-039 Source Area 2

Well ID No.	Type	2021 Annual TCE (µg/L) Project Screening Level 5	TCE Time-Series Plot Trend*
39C027MW	Source	ND	No trend
39C028MW	Source	ND	No trend
39C029MW	Source	ND	No trend
39U001AMW	Source	0.19 J	No trend
39U001BMW	Source	ND	Decreasing
39U002MW	Source	0.53 J	No trend
19C001MW	Plume	**34**	Decreasing
19C002MW	Plume	**43**	Decreasing
19C003MW	Plume	**66**	**Increasing**
19L001MW	Plume	**54**	No trend
19L002MW	Plume	**45**	Decreasing
39C013AMW	Plume	ND	No trend
39C013BMW	Plume	**31**	**Increasing**
39C014AMW	Plume	**9.6**	Decreasing
39C014BMW	Plume	4.3	Variable
39C058AMW	Plume	1.5	Decreasing
39C058BMW	Plume	2.8	Decreasing
39C058CMW	Plume	0.2 J	Decreasing
39U003AMW	Plume	ND	No trend
39U003BMW	Plume	**13**	Decreasing
39U003CMW	Plume	ND	No trend
39U008AMW	Plume	ND	No trend
39U009AMW	Plume	**33**	**Increasing**
39U009BMW	Plume	1.5	Decreasing
A72U003AMW	Plume	3.5	**Increasing**
A72U003BMW	Plume	**28**	Variable
A72U003CMW	Plume	**17**	**Increasing**
39U008BMW	Plume, MRP compliance	**6.1**	No trend
39C016MW	Downgradient	0.34 J	Decreasing
UBL001MW	Downgradient	1.7	No trend

Notes:

*Source: Brice, 2022b ("Basewide Groundwater Monitoring Program 2021 Annual Report, Beale Air Force Base, California," July).

Bold = exceeds project screening level of 5 µg/L or shows an increasing trend

J = estimated quantity

MRP = Monitoring and Reporting Program

ND = not detected

TCE = trichloroethene

µg/L = micograms per liter

Table 4-9. Summary of TCE Concentrations and Long-Term TCE Trends — Plume CG044-003

Well ID No.	Type	2021 Semiannual TCE (µg/L)	2021 Annual TCE (µg/L)	TCE Time-Series Plot Trend*
		Project Screening Level		
		5		
03C031MW	MRP background compliance	**59**	**65**	Decreasing
03C018MW	MRP treatment	**150**	**180**	Decreasing
03C019AMW	MRP treatment	**12 J**	**13**	Decreasing
03C019BMW	MRP treatment	4.3	0.11 J	Decreasing
03C032MW	MRP treatment	**29**	**25**	Decreasing
03C050IW	MRP treatment	ND	ND	No trend
03C051IW	MRP treatment	**28**	**26**	Variable
03C052IW	MRP treatment	ND	ND	No trend
03C053IW	MRP treatment	ND	**71**	Variable
03C054IW	MRP treatment	ND	ND	No trend
03C055IW	MRP treatment	ND	ND	No trend
03C056MW	MRP treatment	0.99 J	0.32 J	Decreasing
03C057MW	MRP treatment	**52**	**50**	Decreasing
03C030MW	MRP transition	**63**	**140**	Variable
03C045AMW	MRP transition	**140**	**150**	Variable
03C013AMW	MRP compliance	**93**	**54**	Decreasing
03C015AMW	MRP compliance	NS	**15**	**Increasing**
03C015BMW	MRP compliance	NS	3.4	**Increasing**
03C045BMW	MRP compliance	NS	1.7	Variable
03R001MW	MRP compliance	NS	3.5	Variable
03R003MW	MRP compliance	NS	**19**	Variable
03C013BMW	Plume	NS	ND	No trend
03C021MW	Plume	**170**	**160**	Variable
03C046AMW	Plume	**41**	**32**	Recently decreasing
03C046BMW	Plume	NS	0.16 J	Decreasing
03C048MW	Plume	**72**	**86**	Variable
03C049MW	Plume	NS	**20**	Variable
FT03PEW4	Plume (Eastern Source Area)	NS	**28**	**Recently increasing**
FT03VW7D	Plume	**17**	**12**	Variable
03C012AMW	Cross gradient	NS	0.32 J	No trend
03C012BMW	Cross gradient	NS	ND	No trend
03C061MW	Cross gradient	NS	ND	No trend
03R002MW	Cross gradient	NS	3.6	**Increasing**
03R011MW	Cross gradient	NS	ND	No trend
03C011MW	Downgradient	NS	0.37 J	No trend
03C058MW	Downgradient	NS	ND	No trend
03C059MW	Downgradient	**24**	**17**	**Increasing**
03C060MW	Downgradient	NS	2.2	No trend
03L001MW	Downgradient	3.7	4.9	Variable
UAL005PZS	Downgradient	NS	ND	No trend

Notes:
*Source: Brice, 2022b ("Basewide Groundwater Monitoring Program 2021 Annual Report, Beale Air Force Base, California," July).
Bold = exceeds project screening level of 5 µg/L or shows an increasing trend
J = estimated quantity
MRP = Monitoring and Reporting Program
ND = not detected
NS = not sampling
TCE = trichloroethene
µg/L = micograms per liter

Table 4-10. Summary of TCE Concentrations and Long-Term TCE Trends — Plume CG044-013

Well ID No.	Type	HSU	2021 Semiannual TCE (µg/L)	2021 Annual TCE (µg/L)	TCE Time-Series Plot Trend*
			Project Screening Level		
			5		
13C004MW	Upgradient	HSU-2A	NS	0.5 J	No trend
13C064IW	MRP background	HSU-2A	NS	**7.3**	**Recently increasing**
13C070VEW	MRP treatment	HSU-1	NS	0.36 J	Decreasing
13C077VEW	MRP treatment	HSU-1	NS	**13**	Decreasing
13C079VEW	MRP treatment	HSU-1	NS	0.18 J	Decreasing
13C083MWa	MRP treatment	HSU-1/2A	NS	**8.6**	**Recently increasing**
13C084MW	MRP treatment	HSU-1	NS	**8.5**	Decreasing
13C085MW	MRP treatment	HSU-1/2A	NS	11	Decreasing
13C086MW	MRP treatment	HSU-1	NS	3.9	Decreasing
13C088MW	MRP treatment	Screened within bioreactor	NS	ND	No trend
13C091MW	MRP treatment	Screened within bioreactor	NS	ND	No trend
13C051EWa	MRP compliance	HSU-2A	NS	**26**	Decreasing
13L004EW	MRP compliance	HSU-2A/2C	1.5	1.3	Decreasing
13C001MW	Plume	HSU-2B	NS	**9.2**	Decreasing
13C006MWa	Plume	HSU-2A	NS	**9.1**	**Recently increasing**
13C011EWa	Plume	HSU-2D	NS	1.4	Decreasing
13C045MW	Plume	HSU-2D	2.9	3.2	Recently decreasing
13C050EW	Plume	HSU-2D	NS	1.2	Decreasing
13C054MW	Plume	HSU-2D	3.7	2.6	Recently decreasing
13C081EW	Plume	HSU-1/2A	NS	3.9	No trend
13C090BMW	Plume	HSU-2A	**5.5**	**5.1**	Recently decreasing
13L001EW	Plume	HSU-2A/2C	NS	4.8	Decreasing
13L001MW	Plume	HSU-2B	NS	**16**	Decreasing
13L003EW	Plume	HSU-2A/2C	NS	**5.8**	No trend
13L004MWa	Plume	HSU-2A	NS	**28**	Decreasing
13L005MW	Plume	HSU-2C	NS	**7.8**	No trend
13L006MW	Plume	HSU-2C	NS	**40**	**Recently increasing**
13L011MW	Plume	HSU-2A	NS	**7.7**	Decreasing
13L027MW	Plume	HSU-2C	NS	**5.1**	Decreasing
13L029MW	Plume	HSU-2A	2.1	2.8	Recently decreasing
13O005EWa	Plume	HSU-2A/2B/2C	NS	3.7	Decreasing
13C010EW	On-Base downgradient	HSU-2C	NS	ND	No trend
13C038MW	On-Base downgradient	HSU-2A	NS	ND	No trend
13C039MW	On-Base downgradient	HSU-2C	NS	ND	No trend
13C056MW	On-Base downgradient	HSU-2A	NS	ND	No trend
13C058MW	On-Base downgradient	HSU-4	NS	1.2	**Recently increasing**
13C089AMW	On-Base downgradient	HSU-1	NS	ND	No trend
13C089BMW	On-Base downgradient	HSU-2A	NS	0.24 J	No trend
13C090AMW	On-Base downgradient	HSU-1	ND	0.21 J	No trend
13C105MW	On-Base downgradient	HSU-2D	NS	ND	No trend
13L002EW	On-Base downgradient	HSU-2A/HSU-2C	NS	4.4	No trend
13L010MW	On-Base downgradient	HSU-2A	NS	**8.9**	**Recently increasing**

Table 4-10. Summary of TCE Concentrations and Long-Term TCE Trends — Plume CG044-013

Well ID No.	Type	HSU	2021 Semiannual TCE (µg/L)	2021 Annual TCE (µg/L)	TCE Time-Series Plot Trend*
			Project Screening Level		
			5		
13L018MW	On-Base downgradient	HSU-2D	NS	ND	No trend
13L022MW	On-Base downgradient	HSU-2D	NS	3.4	Decreasing
13L028MW	On-Base downgradient	HSU-2D	NS	ND	No trend
13O007EW	On-Base downgradient	HSU-2A and HSU-2C	NS	1.9	No trend
13O009EW	On-Base downgradient	HSU-2B	NS	0.23 J	No trend
13O036MW	On-Base downgradient	HSU-2C	NS	ND	No trend
13O037MW	On-Base downgradient	HSU-2D	NS	**5.4**	Variable
13C041PZS	Off-Base downgradient	HSU-2B	NS	ND	No trend
13C041PZM	Off-Base downgradient	HSU-2C	NS	ND	No trend
13C041PZD	Off-Base downgradient	HSU-2D	NS	ND	No trend
13C042MW	Off-Base downgradient	HSU-2D	NS	ND	No trend
13C043MW	Off-Base downgradient	HSU-2D	NS	ND	No trend
13C044MW	Off-Base downgradient	HSU-2D	NS	ND	No trend
13C046MW	Off-Base downgradient	HSU-2D	NS	0.5	No trend
13C055MW	Off-Base downgradient	HSU-4	NS	1.2	**Increasing**
13C103MW	Off-Base downgradient	HSU-2A	NS	ND	No trend
13C104MW	Off-Base downgradient	HSU-2A and HSU-2B	NS	ND	No trend
13C106MW	Off-Base downgradient	HSU-2D	NS	ND	No trend
13L030MW	Off-Base downgradient	HSU-2D	NS	2.8	Variable
13L031MW	Off-Base downgradient	HSU-2D	NS	1.2	No trend
13L032MW	Off-Base downgradient	HSU-2D	NS	0.2 J	Decreasing
13O033MW	Off-Base downgradient	HSU-2B	NS	ND	No trend
13O034MW	Off-Base downgradient	HSU-2C	NS	ND	No trend
13O035MW	Off-Base downgradient	HSU-2D	NS	ND	Decreasing

Notes:

*Source: Brice, 2022b ("Basewide Groundwater Monitoring Program 2021 Annual Report, Beale Air Force Base, California," July).

a = active extraction well during 2021 annual sampling

Bold = exceeds project screening level of 5 µg/L or shows an increasing trend

HSU = hydrostratigraphic unit

J = estimated quantity

MRP = Monitoring and Reporting Program

ND = not detected

NS = not sampling

TCE = trichloroethene

µg/L = micograms per liter

Table 4-11. Summary of TCE Concentrations and Long-Term TCE Trends — Plume CG044-031

Well ID No.	Type	2021 Annual TCE (µg/L) Project Screening Level 5	TCE Time-Series Plot Trend*
31C003MW	MRP performance	0.25	No trend
31C005AMW	MRP performance	**6.4**	No trend
31C005BMW	MRP performance	1.1	No trend
31C006BMW	MRP performance	0.23 J	No trend
31C010AMW	MRP performance	**9.9**	Decreasing
31C011AMW	MRP performance	ND	Decreasing
31C013MW	MRP performance	3	No trend
31C014MW	MRP performance	0.39 J	No trend
31C032MW	MRP performance	ND	No trend
31C033MW	MRP performance	2.1	No trend
31C034MW	MRP performance	0.95	No trend
31C035MW	MRP performance	1.4	No trend
31M002MW	MRP performance	ND	No trend
31M003MW	MRP performance	0.16	No trend
31U001AMW	MRP performance	3	Decreasing
31U003BMW	MRP performance	**29**	Decreasing
31C041BMW	MRP compliance	**45**	Variable
31C044MW	MRP compliance	**81**	Decreasing
31C045AMW	MRP compliance	ND	No trend
31C049MW	MRP compliance	**5.3**	Variable
31M001MW	MRP background	4.4	**Increasing**
31C006CMW	Plume	**8.6**	Decreasing
31C011BMW	Plume	1.5	Variable
31C012AMW	Plume	1.7	Variable
31C012BMW	Plume	**57**	Recently decreasing
31C015MW	Plume	**13**	No trend
31C018MW	Plume	**170**	No trend
31C020MW	Plume	**84**	No trend
31C022MW	Plume	**500**	**Recently increasing**
31C026MW	Plume	1.7	Decreasing
31C042AMW	Plume	**1,500**	Variable
31C042BMW	Plume	**9,100**	Decreasing
31C043MW	Plume	**5,200**	Decreasing
31R003MW	Plume	**210**	Variable
31R004BMW	Plume	0.86	No trend
31U001BMW	Plume	0.27 J	No trend
31C041AMW	Downgradient	1.2	No trend
31C046AMW	Downgradient	ND	No trend
31C046BMW	Downgradient	ND	No trend
31C047AMW	Downgradient	ND	No trend
31C047BMW	Downgradient	ND	No trend
31C048AMW	Downgradient	ND	No trend
31C048BMW	Downgradient	ND	No trend
UBL003MW	Downgradient	0.47 J	No trend

Notes:
*Source: Brice, 2022b ("Basewide Groundwater Monitoring Program 2021 Annual Report, Beale Air Force Base, California," July).
Bold = exceeds project screening level of 5 µg/L or shows an increasing trend
HSU = hydrostratigraphic unit
J = estimated quantity
MRP = Monitoring and Reporting Program
ND = not detected
TCE = trichloroethene
µg/L = micograms per liter

Table 4-12. Summary of TCE Concentrations and Long-Term TCE Trends — Plume CG044-032

Well ID No.	Type	2021 Semiannual TCE (µg/L)	2021 Annual TCE (µg/L)	TCE Time-Series Plot Trend*
		Project Screening Level		
		5		
Northern Source Area				
32C004MW	MRP treatment	NS	**16**	Decreasing
32C039MW	MRP treatment	NS	4.9	No trend
32C048MW	MRP treatment	NS	**28**	No trend
32M001MW	MRP treatment	NS	**170**	**Recently increasing**
32M002MW	MRP treatment	NS	**24**	Decreasing
32C068MW	MRP treatment	NS	**6.1**	Decreasing
32M003MW	MRP treatment	NS	1	No trend
32R002MW	MRP compliance	NS	ND	No trend
SD32VE4D	Plume	NS	0.96 J	Decreasing
Southern Source Area				
32C024MW	MRP treatment	NS	**9.6**	No trend
32C067MW	MRP transition	NS	**21**	Recently decreasing
05R002MW	MRP compliance	NS	**55**	Recently decreasing
32C026IW	MRP compliance	NS	**46**	Variable
32C027EW	MRP compliance	NS	**53**	**Increasing**
32C037MW	MRP compliance	NS	1.4	No trend
05R003MW	Plume	**110**	**14**	**Increasing**
32C040MW	Plume	NS	**7.3**	Decreasing
Distal Plume Area (west of the source areas)				
01C009AMW	Plume	NS	3.1	Variable
01C009BMW	Plume	**26**	**21**	Variable
01C009CMW	Plume	NS	0.4 J	Decreasing
01C103AMW	Plume	NS	**48**	Variable
01C103BMW	Plume	NS	0.12 J	Decreasing
01C104AMW	Plume	**17**	2.7	Recently decreasing
01C104BMW	Plume	NS	**9.5**	**Increasing**
01L009MW	Plume	4.5	**5.8**	Decreasing
21L001MW	Plume	NS	**6.7**	**Increasing**
21L002MW	Plume	**120**	**13**	Variable
Cross-Gradient Wells				
01C102AMW	Northwest cross gradient	NS	ND	No trend
01C102BMW	Northwest cross gradient	NS	ND	No trend
01R008MW	Northwest cross gradient	NS	ND	No trend
32C009AMW	Northwest cross gradient	NS	**7.9**	No trend
32C009BMW	Northwest cross gradient	NS	ND	No trend
Upgradient Wells				
11C003MW	Upgradient	NS	**5.5**	Recently decreasing
11C004MW	Upgradient	NS	2.5	Recently decreasing
Downgradient Wells				
01C007AMW	Downgradient	0.14 J	ND	No trend
01C007BMW	Downgradient	0.28 J	0.3 J	No trend
01C007CMW	Downgradient	0.19 J	0.32 J	No trend
01C008AMW	Downgradient	**8.1**	4.9	**Increasing**

Table 4-12. Summary of TCE Concentrations and Long-Term TCE Trends — Plume CG044-032

Well ID No.	Type	2021 Semiannual TCE (µg/L)	2021 Annual TCE (µg/L)	TCE Time-Series Plot Trend*
		Project Screening Level		
		5		
Downgradient Wells *(continued)*				
01C008BMW	Downgradient	**7.6**	**5.5**	**Increasing**
01C008CMW	Downgradient	**11**	**9.9**	**Increasing**
01C011AMW	Downgradient	ND	ND	No trend
01C011BMW	Downgradient	ND	ND	No trend
01C011CMW	Downgradient	ND	ND	No trend
01C101AMW	Downgradient	NS	2	Variable
01C101BMW	Downgradient	NS	2.6	Variable
01C106MW	Downgradient	NS	ND	No trend
01L001MW	Downgradient	NS	0.92	**Increasing**
01L002MW	Downgradient	ND	ND	No trend
01L003MW	Downgradient	ND	ND	No trend
01L005MW	Downgradient	NS	1.4	Decreasing
01L010MW	Downgradient	NS	ND	No trend
32C081MW	Downgradient	**31**	**19**	**Increasing**
32C082AMW	Downgradient	1.1	0.92 J	**Increasing**
32C082BMW	Downgradient	ND	ND	No trend
32C083AMW	Downgradient	**8.7**	7.1	**Increasing**
32C083BMW	Downgradient	ND	ND	No trend
32C084AMW	Downgradient	1.6	1.5	**Increasing**
32C084BMW	Downgradient	ND	ND	No trend

Notes:

*Source: Brice, 2022b ("Basewide Groundwater Monitoring Program 2021 Annual Report, Beale Air Force Base, California," July).

Bold = exceeds project screening level of 5 µg/L or shows an increasing trend

J = estimated quantity

MRP = Monitoring and Reporting Program

ND = not detected

NS = not sampled

TCE = trichloroethene

µg/L = micograms per liter

Table 4-13. Summary of TCE Concentrations and Long-Term TCE Trends — Eastern Plume CG044-040

Well ID No.	Type	2021 Annual TCE (µg/L) Project Screening Level 5	TCE Time-Series Plot Trend*
40C002AMW	Plume	NS	No trend
40C002BMW	Plume	**9.1**	Decreasing
40C002CMW	Plume	NS	No trend
40C005AMW	Plume	2.9	Decreasing
40C005BMW	Plume	2.2	Decreasing
40C005CMW	Plume	**240**	Decreasing
40C009AMW	Plume	**32**	Decreasing
40C009BMW	Plume	0.77	No trend
40C009CMW	Plume	ND	No trend
40C025MW	Plume	**5.2**	Decreasing
40C055MW	Plume	**35**	Variable
40C056MW	Plume	**100**	Variable
40C057MW	Plume	**15**	**Increasing**
40C058AMW	Plume	**30**	No trend
40C058BMW	Plume	ND	No trend
40C059MW	Plume	**29**	Variable
40C060MW	Plume	**13**	Variable
40C061AMW	Plume	**24**	Variable
40C061BMW	Plume	**15**	Variable
UBL002MW	Plume	**22**	Decreasing

Notes:

*Source: Brice, 2022b ("Basewide Groundwater Monitoring Program 2021 Annual Report, Beale Air Force Base, California," July).

Bold = exceeds project screening level of 5 µg/L or shows an increasing trend

J = estimated quantity

ND = not detected

NS = not sampled

TCE = trichloroethene

µg/L = micograms per liter

Table 4-14. Summary of TCE Concentrations and Long-Term TCE Trends — Western Plume CG044-040

Well ID No.	Type	2021 Annual TCE (µg/L) Project Screening Level 5	TCE Time-Series Plot Trend*
40C017MW	MRP Background	**160**	**Recently increasing**
40C026MW	MRP Treatment zone	**16**	Variable
40C034AMW	MRP Treatment zone	**54**	Variable
40C035MW	MRP Treatment zone	**550**	Variable
40C039MW	MRP Treatment zone	**360**	**Recently increasing**
40C034BMW	MRP Plume	**120**	Variable
40C033AMW	MRP Compliance	**50**	Decreasing
40C033BMW	MRP Compliance	**39**	Variable
40C033CMW	MRP Compliance	ND	No trend
40C018AMW	Plume	0.43 J	No trend
40C018BMW	Plume	**29**	Recently decreasing
40C021AMW	Plume	ND	No trend
40C021BMW	Plume	ND	No trend
40C022MW	Plume	**82**	Variable
40C023MW	Plume	**40**	Variable
40C024AMW	Plume	**8.4**	Variable
40C024BMW	Plume	**32**	Variable
40C036MW	Plume	**64**	Variable
40C037AMW	Plume	1.5	Variable
40C037BMW	Plume	**47**	Variable
40C037CMW	Plume	**35**	**Recently increasing**
40C038MW	Plume	**580**	Variable
40C044MW	Plume	**43**	**Increasing**
40C054MW	Plume	**180**	Variable
JST MW-07	Plume	**18**	Decreasing

Notes:

*Source: Brice, 2022b ("Basewide Groundwater Monitoring Program 2021 Annual Report, Beale Air Force Base, California," July).

Bold = exceeds project screening level of 5 µg/L or shows an increasing trend

J = estimated quantity

MRP = Monitoring and Reporting Program

ND = not detected

TCE = trichloroethene

µg/L = micograms per liter

Appendix A.
Community Notification (Published Public Notice)

PROOF OF PUBLICATION

APPEAL-DEMOCRAT

1530 Ellis Lake Drive, Marysville, CA 95901 * (530) 749-4700

STATE OF CALIFORNIA * Counties of Yuba and Sutter

I am not a party to, nor interested in the above entitled matter. I am the principal clerk of the printer and publisher of THE APPEAL-DEMOCRAT, a newspaper of general circulation, printed and published in the City of Marysville, County of Yuba, to which Newspaper has been adjudged a newspaper of general circulation by The Superior Court of the County of Yuba, State of California under the date of November 9, 1951, No. 11481, and County of Sutter to which Newspaper has been adjudged a newspaper of general circulation by the Superior Court of the County of Sutter, State of California under the date of May 17, 1999, Case No. CVPT99-0819. The Notice, of which the annexed is a copy, appeared in said newspaper on the following dates:

February 9, 2023

I declare under penalty of perjury that the foregoing is true and correct.

February 9, 2023 Kathy Tannehill

Date Signature

Barrett Resource Group Public Notice

COPY:

PUBLIC NOTICE
COMMENCEMENT OF THE THIRD
FIVE-YEAR REVIEW AT MULTIPLE SITES
AT BEALE AIR FORCE BASE

The Air Force Civil Engineer Center (AFCEC) announces it has begun preparations for the Third Five-Year Review to evaluate ongoing environmental remedies at seven environmental restoration sites at Beale Air Force Base (AFB) in Yuba County, California.

This is the Third Five-Year Review conducted for the base. It is being prepared pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act, Section 121, and the National Contingency Plan. It is being performed because hazardous substances, pollutants, and/or contaminants remain at the sites above levels that allow for unlimited use and unrestricted exposure. The purpose of the Five-Year Review is to evaluate the performance of remedies and their progress toward achieving site cleanup objectives. This Third Five-Year Review will verify if the remedies are protective of human health and the environment.

Upon completion of the review, a Five-Year Review Report will be issued. The report will provide protectiveness statements and, if needed, will recommend actions to be taken before the next Five-Year Review. Public involvement is an important part of the Five-Year Review process. The final report will become a part of the AFCEC Administrative Record and will be available for public viewing on the AFCEC public website (https://ar.afcec-cloud.af.mil/).

If you have any issues or concerns about the cleanup actions at the seven environmental restoration sites on Beale AFB, or if you want to be placed on the Beale AFB mailing list, please contact 2nd Lieutenant Hailey Malay, Public Affairs Officer, Office of Public Affairs, at (530) 634-8887 or via email at hailey.malay@us.af.mil.

FOR MORE INFORMATION:

If you have questions, comments, or input related to the upcoming Five-Year Review process, please contact:

Mr. Darren Rector
Restoration Program Manager, Beale AFB
AFCEC/CZOW
6451 B Street, Building 2535
Beale AFB, CA 95903-1708
Email: Darren.rector.2@usaf.mil

Phone: (530) 634-2606, Alternate: (530) 434-9740

February 9, 2023 Ad #00287884

Legals 1000

FICTITIOUS BUSINESS NAME STATEMENT
FILE NO. 2023-0000043
The following person(s) are doing business as
MJ TRANS
1350 Jamie Dr.
Yuba City, CA 95993
1) MJ Boparai Trans Inc.
1350 Jamie Dr.
Yuba City, CA 95993
State: CA
This business is conducted by an Individual. The registrant commenced to transact business under the fictitious business name or names listed above on 1/1/2023. (I declare that all information in this statement is true and correct). Signed: **Jatinderpal Singh Boparai.**
This statement was filed with the County Clerk of Sutter County on January 26, 2023. (I Hereby Certify That This Copy is a Correct Copy of the Original on File in my Office).
DONNA M. JOHNSTON,
County Clerk
By S. Becerra
Deputy Clerk
February 2, 9, 16 & 23, 2023
Ad #00287658

FICTITIOUS BUSINESS NAME STATEMENT
FILE NO. 2023F-024
The following person(s) are doing business as
SISSY'S ATTIC
419 D Street
Marysville, CA 95901
1) Dana Burroughs
2225 Covillaud Street
Marysville, CA 95901
This business is conducted by an Individual. The registrant commenced to transact business under the fictitious business name or names listed above on February 1, 2018. (I declare that all information in this statement is true and correct). Signed: **Dana Burroughs, Owner**
This statement was filed with the County Clerk of Yuba County on January 24, 2023, indicated by file stamp. (I Hereby Certify That This Copy is a Correct Copy of the Original on File in my Office).
DONNA HILLEGASS,
County Clerk
By B. Evans,
Deputy Clerk
February 9, 16, 23 & March 2, 2023
Ad #00287891

T.S. No.: 22-6771
Notice of Trustee's Sale
Loan No.: *******092 APN: 14-111-027 You Are In Default Under A Deed Of Trust Dated 9/24/2015. Unless You Take Action To Protect Your Property, It May Be Sold At A Public Sale. If You Need An Explanation Of The Nature Of The Proceeding Against You, You Should Contact A Lawyer. A public auction sale to the highest bidder for cash, cashier's check drawn on a state or national bank, check drawn by a state or federal credit union, or a check drawn by a state or federal savings and loan association, or savings association, or savings bank specified in Section 5102 of the Financial Code and authorized to do business in this state will be held by the duly appointed trustee as shown below, of all right, title, and interest conveyed to and now held by the trustee in the hereinafter described property under and pursuant to a Deed of Trust described below. The sale will be made, but without covenant or warranty, expressed or implied, regarding title, possession, or encumbrances, to pay the remaining principal sum of the note(s) secured by the Deed of Trust, with interest and late charges thereon, as provided in the note(s), advances, under the terms of the Deed of Trust, interest thereon, fees, charges and expenses of the Trustee for the total amount (at the time of the initial publication of the Notice of Sale) reasonably estimated to be set forth below. The amount may be greater on the day of sale. Trustor: Bobby T. Elder And Shirley S. Elder, Husband And Wife And Clyde E. Elder, A Single Man, All As Joint Tenants Duly Appointed Trustee: Prestige Default Services, LLC Recorded 10/5/2015 as Instrument No. 2015-0014341 of Official Records in the office of the Recorder of Sutter County, California, Date of Sale: 2/23/2023 at 11:00 AM Place of Sale: steps to main entrance County Courthouse, 446 Second Street, Yuba City Amount of unpaid balance and other charges: $118,239.07 Street Address or other common designation of real property: 2614 Palm St. Sutter California 95982 A.P.N.: 14-111-027 The undersigned Trustee disclaims any liability for any incorrectness of the street address or other common designation, if any, shown above. If no street address or other common designation is shown, directions to the location of the property may be obtained by sending a written request to the beneficiary within 10 days of the date of first publication of this Notice of Sale. Notice To Potential Bidders: If you are considering bidding on this property lien, you should understand that there are risks involved in bidding at a trustee auction. You will be bidding on a lien, not on the property itself. Placing the highest bid at a trustee auction does not automatically entitle you to free and clear ownership of the property. You should also be aware that the lien being auctioned off may be a junior lien. If you are the highest bidder at the auction, you are or may be responsible for paying off all liens senior to the lien being auctioned off, before you can receive clear title to the property. You are encouraged to investigate the existence, priority, and size of outstanding liens that may exist on this property by contacting the county recorder's office or a title insurance company, either of which may charge you a fee for this information. If you consult either of these resources, you should be aware that the same lender may hold more than one mortgage or deed of trust on the property. All checks payable to Prestige Default Services, LLC. Notice To Property Owner: The sale date shown on this notice of sale may be postponed one or more times by the mortgagee, beneficiary, trustee, or a court, pursuant to Section 2924g of the California Civil Code. The law requires that information about trustee sale postponements be made available to you and to the public, as a courtesy to those not present at the sale. If you wish to learn whether your sale date has been postponed, and, if applicable, the rescheduled time and date for the sale of this property, you may call (877) 440-4460 or visit this Internet Web site https://mkconsultantsinc.com/trustees-sales/, using the file number assigned to this case 22-6771. Information about postponements that are very short in duration or that occur close in time to the scheduled sale may not immediately be reflected in the telephone information or on the Internet Web site. The best way to verify postponement information is to attend the scheduled sale. Notice To Tenant: You may have a right to purchase this property after the trustee auction pursuant to Section 2924m of the California Civil Code. If you are an "eligible tenant buyer," you can purchase the property if you match the last and highest bid placed at the trustee auction. If you are an "eligible bidder," you may be able to purchase the property if you exceed the last and highest bid placed at the trustee auction. There are three steps to exercising this right of purchase. First, 48 hours after the date of the trustee sale, you can call (877) 440-4460, or visit this internet website https://mkconsultantsinc.com/trustees-sales/, using the file number assigned to this case 22-6771 to find the date on which the trustee's sale was held, the amount of the last and highest bid, and the address of the trustee. Second, you must send a written notice of intent to place a bid so that the trustee receives it no more than 15 days after the trustee's sale. Third, you must submit a bid so that the trustee receives it no more than 45 days after the trustee's sale. If you think you may qualify as an "eligible tenant buyer" or "eligible bidder," you should consider contacting an attorney or appropriate real estate professional immediately for advice regarding this potential right to purchase. Date: 1/12/2023 Prestige Default Services, LLC 1920 Old Tustin Ave. Santa Ana, California 92705 Questions: 949-427-2010 Sale Line: (877) 440-4460 Patricia Sanchez, Trustee Sale Officer. 1/26, 2/2, 2/9/23. Ad #00287453

Merchandise for Sale 0775

Legals 1000

Notice of Public Hearing on Proposed Stormwater Service Fee

To: Landowners within the Boundaries of Reclamation District No. 1000

PLEASE TAKE NOTICE that a Public Hearing on a proposed RD 1000 Stormwater Service Fee will be held on March 10 at 8 a.m. at the District Offices, located at 1633 Garden Highway, Sacramento, California, pursuant to Proposition 218. The proposed fee would fund maintenance, operation, and upgrading of the District's interior drainage systems. At the public hearing, the agency shall consider all objections or protests, if any, to the proposed fee. Ballots have been mailed to all affected property owners, and must be returned before the close of the Public Hearing to be counted. If a majority of returned ballots are cast in favor of the proposed fee, the District may consider levying the proposed fee. For more information on the proposed Stormwater Service Fee, including details on the calculation of the fee and ballot tabulation, please visit www.4Natomas.org.

Joleen Gutierrez, Board Secretary
Reclamation District No. 1000

February 9, 2023 Ad #00287904

Legals 1000

SUPERIOR COURT OF CALIFORNIA
COUNTY OF SUTTER
IN THE MATTER OF THE APPLICATION OF:
PETITIONER: JULIANA RIVAS ALBOR
CASE NUMBER: CVCS 22-2197
ORDER TO SHOW CAUSE
FOR CHANGE OF NAME
Petitioner(s) Juliana Rivas Albor filed a petition with this court for a decree changing name as follows:
from: Emmanuel Lorenzo Rivas Medina
to: Emmanuel Lorenzo Rivas
THE COURT ORDERS that all persons interested in this matter appear before this court at the hearing indicated below to show cause, if any, why the petition for change of name should not be granted. Any person objecting to the name changes described above must file a written objection that includes the reasons for the objection at least two court days before the matter is scheduled to be heard and must appear at the hearing to show cause why the petition should not be granted. If no written objection is timely filed, the court may grant the petition without a hearing.
NOTICE OF HEARING:
March 20, 2023 at 9:00 a.m. in Dept. 1
1175 Civic Center Blvd., Yuba City, CA 95993
A copy of this Order to Show Cause shall be published at least once each week for four successive weeks prior to the date set for hearing on the petition in the following newspaper of general circulation, printed in this county Appeal-Democrat.
Date: January 26, 2023
PERRY PARKER
JUDGE OF THE SUPERIOR COURT
February 2, 9, 16 & 23, 2023 Ad #00287712

Legals 1000

SUPERIOR COURT OF CALIFORNIA
COUNTY OF SUTTER
IN THE MATTER OF THE APPLICATION OF:
PETITIONER: ZOHAL HAYATZADA
CASE NUMBER: CVCS 23-86
ORDER TO SHOW CAUSE
FOR CHANGE OF NAME
Petitioner(s) Zohal Hayatzada filed a petition with this court for a decree changing name as follows:
from: Zohal Hayatzada
to: Zohal Enayat

from: Omar Hayatzada
to: Omar Enayat

from: Nahan Hayatzada
to: Nahan Enayat
THE COURT ORDERS that all persons interested in this matter appear before this court at the hearing indicated below to show cause, if any, why the petition for change of name should not be granted. Any person objecting to the name changes described above must file a written objection that includes the reasons for the objection at least two court days before the matter is scheduled to be heard and must appear at the hearing to show cause why the petition should not be granted. If no written objection is timely filed, the court may grant the petition without a hearing.
NOTICE OF HEARING:
March 6, 2023 at 9:00 a.m. in Dept. 1
1175 Civic Center Blvd., Yuba City, CA 95993
A copy of this Order to Show Cause shall be published at least once each week for four successive weeks prior to the date set for hearing on the petition in the following newspaper of general circulation, printed in this county Appeal-Democrat.
Date: 1-23-2023
PERRY PARKER
JUDGE OF THE SUPERIOR COURT
February 2, 9, 16 & 23, 2023 Ad #00287663

Legals 1000

PUBLIC NOTICE
COMMENCEMENT OF THE THIRD
FIVE-YEAR REVIEW AT MULTIPLE SITES
AT BEALE AIR FORCE BASE

The Air Force Civil Engineer Center (AFCEC) announces it has begun preparations for the Third Five-Year Review to evaluate ongoing environmental remedies at seven environmental restoration sites at Beale Air Force Base (AFB) in Yuba County, California.

This is the Third Five-Year Review conducted for the base. It is being prepared pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act, Section 121, and the National Contingency Plan. It is being performed because hazardous substances, pollutants, and/or contaminants remain at the sites above levels that allow for unlimited use and unrestricted exposure. The purpose of the Five-Year Review is to evaluate the performance of remedies and their progress toward achieving site cleanup objectives. This Third Five-Year Review will verify if the remedies are protective of human health and the environment.

Upon completion of the review, a Five-Year Review Report will be issued. The report will provide protectiveness statements and, if needed, will recommend actions to be taken before the next Five-Year Review. Public involvement is an important part of the Five-Year Review process. The final report will become a part of the AFCEC Administrative Record and will be available for public viewing on the AFCEC public website (https://ar.afcec-cloud.af.mil/).

If you have any issues or concerns about the cleanup actions at the seven environmental restoration sites on Beale AFB, or if you want to be placed on the Beale AFB mailing list, please contact 2nd Lieutenant Hailey Malay, Public Affairs Officer, Office of Public Affairs, at (530) 634-8887 or via email at hailey.malay@us.af.mil.

FOR MORE INFORMATION:

If you have questions, comments, or input related to the upcoming Five-Year Review process, please contact:

Mr. Darren Rector
Restoration Program Manager, Beale AFB
AFCEC/CZOW
6451 B Street, Building 2535
Beale AFB, CA 95903-1708
Email: Darren.rector.2@usaf.mil
Phone: (530) 634-2606, Alternate: (530) 434-9740

February 9, 2023 Ad #00287884

Appendix B.
Interview Record Forms

#1

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Friday, April 21, 2023 1:31:56 PM
Last Modified:	Friday, April 21, 2023 2:22:37 PM
Time Spent:	00:50:40
IP Address:	165.235.31.126

Page 2

Q1

Please provide your contact information

Name	**Mark Clardy**
Company	**Central Valley Regional Water Quality Control Board**
Address	**11020 Sun Center Drive, #200**
City/Town	**Rancho Cordova**
State/Province	**CA**
ZIP/Postal Code	**95742**
Country	**United States**
Email Address	**mark.clardy@waterboards.ca.gov**
Phone Number	**9164644719**

Q2

What is your overall impression of the project? (general sentiment)

Sites are satisfactorily progressing through RI/FS and cleanup phases

Q3

Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please give purpose and results.

Yes (please specify):
Water Board staff has collected split groundwater samples with the Air Force from offbase domestic supply wells several times and trichloroethene (TCE) concentrations have been below the MCL. Staff routinely reviews and comments on remedial investigation/feasibility study work plans and reports, remedial action plans, proposed plans, and records of decision. Air Force responses to review comments have generally been acceptable.

Q4

Have there been any complaints, violations, or other incidents related to the site requiring a response by your office? If so, please give details of the events and results of the responses.

Yes (please specify):
Water Board staff has been notified of leaks and spills from groundwater treatment system operations at CG044-013 on at least two occasions. Staff has followed up with the Air Force on spill information, sample analytical data, and planned response activities to resolve and prevent the issue from occurring in the future.

Q5

Do you feel well-informed about the site's activities and progress?

Yes

Q6

Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

Timely notification of California Office of Emergency Services in the event of an unauthorized discharge.

INTERVIEW RECORD

Regulatory Agency Input

Beale Air Force Base Environmental Remediation Program

Third Five Year Review

Site Names:
CG041 *(Plumes CG041-010, CG041-016, CG041-017, CG041-018, CG041-029, CG041-035, CG041-039),*
CG-044 *(Plumes CG044-003, CG044-013, CG044-031, CG044-032, CG044-040),*
LF013, OT017, SD032, ST018, and TU509

Review period: July 2016 – June 2022

Subject: Third Five Year Review **Date:** 6/21/2023

How did you receive this interview form? ☒ Email ☐ US Mail ☐ Other

Contact Made By:

Name: Elizabeth Basinet **Title:** Community Outreach Specialist **Organization:** Bayside Engineering and Construction, Inc.

Individual Contacted:

Name: Kimiye Touchi **Organization:**

Title: **Beale RPM, Haz Mtl, Engineer** **Mailing Address (Street):** **8800 Cal**

Telephone: 916-255-3667 **Address (cont'd):** Center Drive

Fax: **City, State, ZIP:** Sacramento, CA 95826

E-Mail: Kimiye.touchi@dtsc.ca.gov

Summary of Conversation

1. What is your overall impression of the project? (general sentiment)

The ERP program at Beale appears well managed. The Air Force, contractor, and Corp of Engineer contract manager appear to coordinate well to ensure that work that needs to get done can occur with relative efficiency. Unexpected conditions cause some delays in the ability to complete work in a timely manner, but they are typically short lived.

2. Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please give purpose and results.

DTSC conducted one to two site visits per year between 2020 and 2023. Site visits included site walks to assess site conditions, observe field activities, and attend RAB field trips.

Most communications are via team meeting where the Air Force invites interested parties to discuss site activities and/or concerns on a regular basis. Some occur monthly depending on the need. The Air Force is able to arrange for DTSC/Water Board to hold technical discussions with the contractor to resolve technical concerns. The AF RPM also is willing to have one-on-one discussions as needed to answer questions.

INTERVIEW RECORD

Regulatory Agency Input

Beale Air Force Base Environmental Remediation Program

Third Five Year Review

Site Names:
CG041 *(Plumes CG041-010, CG041-016, CG041-017, CG041-018, CG041-029, CG041-035, CG041-039),*
CG-044 *(Plumes CG044-003, CG044-013, CG044-031, CG044-032, CG044-040),*
LF013, OT017, SD032, ST018, and TU509

Review period: July 2016 – June 2022

3. Have there been any complaints, violations, or other incidents related to the site requiring a response by your office? If so, please give details of the events and results of the responses.

None

4. Do you feel well informed about the site's activities and progress?

In general, the Air Force provides adequate updates, but with field work, more frequent updates would be welcome.

5. Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

When field work is occurring, weekly updates on progress would be welcome.

#1

COMPLETE

Collector:	Brice Response (Web Link)
Started:	Wednesday, April 26, 2023 8:34:06 PM
Last Modified:	Wednesday, April 26, 2023 8:38:17 PM
Time Spent:	00:04:11
IP Address:	68.7.156.162

Page 2

Q1

Please provide your contact information

Name	**Leah Waller, Scott Dressler**
Company	**Brice Environmental, Inc**
Address	**3700 Centerpoint Dr**
Address 2	**Suite 8133**
City/Town	**Anchorage**
State/Province	**AK**
ZIP/Postal Code	**99503**
Country	**United States**
Email Address	**lwaller@briceenvironmental.com, sdressler@briceenvironmental.com**
Phone Number	**(907) 275-2896**

Q2

What is your overall impression of the remedies selected for Beale AFB's Environmental Restoration Program (ERP) Third Five-Year Review (FYR) sites listed above?

The remedies provide a best value while maintaining protectiveness.

Q3

Are the source removal and/or the groundwater remedies functioning as expected? Do you have any concerns regarding the function of the remedies?

Please see information provided in the Annual, Semiannual, and Monthly Long-Term Operation and Maintenance (LTO&M) and Basewide Groundwater Monitoring Program (BGMP) Reports that assess the groundwater remedies.

Q4

What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?

Please see information provided in the Basewide Groundwater Monitoring Reports that assess contaminant levels and trends which vary by site/plume.

Q5

Is there a continuous on-site Operations and Maintenance (O&M) presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.

Please see information provided in the LTO&M Reports. Since award of Brice's contract in August 2020, Brice has subcontracted O&M to Jacobs Engineering. O&M activities for active remedies vary by site as described in the LTO&M Reports. Land Use Control inspections are performed twice annually as described in Annual Land Use Control (LUC) Reports.

Q6

Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines since start-up or in the last five years? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.

Please see information provided in the Annual LTO&M and BGMP Reports. MRP and sampling changes are summarized in the BGMP Reports. Optimization of basewide groundwater sampling is ongoing and changes in sampling are documented in the Annual BGMP Reports. Since award of Brice's contract in August 2020, the following changes have occurred in LTO&M: On 5 April 2021, Central Valley Water Board issued a NOA authorizing Beale AFB to discharge CG044-013 GTS effluent to Hutchinson Creek. As construction of the CG041-17 remedial action was delayed from 2021 to 2023 due to lack of site access (delay in the bridge construction by Beale AFB), additional LTO&M of the GETS (interim remedy) was required from May 2021 to April 2022. The CG041-17 GETS was shutdown in April 2022 due to contaminant breakthrough of the lag granular activated carbon (GAC) vessel. Vinyl chloride concentrations in the effluent were slightly below the MCL. GAC changeout was delayed because of lack of site access.

Q7

Have there been unexpected O&M difficulties or costs at the site since the startup or in the last five years?

Since award of Brice's contract in August 2020, there has been cost inflation and decreased availability of some materials, such as EVO.

Q8

Would you say that O&M and/or sampling efforts have been optimized? Please describe how improved efficiency has or has not occurred.

Please see information provided in the Annual LTO&M and BGMP Reports. O&M and/or sampling efforts have been optimized as technically feasible.

Q9

What were some of the successes/problems in the implementation of access and institutional/land use controls?

We have no additional information beyond what is documented in the Annual Land Use Control (LUC) Reports.

Q10

Do the land use and site conditions remain the same at the Third FYR Sites since the respective decision documents were finalized and/or since the last FYR?

Other than the information provided in Annual LUC Reports, we have no additional information regarding land use and site conditions.

Q11

Have the Third FYR sites been in compliance with permitting and reporting requirements?

Please see information provided in the Annual LTO&M Reports. MRP changes and compliance with Waste Discharge Requirements are also documented in the BGMP Reports.

Q12

Do you have any comments, suggestions, or recommendations regarding the implementation of the remedies or how the program has been conducted in general?

We have no recommended changes beyond those documented in the Annual Reports.

Q13

Do you have any comments on the operation of the remedies related to future effectiveness or optimization of operations?

We have no additional information beyond what is provided in the Annual Reports.

Q14

What is your single greatest concern regarding the ongoing performance of the remedies for the Third FYR sites?

Impacts from off-base pumping.

Q15

Have any new or emerging Contaminants of Concern (COCs) been identified? If so, have they impacted the effectiveness of the remedies?

Please see the PFAS Site Inspection Report and Phase I Remedial Investigation Work Plan regarding the presence of PFAS in soil and groundwater. Please see the 1,4-Dioxane and 1,2,3-TCP Fieldwork Summary Technical Memorandum regarding the presence of 1,2,3-trichloropropane (TCP) in groundwater.

Q16

What effects have site operations had on the surrounding community?

None are known at this time.

Q17

Are you aware of any community concerns regarding the site or its operation and administration?

None are known at this time.

Q18

Are you aware of any events, incidents, or activities at any of the Third FYR sites such as vandalism, trespassing, or emergency responses from local authorities? If so, please include details.

None are known.

Q19

Have there been any complaints, violations, or other incidents related to any of the Third FYR sites requiring a response?

None are known.

Q20

Do you have any other overall comments, suggestions, or recommendations regarding the Third FYR Sites?

No additional comments.

#2

COMPLETE

Collector:	Jacobs Response (Web Link)
Started:	Thursday, April 27, 2023 10:15:13 AM
Last Modified:	Thursday, April 27, 2023 10:24:03 AM
Time Spent:	00:08:49
IP Address:	68.7.156.162

Page 2

Q1

Please provide your contact information

Name	**Jay Wilburn**
Company	**Jacobs Engineering Group, Inc.**
Address	**2485 Natomas Park Drive**
Address 2	**Suite 600**
City/Town	**Sacramento**
State/Province	**CA**
ZIP/Postal Code	**95833**
Country	**United States**
Email Address	**E-Mail: jay.wilburn@jacobs.com**
Phone Number	**(248) 719-5089**

Q2

What is your overall impression of the remedies selected for Beale AFB's Environmental Restoration Program (ERP) Third Five-Year Review (FYR) sites listed above?

The remedies provide a best value while maintaining protectiveness.

Q3

Are the source removal and/or the groundwater remedies functioning as expected? Do you have any concerns regarding the function of the remedies?

Please see information provided in the Semiannual and Annual Long-Term Operation and Maintenance (LTO&M) Reports and Annual Basewide Groundwater Monitoring Program (BGMP) Reports that assesses the groundwater remedies.

Q4

What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?

Please see information provided in the Annual BGMP Reports that assesses contaminant levels and trends which vary by site.

Q5

Is there a continuous on-site Operations and Maintenance (O&M) presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.

There was a continuous on-site O&M presence during the five-year review period. Please see information provided in the Semiannual and Annual LTO&M Reports. From July 2016 to July 2020, CH2M HILL performed O&M at Beale AFB. Since award of Brice's contract in August 2020, Brice has subcontracted O&M to Jacobs Engineering. O&M activities for active remedies vary by site as described in the LTO&M Reports. Land Use Control inspections are performed twice annually.

Q6

Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines since start-up or in the last five years? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.

Please see information provided in the Semiannual and Annual LTO&M Reports and Annual BGMP Reports. Monitoring and Reporting Program (MRP) and sampling changes are summarized in the Annual BGMP Reports. Optimization of basewide groundwater sampling is ongoing and changes in sampling are documented in the Annual BGMP Reports. Since award of Brice's contract in August 2020, the following changes have occurred in LTO&M: On 5 April 2021, the Central Valley Water Board (CVWB) issued a Notice of Applicability (NOA) authorizing Beale AFB to discharge CG044-013 Groundwater Treatment System (GTS) effluent to Hutchinson Creek. Discharge to Hutchinson Creek is performed in accordance with a National Pollutant Discharge Elimination System (NPDES) permit issued to Beale AFB by CVWB. Discharge of GTS effluent to Hutchinson Creek began on 1 September 2021. Sampling and monitoring performed in accordance with the NPDES permit are documented in quarterly reports submitted to CVWB. As construction of the CG041-017 remedial action was delayed from 2021 to 2023 due to lack of site access (delay in the bridge construction by Beale AFB), additional LTO&M of the groundwater extraction and treatment system (GETS; interim remedy) was required from May 2021 to April 2022. The CG041-017 GETS was shut down in April 2022 due to contaminant breakthrough of the lag granular activated carbon (GAC) vessel. Vinyl chloride concentrations in the GETS effluent were slightly below the maximum contaminant level. GAC changeout was delayed because of lack of site access due to a delay in bridge construction by Beale AFB.

Q7

Have there been unexpected O&M difficulties or costs at the site since the startup or in the last five years?

Please see information provided in the Semiannual and Annual LTO&M Reports. Since award of Brice's contract in August 2020, there has been cost inflation and decreased availability of some materials, such as emulsified vegetable oil.

Q8

Would you say that O&M and/or sampling efforts have been optimized? Please describe how improved efficiency has or has not occurred.

Please see information provided in the Semiannual and Annual LTO&M Reports and Annual BGMP Reports. O&M and/or sampling efforts have been optimized as technically feasible.

Q9

What were some of the successes/problems in the implementation of access and institutional/land use controls?

We have no additional information beyond what is documented in the Annual Land Use Control (LUC) Reports.

Q10

Do the land use and site conditions remain the same at the Third FYR Sites since the respective decision documents were finalized and/or since the last FYR?

Other than the information provided in Annual LUC Reports, we have no additional information regarding land use and site conditions.

Q11

Have the Third FYR sites been in compliance with permitting and reporting requirements?

Please see information provided in the Semiannual and Annual LTO&M Reports, quarterly NPDES Reports for the CG044 013 GTS, and Annual BGMP Reports. MRP changes and compliance with Waste Discharge Requirements (WDR) are also documented in the Annual BGMP Reports.

Q12

Do you have any comments, suggestions, or recommendations regarding the implementation of the remedies or how the program has been conducted in general?

We have no recommended changes beyond those documented in the Annual Reports.

Q13

Do you have any comments on the operation of the remedies related to future effectiveness or optimization of operations?

We have no additional information beyond what is provided in the Annual Reports.

Q14

What is your single greatest concern regarding the ongoing performance of the remedies for the Third FYR sites?

Impacts from off-base pumping.

Q15

Have any new or emerging Contaminants of Concern (COCs) been identified? If so, have they impacted the effectiveness of the remedies?

Please see the PFAS Site Inspection Report and Phase I Remedial Investigation Work Plan regarding the presence of PFAS in soil and groundwater. Please see the 1,4-Dioxane and 1,2,3-TCP Fieldwork Summary Technical Memorandum regarding the presence of 1,2,3-trichloropropane (TCP) in groundwater.

Q16

What effects have site operations had on the surrounding community?

None are known at this time.

Q17

Are you aware of any community concerns regarding the site or its operation and administration?

None are known at this time.

Q18

Are you aware of any events, incidents, or activities at any of the Third FYR sites such as vandalism, trespassing, or emergency responses from local authorities? If so, please include details.

None are known.

Q19

Have there been any complaints, violations, or other incidents related to any of the Third FYR sites requiring a response?

The NOA requires Beale AFB to monitor water temperature in Hutchinson Creek upstream and downstream of the outfall where CG044-013 GTS effluent discharges to the creek. On 2 December 2022, the CVWB sent a letter to Beale AFB titled Self-Monitoring Report Review and Notice of Violation, Department of the Air Force, Plume CG044-013 Groundwater Treatment System, Yuba County. The letter states that the GTS discharge violated receiving water limitations contained in the applicable WDRs. Specifically, the water temperature increased by more than 5 degrees Fahrenheit between the upstream and downstream monitoring locations on 8 March and 6 April 2022. On both dates, the temperature changes may have resulted from two factors, including (1) the difference in temperatures measured at the effluent and upstream monitoring locations, and (2) the limited flow in Hutchinson Creek. The temperature change exceedances were most likely caused by the higher temperature of the effluent relative to the upstream location and by the low flow rate at the upstream location. The flow rate in the creek upstream of the GTS outfall was too low to offset the temperature increase caused by mixing with GTS effluent. Beale AFB natural resources (NR) management staff concluded that the receiving water temperature increases measured on 8 March and 6 April 2022 would have insignificant impacts on aquatic life in Hutchinson Creek and were not a cause for concern. Beale NR staff relayed that Hutchinson Creek is a seasonal creek, dead-ending on Beale AFB and is not spawning water for sensitive species. The GTS discharge is ecologically beneficial due to the continued source of water downstream of the outfall during non-rain season months. In response to the CVWB's letter, Beale AFB will collect additional data in 2023 to improve its understanding of the impact of the GTS discharge on receiving water temperature in Hutchinson Creek. From January through May 2023, Beale AFB will temporarily shut down the GTS once per month to collect baseline temperature and streamflow data while the GTS is not discharging to the creek. The creek characteristics between the upstream and downstream monitoring locations (width, water movement, and exposure to sunlight) will also be noted and photographed. Beale AFB will submit the baseline streamflow and temperature data to CVWB separately from the quarterly NPDES reports. Additionally, if it is determined that the upstream flow rate is not adequate to offset the temperature increase from the effluent discharge, the GTS will be shut down or the GTS effluent will be diverted to the clarifying pond at the Base's wastewater treatment plant.

Q20

Do you have any other overall comments, suggestions, or recommendations regarding the Third FYR Sites?

No additional comments.

#1

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Sunday, April 23, 2023 1:22:49 PM
Last Modified:	Sunday, April 23, 2023 1:27:18 PM
Time Spent:	00:04:29
IP Address:	67.182.161.49

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Q1

Please provide your contact information

Name	**Marcus H Bole**
Company	**Marcus H Bole & Associates**
Address	**104 Brock Drive**
City/Town	**Wheatland**
State/Province	**CA**
ZIP/Postal Code	**95692**
Country	**United States**
Email Address	**mbole@aol.com**
Phone Number	**5306330117**

Q2

Are you a member of the Beale AFB Restoration Advisory Board (RAB)?

Yes

Q3

What is your overall impression of the remedies selected for Beale AFB's Environmental Restoration Program (ERP) Third Five-Year Review (FYR) sites listed above?

Impressive, well researched and effective

Q4

What effects have site operations had on the surrounding community?

Positive, the local community has greatly benefited from the communication on site operations

Q5

Are you aware of any community concerns regarding the site or its operation and administration?

No

Q6

Are you aware of any events, incidents, or activities at any of the Third FYR sites such as vandalism, trespassing, or emergency responses from local authorities? If so, please include details.

No

Q7

Have there been any complaints, violations, or other incidents related to any of the Third FYR sites requiring a response?

No

Q8

Do you feel well-informed about the site's activities and progress?

Yes

Q9

Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

Superb management in all aspects. I am proud to be a part of the RAB

#2

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Sunday, April 23, 2023 4:17:42 PM
Last Modified:	Sunday, April 23, 2023 4:27:27 PM
Time Spent:	00:09:45
IP Address:	107.127.18.36

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Q1

Please provide your contact information

Name	**Sandy Saunders**
Company	**Lindsey community.**
Address	**1808 Sierra way**
City/Town	**Marysville**
State/Province	**CA**
ZIP/Postal Code	**95901**
Country	**USA**
Email Address	**jcspcs36@gmail.com**
Phone Number	**5303014658**

Q2

Are you a member of the Beale AFB Restoration Advisory Board (RAB)?

Yes

Q3

What is your overall impression of the remedies selected for Beale AFB's Environmental Restoration Program (ERP) Third Five-Year Review (FYR) sites listed above?

Excellent

Q4

What effects have site operations had on the surrounding community?

Safer environment

Q5

Are you aware of any community concerns regarding the site or its operation and administration?

No

Q6

Are you aware of any events, incidents, or activities at any of the Third FYR sites such as vandalism, trespassing, or emergency responses from local authorities? If so, please include details.

No

Q7

Have there been any complaints, violations, or other incidents related to any of the Third FYR sites requiring a response?

No

Q8

Do you feel well-informed about the site’s activities and progress?

Yes

Q9

Do you have any comments, suggestions, or recommendations regarding the site’s management or operation?

Respondent skipped this question

Appendix C.
Site Inspection Checklist and Photograph Log

Photo C-1. CG041-010 (SD010) –Monitoring wells in the foreground and background (EA monitoring)

Photo C-2. CG041-010 (SD010) – ERD (EVO injections) for wells exhibiting rebound

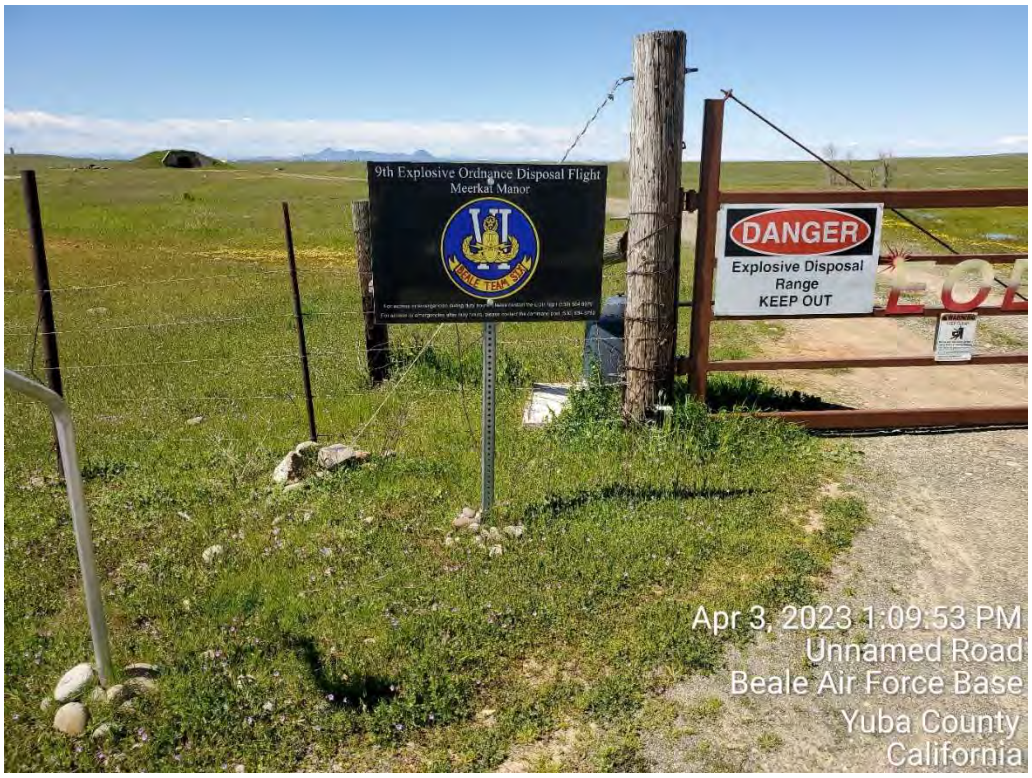

Photo C-3. CG041-016 (WP016) – Explosive ordnance disposal site

Photo C-4. CG041-017 – GTS with air stripping towers and the GAC vessel

Photo C-5. CG041-017/OT-017 – Permeable reactive barrier and slurry wall area

Photo C-6. CG041-017/OT-017 – Best Slough slurry wall alignment

Photo C-7. CG041-018 – Well 18U007BMW (in the foreground to the left) with a passive skimmer for light nonaqueous-phase liquid recovery

Photo C-8. CG041-018 – Decommissioned biosparging system

Photo C-9. CG041-018 –ERD injection wells and monitoring wells

Photo C-10. CG041-029 (FT029) – Former SVE system area

Photo C-11. CG041-035 (SS035) – Former SVE system area

Photo C-12. CG041-035 (SS035) – Former in-situ bioreactor area

Photo C-13. CG041-039 (SS039) – Former SVE system area

Photo C-14. CG041-039 (SS039) – ERD injection well

Photo C-15. CG044-003 (FT003) – Former Fire Training Area

Photo C-16. CG044-013 – Groundwater treatment system with air strippers

Photo C-17. CG044-013 – Groundwater treatment system control building

Photo C-18. CG044-013 – Groundwater extraction well field (to northwest)

Photo C-19. CG044-013 – Groundwater extraction well field (to west)

Photo C-20. CG044-013 – Groundwater wells and remnants of former SVE system

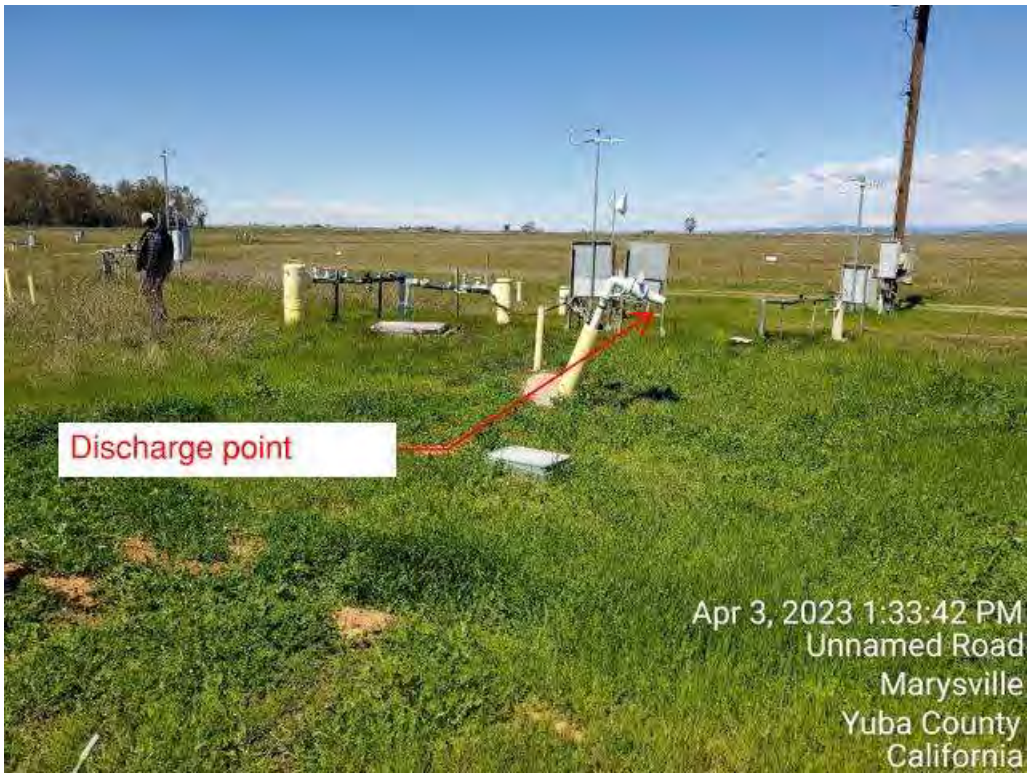

Photo C-21. CG044-013 – Bioreactor area

Photo C-22. CG044-013 / LF013 – Landfill cap

Photo C-23. CG044-013 / LF013 – Landfill cap

Photo C-24. CG044-013 – Hutchinson creek outfall for discharging GTS effluent

Photo C-25. CG044-031 – Former EISB System ancillary components

Photo C-26. CG044-031 – Former Building 896 foundations
(taken from the northwest corner of the parcel)

Photo C-27. CG044-031 –Source Area Between Well Cluster 31C053[A/B/C] and 31C043MW (taken from the northwest corner of the parcel)

Photo C-28. CG044-032 (SD032) – Former SVE area

Photo C-29. CG044-032 (SD032) – Monitoring well intact; no signs of damage

Photo C-30. Wellhead treatment system for off-Base residential well OBL004AW

Photo C-31. Wellhead treatment system for off-Base residential well OBL005AW

Photo C-32. Wellhead treatment system for off-Base residential well OBL008AW

Photo C-33. CG044-040 – Groundwater treatment area (Biobarrier)

Photo C-34. Site TU509 – Former UST and treatment area

Photo C-35. Site TU509 – Treatment area

I. SITE INFORMATION	
Site name: Beale AFB Sites LF013, OT017, SD032, ST018, TU509, CG041 Plume Sites, and CG044 Plume Sites	**Date of Inspection:** 03 April 2023, 18 May 2023, and 20 July 2023
Location and Region: Beale AFB, Yuba County, CA	**EPA ID:** N/A
Agency, office, or company leading the five-year review: Bayside Engineering Construction, Inc.	**Weather/temperature:** Sunny/65ºF–70ºF

Remedy Includes: (Check all that apply)

- ☒ Landfill cover/containment
- ☒ Access controls
- ☒ Institutional controls
- ☒ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☒ Other: In-Situ Treatment
- ☒ Enhanced attenuation
- ☒ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☒ Inspection photograph log attached ☒ Site map attached (under Figures)

II. INTERVIEWS (Check all that apply)

1. **O&M Prime Contractor** _ Leah Waller, Brice Environmental_ ___Project Manager____ __4/26/23___
   Name Title Date
   Interviewed ☐ at site ☐ at office ☒ by email email: __ lwaller@briceenvironmental.com _
   Problems, suggestions; ☐ Report attached _____
   Appendix B includes the interview record form completed by Brice Environmental Corporation.

2. **O&M Subcontractor** __ Jay Wilburn _____ __Project Manager__ __4/27/23___
   Name Title Date
   Interviewed ☐ at site ☐ at office ☒ by email email: _ jay.wilburn@jacobs.com _
   Problems, suggestions; ☐ Report attached _____
   __Appendix B includes interview record form completed by Jacobs Environmental Engineering

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

   Agency _Central Valley Regional Water Quality Control Board
   Contact ___Mark W. Clardy_____ Remedial Project Manager __4/21/23 916-464-4719
   Name Title Date Phone no.
   Problems; suggestions; ☐ _Report attached
   _____Appendix B includes the interview record form

   Agency __ Department of Toxic Substances Control__
   Contact __ Kimiye Touchi _____ _Remedial Project Manager __6/21/23_ 916-255-3667_ __
   Name Title Date Phone no.
   Problems; suggestions; ☐ Report attached
   __ Appendix B includes the interview record form _____

4. **Other interviews** (optional) ☐ Report attached.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
   - ☒ O&M manual — ☒ Readily available — ☒ Up to date — ☐ N/A
   - ☒ As-built drawings — ☒ Readily available — ☒ Up to date — ☐ N/A
   - ☒ Maintenance logs — ☒ Readily available — ☒ Up to date — ☐ N/A

   Remarks O&M Work Plan prepared under the Beale ORC

2. **Site-Specific Health and Safety Plan** — ☒ Readily available — ☒ Up to date — ☐ N/A
   - ☒ Contingency plan/emergency response plan — ☒ Readily available — ☒ Up to date — ☐ N/A

   Remarks

3. **O&M and OSHA Training Records** — ☒ Readily available — ☒ Up to date — ☐ N/A

   Remarks

4. **Permits and Service Agreements**
   - ☒ Air discharge permit — ☒ Readily available — ☒ Up to date — ☐ N/A
   - ☒ Effluent discharge — ☒ Readily available — ☒ Up to date — ☐ N/A
   - ☐ Waste disposal, POTW — ☐ Readily available — ☐ Up to date — ☒ N/A
   - ☐ Other permits: WDR (General) — ☒ Readily available — ☒ Up to date — ☐ N/A

   Remarks Air permit is a letter from FRAQMD

5. **Gas Generation Records** — ☐ Readily available — ☐ Up to date — ☒ N/A

   Remarks

6. **Settlement Monument Records** — ☐ Readily available — ☐ Up to date — ☒ N/A

   Remarks

7. **Groundwater Monitoring Records** — ☒ Readily available — ☒ Up to date — ☐ N/A

   Remarks

8. **Leachate Extraction Records** — ☐ Readily available — ☐ Up to date — ☒ N/A

   Remarks

9. **Discharge Compliance Records**
   - ☒ Air — ☒ Readily available — ☒ Up to date — ☐ N/A
   - ☒ Water (effluent) — ☒ Readily available — ☒ Up to date — ☐ N/A

   Remarks

10. **Daily Access/Security Logs** — ☐ Readily available — ☐ Up to date — ☒ N/A

    Remarks

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ☒ Gates secured ☐ N/A
Remarks

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A
Remarks Signs and other security measures are in place.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**
Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) Contractor site visits
Frequency Semiannual and on an as-needed basis
Responsible party/agency:
Contact: _____ _____ _____.
Name Title Phone no.

Reporting is up-to-date ☒ Yes ☐ No ☐ N/A
Reports are verified by the lead agency ☒ Yes ☐ No ☐ N/A
Specific requirements in deed or decision documents have been met ☒ Yes ☐ No ☐ N/A
Violations have been reported ☐ Yes ☒ No ☐ N/A
Other problems or suggestions: ☐ Report attached
Please refer to the Annual Land Use Control inspection reports.

2. **Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks Land use controls / ICs will be updated for Site CG044 in the forthcoming Record of Decision.

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident
Remarks

2. **Land use changes on site** ☒ N/A
Remarks

3. **Land use changes off site** ☒ N/A
Remarks

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A
Remarks_____

B. Other Site Conditions

Remarks Roadway construction. Water main replacement at CG044-040 (remedy protectiveness is not affected)_____

VII. LANDFILL COVERS ☒ Applicable ☐ N/A

A. Landfill Surface

1. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident
Areal extent_____ Depth_____
Remarks_____

2. **Cracks** ☐ Location shown on site map ☒ Cracking not evident
Lengths_____ Widths_____ Depths_____
Remarks_____

3. **Erosion** ☐ Location shown on site map ☒ Erosion not evident
Areal extent_____ Depth_____
Remarks_____

4. **Holes** ☐ Location shown on site map ☒ Holes not evident
Areal extent_____ Depth_____
Remarks_____

5. **Vegetative Cover** ☒ Grass ☒ Cover properly established ☒ No signs of stress
☐ Trees/Shrubs (indicate size and locations on a diagram)
Remarks_____

6. **Alternative Cover (armored rock, concrete, etc.)** ☒ N/A
Remarks_____

7. **Bulges** ☐ Location shown on site map ☒ Bulges not evident
Areal extent_____ Height_____
Remarks_____

8. **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident
- ☐ Wet areas ☐ Location shown on site map Areal extent_____
- ☐ Ponding ☐ Location shown on site map Areal extent_____
- ☐ Seeps ☐ Location shown on site map Areal extent_____
- ☐ Soft subgrade ☐ Location shown on site map Areal extent_____

Remarks _____

9. **Slope Instability** ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability
Areal extent_____
Remarks_____

B. Benches ☐ Applicable ☒ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

1. **Flows Bypass Bench** ☐ Location shown on site map ☒ N/A or okay
Remarks_____

2. **Bench Breached** ☐ Location shown on site map ☒ N/A or okay
Remarks_____

3. **Bench Overtopped** ☐ Location shown on site map ☒ N/A or okay
Remarks_____

C. Letdown Channels ☐ Applicable ☒ N/A
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

1. **Settlement** ☐ Location shown on site map ☐ No evidence of settlement
Areal extent_____ Depth_____
Remarks_____

2. **Material Degradation** ☐ Location shown on site map ☐ No evidence of degradation
Material type_____ Areal extent_____
Remarks_____

3. **Erosion** ☐ Location shown on site map ☐ No evidence of erosion
Areal extent_____ Depth_____
Remarks_____

4. **Undercutting** ☐ Location shown on site map ☐ No evidence of undercutting
Areal extent_____ Depth_____
Remarks_____
_____

5. **Obstructions** Type_____ ☐ No obstructions
☐ Location shown on site map Areal extent_____
Size_____
Remarks_____
_____

6. **Excessive Vegetative Growth** Type_____
☐ No evidence of excessive growth
☐ Vegetation in channels does not obstruct flow
☐ Location shown on site map Areal extent_____
Remarks_____
_____

D. Cover Penetrations ☐ Applicable ☒ N/A

1. **Gas Vents** ☐ Active ☐ Passive
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance
☐ N/A
Remarks_____
_____

2. **Gas Monitoring Probes**
☐ Properly secured/locked ☐ Functioning ☒ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____
_____

3. **Monitoring Wells** (within surface area of landfill)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____
_____

4. **Leachate Extraction Wells**
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____
_____

5. **Settlement Monuments** ☐ Located ☐ Routinely surveyed ☐ N/A
Remarks_____
_____

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

1. **Gas Treatment Facilities**
   ☐ Flaring ☐ Thermal destruction ☐ Collection for reuse
   ☐ Good condition ☐ Needs Maintenance
   Remarks_____

2. **Gas Collection Wells, Manifolds and Piping**
   ☐ Good condition ☐ Needs Maintenance
   Remarks_____

3. **Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings)
   ☐ Good condition ☐ Needs Maintenance ☐ N/A
   Remarks_____

F. Cover Drainage Layer ☐ Applicable ☒ N/A

1. **Outlet Pipes Inspected** ☐ Functioning ☐ N/A
   Remarks_____

2. **Outlet Rock Inspected** ☐ Functioning ☐ N/A
   Remarks_____

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

1. **Siltation** Areal extent_____ Depth_____ ☐ N/A
   ☐ Siltation not evident
   Remarks_____

2. **Erosion** Areal extent_____ Depth_____
   ☐ Erosion not evident
   Remarks_____

3. **Outlet Works** ☐ Functioning ☐ N/A
   Remarks_____

4. **Dam** ☐ Functioning ☐ N/A
   Remarks_____

H. Retaining Walls ☐ Applicable ☒ N/A

1. **Deformations** ☐ Location shown on site map ☐ Deformation not evident
   Horizontal displacement_____ Vertical displacement_____
   Rotational displacement_____
   Remarks_____

2. **Degradation** ☐ Location shown on site map ☐ Degradation not evident
   Remarks_____

I. Perimeter Ditches/Off-Site Discharge ☐ Applicable ☒ N/A

1. **Siltation** ☐ Location shown on site map ☐ Siltation not evident
   Areal extent_____ Depth_____
   Remarks_____

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A
   ☐ Vegetation does not impede flow
   Areal extent_____ Type_____
   Remarks_____

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident
   Areal extent_____ Depth_____
   Remarks_____

4. **Discharge Structure** ☒ Functioning ☐ N/A
   Remarks_____

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident
   Areal extent_____ Depth_____
   Remarks_____

2. **Performance Monitoring** Type of monitoring_____
   ☐ Performance not monitored
   Frequency_____ ☐ Evidence of breaching
   Head differential_____
   Remarks_____

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A

Remarks All extraction wells that are required are working properly

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☒ Good condition ☐ Needs Maintenance ☐ N/A

Remarks

3. **Spare Parts and Equipment**
☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks Parts purchased as needed

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A

1. **Collection Structures, Pumps, and Electrical**
☐ Good condition ☐ Needs Maintenance

Remarks

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☐ Good condition ☐ Needs Maintenance

Remarks

3. **Spare Parts and Equipment**
☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks

C. Treatment System ☒ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)
☐ Metals removal ☐ Oil/water separation ☒ Bioremediation
☒ Air stripping ☒ Carbon adsorbers
☐ Filters_____
☐ Additive (*e.g.*, chelation agent, flocculent)_____
☐ Others_____
☒ Good condition ☐ Needs Maintenance
☒ Sampling ports properly marked and functional
☒ Sampling/maintenance log displayed and up to date
☒ Equipment properly identified
☒ Quantity of groundwater treated annually See Annual LTO&M Reports
☐ Quantity of surface water treated annually_____
Remarks Applicable to CG044-013 GTS and bioreactor; and offbase residential treatment systems. CG041-017 GETS is not in operation – system will be modified with final remedy and replaced with two bioreactors, PRB – ZVI, and EVO injection/wells

2. **Electrical Enclosures and Panels** (properly rated and functional)
☐ N/A ☒ Good condition ☐ Needs Maintenance
Remarks_____

3. **Tanks, Vaults, Storage Vessels**
☐ N/A ☒ Good condition ☒ Proper secondary containment ☐ Needs Maintenance
Remarks_____

4. **Discharge Structure and Appurtenances**
☐ N/A ☒ Good condition ☐ Needs Maintenance
Remarks_____

5. **Treatment Building(s)**
☒ N/A ☐ Good condition (esp. roof and doorways) ☐ Needs repair
☐ Chemicals and equipment properly stored
Remarks All outdoors, Residential treatment system in wooden sheds_____

6. **Monitoring Wells** (associated with the pump and treatment remedy)
☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition
☒ All required wells located ☐ Needs Maintenance ☐ N/A
Remarks_____

Status of Monitoring Wells (enhanced natural attenuation remedy and other remedies)
☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition
☒ All required wells located ☐ Needs Maintenance ☐ N/A
Remarks:_____

D. Monitoring Data		
1.	Monitoring Data ☒ Is routinely submitted on time	☒ Is of acceptable quality
2.	Monitoring data suggests (please refer to Section 4.4 in the report text) ☐ Groundwater plume is effectively contained	☐ Contaminant concentrations are declining

E. Monitored Natural Attenuation

1. **Monitoring Wells** (enhanced attenuation remedy)
☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition
☐ All required wells located ☐ Needs Maintenance ☐ N/A
Remarks

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

Described in the main FYR report.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Section 2 of the Third FYR Report describes O&M of the systems.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.

No issues were identified.

D.	Opportunities for Optimization
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. O&M and sampling efforts have been optimized as technically feasible (Appendix B).

Appendix D.
Climate Change Analysis

Three climate change tools were used to assess the sites covered for the Beale Air Force Base (AFB) Third Five-Year Review (FYR). Screenshots from each of the tools assessed are shown below.

The first tool used to assess the Beale AFB is called *The Climate Explorer.* As seen on Figure D-1, there is a projected increase in days per year with a maximum temperature >100° F. Figure D-2 displays an increase in potential drought conditions due to a slight increase in the "dry days" per year with no precipitation (NEMAC, 2023). Figure D-3 summarizes the Top Climate Concerns from the tool.

The second tool used is called *Risk Factor (formerly Flood Factor).* According to this tool, 0 residential properties at Beale AFB, California, have a greater than >26% risk of being severely affected by flooding over the next 30 years. Residential properties represent 6% of all properties, with the remainder represented by Commercial, Roads, and Critical Infrastructure at Beale AFB, California. Overall, Beale AFB, California, has a minor risk of flooding over the next 30 years (Figure D-4).

The third tool used is called *Sea Level Rise.* According to this tool the area of Beale AFB is not at risk due to sea level rise, high tide flooding, or marsh migration (National Oceanic and Atmospheric Administration [NOAA], 2023). As seen on Figure D-5, the area is considered to have a low social vulnerability level.

The fourth tool is NOAA's graphic called *Probability of a Wildfire ≥ 100 acres* (Figure D-6). This graphic illustrates that Beale AFB has a 15–20% risk of a large wildfire in the summer. Furthermore, a NOAA graphic called *Risk of very large fires could increase sixfold by mid-century* (Figure D-7) shows that the Yuba County area will experience about 100 to 200% more weeks with large fires. Therefore, Beale AFB will have a moderate risk of wildfires over time that may increase during the summer.

Figure D-1: The Climate Explorer – Beale AFB, CA Days with Maximum Temperatures >100°F

Figure D-2: The Climate Explorer – Beale AFB, CA Dry Days

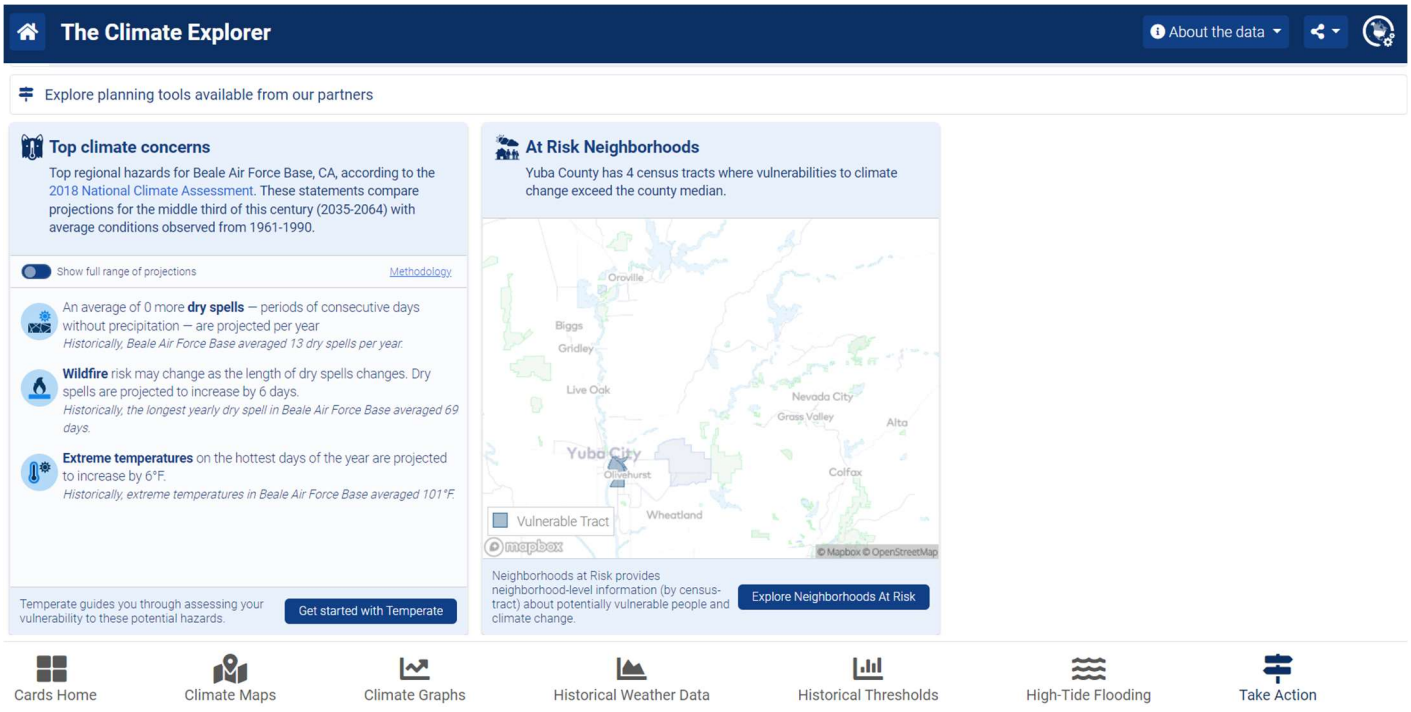

Figure D-3: The Climate Explorer – Beale Air Force Base, CA

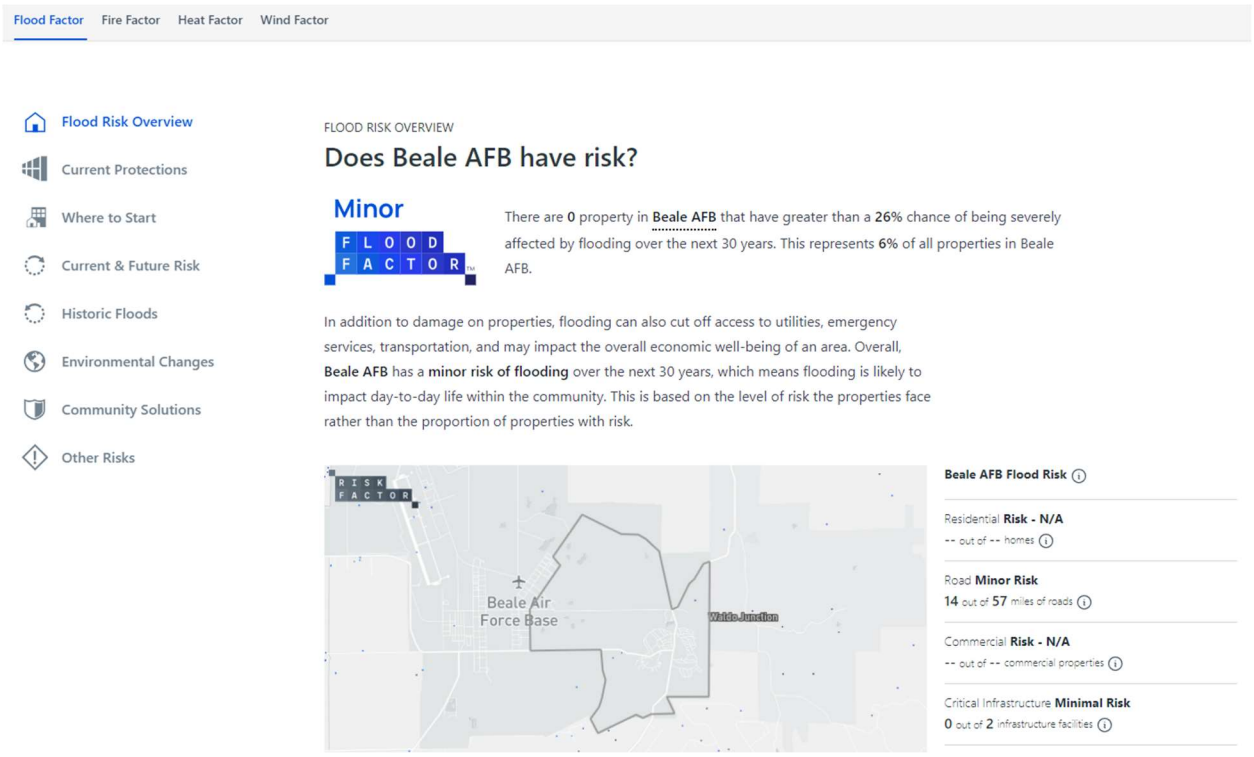

Figure D-4: Flood Risk Overview, Beale AFB, CA

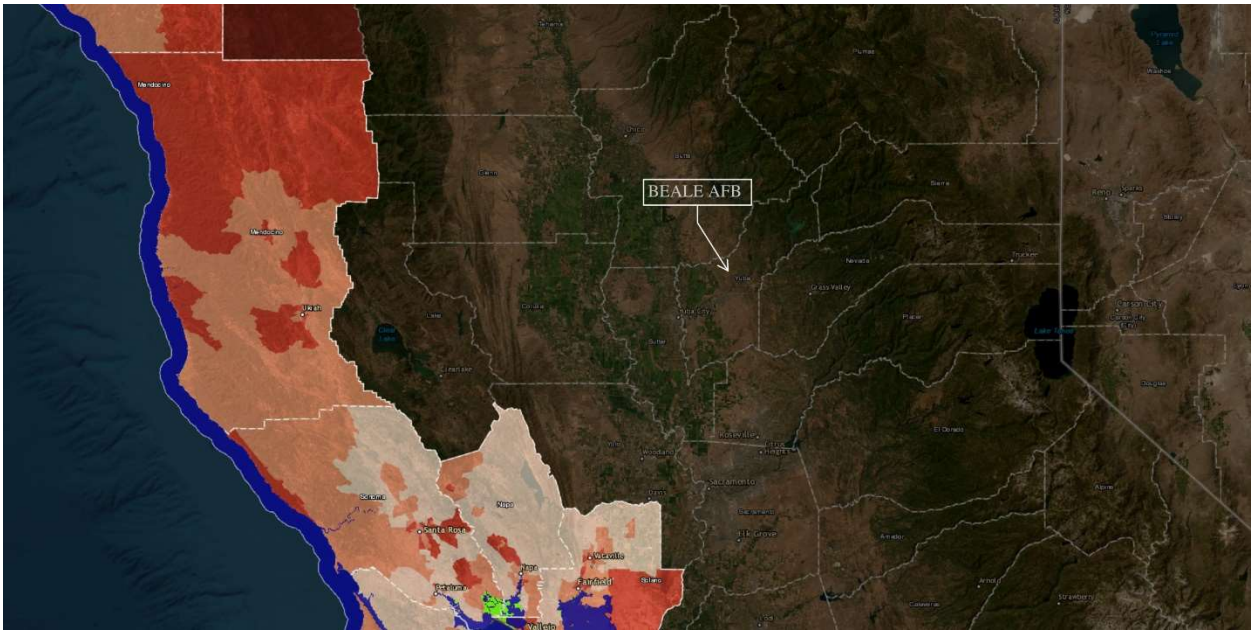

Figure D-5: Sea Level Rise, Beale AFB, CA

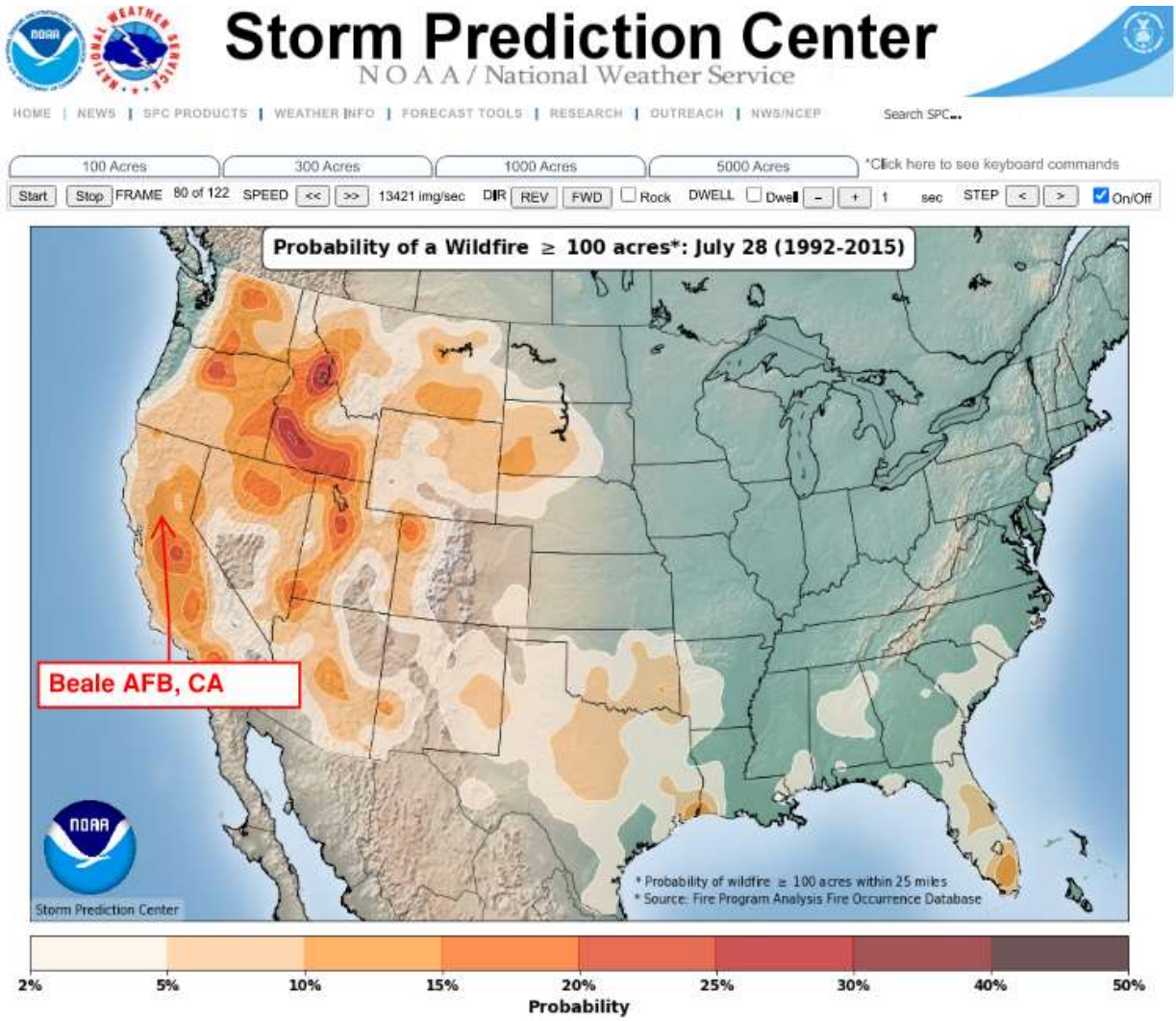

Figure D-6: Probability of a Wildfire ≥ 100 acres

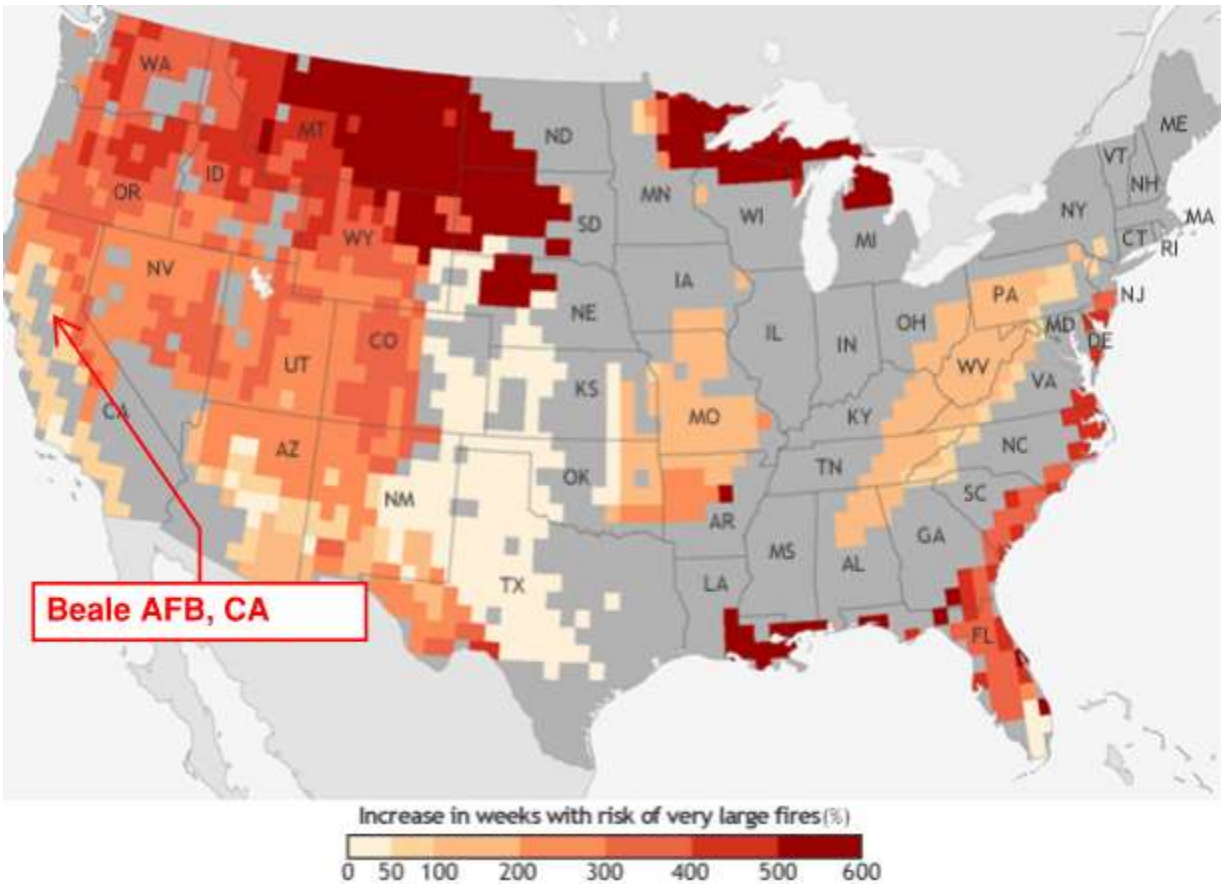

Figure D-7: Risk of Very Large Fires (Could Increase Sixfold by Mid-Century)

Appendix E.
Supporting Analysis for Technical Assessment Question B

Table E-1. Screening Level Risk Evaluation Groundwater to Indoor Air Vapor Intrusion Pathway

Groundwater COC (CG044 and CG041)	MCL	H'	$C_{vapor-gw}$ (see text for equation)	C_{IA} (see text for equation)	Screening Level for Residential Air, Cancer Endpoint		Residential Cancer Risk (see text for equation)	Screening Level for Residential Air, Noncancer Endpoint		Residential Noncancer Hazard (see text for equation)	Screening Level for Commercial/ Industrial Air, Cancer Endpoint		Industrial Cancer Risk (see text for equation)	Screening Level for Commercial/Industrial Air, Noncancer Endpoint		Industrial Noncancer Hazard (see text for equation)
	µg/L	Unitless	µg/m^3	µg/m^3	µg/m^3	Reference		µg/m^3	Reference		µg/m^3	Reference		µg/m^3	Reference	
Benzene*	1.0	0.227	226.901	0.227	0.097	DTSC-SL	**2.3E-06**	3.100	DTSC-SL	**7.3E-02**	0.420	DTSC-SL	**5.4E-07**	13.000	DTSC-SL	**1.7E-02**
Carbon tetrachloride	0.5	1.128	564.186	0.564	0.470	EPA RSL	**1.2E-06**	42.000	DTSC-SL	**1.3E-02**	2.000	EPA RSL	**2.8E-07**	180.000	DTSC-SL	**3.1E-03**
Chloroform*	80.0	0.150	12,003.271	12.003	0.120	EPA RSL	**1.0E-04**	100.000	EPA RSL	**1.2E-01**	0.530	EPA RSL	**2.3E-05**	430.000	EPA RSL	**2.8E-02**
1,2-DCA	0.5	0.048	24.121	0.024	0.110	EPA RSL	**2.2E-07**	7.300	EPA RSL	**3.3E-03**	0.470	EPA RSL	**5.1E-08**	31.000	EPA RSL	**7.8E-04**
1,1-DCE	6.0	1.067	6,402.289	6.402	--	--		73.000	DTSC-SL	**8.8E-02**	--	--		310.000	DTSC-SL	**2.1E-02**
Cis-1,2-DCE	6.0	0.167	1,000.818	1.001	--	--		8.300	DTSC-SL	**1.2E-01**	--	--		35.000	DTSC-SL	**2.9E-02**
Trans-1,2-DCE	10.0	0.383	3,834.832	3.835	--	--		83.000	DTSC-SL	**4.6E-02**	--	--		350.000	DTSC-SL	**1.1E-02**
Perchlorate*	6.0	Nonvolatile														
Methylene chloride*	5.0	0.133	664.350	0.664	1.000	DTSC-SL	**6.6E-07**	420.000	DTSC-SL	**1.6E-03**	12.000	DTSC-SL	**5.5E-08**	1,800.000	DTSC-SL	**3.7E-04**
PCE	5.0	0.724	3,618.152	3.618	0.460	DTSC-SL	**7.9E-06**	42.000	EPA RSL	**8.6E-02**	2.000	DTSC-SL	**1.8E-06**	180.000	EPA RSL	**2.0E-02**
1,1,2-TCA	5.0	0.034	168.438	0.168	0.180	EPA RSL	**9.4E-07**	0.210	EPA RSL	**8.0E-01**	0.770	EPA RSL	**2.2E-07**	0.880	EPA RSL	
1,1,2,2-TeCA	1.0	0.015	15.004	0.015	0.048	EPA RSL	**3.1E-07**	83.000	DTSC-SL	**1.8E-04**	0.210	EPA RSL	**7.1E-08**	350.000	DTSC-SL	**4.3E-05**
TCE	5.0	0.403	2,013.491	2.013	0.480	EPA RSL	**4.2E-06**	2.100	EPA RSL	**9.6E-01**	3.000	EPA RSL	**6.7E-07**	8.800	EPA RSL	
Vinyl chloride	0.5	1.137	568.275	0.568	0.010	DTSC-SL	**6.0E-05**	100.000	EPA RSL	**5.7E-03**	0.160	DTSC-SL	**3.6E-06**	440.000	EPA RSL	**1.3E-03**
1,1,1,2-TeCA**	NA	0.102			0.380	EPA RSL		130.000	DTSC-SL		1.700	EPA RSL		530.000	DTSC-SL	
Manganese**	50	Nonvolatile														
Nickel**	100	Nonvolatile														

Notes:

* = CG041 COC only

** = CG044 COC only

C_{IA} = Indoor air concentration in µg/m3

COC = chemical of concern

$C_{vapor-gw}$ = vapor concentration in equilibrium with water in µg/m^3

DCA = dichloroethane

DCE = dichloroethene

DTSC-SL = Department of Toxic Substances Control Modified Screening Level

EPA RSL = U.S. Environmental Protection Agency Regional Screening Levels

H' = chemical-specific Henry's Law constant (unitless)

MCL = maximum contaminant level

PCE = tetrachloroethene

TCA = trichloroethane

TCE = trichloroethene

TeCA = tetrachloroethane

µg/L = micrograms per liter

µg/m^3 = micrograms per cubic meter

-- = not available

Vapor Intrusion Screening Level

1,1,1,2-Tetrachloroethane

Residential Scenario

Commercial/Industrial Scenario

Resident Air Inputs

Variable	Resident Air Default Value	Site-Specific Value
AF_{gw} (Attenuation Factor Groundwater) unitless	0.001	0.001
AF_{ss} (Attenuation Factor Sub-Slab) unitless	0.03	0.03
ED_{res} (exposure duration) years	26	26
ED_{0-2} (mutagenic exposure duration first phase) years	2	2
ED_{2-6} (mutagenic exposure duration second phase) years	4	4
ED_{6-16} (mutagenic exposure duration third phase) years	10	10
ED_{16-26} (mutagenic exposure duration fourth phase) years	10	10
EF_{res} (exposure frequency) days/year	350	350
EF_{0-2} (mutagenic exposure frequency first phase) days/year	350	350
EF_{2-6} (mutagenic exposure frequency second phase) days/year	350	350
EF_{6-16} (mutagenic exposure frequency third phase) days/year	350	350
EF_{16-26} (mutagenic exposure frequency fourth phase) days/year	350	350
ET_{res} (exposure time) hours/day	24	24
ET_{0-2} (mutagenic exposure time first phase) hours/day	24	24
ET_{2-6} (mutagenic exposure time second phase) hours/day	24	24
ET_{6-16} (mutagenic exposure time third phase) hours/day	24	24
ET_{16-26} (mutagenic exposure time fourth phase) hours/day	24	24
THQ (target hazard quotient) unitless	0.1	1
LT (lifetime) years	70	70
TR (target risk) unitless	1.0E-06	1.0E-06

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Resident Vapor Intrusion Screening Levels (VISL)

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; U = user provided; G = see RSL User's Guide Section 5; CA = cancer; NC = noncancer.

Chemical	CAS Number	Does the chemical meet the definition for volatility? (HLC>1E-5 or VP>1)	Does the chemical have inhalation toxicity data? (IUR and/or RfC)	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Soil Source? (C_{vp} > $C_{i,a}$,Target?)	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Groundwater Source? (C_{hc} > $C_{i,a}$,Target?)	Target Indoor Air Concentration (TCR=1E-06 or THQ=1) MIN($C_{ia,c}$,$C_{ia,nc}$) ($\mu g/m^3$)	Toxicity Basis	Target Sub-Slab and Near-source Soil Gas Concentration (TCR=1E-06 or THQ=1) C_{sg},Target ($\mu g/m^3$)	Target Groundwater Concentration (TCR=1E-06 or THQ=1) C_{gw},Target ($\mu g/L$)
Tetrachloroethane, 1,1,1,2-	630-20-6	Yes	Yes	Yes	Yes	3.79E-01	CA	1.26E+01	3.71E+00

Is Target Groundwater Concentration < MCL? (C_{gw} < MCL?)	Pure Phase Vapor Concentration C_{vp}\ (25 °C)\ ($\mu g/m^3$)	Maximum Groundwater Vapor Concentration C_{hc}\ ($\mu g/m^3$)	Temperature for Maximum Groundwater Vapor Concentration (°C)	Lower Explosive Limit LEL (% by volume)	LEL Ref	IUR (ug/m^3)$^{-1}$	IUR Ref	RfC (mg/m^3)	RfC Ref	Mutagenic Indicator	Carcinogenic VISL TCR=1E-06 $C_{ia,c}$ ($\mu g/m^3$)	Noncarcinogenic VISL THQ=1 $C_{ia,nc}$ ($\mu g/m^3$)
--	1.08E+08	1.09E+08	25	4.90	U	7.40E-06	U	1.20E-01	U	No	3.79E-01	1.25E+02

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Chemical Properties

Chemical	CAS Number	Does the chemical meet the definition for volatility? (HLC>1E-5 or VP>1)	Does the chemical have inhalation toxicity data? (IUR and/or RfC)	MW	MW Ref	Vapor Pressure VP (mm Hg)	VP Ref	S (mg/L)	S Ref	MCL (ug/L)
Tetrachloroethane, 1,1,1,2-	630-20-6	Yes	Yes	167.85	U	1.20E+01	U	1.07E+03	U	-

HLC (atm-m ^{3}/mole)	Henry's Law Constant (unitless)	H` and HLC Ref	Henry's Law Constant Used in Calcs (unitless)	Normal Boiling Point BP (K)	BP Ref	Critical Temperature T_c\ (K)	T_c\ Ref	Enthalpy of vaporization at the normal boiling point $\Delta H_{v,b}$\ (cal/mol)	$\Delta H_{v,b}$\ Ref	Lower Explosive Limit LEL (% by volume)	LEL Ref
2.50E-03	1.02E-01	U	1.02E-01	403.15	U	6.24E+02	U	9770.00	U	4.90	U

Commercial Air Inputs

Variable	Commercial Air Default Value	Site-Specific Value
AF_{gw} (Attenuation Factor Groundwater) unitless	0.001	0.001
AF_{ss} (Attenuation Factor Sub-Slab) unitless	0.03	0.03
AT_{com} (averaging time - composite worker)	365	365
ED_{com} (exposure duration - composite worker) yr	25	25
EF_{com} (exposure frequency - composite worker) day/yr	250	250
ET_{com} (exposure time - composite worker) hr	8	8
THQ (target hazard quotient) unitless	0.1	1
LT (lifetime) yr	70	70
TR (target risk) unitless	1.0E-06	1.0E-06

Commercial Vapor Intrusion Screening Levels (VISL)

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; U = user provided; G = see RSL User's Guide Section 5; CA = cancer; NC = noncancer.

Chemical	CAS Number	Does the chemical meet the definition for volatility? (HLC>1E-5 or VP>1)	Does the chemical have inhalation toxicity data? (IUR and/or RfC)	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Soil Source? (C_{vp} > $C_{i,a}$,Target?)	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Groundwater Source? (C_{hc} > $C_{i,a}$,Target?)	Target Indoor Air Concentration (TCR=1E-06 or THQ=1) MIN($C_{ia,c}$,$C_{ia,nc}$) (µg/m³)	Toxicity Basis	Target Sub-Slab and Near-source Soil Gas Concentration (TCR=1E-06 or THQ=1) C_{sg},Target (µg/m³)	Target Groundwater Concentration (TCR=1E-06 or THQ=1) C_{gw},Target (µg/L)
Tetrachloroethane, 1,1,1,2-	630-20-6	Yes	Yes	Yes	Yes	1.66E+00	CA	5.52E+01	1.62E+01

Is Target Groundwater Concentration < MCL? (C_{gw} < MCL?)	Pure Phase Vapor Concentration C_{vp}\ (25 °C)\ (µg/m³)	Maximum Groundwater Vapor Concentration C_{hc}\ (µg/m³)	Temperature for Maximum Groundwater Vapor Concentration (°C)	Lower Explosive Limit LEL (% by volume)	LEL Ref	IUR (ug/m³)$^{-1}$	IUR Ref	RfC (mg/m³)	RfC Ref	Mutagenic Indicator	Carcinogenic VISL TCR=1E-06 $C_{ia,c}$ (µg/m³)	Noncarcinogenic VISL THQ=1 $C_{ia,nc}$ (µg/m³)
--	1.08E+08	1.09E+08	25	4.90	U	7.40E-06	U	1.20E-01	U	No	1.66E+00	5.26E+02

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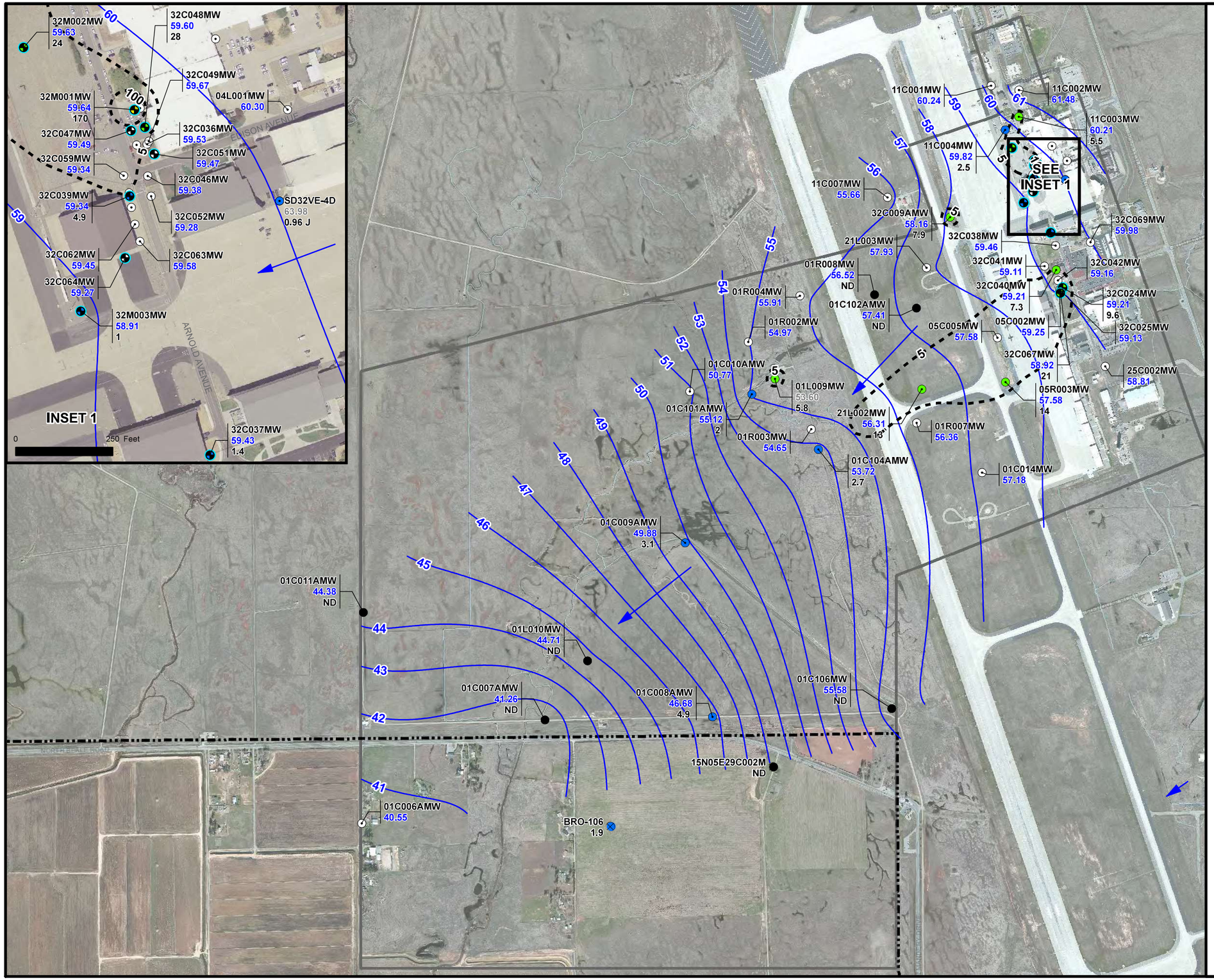
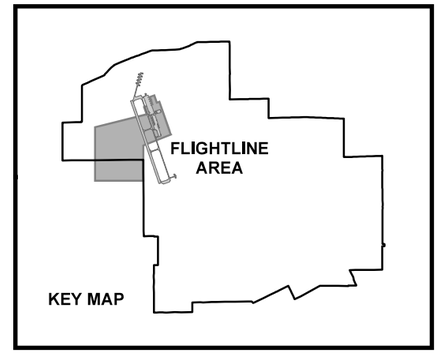
Chemical Properties

Chemical	CAS Number	Does the chemical meet the definition for volatility? (HLC>1E-5 or VP>1)	Does the chemical have inhalation toxicity data? (IUR and/or RfC)	MW	MW Ref	Vapor Pressure VP (mm Hg)	VP Ref	S (mg/L)	S Ref	MCL (ug/L)
Tetrachloroethane, 1,1,1,2-	630-20-6	Yes	Yes	167.85	U	1.20E+01	U	1.07E+03	U	-

HLC (atm-m ^{3}/mole)	Henry's Law Constant (unitless)	H` and HLC Ref	Henry's Law Constant Used in Calcs (unitless)	Normal Boiling Point BP (K)	BP Ref	Critical Temperature T_c\ (K)	T_c\ Ref	Enthalpy of vaporization at the normal boiling point $\Delta H_{v,b}$\ (cal/mol)	$\Delta H_{v,b}$\ Ref	Lower Explosive Limit LEL (% by volume)	LEL Ref
2.50E-03	1.02E-01	U	1.02E-01	403.15	U	6.24E+02	U	9770.00	U	4.90	U

Appendix F.
Figures Displaying Off-Base Agricultural Wells and Their Relation to CG044-032





LEGEND

TCE CONCENTRATION IN GROUNDWATER (µg/L)

- NOT DETECTED (ND)
- ND to 5
- 5 to 100
- 100 to 500
- 500 to 1,000
- >1,000
- GROUNDWATER MONITORING WELL
- MONITORING AND REPORTING PROGRAM WELL
- AGRICULTURAL WELL SAMPLING LOCATION
- 57.63 MEASURED GROUNDWATER ELEVATION (feet NAVD88) (GREY TEXT INDICATES ELEVATION NOT USED IN CONTOURING)
- 36.3 TCE CONCENTRATION IN GROUNDWATER (µg/L)
- TCE CONCENTRATION CONTOUR (µg/L)
- GROUNDWATER ELEVATION CONTOUR (feet NAVD88)
- GROUNDWATER FLOW DIRECTION (APPROXIMATE)
- SITE INVESTIGATION BOUNDARY
- BASE BOUNDARY
- STREAMS

NOTES:

ONLY PLUME CG044-032 WELLS WHERE DATA WERE COLLECTED DURING THE 2021 BGMP ANNUAL SAMPLING EVENT ARE LABELED ON THIS FIGURE. ALL PLUME CG044-032 WELLS ARE LABELED ON FIGURE 2-2.

J = THE ANALYTE WAS POSITIVELY IDENTIFIED, THE QUANTITATION IS AN ESTIMATE.

FIGURE PREPARED BY JACOBS.

N

0 1,200 2,400 Feet

FIGURE 4-7
PLUME CG044-032 JULY 2021 TCE CONCENTRATIONS IN SHALLOW GROUNDWATER

SITE CG044 PRE-RECORD OF DECISION
INVESTIGATION DATA SUMMARY
BEALE AIR FORCE BASE, CALIFORNIA

Brice ENVIRONMENTAL

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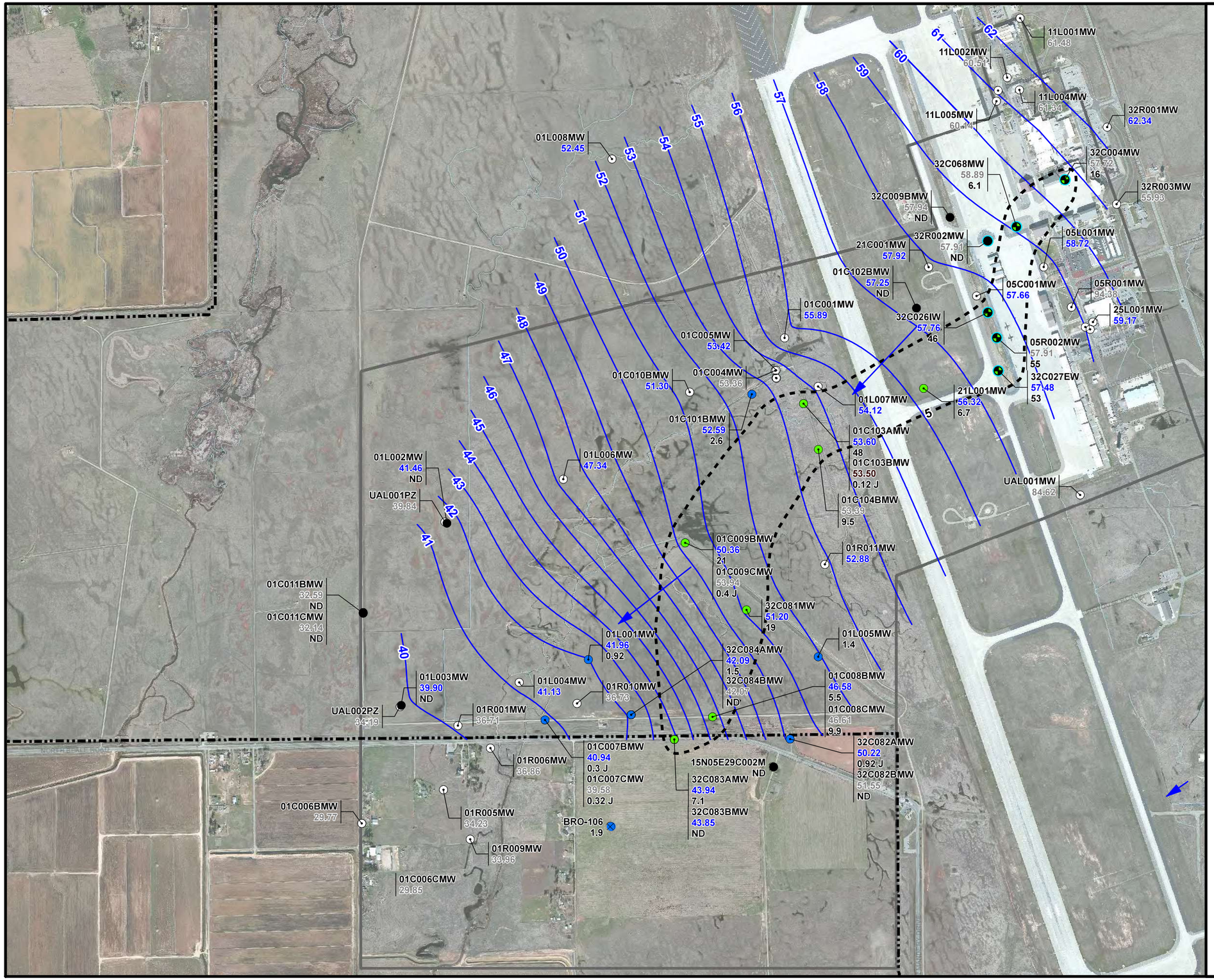

LEGEND

TCE CONCENTRATION IN GROUNDWATER (µg/L)

- NOT DETECTED (ND)
- ND to 5
- 5 to 100
- 100 to 500
- 500 to 1,000
- >1,000
- GROUNDWATER MONITORING WELL
- MONITORING AND REPORTING PROGRAM WELL
- AGRICULTURAL WELL SAMPLING LOCATION
- 57.63 MEASURED GROUNDWATER ELEVATION (feet NAVD88) (GREY TEXT INDICATES ELEVATION NOT USED IN CONTOURING)
- 36.3 TCE CONCENTRATION IN GROUNDWATER (µg/L)
- TCE CONCENTRATION CONTOUR (µg/L)
- GROUNDWATER ELEVATION CONTOUR (feet NAVD88)
- GROUNDWATER FLOW DIRECTION (APPROXIMATE)
- SITE INVESTIGATION BOUNDARY
- BASE BOUNDARY
- STREAMS

NOTES:

ONLY PLUME CG044-032 WELLS WHERE DATA WERE COLLECTED DURING THE 2021 BGMP ANNUAL SAMPLING EVENT ARE LABELED ON THIS FIGURE. ALL PLUME CG044-032 WELLS ARE LABELED ON FIGURE 2-2.

J = THE ANALYTE WAS POSITIVELY IDENTIFIED, THE QUANTITATION IS AN ESTIMATE.

FIGURE PREPARED BY JACOBS.

N

0 1,200 2,400 Feet

FIGURE 4-8
PLUME CG044-032 JULY 2021 TCE CONCENTRATIONS IN DEEP GROUNDWATER

SITE CG044 PRE-RECORD OF DECISION
INVESTIGATION DATA SUMMARY
BEALE AIR FORCE BASE, CALIFORNIA

Brice ENVIRONMENTAL

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Appendix G.
Air Force Responses to Regulatory Agency Comments on the Draft Final Report

Appendix G.
Air Force Responses to Regulatory Agency Comments on the Draft Final Report

Central Valley Regional Water Quality Control Board
Comment Date: 09/15/2023
Document Date: 08/15/2023

Beale AFB Common Comment and Response Worksheet

Comment Date 09/15/2023	Document Date 08/15/2023					Document Title (version) Draft Final *Third Five-Year Review Report, Multiple Sites at Beale Air Force Base*	Contract/TO Number W9123822C0027
Item	**Section**	**Page**	**Para**	**Line**	**Class**	**Comment**	**Response**
Central Valley Regional Water Quality Control Board, Holly H. Young, PG – General Comments							
1.						The Report concludes the interim remedies implemented at CG044 are protective of human health and the environment. However, institutional controls intended to prevent exposure to contaminated groundwater are not presently in place for all portions of the CG044-032 plume. Additionally, there are indicators of potential remedy problems, and some of the original assumptions regarding physical features of the CG044 plumes have changed since the interim remedies were developed. Central Valley Water Board staff does not concur with the "protective" determination and asserts that a determination of "short-term protective" or "protectiveness deferred" would be more appropriate for CG044. Justifications for this assertion are provided below.	Comment acknowledged. The protectives statement has been revised to 'Short-term Protective' as described in the responses below.
a.						The issue of incomplete or unimplemented institutional controls is discussed in the U.S. Environmental Protection Agency's (EPA) *Comprehensive Five- Year Review Guidance* (EPA, 2001), the EPA's *Recommended Evaluation of Institutional Controls: Supplement to the "Comprehensive Five-Year Review Guidance*" (EPA, 2011), and the EPA's *Clarifying the Use of Protectiveness Determinations for [CERCLA] Five-Year Reviews* (EPA, 2012). Central Valley Water Board staff refers the Air Force to these documents for detailed discussions and examples of incomplete or unimplemented institutional controls and appropriate protectiveness determinations for sites lacking necessary institutional controls.	Comment acknowledged.
b.						Institutional controls needed to successfully prevent exposure are not in place for the off-Base portion of Plume CG044-032. As discussed in the Report, the 5-microgram per liter (µg/L) trichloroethylene (TCE) CG044-032 plume has been known to extend beyond the Base boundary since 2019. The interim remedy for CG044-032 includes the following component: "Establish and enforce [land use controls] LUCs to restrict groundwater use by prohibiting water supply well installation where contaminants remaining in groundwater at concentrations exceeding interim cleanup goals." (Air Force, 2007). The interim cleanup goal for TCE was set at 5 µg/L, equivalent to the federal and State of California maximum contaminant level (MCL).	Comment acknowledged. Sections 4.4.3.4, 5.7, 6, and 7 have been revised as described below. **Section 4.4.3.4**: The fourth bullet in Section 4.4.3.4 has been revised as shown below by including off-Base monitoring well TCE concentration trends and off-Base agricultural well TCE concentrations: "Off-Base: • The TCE plume has migrated beyond the Base boundary, south of well pair 32C083A/BMW (Figure 4-28). In 2021, TCE was detected at concentrations (8.7 µg/L and 7.1 µg/L) exceeding the PSL (PHG of 1.7 µg/L) in deep well 32C083AMW (Brice, 2022b). The chemical time-series plot for well 32C083AMW indicates an increasing trend in TCE concentrations. • The TCE plume is not currently bound to the south of well 32C083AMW (Brice, 2022b). As part of the Pre-ROD investigation at CG044-032, groundwater samples were collected in August 2021 from two existing offbase agricultural wells (15N05E29C002M and BRO-106; Brice, 2022f). Appendix F includes Figures 4-7 and 4-8 from the "Revised Final Site CG044 Pre-Record of Decision Investigation Data Summary" (Brice, 2022f) which show the TCE concentrations in the off-Base agricultural wells and their relation to CG044-032. The screen depths for the wells are unknown (Brice, 2022b and 2022f). The wells are located approximately 1,350 southeast and 1,200 feet southwest of well cluster 32C083A/BMW.

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b. *(cont.)*						*(also see above)* Section 5.7.1, Question A – Is the Remedy Functioning as Intended by the Decision Documents?, of the Report states that the forthcoming CG044 Record of Decision (ROD) will address the issue of groundwater contamination occurring beyond LUC boundaries at multiple CG044 plume sites, including CG044-032. This section goes on to state that protectiveness is maintained in the interim because groundwater is not in use and the Work Clearance Request process has been effective in preventing groundwater use. However, 1) the interim remedy requires that LUCs be established and enforced to prohibit water supply well installation where contaminant concentrations exceed interim cleanup goals, and 2) any Work Clearance Request process that may extend to portions of the Base outside of LUC boundaries does not extend beyond the Base boundary. No LUCs are present on the portion of the CG044-032 plume which extends outside the Base boundary, and the Air Force does not have the authority to encumber off-Base property with LUCs. Though there is no evidence that any exposure above the interim cleanup goal is presently occurring, there is the potential for exposure to occur. As discussed in EPA guidance documents (EPA, 2001; EPA, 2011; EPA, 2012), evaluation of institutional controls included in a site's selected remedy should include whether institutional controls are currently in place and effective for all areas of the site that do not achieve UU/UE and whether additional institutional controls are needed to ensure protectiveness (i.e., render the potential exposure pathway incomplete). Institutional controls are not in place for the off-Base portion of CG044-032. Therefore, "No" is the proper answer to Question A, and a determination of "protective" is inappropriate for CG044. The issue of off-Base groundwater contamination sourced from CG044-032 should be discussed in Section 6, Issues/Recommendations, and the final remedy should include provisions to mitigate this.	• TCE was not detected in well 15N05E029C002M. At well BRO-106, TCE was detected at a concentration of 1.9 µg/L, which exceeded the PSL. • Between March and August 2021, groundwater elevations decreased across all 35 wells, ranging from a 5.90-foot decrease at 01C009CMW (located approximately 2,500 feet north of the Base boundary) to a maximum 21.45-foot decrease at 01C006BMW (located close to the off-Base agricultural wells), with an average decrease of 14.59 feet (Brice, 2022f). The large decrease in groundwater elevations is likely a result of the continual pumping of groundwater at the off-Base agricultural wells for irrigation purposes to offset the drought resulting in the downgradient plume migrating south toward the off-Base pasture fields while the hydraulic gradient is to the west-southwest or southwest (Brice, 2022f). • As described in the "Revised Final Site CG044 Pre-Record of Decision Investigation Data Summary Report," dated August 2022, the proposed triple-completion off-Base wells 32C087MW(A/B/C) were to be installed to define the downgradient extent of the off-Base TCE plume, south of North Beale Road. However, the wells could not be installed because a right-of-entry (ROE) agreement between the Base and the property owner could not be obtained. • The additional wells that are needed downgradient of well BRO-106 to delineate the off-Base CG044-032 plume to the Office of Environmental Health Hazard Assessment's PHG will be installed post-ROD when the ROE agreement becomes available (Brice, 2022f)." **<u>Section 5.7</u>**: The following text has been deleted from the first paragraph of Section 5 7.1: "~~A Final Proposed Plan was released in April 2023 (Air Force, 2023), which identified the preferred remedial alternatives for each CG044 plume site, as discussed in Section 2.7. The ROD for CG044 is forthcoming.~~" The following text has been added to the first paragraph in Section 5.7.1: "An FFS for CG044 was completed in August 2020 to support the selection of a final remedy for CG044 (CH2M, 2020e)." The following text has been added to the fourth bullet in Section 5.7.1: "As stated in Section 4.4.3.4, the TCE plume has migrated beyond the Base boundary, south of well pair 32C083A/BMW (Figure 4-28), with an increasing trend in TCE concentrations. The TCE plume is not currently bound to the south of well 32C083AMW. In August 2021, sampling results for the two offbase agricultural wells, 15N05E029C002M and BRO-106 (Appendix F), that had unknown screen depths and were located approximately 1,350 southeast and 1,200 feet southwest of well cluster 32C083A/BMW (Appendix E) indicated that TCE was not detected in well 15N05E029C002M. At well BRO-106, TCE was detected at a concentration of 1.9 µg/L, which exceed the PSL (PHG of 1.7 µg/L; Brice, 2022b and 2022f). An additional well that is needed downgradient of well BRO-106 to delineate the off-Base CG044-032 plume to the Office of Environmental Health Hazard Assessment's PHG will be installed post-ROD when the ROE agreement becomes available (Brice, 2022f)."

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b. *(cont.)*						*(see above)*	The following text has been deleted from the 11th bullet (second sentence) in Section 5.7.1: "~~Semiannual LUC inspections indicated that LUCs are being implemented per the Final ROD for CG041 (Air Force, 2018b).~~" The following text has been deleted from the 11th bullet (fourth and fifth sentences) in Section 5.7.1: "~~The CG044 ROD is forthcoming, which is expected to address this issue. During the interim, the protectiveness is maintained because groundwater is not in use for the area within the LUC boundary and for the area outside the LUC boundary. The Work Clearance Request process followed by the Operation Flight of the Civil Engineering Office has been effective in preventing groundwater use and activities that would adversely affect implementation of the selected remedy until COC concentrations in groundwater allow for UU/UE.~~" The following text has been deleted from the last paragraph in Section 5.7.1: "~~The CG044 ROD is forthcoming, which will address this issue.~~" The last three sentences in the last paragraph in Section 5.7.1 have been revised as shown below. "During the interim, the protectiveness is maintained considering that groundwater is not in use and that the Work Clearance Request process has been effective in preventing groundwater use on-Base. Off-Base wellhead treatment systems are in place that effectively prevent exposure to contamination. An additional well to delineate the off-Base CG044-032 plume downgradient of agricultural well BRO-106 will be installed post-ROD when the ROE agreement becomes available (Brice, 2022f). While the timelines for restoring groundwater to UU/UE vary, progress is being made toward achieving that goal. Overall, the implemented remedies for the CG044 plume sites are functioning as intended by the respective interim Decision Documents and are protective of human health and the environment in the short-term as of the date of this FYR. The remedies will continue to be implemented and monitored." The following additional revisions have been made in Sections 6 and 7. **Section 6** In Section 6, the following issue has been added for Site CG044: "The combination of below average rainfall and increased off-Base groundwater pumping for agricultural purposes near the western Base boundary has likely caused the downgradient plume to migrate south toward the off-Base pasture fields at CG044-032. The off-Base CG044-032 TCE plume needs to be delineated." The first recommendation in Section 6.0 has been revised as shown below. "Reevaluate and establish appropriate LUC boundaries on-Base for CG044 plume sites CG044-003, CG044-031, and CG044-32 in the forthcoming CG044 ROD. Currently, groundwater at these sites is not in use on-base. For the on-Base plume areas that are outside the LUC boundaries, continue to verify that groundwater will not be used. For CG044-032 off-Base plume areas, a contingency action to address future plume expansion should be included in the Decision Document that includes implementing wellhead treatment on residential drinking water wells that do not currently have a wellhead treatment system." The following recommendation has been added as a new recommendation in Section 6.0: "When the ROE agreement becomes available (post-ROD), an additional well should be installed downgradient of agricultural well BRO-106 to delineate the off-Base CG044-032 plume by 2025."

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c.						There are indicators of potential interim remedy problems at CG044-032. To develop a response to Question A listed above, guidance documents state that, among other lines of evidence, early indicators of potential remedy problems should be assessed. EPA guidance states, "…Some examples of indicators of potential remedy problems could include…trend analysis of sampling data showing no decrease in contaminant levels…or that the extent of the groundwater contamination plume exceeds the outer reaches of the monitoring network." (EPA, 2001). The interim remedy for CG044-032 includes the following component: "Collect additional groundwater data during interim remedy implementation to further define the extent of contamination and to assess the need for additional remedial actions beyond the scope of this interim action." (Air Force, 2007). The intent of this remedy component seems to be to 1) delineate the extent of groundwater contamination, and 2) determine if additional active remediation is needed. The 32C083AMW/BMW well pair is located just south of the Base boundary and is the farthest downgradient monitoring well associated with CG044-032. As discussed in the Report, TCE concentrations have an increasing trend at well 32C083AMW, and the CG044-032 groundwater plume has migrated south of this paired well location. Central Valley Water Board staff considers that the continued increasing TCE concentration at this downgradient-most monitoring well is an indicator of a remedy problem. Additionally, the fact that the TCE plume extends an unknown distance downgradient of this location is a second indicator of a remedy problem. The downgradient extent of the CG044-032 plume is currently undefined. This is of particular concern to Central Valley Water Board staff, as it indicates more area than is presently known may be impacted by TCE at concentrations greater than 5 µg/L outside of the Base boundary. The two indicators of remedy problems discussed above should be addressed in Section 5.7.1 and Section 6. These issues may be significant enough to justify a "No" answer to Question A for CG044 and a determination of "protectiveness deferred" until the issues have been resolved. The Air Force should develop recommendations to resolve these issues and include them in Section 6.	Comment acknowledged. As described in Response 1.b, Section 5.7.1 and the issues and recommendations in Section 6 for Site CG044 have been revised. The protectiveness statement in Section 7 for Site CG044- has also been revised as shown below. "Protectiveness Determination: Short-term Protective" "The interim remedies for Site CG044 currently protect human health and the environment because LUCs established in interim Decision Documents remain in place on-Base to prevent potential exposures through the VI or direct contact pathways. In addition, on-Base groundwater sources are sampled quarterly and are not impacted by CG044 COCs. For the CG044 plume sites with on-Base groundwater contamination extending past the LUC boundaries due to off-Base pumping, protectiveness is currently maintained because groundwater is not in use and the Work Clearance Request process has been effective in preventing groundwater use within the Base boundaries. For Plume CG044-032 with the TCE plume extending off-Base, wellhead treatment systems are in place for three residential wells. However, in order for the Site CG044 remedy to be protective in the long-term, the CG-044 ROD will need to be finalized and the remedies will need to be implemented; the off-Base CG044-032 plume will need to be delineated; and, to address future plume expansion of CG044-032 off-Base plume areas, a contingency action should be included in the Decision Document that includes implementing wellhead treatment on residential drinking water wells that do not currently have a wellhead treatment system. In addition, PFAS in groundwater at CG044-013 will need to be characterized to assess how the presence of PFAS in groundwater affects the effectiveness of the remedy. LUCs and groundwater monitoring and evaluation should be a part of any final remedy selected until such time as RAOs are achieved and the site is suitable for UU/UE."

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d.						The physical features of CG044 have changed since the development of the interim remedies and completion of the previous Five-Year Review. With regard to developing an answer to Question B listed above, EPA guidance states, "… you should evaluate whether the original assumptions regarding current and future land/groundwater uses and contaminants of concern are still valid, and whether any physical features (or understanding of physical site conditions) have changed (e.g., changes in anticipated direction or rate of groundwater or indication of a new groundwater divide). All of these factors may have a bearing on the validity of the [RAOs] and may affect the protectiveness of the remedy." (EPA, 2001). EPA guidance indicates changes in physical site conditions affect exposure pathway assumptions (EPA, 2001). As discussed in the Report, groundwater elevations in wells along the Base boundary have declined and the horizontal gradient has doubled since 2019. These changes are reportedly due to increased off-Base agricultural pumping. Presently, the issue of off-Base pumping is discussed in Section 5.7.3, Question C – Has Any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy? However, the discussion should be moved to Section 5.7.2, Question B – Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and RAOs Used at the Time of the Remedy Selection Still Valid? Given the change to the groundwater gradient that has occurred since the interim remedy was put in place, Central Valley Water Board staff considers that the answer to Question B should be "No." At the time the interim remedy was finalized in 2007, no off-Base impacts were known or anticipated for the site corresponding to the current CG044-032 plume. Additionally, CG044 had not yet been decoupled from CG041 in June 2016, the end of the five-year period covered by the previous Five-Year Review, and the magnitude of impacts was not known at that point. The significant increase in groundwater gradient has greatly altered the exposure pathway assumptions for the CG044 plumes, especially CG044-032, and should be addressed as an issue in Section 6.	Comment acknowledged. The discussion of off-Base agricultural pumping has been moved from Section 5.7.3, Question C to Section 5.7.2, Question B. The first paragraph in Section 5.7.2 has been revised as described below. "As discussed in Sections 4.4.1 and 4.4.3.4, the combination of below average rainfall and increased off-Base groundwater pumping for agricultural purposes near the western Base boundary has resulted in decreased groundwater elevations. This has resulted in an increase in horizontal gradient and groundwater flow velocity and downgradient plume migration. At some CG044 plume sites, groundwater contamination has been observed to extend past the LUC boundaries; however, exposure conditions on-Base are similar to those within the LUC boundaries. ~~The CG044 ROD is forthcoming, which will address this issue.~~ During the interim, the protectiveness is maintained on-Base considering that groundwater is not in use for the area within the LUC boundary and for the area outside the LUC boundary. The Work Clearance Request process followed by the Operation Flight of the Civil Engineering Office has been effective in preventing on-Base groundwater use and activities that would adversely affect implementation of the selected remedy until COC concentrations in groundwater allow for UU/UE. Wellhead treatment systems are in place at three off-Base residential wells. The remedy for CG044 is short-term protective, which is consistent with the definition of short-term protectiveness. Human and ecological risks are currently under control and no unacceptable risks are occurring. However, the data indicate that future protectiveness or remedy performance may not be sufficient, but the remedy is currently protective."

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1 *(cont.)*						A recurring theme in the Report is that the forthcoming CG044 ROD is expected to address several issues, including those discussed above. A Five-Year Review should evaluate the implementation and performance of the in-place or under construction remedies, not those that may be included in future decision documents. Preparing and finalizing the CG044 ROD is an acceptable recommendation for addressing some of the cited issues, but ultimately it is the protectiveness of the current remedies that is being assessed. Current remedy issues atCG044-032 include: there are no LUCs in place for areas of off-Base groundwater contamination, the extent of off-Base TCE contamination exceeding the MCL is unknown, the most-downgradient monitoring well location associated with the site has an increasing TCE trend, and the original assumptions regarding the groundwater flow direction and gradient are no longer valid. The determination of "protective" for CG044 should be reevaluated. After the reevaluation is completed, relevant sections of the report should be updated and recommendations provided to remedy the identified issues. In particular, the issues of migration and the undefined extent for the CG044-032 off-Base contamination, and a recommendation to address these issues, should be included in the final document.	Comment acknowledged. The issues and recommendations in Section 6 have been revised as discussed in Response 1.b. The protectiveness determination in Section 7 has also been revised as described in Response 1.c.
2.						There are indicators of potential remedy problems at CG041-017. The Report discusses increasing TCE trends at wells 17C165BMW, 17C166MW, and 17H16BMW. These three wells are located downgradient of the second source area slurry wall (also known as the South Area Slurry Wall). According to the 2021 Annual Basewide Groundwater Monitoring Program Report, the increasing trends indicate a source of TCE exists outside the South Area Slurry Wall, downgradient of the permeable reactive barrier (PRB), suggesting a leak may be traveling through or underneath the slurry walls since the PRB was constructed (Brice, 2022). The Report also states well 17V012MW has exhibited extremely variable TCE concentrations. This well is located downgradient of the primary source area slurry wall and cross-gradient of the South Area Slurry Wall. The variable TCE concentrations noted at this well may indicate a leak traveling through or underneath the primary slurry wall. The selected remedy for CG041-017 in the Final ROD for CG041 (Air Force, 2018) includes the following component: "Continued containment using existing slurry walls." Based on the TCE trends of the four wells mentioned above and the interpretation of the trends in the 2021 Annual Basewide Groundwater Monitoring Program Report, it appears the existing slurry walls may not be effectively containing TCE to the source area of CG041-017. This issue should be discussed in Section 5.6.1, Question A – Is the Remedy Functioning as Intended by the Decision Documents, and Section 6. The Air Force should develop a recommendation to address this issue and include it in the final document.	Comment acknowledged. As discussed in the BGMP 2021 Annual Report (Brice, 2022b), groundwater gradients were measured in June 2021 in wells along the slurry wall in the Primary Source Area (outside of the Secondary Source Area). The 2021 measurements indicated that the groundwater gradient is inward and the containment system is operating as designed (Brice, 2022b). As also discussed in the BGMP 2021 Annual Report (Brice, 2022b), an inward hydraulic gradient has been maintained since the slurry wall was constructed in the Primary Source Area, except for short periods in 2008, 2017, and 2019. As discussed in the BGMP 2021 Annual Report (Brice, 2021b), the observed long-term increasing TCE trends at wells 17C165BMW, 17C166MW, and 17H16BMW are likely a result of TCE present outside the slurry walls during construction in 2007 (Brice, 2022b) and not indicative of a leak. TCE contamination located outside the slurry walls may have migrated south to these locations after the PRB was constructed (Brice, 2022b). Implementation of the selected remedy (hotspot treatment) to address COCs in groundwater at Plume CG041-017 began in August 2023. The remedy includes hotspot treatment with ERD and PRB with in-situ chemical reduction (hotspot generally defined by residual TCE concentrations greater than 10,000 µg/L inside the slurry walls and 500 µg/L outside the slurry walls). Portions of the remedy construction, including construction of the PRB and two bioreactors, have been completed. Full remedy construction is expected to be completed in 2024. The following sentence in the second bullet in Section 4.4.2.3 of the Draft Final FYR has been deleted: ~~"The increasing trends indicate that a local source of TCE exists outside the South Area Slurry Wall and downgradient of the PRB, suggesting a leak may be traveling through or underneath the slurry walls since the PRB was constructed (Brice, 2022b)."~~ The following text has been added in the second bullet in Section 4.4.2.3:

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2 *(cont.)*						*(see above)*	"Well 17C165BMW is about 100 feet southeast and downgradient of the PRB. Well 17C166MW is located about 260 feet southwest and downgradient of the PRB. Plume well 17H16BMW is located farther downgradient, approximately 750 feet south of the PRB. TCE outside the slurry walls at the time of construction (2007) is apparently migrating (Brice, 2022b). TCE contamination located outside the slurry walls may have migrated south to these locations since the construction of the PRB (Brice, 2022b)." The following text has been added toward the end of the first paragraph in Section 5.6.1: "The observed long-term increasing TCE trends at wells 17C165BMW, 17C166MW, and 17H16BMW are likely a result of TCE present outside the slurry walls at the time of construction in 2007 (Brice, 2022b). Groundwater gradients measured in June 2021 in wells along the slurry wall in the Primary Source Area (outside of the Secondary Source Area) indicated that the groundwater gradient is inward and the containment system is operating as designed (Brice, 2022b). Based on the observed hydraulic performance of the slurry wall, implementation of the final remedy (which is in progress), the CG041-017 remedy is protective in the short-term. For the Site CG041 remedy to be fully protective, the ongoing implementation of the final remedy for Plume CG041-017 will need to be completed." Based on the observed hydraulic performance of the slurry wall described above, implementation of the final remedy (which is in progress), and the discussion presented above, the CG041-017 remedy is protective in the short-term. The protectiveness determination for Site CG041 in Section 7 has been changed from "Protective" to "Short-term Protective." The protectiveness statement for Site CG041 has also been revised as shown below. "Protectiveness Statement: The remedies for Site CG041 currently protect human health and the environment because LUCs and most of the other remedies established in the CG041 Final ROD have been implemented. LUCs remain in place to prevent potential exposures through VI or direct contact pathways. In addition, the implemented remedies are functioning as intended by the CG041 ROD. Groundwater is not in use. However, for the Site CG041 remedy to be fully protective, the ongoing implementation of the final remedy for Plume CG041-017 will need to be completed. LUCs and groundwater monitoring and evaluation for Site CG041 should be continued until such time as RAOs are achieved and the site is suitable for UU/UE."
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1.	3.1		1st			LF013 – Former Landfill No. 1: The protectiveness statement quoted in this section is the protectiveness determination from the first Five-Year Review (URS, 2012), not the Second Five-Year Review Report (AECOM, 2018), as stated. The quoted text should be replaced with the protectiveness determination from the Second Five-Year Review Report.	Comment acknowledged. The protectiveness statement for Site LF013 in Section 3.1 has been replaced as follows: "The remedy at Site LF013 is protective of human health and the environment under current and anticipated future land uses. If these conditions change and, for example, buildings are constructed, the implications to human health risk may need to be re-evaluated."
2.	4.4.2.3					CG041-017, eighth bullet point: The Report states the calculated area of the inferred 5 µg/L TCE isocontour for 2019 is 30.5 acres. However, Figure 4-7, Plume CG041-017 Groundwater TCE Isocontours (2016, 2019, and 2021), indicates the inferred area for 2019 is 25.3 acres. Please confirm the correct area and correct the text or figure, as appropriate.	Comment acknowledged. The calculated area of 25.3 acres on Figure 4-7 is correct. The eighth bullet in Section 4.4.2.3, CG041-017, has been revised to 25.3 acres.

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3.	4.4.3.3					CG044-031, third bullet point: The Report states the calculated area of the inferred 5-µg/L TCE isocontour for 2016 is 14.4 acres. However, Figure 4-26, Plume CG044-031 Groundwater TCE Isocontours (2016, 2019, and 2021), indicates the inferred area for 2016 is 14.73 acres. Please confirm the correct area and correct the text or figure, as appropriate.	Comment acknowledged. The calculated area of 14.7 acres on Figure 4-26 is correct. The third bullet in Section 4.4.3.3, CG044-033, has been revised to 14.7 acres.
4.						Figure ES-1, Third Five-Year Review Sites: The figure does not show the site boundary for CG044-031. This site boundary should be added to the figure.	Comment acknowledged. Figure ES-1 has been revised to include the site boundary for CG044-031.
5.						Figure 1-1, Regional Site Location Map: Beale Air Force Base: The figure does not show the city limits of Wheatland. The Wheatland city limits should be added to the figure.	Comment acknowledged. Figure 1-1 has been revised to include the city limits of Wheatland.
6.						Figure 1-2, Third Five-Year Review Sites: The figure does not show the site boundary for CG044-031. This site boundary should be added to the figure.	Comment acknowledged. Figure 1-2 has been revised to include the site boundary for CG044-031.
7.						Figure 2-1, Site LF013 Features and Land Use Control Boundary: The acronyms "JPTS" and "POL" are defined in the legend but not used on the figure. These acronyms should be removed from the legend.	Comment acknowledged. Figure 2-1 has been revised to remove the acronyms "JPTS" and "POL" from the legend.
8.						Figure 2-3, Site SD032 Features and Land Use Control Boundary: The symbol "-x" is shown on the figure but not included in the legend. Based on other figures in the report, the symbol likely indicates a fence line. The symbol should be added to the legend and defined.	Comment acknowledged. Figure 2-3 has been revised to show the fence line as x—x–x–x–x ,and is defined in the legend as the fence line.
9.						9. Figure 2-5, Site TU509 Features and Land Use Control Boundary: The acronyms "JPTS" and "POL" are defined in the legend but not used on the figure. These acronyms should be removed from the legend.	Comment acknowledged. Figure 2-5 has been revised to remove the acronyms "JPTS" and "POL" from the legend.
10.						Figure 4-5, Plume CG041-016 Groundwater Perchlorate Isocontours (2016, 2019, and 2020): The label on the map showing the most recent perchlorate plume extent is "2021." However, the Report and figure title state 2020 was the most recent data used for CG041-016. The label should be corrected.	Comment acknowledged. The label on Figure 4-5 has been revised to show the most recent perchlorate plume extent as "2020."
11.						Figure 4-17, Plume CG041-039 Groundwater TCE Isocontours (2016, 2019, and 2021): The isocontours shown on the 2019 map are not labeled. Corresponding concentration labels should be added to the isocontours.	Comment acknowledged. Figure 4-17 has been revised to include concentration labels on the 2019 isocontours.
12.						Figure 4-20, Plume CG044-003 Annual 2021 Groundwater TCE Concentrations: Fire Protection Training Area (FTPA) No. 3 is not labeled on the figure. The label for FPTA No. 3 should be added.	Comment acknowledged. On Figure 4-20, the existing label for FTPA 3 has been moved to a more prominent location.
13.						Tables: The tables included in the Report include a column titled "TCE Time-Series Plot Trend." A footnote should be added to the tables or text should be added to the Report discussing the method used to determine the TCE trends listed in the tables.	Comment acknowledged. The following footnote has been added to the column titled "TCE Time-Series Plot Trend" in Tables 4-1 to 4-14. Source: Brice, 2022b ("Basewide Groundwater Monitoring Program 2021 Annual Report, Beale Air Force Base, California," July).

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Central Valley Regional Water Quality Control Board
Comment Date: 11/13/2023
Document Date: 10/2023

Beale AFB Common Comment and Response Worksheet

Comment Date 11/13/2023	Document Date October 2023					Document Title (version) Response to Comments, Draft Final Third Five-Year Review Report; and Tracked Changes Version of the Final Third Five-Year Review Report Text, Multiple Sites at Beale Air Force Base	Contract/TO Number W9123822C0027
Item	**Section**	**Page**	**Para**	**Line**	**Class**	**Comment**	**Response**
Central Valley Regional Water Quality Control Board, Holly H. Young, PG							
1	--	--	--	--	--	General Comment #2 from Central Valley Water Board staff is not included in the RTCs. It should be added, and a response should be provided.	Comment acknowledged; General Comment #2 was inadvertently not included in the RTCs. General Comment #2 and the corresponding response have been added in yellow highlighting in the revised version of the RTCs. General Comment #2 and the corresponding response are also included below. **General Comment 2:** There are indicators of potential remedy problems at CG041-017. The Report discusses increasing TCE trends at wells 17C165BMW, 17C166MW, and 17H16BMW. These three wells are located downgradient of the second source area slurry wall (also known as the South Area Slurry Wall). According to the 2021 Annual Basewide Groundwater Monitoring Program Report, the increasing trends indicate a source of TCE exists outside the South Area Slurry Wall, downgradient of the permeable reactive barrier (PRB), suggesting a leak may be traveling through or underneath the slurry walls since the PRB was constructed (Brice, 2022). The Report also states well 17V012MW has exhibited extremely variable TCE concentrations. This well is located downgradient of the primary source area slurry wall and cross-gradient of the South Area Slurry Wall. The variable TCE concentrations noted at this well may indicate a leak traveling through or underneath the primary slurry wall. The selected remedy for CG041-017 in the Final ROD for CG041 (Air Force, 2018) includes the following component: “Continued containment using existing slurry walls.” Based on the TCE trends of the four wells mentioned above and the interpretation of the trends in the 2021 Annual Basewide Groundwater Monitoring Program Report, it appears the existing slurry walls may not be effectively containing TCE to the source area of CG041-017. This issue should be discussed in Section 5.6.1, Question A – Is the Remedy Functioning as Intended by the Decision Documents, and Section 6. The Air Force should develop a recommendation to address this issue and include it in the final document. **Response:** Comment acknowledged. As discussed in the BGMP 2021 Annual Report (Brice, 2022b), groundwater gradients were measured in June 2021 in wells along the slurry wall in the Primary Source Area (outside of the Secondary Source Area). The 2021 measurements indicated that the groundwater gradient is inward and the containment system is operating as designed (Brice, 2022b). As also discussed in the BGMP 2021 Annual Report (Brice, 2022b), an inward hydraulic gradient has been maintained since the slurry wall was constructed in the Primary Source Area, except for short periods in 2008, 2017, and 2019. As discussed in the BGMP 2021 Annual Report (Brice, 2021b), the observed long-term increasing TCE trends at wells 17C165BMW, 17C166MW, and 17H16BMW are likely a result of TCE present outside the slurry walls during construction in 2007 (Brice, 2022b) and not indicative of a leak. TCE contamination located outside the slurry walls may have migrated south to these locations after the PRB was constructed (Brice, 2022b). Implementation of the selected remedy (hotspot treatment) to address COCs in groundwater at Plume CG041-017 began in August 2023. The remedy includes hotspot treatment with ERD and PRB with in-situ chemical reduction (hotspot generally defined by residual TCE concentrations greater than 10,000 µg/L inside the slurry walls and 500 µg/L outside the slurry walls).

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1						General Comment #2 from Central Valley Water Board staff is not included in the RTCs. It should be added, and a response should be provided.	Portions of the remedy construction, including construction of the PRB and two bioreactors, have been completed. Full remedy construction is expected to be completed in 2024. The following sentence in the second bullet in Section 4.4.2.3 of the Draft Final FYR has been deleted: ~~"The increasing trends indicate that a local source of TCE exists outside the South Area Slurry Wall and downgradient of the PRB, suggesting a leak may be traveling through or underneath the slurry walls since the PRB was constructed (Brice, 2022b)."~~ The following text has been added in the second bullet in Section 4.4.2.3: *"Well 17C165BMW is about 100 feet southeast and downgradient of the PRB. Well 17C166MW is located about 260 feet southwest and downgradient of the PRB. Plume well 17H16BMW is located farther downgradient, approximately 750 feet south of the PRB. TCE outside the slurry walls at the time of construction (2007) is apparently migrating (Brice, 2022b). TCE contamination located outside the slurry walls may have migrated south to these locations since the construction of the PRB (Brice, 2022b)."* The following text has been added toward the end of the first paragraph in Section 5.6.1: *"The observed long-term increasing TCE trends at wells 17C165BMW, 17C166MW, and 17H16BMW are likely a result of TCE present outside the slurry walls at the time of construction in 2007 (Brice, 2022b). Groundwater gradients measured in June 2021 in wells along the slurry wall in the Primary Source Area (outside of the Secondary Source Area) indicated that the groundwater gradient is inward and the containment system is operating as designed (Brice, 2022b). Based on the observed hydraulic performance of the slurry wall, implementation of the final remedy (which is in progress), the CG041-017 remedy is protective in the short-term. For the Site CG041 remedy to be fully protective, the ongoing implementation of the final remedy for Plume CG041-017 will need to be completed."* Based on the observed hydraulic performance of the slurry wall described above, implementation of the final remedy (which is in progress), and the discussion presented above, the CG041-017 remedy is protective in the short-term. The protectiveness determination for Site CG041 in Section 7 has been changed from "Protective" to "Short-term Protective." The protectiveness statement for Site CG041 has also been revised as shown below. "Protectiveness Statement: The remedies for Site CG041 currently protect human health and the environment because LUCs and most of the other remedies established in the CG041 Final ROD have been implemented. LUCs remain in place to prevent potential exposures through VI or direct contact pathways. In addition, the implemented remedies are functioning as intended by the CG041 ROD. Groundwater is not in use. However, for the Site CG041 remedy to be fully protective, the ongoing implementation of the final remedy for Plume CG041-017 will need to be completed. LUCs and groundwater monitoring and evaluation for Site CG041 should be continued until such time as RAOs are achieved and the site is suitable for UU/UE."

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2						Item 1.d. The final two sentences of the quoted amended text are not included in the track changes document. The missing sentences should be added to the document.	Comment acknowledged. The following text has been added at the end of the first paragraph in Section 5.7.2 in yellow highlighting: "The remedy for CG044 is short-term protective, which is consistent with the definition of short-term protectiveness. Human and ecological risks are currently under control, and no unacceptable risks are occurring. However, the data indicate that future protectiveness or remedy performance may not be sufficient, but the remedy is currently protective."
3						Figure 2-2: The label for the Groundwater Treatment System appears to be truncated.	Comment acknowledged. Figure 2-2 has been revised to display the Groundwater Treatment System label.
4						Figure 2-3: A number of white circles and two yellow rectangles appear to have been added to the revised figure but are not shown in the legend.	Comment acknowledged. Figure 2-3 has been revised so that the oil/water separators (represented by white circles) and wash racks (represented by yellow rectangles) are shown in the legend.
5						Figure 2-5: Dark red polygons appear to have been added near Buildings 5702 and 5700. Doesn't look like these are in the legend.	Comment acknowledged. Figure 2-5 has been revised so that the referenced red polygon layer is not displayed.
6						Figure 4-17: The plume area total acreages are not shown on the revised figure.	Comment acknowledged. Figure 4-17 has been revised to include plume acreage labels.
7						Figure 4-20: The plume isoconcentration labels in the main figure extent are not shown.	Comment acknowledged. Figure 4-20 has been revised to include isoconcentration contour labels.
8						Figure 4-31: The "Vernal Pool or Wetland" data layer is not shown on the revised figure, though it is included in the legend.	Comment acknowledged. The "Vernal Pool or Wetland" layer has been removed from the legend on Figure 4-31.

Department of Toxic Substances Control
Comment Dates: 09/22/2023
11/27/2023
02/16/2024
Document Date: 08/15/2023

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DTSC-FFU, Kimiye Touchi, P.E. – General Comments									
1.								1. Worksheet Section 5, Question B – Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and remedial action objectives (RAOs) Used at the Time of the Remedy Selection Still Valid? • An evaluation of the Applicable or Relevant and Appropriate Requirements (ARARs) established in the final record of decision document for each site was performed. The Third FYR Report determines that there were "…no major changes to the ARARs listed in the Final ROD…." for each site. And that "…. the exposure assumptions, toxicity data, cleanup levels, and RAOs have not changed in a way that could affect the protectiveness of the remedy for the site…." • DTSC disagrees with the Third FYR statement that there were no major changes to the ARARs listed in the Final Record of Decision (ROD), because the State of California promulgated the Toxicity Criteria Rule (TCR) in September 2018, after the second FYR. The promulgated TCR should be considered a "new" ARAR. However, the evaluation provided in the third FYR Report demonstrates that application of the TCR results in no change to the remedy or protectiveness determination because there are remedies in-place (i.e., institutional controls, etc.) at subsites which contain contaminants of concern listed in the TCR that are already protective regardless of which toxicity criteria is used. In addition, the risk calculations provided in Section 5 are based on toxicity criteria from the DTSC's HERO Note 3. Therefore, while the TCR values are more stringent than the federal values, evaluation using TCR values does not impact the protectiveness determination. DTSC's position is that the TCR is an ARAR and will continue to consistently evaluate the more stringent TCR values and their application at all cleanup sites in California, including federal facilities.	Comment acknowledged. The AF has not agreed to ARAR designation of the Toxicity Criteria Rule (TCR).
	1							State of California Toxicity Criteria Rule. Response is noted.	Acknowledged

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DTSC-FFU, Kimiye Touchi, PE – General Comments *(continued)*									
2.								1. OT017/CG041-017. Increasing trichloroethene (TCE) concentrations outside of the slurry wall suggests a leak in the wall may allow TCE in groundwater to travel through or underneath the slurry walls. The protectiveness evaluation of the primary slurry wall should include sampling of the wells located between the slurry wall and Best Slough as part of the five-year review process.	Comment acknowledged. As discussed in the BGMP 2021 Annual Report (Brice, 2022b), groundwater gradients measured in June 2021 in wells along the slurry wall in the Primary Source Area (outside of the Secondary Source Area) indicated that the groundwater gradient is inward and the containment system is operating as designed (Brice, 2022b). As also discussed in the BGMP 2021 Annual Report (Brice, 2022b), an inward hydraulic gradient has been maintained since the Primary Source Area slurry wall was constructed, except for short periods in 2008, 2017, and 2019. As discussed in the BGMP 2021 Annual Report (Brice, 2021b), the observed long-term increasing TCE trends at wells 17C165BMW, 17C166MW, and 17H16BMW are likely a result of TCE present outside of the slurry walls at the time of construction in 2007 and not indicative of a leak (Brice, 2022b). TCE contamination located outside the slurry walls may have migrated south to these locations after the PRB was constructed (Brice, 2021b). The EA monitoring and the groundwater LUCs component of the remedy will be used to address the increasing TCE concentration trends. Results from the ongoing groundwater monitoring will be used to assess the performance of the slurry wall. Implementation of the selected remedy (hot spot treatment) to address the COCs in groundwater at Plume CG041-017 began in August 2023. This remedy includes hotspot treatment with enhanced reductive dechlorination (ERD) and PRB with in-situ chemical reduction (hotspot generally defined by residual TCE greater than 10,000 µg/L inside the slurry walls and 500 µg/L outside the slurry walls). Portions of the remedy construction, including construction of the PRB and two bioreactors, have been completed. Full remedy construction is expected to be completed in 2024. The following second sentence in the second bullet in Section 4.4.2.3 of the Draft Final FYR has been deleted: "~~The increasing trends indicate that a local source of TCE exists outside the South Area Slurry Wall and downgradient of the PRB, suggesting a leak may be traveling through or underneath the slurry walls since the PRB was constructed (Brice, 2022b).~~"

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DTSC-FFU, Kimiye Touchi, PE – General Comments *(continued)*									
2. *(cont.)*								*(see above)*	The following text has been added in the second bullet in Section 4.4.2.3: "The observed long-term increasing TCE trends at wells 17C165BMW, 17C166MW, and 17H16BMW are likely a result of TCE migration outside the slurry walls at the time of construction (2007). TCE contamination located outside the slurry walls may have migrated south to these locations since the PRB was constructed (Brice, 2021b). The EA monitoring and the groundwater LUCs component of the remedy will be used to address the increasing TCE concentration trends. Results from the ongoing groundwater monitoring will be used to continue to assess the performance of the slurry wall." Based on the observed hydraulic performance of the slurry wall described above, implementation of the final remedy (which is in progress), and the discussion presented above, the CG041-017 remedy is protective in the short-term. The protectiveness determination for Site CG041 in Section 7 has been changed from "Protective" to "Short-term Protective." The protectiveness statement for Site CG041 has also been revised as shown below. "Protectiveness Statement: The remedies for Site CG041 currently protect human health and the environment because LUCs and most of the other remedies established in the CG041 Final ROD have been implemented. LUCs remain in place to prevent potential exposures through VI or direct contact pathways. In addition, the implemented remedies are functioning as intended by the CG041 ROD. Groundwater is not in use. However, for the Site CG041 remedy to be fully protective, the ongoing implementation of the final remedy for Plume CG041-017 will need to be completed. LUCs and groundwater monitoring and evaluation for Site CG041 should be continued until such time as RAOs are achieved and the site is suitable for UU/UE."

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DTSC-FFU, Kimiye Touchi, PE – General Comments *(continued)*									
	2							2. OT017/CG041-017. Long-term increasing trichloroethene (TCE) trends are observed at wells 17C165BMW, 17C166MW, and 17H16BMW. These wells are downgradient of the secondary slurry wall and permeable reactive barrier (PRB). The removal of text correlating the increasing concentration trend with the possibility of a leak in the slurry wall is noted. The reasoning that the increasing TCE trend could be associated with TCE contamination outside of the slurry wall is plausible, however, and cannot be ruled out. Ongoing groundwater monitoring may be able to assess the more likely reason for the increasing TCE concentration trend and to allow the Air Force to proactively address a failure in the slurry wall before protectiveness of human health and the environment are adversely affected. The remedy for CG041-017 identified in the Record of Decision (ROD) includes hot spot treatment if TCE concentrations are above the trigger of 500 micrograms per liter (ug/L). The TCE concentrations observed at wells outside of the slurry walls (17C165BMW, 17C166MW, and 17H16BMW) are below the trigger. Enhanced Attenuation (EA) monitoring and the groundwater land use controls (LUCs) will therefore be the components of the remedy that will be applied to the increasing TCE concentration trends downgradient of the secondary slurry wall. The response in the RTC table should be revised appropriately. The Air Force decision to change the protectiveness statement to protectiveness in the short term is noted.	Comment acknowledged. The following text has been added at the end of the second paragraph in the response. "The EA monitoring and the groundwater LUCs component of the remedy will be used to address the increasing TCE concentration trends. Results from the ongoing groundwater monitoring will be used to continue to assess the performance of the slurry wall." The above text has been included as a part of the second bullet in Section 4.4.2.3 of the Third FYR text.
3								Tables 2-1, 2-2, 2-3, 2-4 - Chronology of Major Activities and Events for Sites LF013, OT017, SD032, and ST018. "Land Use Control Inspections" in these tables are marked as "Ongoing". The Land Use Control (LUC) Implementation Report for these sites was finalized in September 2021 and the most recent LUC Inspection Report was finalized in December 2021. Please provide an appropriate date range in the table for clarity.	Comment acknowledged. The activity name in the last row in the tables was meant to indicate LUC implementation (and not "LUC inspection"). Accordingly, the activity name has been changed from "Land Use Control Inspections" to "Land Use Control Implementation." Because LUC implementation is ongoing for these sites, no change has been made to the date range in the tables.
	3.							Response is acceptable.	Acknowledged.

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DTSC Kimiye Touchi, PE – Specific Comments									
1.a.			2.6	2-12				Plume CG041 a. The text states that the "…… Risk-based groundwater concentrations protective of the indoor air pathway at Site CG041 were calculated and are higher than the MCLs (Air Force, 2018b). Thus, cleanup to MCLs will be protective of the VI pathway." The risk-based groundwater cleanup goals for vapor intrusion pathway should be checked to confirm that this statement is still true. The risk- based groundwater cleanup goals for the vapor intrusion pathway that are provided in Appendix E of the CG044 Focused Feasibility Study are acceptable for the CG044 constituents of concern (COC); the validity of the statement will need to be checked for all other CG041 COCs.	Comment acknowledged. Risk-based groundwater concentrations protective of the indoor air pathway at Site CG041 were calculated and are higher than the MCLs (Air Force, 2018b). Thus, cleanup to MCLs will be protective of the VI pathway. Discussion on the protectiveness of the MCLs is provided in Section 5 and Table E1. Table E-1 in Appendix E presents the calculations of estimated risk and hazards resulting from the groundwater (concentrations at MCLs) to-indoor air VI pathway, under both residential and industrial scenarios. A review of the results indicates that health risks are either less than or within the EPA's generally acceptable risk management range of 10^{-6} to 10^{-4} as discussed in the National Contingency Plan (NCP), 40 CFR 300.430, with a risk level of 10^{-6} used as a point of departure for determining remedial goals when ARARs are not available or are not sufficiently protective. The highest risk estimate is attributed to chloroform, which is within the acceptable risk management range.
	1.							CG041 – Responses are acceptable for comments 1b and 1c. Comments to the responses to comments 1a and 1d are provided.	Acknowledged.
	1.a.							1a. The Air Force response indicates that the maximum contaminant levels (MCLs) will be protective of the vapor intrusive pathway. The bullet should be revised to indicate that the reduction in mass is associated with all remedies implemented to date and not just those implemented since the CG041 ROD.	Comment acknowledged. The portion of the text, "reduction in mass is associated with all remedies implemented to date and not just those implemented since the CG041 ROD" is associated with Specific Comment 1.b, requiring a revision to the first bullet in Section 5.6.1 (Section 5.6.1 – page 5-11, First bullet in the Draft Final PDF). Accordingly, the following text has been added to Response 1.b in the RTCs: "The reduction in mass is associated with all remedies implemented to date and not just those implemented since the CG041 ROD." The above text has also been added to the first bullet in Section 5.6.1
1.b.			5.6.1	5-11				b. Section 5.6.1 – page 5-11, First bullet. The bullet discusses reduction in TCE mass by remedies implemented at the CG041 plume sites. The text should clarify if this statement applies to all remedies implemented to date or if it applies to the interim remedies implemented prior to the CG041 ROD.	Comment acknowledged. The TCE mass reductions are based on the annual 2021 groundwater monitoring results and apply to all remedies implemented through 2021. The first bullet in Section 5.6.1 has been revised as shown below to clarify. "Based on the 2021 annual groundwater monitoring results, the remedies implemented at CG041 plume sites CG041-010, CG041-029, CG041-035, and CG041-039 have reduced TCE by more than 90 percent in the target treatment area. At CG041-018, TCE was reduced by more than 75 percent in the target treatment area. The reduction in mass is associated with all remedies implemented to date and not just those implemented since the CG041 ROD."

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DTSC Kimiye Touchi, PE – Specific Comments *(continued)*									
1.c.			5.6.1	5-11				c. Section 5.6.1 – page 5-11, last paragraph. "The component […] not in place as of this FYR period is scheduled for implementation beginning in August 2023". Since August 2023 has passed, please update the date or status of implementation.	Comment acknowledged. Section 5.6.1 has been revised as shown below to update the status of remedy implementation at CG041-017. "Implementation of the selected remedy to address the COCs in groundwater at Plume CG041-017 began in August 2023. The remedy includes hotspot treatment with ERD and PRB with in-situ chemical reduction (hotspot generally defined by residual TCE concentrations greater than 10,000 µg/L inside the slurry walls and 500 µg/L outside the slurry walls). Portions of the remedy construction, including construction of the bioreactors, have been completed. The full remedy construction is expected to be completed in 2024."
1.d.			6	6-1				d. Section 6, page 6-1. Issues for Site CG041 are identified. The first bullet identifies when implementation of the last remedial component is to begin. An anticipated completion date should also be provided.	Comment acknowledged. The recommendation for CG041 has been revised as shown below. "Per the CG041 Final ROD (Air Force, 2018b), implement hotspot treatment with ERD and PRB with in-situ chemical reduction at plume site CG041-017 by 2024."
	1.d.							d. The Air Force recommends short-term protectiveness. Based on our discussion in General Comment #2, response is noted.	Acknowledged.
1.e.			7					e. Section 7. Protectiveness for Site CG041 should be changed to protectiveness in the short term. Although the surface water sampling data collected indicates that groundwater from CG041-017 does not appear to be impacting surface water concentrations, the surface water sample location is a considerable distance from the northern edge of the primary slurry wall and the primary slurry wall appears to be leaking. The monitoring wells between the primary slurry wall and Best Slough have not been sampled for over 10 years. It is therefore not possible to determine if groundwater from the primary slurry wall is migrating toward Best Slough to the north, northwest, and northeast. A surface water sample location closer to the northern end of the primary slurry wall should be added to the annual monitoring program and groundwater monitoring data should be collected from wells between the primary slurry wall and Best Slough. These wells should be sampled sometime in the next year and a regular sampling interval should be established to allow for the evaluation of long-term effectiveness of the slurry wall and assess migration toward Best Slough.	Comment acknowledged. The protectiveness determination for Site CG041 has been changed to "Short-term Protective." The protectiveness statement has also been revised as discussed in General Comment 2. Regarding the slurry wall performance, please see the response to General Comment 2.
2.								Plume CG041-016 a. Figure 2-8. The LUC boundary is not marked on the map and should be added.	Comment acknowledged. Figure 2-8 has been revised to include the LUC boundary.
	2.							2. Response is acceptable.	Acknowledged.

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DTSC Kimiye Touchi, PE – Specific Comments *(continued)*									
3.								OT017/Plume CG041-017	
	3.							3. OT017/Plume CG041-017 – Responses are acceptable for comments 3b through 4d. Comments to the responses to comments 3a and 3e are provided.	Acknowledged.
3.a.								a. Figure 2-2 – The LUC boundary for soil is depicted by a brown dashed line. This line appears to show the soil vapor LUC boundary. The identifier in the legend should be corrected as appropriate and a different identifier used to depict the LUC boundary for soil.	Comment acknowledged. Figure 4-6 has been revised to show the LUC boundary for soil vapor in green instead of brown and the legend has been updated.
	3.a.							a. The Air Force added the LUC boundary for soil vapor on Figures 2-2 and 4-6. The label for the Groundwater Treatment System was changed to "Groundwater" and should be labeled "Groundwater Treatment System".	Comment acknowledged. Figures 2-2 and 4-6 have been revised to include the "Groundwater Treatment System" label and the "Vernal Pools" layer.
3.b.								b. Figure 4-6. The LUC boundary for soil vapor is not shown on the map and should be added.	Comment acknowledged. Figure 4-6 has been revised to include the LUC boundary for soil vapor.
3.c.								Figures: The surface water sample location, 17L008SW should be shown.	Comment acknowledged. On Figure 4-6, the surface water sample location 17L008SW is present and labeled in the main map frame. Figure 4-6 has been revised to also show the sample in the detail inset frame.
3.d.								Figures: Parks Lake should be labeled.	Comment acknowledged. Figure 4-6 has been revised to include a label on Parks Lake.
	3.d.							d. The Air Force recommends protective in the short-term. This recommendation is noted.	Acknowledged.
3.e.			2.6.3.1	2-20	2			The decision to shut down the GTS on April 18, 2022 should be elaborated on regarding protectiveness of the decision.	Comment acknowledged. The following text has been added in the last paragraph in Section 2.6.3.1: "As described above under Section 2.6.3, heavy equipment could not access the site to replace the spent GAC due to access limitations as a result of bridge construction. While the GTS was shutdown, remedy protectiveness in the short-term is maintained considering that LUCs are being implemented. Implementation of the final remedy, which began in August 2023 and is expected to be completed in 2024, is expected to address long-term protectiveness of the remedy for Plume CG041-017."
4.								Plume CG041-039	
	4.							4. CG041-039 – Responses are acceptable for comments 4b through 4d. Comments to the response to comment 4a are provided.	Acknowledged.

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4.a.			2.6.7		2			a. Contamination at Source Area 2 is suspected to result from disposal of TCE and tetrachloroethene (PCE) into sanitary sewer or storm drain lines. The description should specify if the sanitary sewer and/or storm drain lines were checked for leaks, flushed, repaired, or if other actions were taken to remove the source.	Comment acknowledged. A review of the previous documents did not indicate references to checking for leaks and taking additional actions, including flushing and repairing, to remove the source.
	4.a							a. The text should be amended to note that it is not known if a study was conducted to check for leaks in the sanitary and storm drains and that it is not known if additional actions such as flushing of lines and repair of the lines was taken to address the source.	Comment acknowledged. The following text has been added at the end of third paragraph in Section 2.6.7: "It is not known if a study was conducted to check for leaks in the sanitary and storm drains, and if additional actions such as flushing of lines and repair of the lines were taken to address the source."
4.b.			2.6.7					b. The CG041-039 text does not discuss the Site SS507 1,1-DCE plume, the SS023 TCE plume, or the Site CG041-508 PCE plume, but they are shown on the CG041-039 figures. A discussion of these Cantonment Area groundwater sites and why they are not included in the Third FYR Report is requested.	Comment acknowledged. The source areas associated with Plume CG041-039 are Site SS039 Source Area 1 and Site SS039 Source Area 2. Figure 4-16 showing CG041-39 plume has been revised to remove the SS507 1,1-DCE source area, the SS023 TCE plume source area, and the Site CG041-508 PCE plume source area because they are not pertinent to the figure. As stated in Table 2-6 in Section 2.6, the groundwater contamination underlying Site SS023, CG041-508, and SS507 is addressed under RCRA, therefore; will not be addressed under the Third FYR.
4.c.								c. Figure 4-16. The industrial/commercial LUC boundary is shown on the figure, but not identified in the legend. This discrepancy should be resolved.	Comment acknowledged. Figure 4-16 has been revised to show the industrial/commercial LUC boundary in the legend.
4.d.								d. Figure 4-16. The CG041-508 LUC boundary is shown on the figure, but not identified in the legend. This discrepancy should be resolved. LUC boundaries for other Cantonment Area plumes of interest should also be included.	Comment acknowledged. Figure 4-16 has been revised to remove the CG041-508 LUC boundary and the labels for the other Cantonment Area plume sources.
5.								Site CG044 – Western Groundwater Plumes	
	5.							Site CG044 – Responses are acceptable for comments 5a and 5b. Comments to 5c are provided. Section 7.2 – The protectiveness determination has been changed to short-term protective. Response is acceptable.	Acknowledged. Acknowledged.
5.a.			2.7	2-28	2, 3			a. The text discusses the Final Proposed Plan and the pending ROD for CG044. Since these documents are outside of the time frame for the Third FYR, the text should instead reference the Final Focused Feasibility Study for Site CG044 (FFS) (CH2M, 2020g) and/or the Revised Final Site CG044 Pre-Record of Decision Investigation Data Summary (Brice, 2022f).	Comment acknowledged. References to the Proposed Plan and the pending ROD have been replaced with the Final Focused Feasibility Study.

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5.b.			6	6-1				b. Issues for Site CG044 are identified. CG044 plume sites where offbase pumping has resulted in plume migration beyond the LUC boundaries established in the interim remedies are identified. It lists CG044-003, CG044-031, and CG044-032, but does not list CG044-040. The discussion in Section 4.4.5.3 indicates that CG044-040 should be added to this list.	Comment acknowledged. It is stated in Section 4.11.6 of the 2021 BGMP Annual Report (Brice, 2022b) that Site SS043 RI data confirms that TCE has migrated to the Base boundary and that a data gap investigation would be performed prior to the SS043 FS to evaluate the extent of TCE that has migrated to the west of the Base boundary (Brice, 2022b). Off-base plume migration will be addressed as a part of Site SS043. The following text has been added to the last bullet in Section 4.4.3.5: "Site SS043 RI data confirm that TCE has migrated to the Base boundary and a data gap investigation will be performed prior to the SS043 FS to evaluate the extent of TCE that has migrated to the west of the Base boundary (Brice, 2022b). Off-base plume migration will be addressed as a part of Site SS043."
5.c.			7.2					c. The protectiveness determination for CG044 should be changed to Protectiveness Deferred based on the lack of adequate data at CG044-013 and CG044-032.	Comment acknowledged. The protectiveness determination has been revised to "Short-Term Protective" as discussed below.
5.c.i.								The CG044-013 groundwater is comingled with polyfluoroalkyl substances (PFAS). Groundwater is extracted and treated with an air stripper before being discharged to surface water. Air stripping is not an effective treatment remedy for PFAS. Any PFAS in the influent would therefore be present in the effluent which discharges to surface water. PFAS in groundwater at CG044-013 should be characterized to determine how the presence of PFAS in the groundwater affects the effectiveness of the remedy. Until characterization is conducted and a determination of the protectiveness of the remedy established, protectiveness for the CG044-013 groundwater treatment system should be deferred.	Comment acknowledged. The protectiveness statement for Site CG044 has been updated to include the following language for Plume CG044-013. In addition, an issue related to PFAS in CG044-013 groundwater has been added along with the corresponding recommendation as further stated below. "In addition, PFAS in groundwater at CG044-013 will need to be characterized to assess how the presence of PFAS in groundwater affects the effectiveness of the remedy. LUCs and groundwater monitoring and evaluation should be a part of any final remedy selected until such time as RAOs are achieved and the site is suitable for UU/UE." The following issue has been added in Section 6 for Site CG044: "PFAS in groundwater at CG044-013 needs to be characterized to assess how the presence of PFAS in groundwater affects the effectiveness of the remedy." The following recommendation has also been added in Section 6 for Site CG044: "Characterize PFAS in groundwater at CG044-013 to assess how the presence of PFAS in groundwater affects the effectiveness of the remedy."

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	5.c.i.							CG044-013. The revised text is acceptable. A clarification is requested. Wellhead treatment for residential drinking water wells that do not currently have a wellhead treatment system is discussed. The Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) for sampling of the off-base residential wells should be updated to ensure that the detection limits are below acceptable criteria such as the U.S. EPA Regional Screening Levels (RSLs) and proposed MCLs for per- and polyfluoroalkyl substances (PFAS). These wells should then be resampled for PFAS.	Comment acknowledged. The response to Specific Comment 5.c.i included the updated protectiveness statement for CG044. In addition to CG044-013, the updated protectiveness statement also refers to CG044-032 because this plume is part of CG044. Currently, there are wellhead treatment systems for the residential wells at CG044-032. For Plume CG044-013, a domestic water line is supplying drinking water to the resident west of CG044-013. Therefore, the wellhead treatment language in the updated protectiveness statement applies to Plume CG044-032 only. Wellhead treatment language is not applicable to Plume CG044-013. For further clarity, only the CG044-013 portion of the updated CG044 protectiveness statement has been included in the Response to Specific Comment 5.c.i as discussed below.
								The last sentence of the response provided in the RTC table should be revised. As written, the text of the response applies to CG044-032 but reiterates the characterization of PFAS in groundwater used for CG044-013. The text in the RLSO is the correct text. The response should be consistent with the text in the RLSO.	Comment acknowledged. As stated above, Response to Specific Comment 5.c.i included the updated protectiveness statement for Site CG044. In addition to CG044-013, the updated protectiveness statement also refers to CG044-032 as this Plume is part of CG044. For further clarity, only the CG044-013 portion of the protectiveness statement has been included in the response 5.c.i as shown below. "The protectiveness statement for Site CG044 has been updated to include the following language for Plume CG044-013: "In addition, PFAS in groundwater at CG044-013 will need to be characterized to assess how the presence of PFAS in groundwater affects the effectiveness of the remedy. LUCs and groundwater monitoring and evaluation should be a part of any final remedy selected until such time as RAOs are achieved and the site is suitable for UU/UE."
5.c.ii.								The CG044-032 groundwater plume is migrating offbase. Although the three off base residents with VOCs in their drinking water have been provided with a treatment system for VOCs, the groundwater plume must be delineated to show that it is protective long-term. Until the VOC plume is delineated, protectiveness of CG044-032 should be deferred.	Comment acknowledged. The protectives statement for Site CG044 has been revised. The revised protectiveness statement included under Comment 5.i response includes the need for CG044-032 off-base plume delineation.
	5.c.ii.							5c(ii) CG044-032. The Air Force revised protectiveness determination of short-term is protective is acceptable.	Acknowledged.
6.								LF013/Plume CG044-013	
	6.							6. LF013/Plume CG044-013 – Responses are acceptable for comments 6a through 6d. Comment to the response to comment 6b is provided.	Acknowledged.

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6.a.								a. The offbase exceedances of 5 micrograms per liter (µg/L) and 1.7 µg/L during the review period should be discussed in Section 2.	Comment acknowledged. Considering that Section 4.4.3.2 discusses TCE concentrations at CG044-013, the following bullet has been added to discuss off-Base exceedances:
									• Off-Base:
									  • During the BGMP Annual 2021 sampling event, TCE was not detected at concentrations exceeding the PSL in any off-Base downgradient wells, indicating the contaminant plume is being effectively confined to this area.
									  • Since 2014, TCE concentrations in off-Base well 13C045MW (Figure 4-23) have slowly increased until 2019, when concentrations peaked then began to decline (Brice, 2022b). This well is in the northern portion of the site and is located about 600 feet west of the Base boundary. Concentration trends in the area appear to reflect migration of a slug of contamination, first through 13L029MW between 2008 and 2014 and then through 13C045MW between 2016 and 2019 (Brice, 2022b). TCE contamination appears to be migrating toward the west in this area (Brice, 2022b). TCE was detected at 2.9 and 3.2 µg/L, during the semiannual and annual 2021 events, less than the PSL (5 µg/L).
									  • Well 13C054MW is located approximately 2,000 feet downgradient of well 13C045MW. During the 2017 semiannual event, TCE was detected at a concentration (5.2 µg/L) exceeding the PSL for the first time in a sample from this well. TCE concentrations also exceeded the PSL during the 2018, 2019, and the 2020 semiannual events. TCE was detected at a concentration (1.9 µg/L) less than the PSL during the 2020 annual event. TCE remained at concentrations (3.7 and 2.6 µg/L) less than the PSL during the 2021 semiannual and annual events, respectively.
									  • Increases in TCE concentrations in samples from wells 13C045MW and 13C054MW may be related to off-Base pumping (Brice, 2022b).

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6.b.			2.7.2	2-30	2			b. Section– page, paragraph. The interim groundwater extraction and treatment system is described. The type of treatment and discharge should be included in the description.	Comment Acknowledged. The following text has been added to Section 2.7.2, second paragraph: "This remedy component includes extraction of groundwater via pumping followed by ex-situ air stripping and on-Base discharge or reuse of treated groundwater (i.e., known as the GTS). The system components include 109 wells, 14 of which are currently configured as extraction wells, and piping, pumps, control panels, a control house, and two air strippers (Brice, 2022g). The air strippers operate in parallel. The effluent was formerly discharged to the base sanitary sewer system. In April 2021, CVWB issued a Notice of Applicability authorizing Beale AFB to discharge treated groundwater effluent from the GTS to Hutchinson Creek, which allows the GTS to operate at higher flow rates to increase TCE mass removal (CVWB, 2021). Discharge of GTS effluent to Hutchinson Creek began on 1 September 2021. Photograph C-21 in Appendix C shows the location of the effluent discharge point. An in-situ bioreactor was also installed to treat groundwater in the source area."
	6.b.							b. Photo C – 21 should be revised to label and point to the discharge point.	Comment acknowledged. Photo C-21 has been revised to include a callout for the discharge point.
6.c.			2.7.2	2-31	3			c. Section– page, paragraph. The paragraph includes a description of the authorization to discharge treated groundwater effluent from the GTS to Hutchinson Creek. The statement should identify the effluent discharge point for the groundwater treatment system at CG044-013 and number of years in use.	Comment acknowledged. Text describing the treated effluent has been moved to the second paragraph in Section 2.7.2 as described in the above response. Text has been added to state that effluent discharge to Hutchinson Creek in September 2021 (please see the above response). Text has also been revised to include a reference to Photograph C-21 in Appendix C.
6.d.			2.7.2	2-33				d. In-Situ Bioreactor discussion. Discharge of water from the bioreactor to the drainage ditch is discussed. The discussion should identify contaminant concentrations and volume, any follow-on cleanup, and if there are concerns with contaminants discharged to the drainage ditch.	Comment acknowledged. The following text has been added to Section 2.7.2. "The excessive pump run-time and discharge from EW 13C083MW on 19 January 2022 resulted in ponded water in the ditch measuring approximately 15 feet long, varying in width from approximately 1 to 7 feet, and with an average depth of 4 inches. The volume of water was estimated to be 1,871 gallons. The ponded water was sampled and found to contain TCE at concentrations ranging from 5.7 to 5.8 µg/L, which slightly exceeded the MCL (5 µg/L). The maximum total mass of TCE contained in the ponded water is estimated to be 0.000010 pound. The estimated maximum total mass of TCE discharged is significantly less than the federal reportable quantity of TCE (100 pounds). There is no state-specific reportable quantity for TCE. The flow of water in the ditch stopped at more than 200 feet from the outfall. None of the water from the bioreactor discharged into the creek. (Brice, 2022d)

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7.								Plume CG044-031	
	7.							7. Plume CG044-031 – Responses are acceptable for comments 7a through 7d. Comments to the response to comment 7e are provided.	Acknowledged.
7.a.			2.7.3	2-33	3			a. LUCs are mentioned in the last two sentences of the paragraph. It is not clear if the type of LUCs discussed in each sentence are the same or are different. Please revise the text to clarify the type of LUCs being discussed.	Comment acknowledged. LUCs discussed in each sentence are the same. Text has been revised as shown below in Section 2.7.3 for clarity: "The IROD for Site 31, Former Building 896 (Air Force, 2007b) identified the selected interim remedies for groundwater, as follows: EISB, groundwater performance monitoring, and LUCs. To prevent exposure to groundwater containing COCs at concentrations exceeding the MCLs, ~~the interim remedy also included~~ LUCs ~~to~~ restrict access to groundwater, so the potential exposure pathway to contaminants is incomplete."
7.b.			2.7.3	2-34	1			b. Emulsified Vegetable Oil injection and enhanced in situ bioremediation system operations are discussed, but no conclusion is provided regarding the ability of the interim remedy to meet established cleanup triggers.	Comment acknowledged. Text describing the treatment system's performance has been revised in Section 2.7.3. The revised text is shown below: "The EISB treatment system <u>installed in 2007</u> consisted of 10 extraction wells and 12 injection wells and was designed to provide sufficient amounts of sodium lactate to stimulate reductive dechlorination of chlorinated ethenes in groundwater within the <u>groundwater source area. The groundwater source area was defined as groundwater with TCE concentrations greater than 1,000-µg/L (Brice, 2022b).</u> ~~TCE plume (Brice, 2022e).~~ <u>This objective was achieved except in one hot spot by 2010.</u> The EISB system operated at CG044-031 from September 2007 until the end of March 2010, when it was shut down for a rebound assessment. Following shutdown of the EISB treatment system, EVO was injected into 14 existing groundwater wells in summer 2010. In 2011 and 2018, additional EVO injections were performed at two groundwater wells and three wells, respectively, at CG044-031. The EISB system was decommissioned in September 2015."
7.c.			4.4.3.3					The TCE plume continues to migrate west. How does the protectiveness statement address this issue?	Comment acknowledged. The revised protectiveness statement for Site CG044 as discussed under Specific Comment 5.c.i considers off-base migration of CG044-032 TCE plume.

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7.d.								Photo C-25 – CG044-031 did not have a groundwater treatment system. Please clarify and correct as appropriate. F	Comment acknowledged. The EISB system at CG044-031 was decommissioned in September 2015. Photograph C-25 shows the EISB system ancillary system components that are present at the site. The photo caption has been revised to "CG044031 – Former EISB System Ancillary Components."
7.e.								Photos C-26 and C-27. The description of Photo C-26 should be revised. Although it is true that the former Building foundation was used to land farm TPH-impacted soil from other areas of the base, information pertinent to TCE remediation should also be mentioned. The former building foundation includes areas where soil vapor extraction was implemented and the eastern part of the TCE source area. Photo C-27 indicates that it is the dry cleaner which was the source area of groundwater contamination. Please verify this information and clarify the description as appropriate. A photo in the vicinity of the current source area should be included. This could include the area between well cluster 31C053[A/B/C] and 31C043MW.	Comment acknowledged. As discussed in Section 2.7.3, Site SD031 was listed as "LDY 20" on the 1944 Completion Map for Camp Beale (Brice, 2022b). No other documentation has been found regarding the former use of Building 896. However, "LDY" may be an abbreviation for "laundry"; the 1944 map shows several steam pipelines entering the building (Brice, 2022b). As a result, the caption for Photograph C-27 referenced the "former dry cleaners." The photo caption been revised to: "CG044-031 – Source area of groundwater contamination (former laundry facility)." A photograph from the area between well cluster 31C053[A/B/C] and 31C043MW was taken on 16 October 2023 and is included in Appendix C as Photograph C-27.
	7.e.							e. Photo C-26 and C-27. The caption for Photo C-26 should be revised. The photo shows the former Building 896 foundation, taken from the northwest corner.	Comment acknowledged. The caption for Picture C-26 title has been revised to "Former Building 896 foundations (taken from the northwest corner of the parcel)." Picture C-27 has been revised to include "(taken from the northwest corner of the parcel)."
8.								SD032/Plume CG044-032	
	8.							8. SD032/Plume CG044-032 – Responses are acceptable for comments 8b, 8c, and 8d. Comments to the responses for comment 8a are provided.	Acknowledged.
8.a.			2.7.4	2-35	last			The text indicates that in 2004, an irrigation system was constructed at OBL005AW to allow property irrigation. The 2021 Semi-annual Basewide Groundwater Monitoring Program (BGMP) Report (Brice, November 2021) is referenced. This information was not found in the 2021 Semi-annual BGMP; a more exact reference is requested. The presence of the irrigation well should be noted in all future BGMP reports and the Air Force should investigate the screen interval and flowrate of the well and determine if it has the potential to draw groundwater contamination from the CG041-032 groundwater plume toward the residential drinking water wells.	Comment acknowledged. The irrigation system is discussed in the Long-Term Operation and Maintenance Calendar Year 2022 Semiannual Report (Brice, 2022d). The reference has been changed in Section 2.7.4, fifth paragraph, accordingly. As discussed in this report, "Voluntarily, the Air Force constructed two residential wellhead treatment systems using GAC in 2000 (OBL004AW and OBL005AW). The Air Force constructed a third wellhead treatment system using GAC in 2001 (OBL008AW) at the request of the resident … The treatment systems are designed to handle flow rates necessary for household water use and typical domestic landscape maintenance. The systems are not large enough to handle the instantaneous flow rates needed to irrigate large areas, such as pastures or extensive landscaping. In 2004, the Air Force constructed an irrigation system at

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8.a. *(cont.)*								*(see above)*	OBL005AW to allow the resident to irrigate the property with treated groundwater. The irrigation system includes two 5,000-gallon water storage tanks, an aboveground pump, piping, valves, level switches, and a foundation for the tanks. This irrigation system is maintained by the resident at OBL005AW and not by the Air Force." There is no irrigation well associated with this system. The following text has been added in Section 2.7.4, fifth paragraph: "The irrigation system includes two 5,000-gallon water storage tanks, an aboveground pump, piping, valves, level switches, and a foundation for the tanks. The irrigation system is maintained by the resident at OBL005AW and not by the Air Force. No irrigation well is associated with the system. Well OBL005AW is a typical residential well that draws water in the range of approximately 5 to 6 gallons per minute."
	8.a.							a. Per conversation with the Air Force representative, the extraction well used for irrigation for the OBL005AW offbase residence is a typical residential well that draws water at a rate on the order of 5 to 6 gpm. The text should be revised to incorporate flow information so that the use of the water for irrigation purposes would not lead readers to anticipate high flows that might draw the plume toward the residential area.	Comment acknowledged. The following text has been added at the end of the fifth paragraph in Section 2.7.4: "Well OBL005AW is a typical residential well that draws water in the range of approximately 5 to 6 gallons per minute."
8.b.			2.7.4	2-36	Bullet 1			The trigger for in-situ chemical oxidation (ISCO) treatment should be included.	Comment acknowledged. The IROD for Site 32 includes a remedial objective to reduce VOCs in groundwater in targeted areas of the highest concentration to the extent technically and economically feasible. There is no specific trigger described in the IROD. As discussed in Section 2.7.4, ISCO was implemented in two separate source areas at CG044-032. Potassium permanganate was injected into the southern source area as part of an ISCO pilot study in 2005. In 2007, potassium permanganate was injected into the northern source area at CG044-032 (Brice, 2022e). The objective of ISCO was to decrease the TCE mass in the groundwater source areas so the plume would stabilize. ISCO performance monitoring was conducted to demonstrate plume stability and reduction of the residual TCE over time. A TEFA was conducted in 2011 and concluded that no significant rebound of VOC concentrations in groundwater had been detected since ISCO treatment was implemented at CG044-032 in early 2007. The TEFA further concluded that the treatment area had been remediated to the technically and economically feasible extent using ISCO (Brice, 2022e).

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8.c.			2.7.4					An offsite well to evaluate off base migration was originally recommended in the Final Site CG044 Pre-Record of Decision Investigation Work Plan (Brice, June 2021). This well has not yet been installed because of difficulties encountered securing a right of entry agreement. The importance of this well should be discussed in the context of protectiveness.	Comment acknowledged. The following text has been added to Section 2.7.4 to describe the proposed off-base triple completion well: "Triple-completion off-Base wells 32C087MW(A/B/C) were proposed to define the downgradient extent of the off-Base TCE plume, south of North Beale Road (Brice, 2022f). However, the wells could not be installed because a right-of-entry (ROE) agreement between the Base and the property owner could not be obtained. The additional well that is needed to delineate the off-Base CG044-032 plume to the Office of Environmental Health Hazard Assessment's PHG will be installed post-ROD when the ROE agreement becomes available (Brice, 2022f)."

8.d.			4.4.3.4	4-13	Bullet 4			The bullet should further detail the offbase migration concerns at CG044-032. The statement regarding the 19 downgradient wells that do not exceed the project screening level should be a separate bullet.	Comment acknowledged. Section 4.4.3.4 has been revised to include the following new bullet to describe off-Base migration of the TCE plume:
									• Off-Base:
									  • The TCE plume has migrated beyond the Base boundary, south of well pair 32C083A/BMW (Figure 4-28). In 2021, TCE was detected at concentrations (8.7 µg/L and 7.1 µg/L) exceeding the PSL (PHG of 1.7 µg/L) in deep well 32C083AMW (Brice, 2022b). The chemical time-series plot for well 32C083AMW indicates an increasing trend in TCE concentrations.
									  • The TCE plume is not currently bound to the south of well 32C083AMW (Brice, 2022b). As part of the Pre-ROD investigation at CG044-032, groundwater samples were collected in August 2021 from two existing off-Base agricultural wells (15N05E29C002M and BRO-106; Brice, 2022f). Appendix F includes Figures 4-7 and 4-8 from the "Revised Final Site CG044 Pre-Record of Decision Investigation Data Summary" (Brice, 2022f) showing the TCE concentrations in the off-Base agricultural wells and their relation to CG044-032. The screen depths for the wells are unknown (Brice, 2022b and 2022f). These wells are located approximately 1,350 southeast and 1,200 feet southwest of well cluster 32C083A/BMW.
									  • TCE was not detected in well 15N05E029C002M. At well BRO-106M TCE was detected at a concentration of 1.9 µg/L, which exceeded the PSL.

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8.d. *(cont.)*								*(See above)*	• Between March and August 2021, groundwater elevations decreased across all 35 wells, ranging from a 5.90-foot decrease at 01C009CMW (located approximately 2,500 feet north of the Base boundary) to a maximum 21.45-foot decrease at 01C006BMW (located close to the off-Base agricultural wells), with an average decrease of 14.59 feet (Brice, 2022f). The large decrease in groundwater elevations is likely a result of the continual pumping of groundwater at the off-Base agricultural wells for irrigation purposes to offset the drought. The off-base is likely one of the causes of the downgradient plume migrating south toward the off-Base pasture fields while the hydraulic gradient is to the west-southwest or southwest (Brice, 2022f). • As described in the "Revised Final Site CG044 Pre-Record of Decision Investigation Data Summary Report," dated August 2022, the proposed triple-completion off-Base wells 32C087MW(A/B/C) were to be installed to define the downgradient extent of the off-Base TCE plume, south of North Beale Road. However, the wells could not be installed because a right-of-entry (ROE) agreement between the Base and the property owner could not be obtained. • An additional well that is needed downgradient of well BRO-106 to delineate the off-Base CG044-032 plume to the Office of Environmental Health Hazard Assessment's PHG will be installed post-ROD when the ROE agreement becomes available (Brice, 2022f).
9.								Plume CG044-040	
	9.							9. Plume CG044-040 – Responses are acceptable for comments 9b and 9c. Comments to the responses for comment 9b are provided.	Acknowledged.
9.a.			2.7.5	2-37	3			The preferred remedial alternative discussion should include a reference to the FFS.	Comment acknowledged. Text in Section 2.7.5 has been revised to reference the FFS for the preferred remedial alternative as shown below. "The FFS (CH2M, 2020e) identified EA monitoring and LUCs as the preferred remedial alternative to address the COC plume at CG044-040 and to meet the RAOs."

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DTSC Kimiye Touchi, PE – Specific Comments *(continued)*									
9.b.			2.7.5					The CG044-040 discussion and figures should clarify between the Site CG044-040 groundwater plume and the Site SS043 groundwater plume.	Comment acknowledged. The following text has been added to Section 2.7.5: "Investigations associated with Site CG040 have resulted in the discovery of a previously unknown VOC source to groundwater at new Site SS043, which is located to the south and west of Site CG040 (CH2M, 2020e). Following the establishment of Site SS043, the Site CG040 boundary was shifted to the LUC boundary (which is also the site investigation boundary) shown on Figure 2-19. Prior to the establishment of Site SS043, Site CG040 was divided into eastern (Site CG040 East), and western (Site CG040 West) portions based on potential source areas for VOCs in groundwater (CH2M, 2020e). The eastern portion includes the area from approximately C Street to the J Street Gas Station, running parallel to Warren Shingle Road (Figure 2-19). The western portion encompassed the area west from the J Street Gas Station to the Base boundary, south from the flightline to approximately 12th Street. Following the establishment of Site SS043, the Site CG040 boundary was revised to that shown on Figure 2-19 (CH2M, 2020e)." Figure 2-19 has been revised to show the pending Site SS043 boundary.
	9.b.							b. Response is acceptable. Figure 2-19 should include a label identifying the location of the J Street Gas Station.	Comment acknowledged. Figure 2-19 has been revised to include a label identifying the J Street Gas Station.
9.c.			4.4.3.5		Bullet 7			The increasing TCE trend at Well 40C044MW indicates that the TCE plume may be migrating off the Base. It is not clear if the statement is referencing the SS043 groundwater plume or if it is referencing the CG044-040 groundwater plume. This should be clarified.	Comment acknowledged. Please refer to response to Comment 5. b.
10.			4.5					Climate Change and Environmental Justice. A wildfire risk discussion is missing from the climate change discussion and should be added.	Comment acknowledged. The following wildfire risk discussion has been added to Section 4.5: "Based on the existing terrain, climatic patterns, and indigenous fauna, wildfires pose a moderate to very high risk according to a State of California's Fire and Resource Assessment Program Map developed by the California Department of Forestry and Fire Protection. Historically, as a part of the LUC remedies, brush removal and landscape maintenance have occurred in various areas as needed. Brush removal and general land maintenance will continue to be implemented as a LUC to mitigate any risks of wildfire."

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Kimiye Touchi, PE – Specific Comments *(continued)*									
	10.							Climate Change. The text in Appendix D appears to indicate that of the four climate change effects evaluated, Beale is not at risk due to sea level rise, has only a minor risk of flooding in the next 30 years, is expected to see higher temperatures and has a risk of wildfire predicted to be moderate to high. Wildfire, therefore, appears to be the only concern at Beale. Please confirm if this is the case in the text of Section 4.5. The text in Section 4.5 states that "……performance of the remedies are currently not at risk due to the expected effects of climate change in the region and near the ERP sites." It also states that "…… wildfires pose a moderate to very high risk…." Based on the information provided in Appendix D, it appears that the only climate change effect that might affect the remedies would be associated with the increased of wildfire. Please specify which climate change effects might be observed in Section 4.5. Additional detail regarding the effects of climate change on remedy elements and/or a discussion of Air Force and/or Base processes that would protect remediation systems from the effects of climate change should be provided to support the "not a risk" statement in the five-year review. If it is found that there is a climate change impact on any of the remedies, an adaptation plan is also requested. If this detailed discussion is beyond the scope of the five-year review, DTSC requests a more detailed vulnerability assessment, and as needed, an associated adaptation plan. Both should be submitted for agency review by fourth quarter 2026.	Comment acknowledged. Appendix D has been revised to include two additional figures, Figure D-6 (Probability of a Wildfire ≥ 100 acres) and Figure D-7 (Risk of Very Large Fires Could Increase Sixfold by Mid-Century). Both figures indicate an existing moderate risk for wildfires at Beale AFB and an increased probability for wildfires in the future. Section 4.5 has been revised as stated in the response to the following comment. Comment acknowledged. The last paragraph in Section 4.5 has been revised as shown below. "Based on the existing terrain, climatic patterns, and indigenous fauna, wildfires pose a moderate to very high risk according to the State of California's Fire and Resource Assessment Program Map developed by the California Department of Forestry and Fire Protection. According to the National Oceanic and Atmospheric Administration, the risk of wildfires at Beale AFB overtime is moderate but may increase during the summer seasons. Historically, as a part of the LUC remedies, brush removal and landscape maintenance have occurred in various areas as needed. Brush removal and general land maintenance will continue to be implemented as a LUC to mitigate any risks of wildfire. Routine inspections and landscape maintenance will continue to be performed. The performance of the remedies is currently not at risk because the expected landscape maintenance efforts would reduce the chances of wildfires near the ERP sites in the future. Appendix D includes a detailed discussion of the climate change assessment."
11.			Appendix D	D-1	3			The text indicates that 6% of the properties at Beale AFB have a >26% risk of being severely affected by flooding over the next 30 years. This conclusion does not follow from the first part of the sentence that says 0 properties have a >26% risk of being severely affected by flooding. Please clarify.	Comment acknowledged. The following text has been added to provide more clarity to the reader: "The second tool used is called Risk Factor (formerly Flood Factor). According to this tool, 0 residential properties at Beale AFB, California, have a greater than 26% risk of being severely affected by flooding over the next 30 years. Residential properties represent 6% of all properties, with the remainder represented by Commercial, Roads, and Critical Infrastructure at Beale AFB, California. Overall, Beale AFB, California, has a minor risk of flooding over the next 30 years (Figure D-4)."
	11.							Response is acceptable.	Acknowledged.

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DTSC-FFU Additional Comments									
	1.							Revised Figures file. The vernal pool/wetland features were removed from the revised figures provided and should be put back on the figures. Where the font was reduced in size, the previous font should be used (e.g., Figure 4-26 and Figure 4-32).	Comment acknowledged. Figures 2-2, 4-6, and 4-31 have been revised to display the vernal pool/wetland features. Figures 4-26 and 4-32: Font size on TCE isocontour labels has been corrected.
	2.							Beale AFB Common Comment and Response Worksheet. Page 15 of 17. HERO Comments, Mark Edwards, P.G. This is a GSU comment; the header should be revised.	Comment acknowledged. The header has been revised as shown below: GSU Comments, Mark Edwards, PG.
		1.						Vernal pool features were removed from Figures 4-6, 4-20, and 4-25 and should be added back into these figures for the final FYR Report.	Comment acknowledged. Vernal pool features have been added to Figures 4-6, 4-20, and 4-25.
		2.						The HERO comments in the Comment and Response Worksheet identify Kimiye Touchi as the reviewer. This should be changed to Farah Esfandiari, Ph.D.	Comment acknowledged. The suggested change has been made and the revised text is shown below. HERO, Farah Esfandiari, Ph.D. – Comments
HERO, Farah Esfandiari, Ph.D. – Comments									
HERO reviewed the Third FYR Report with the main focus on Section 5 where the technical aspects related to the evaluation of potential human health risks from exposure to ERP Sites contaminants are discussed.									
1.								Acceptable Risk: The texts throughout the Section 5 of the FYR Report incorrectly states if the risk falls with or below the risk range of 1 x 10^{-6} to 1 x 10^{-4}, then the chemical is considered unlikely to pose unacceptable carcinogenic risk for the assumed exposure conditions. In accordance with the National Contingency Plan (NCP), the 10^{-6} risk level shall be used as the point of departure for determining remediation goals when ARARs are not available or are not sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure." The actual level of acceptable risk is a site-specific risk management decision. In conformation with the NCP, HERO recommends revising the texts to use 1 x 10^{-6} as the point of departure for acceptable risk in all human health related discussions.	Comment acknowledged. Where appropriate, the risk range discussion have been revised as follows: *"…generally within the EPA's generally acceptable risk management range of 10^{-6} to 10^{-4} as discussed in the NCP (Title 40 CFR § 300.430), with a risk level of 10^{-6} used as a point of departure for determining remedial goals when ARARs are not available or are not sufficiently protective."*
2.								SD032-Building 1086 Vapor Intrusion Risks: Vapor intrusion (VI) indoor air risks for Building 1086 are presented in a table in subsection 5.3.2; page 5-7. In 2014, the maximum residential risk was estimated using TCE concentration detected at 15 ft bgs and for industrial risks the 2014 assessment used the TCE concentration detected at 1.5 feet bgs). For transparency, HERO recommends including a technical justification for using different depth for calculating VI risk for industrial exposure scenario vs residential exposure.	Comment acknowledged. The text has been revised to reflect the risks based on maximum detected concentrations

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HERO, Farah Esfandiari, Ph.D. – Comments *(continued)*									
3.								Vapor Intrusion Risk Tables: The cancer risk and noncancer hazard for LF013 site (section 5.1.) are presented in a table on page 5-3. Residential and industrial VI cancer risk and noncancer hazard for vinyl chloride (VC) are listed as 1E-04 and 7E-06, respectively. Using the screening levels listed in May 2022 DTSC HERO note 3, the calculated risk and hazard for VC are 2E-04 and 1E-05, respectively. The table needs to be revised.	Comment acknowledged. The table has been revised as requested.
	Comment							HERO reviewed the Final Third FYR Report with focus on AFB responses to HERO comments on August 15, 2023, Draft Final FYR Report. HERO reviewed the Final Third FYR to ensure responses to HERO comments have been adequately addressed in the Final FYR.	Acknowledged.
	Comment		5.1.2					All HERO comments have been adequately addressed in the Final FYR Report except comment #3 (Vapor Intrusion Risk Tables). The AFB Response states "Comment acknowledged. The table has been revised as requested". HERO reviewed the Table on page 5-3 (2023 cancer risk and hazard for LF013 site) on section 5.1.2. The listed residential and industrial vapor intrusion cancer risks for vinyl chloride (VC) are still listed as 1E-04 and 7E-06, respectively. Please calculate the cancer risks/hazards using the DTSC recommended risk-based screening levels listed in May 2022 DTSC HERO note 3.	Comment acknowledged. The table on page 5-3 in Section 5.1.2 has been revised to reflect the cancer risks and hazards based on DTSC's current indoor air screening levels for vinyl chloride. The revised residential and industrial risks for vinyl chloride are 2×10^{-4} and 1×10^{-5}, respectively.
	Comment							HERO has no additional technical comments except the above comment. Please let me know if you have any other comment or question (MS Teams and Outlook).	Acknowledged.
GSU Comments, Mark Edwards, PG									
1.								Site CG041-017 Issues and Recommendations. The Issues/Recommendations provided in Section 6 should be revised to identify the potential leak in the slurry wall at Site CG041-017 as an issue and provide recommendations to address the issue. Section 4.4.2.3 of the Third Five-Year Review Report states increasing trends of trichloroethene (TCE) concentrations in groundwater monitoring wells 17C165BMW, 17C166WM, and 17H16BMW indicate a local source of TCE exists outside the South Area Slurry Wall and downgradient of the permeable reactive barrier (PRB), suggesting a leak may be traveling through or underneath the slurry wall. The continued increase of TCE concentrations in the dissolved groundwater plume of Site CG041-017 indicates components of the selected remedy, including containment using slurry walls and enhanced attenuation of contaminants of concern (COCs), are not meeting the Remedial Action Objective (RAO) to reduce and / or monitor reductions in concentrations of COCs in groundwater to support restoration of groundwater to designated beneficial uses (USAF, 2018).	Comment acknowledged. Please see the response to DTSC FFU General Comment 2.

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GSU Comments, Mark Edwards, PG – *(continued)*									
	1							Previous GSU Comment #1 - Site CG041-017 Issues and Recommendations. *Partially Addressed.* The Third Five-Year Review Report was revised to remove the statement in Section 4.4.2.3 that increasing trichloroethene (TCE) concentrations outside the South Area Slurry Wall suggest a leak may be traveling through or underneath the slurry walls and instead states that these long-term increasing trends are likely a result of TCE migration outside the slurry walls at the time of construction. This revision addresses the need to identify the potential leak in the South Area Slurry Wall as an issue in the Third Five-Year Review Report. However, the revisions made fail to acknowledge that the continued increase of TCE concentrations in the dissolved groundwater plume of Site CG041-017 indicates the selected remedy applicable to TCE detected in monitoring wells 17C165BMW, 17C166MW, and 17H16BMW (i.e., enhanced attenuation), is not meeting the Remedial Action Objective (RAO) to reduce and / or monitor reductions in concentrations of contaminants of concern in groundwater to support restoration of groundwater to designated beneficial uses, as specified in the Record of Decision (USAF, 2018).	Comment acknowledged. As stated in the response to Comment 2 in this document, the following text has been added at the end of the second paragraph in the General Comment 2 response. "The EA monitoring and the groundwater LUCs component of the remedy will be used to address the increasing TCE concentration trends. Results from the ongoing groundwater monitoring will be used to continue to assess the performance of the slurry wall." The above text has also been included as a part of the second bullet in Section 4.4.2.3 of the Third FYR text. Implementation of the selected remedy (hot spot treatment) to address the COCs in groundwater at Plume CG041-017 began in August 2023. This remedy includes hotspot treatment with enhanced reductive dechlorination (ERD) and PRB with in-situ chemical reduction (hotspot generally defined by residual TCE greater than 10,000 µg/L inside the slurry walls and 500 µg/L outside the slurry walls). Portions of the remedy construction, including construction of the PRB and two bioreactors, have been completed. Full remedy construction is expected to be completed in 2024.
ERAS–HERO–DTSC Cal Center, Edward A. Fendick, PhD – General Comments									
1.								The primary roles of ERA in the site cleanup processes of the Environmental Restoration Program occur earlier than at the FYR stage: ERA plays a role in identifying ecological COCs and establishing ecological remedial goals for the feasibility study (FS); the FS also evaluates remedial options to achieve those goals effectively and efficiently including other goals (e.g., protection of human health or groundwater), and a Decision Document (e.g., a Record of Decision, ROD) which formally establishes the adopted remedial plan.	Comment acknowledged.
2.								The FYR Report process is a periodic status check on remedy progress and effectiveness. However, evaluation of the activities associated with implementing the selected remedy, and subsequent monitoring and maintenance activities to ensure the effectiveness of the remedy, is outside the purview of ERAS. Accordingly, ERAS defers to DTSC Project Management for decisions about remedy progress, effectiveness, and protectiveness.	Comment acknowledged.

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ERAS–HERO–DTSC Cal Center, Edward A. Fendick, PhD – General Comments *(continued)*									
3.								The primary analysis of the FYR is the Technical Assessment, a series of three questions: • Question A: Is the remedy functioning as intended by the Decision Document? • Question B: Are exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid? • Question C: Has any other information come to light that could call into question the protectiveness of the remedy? ERAS defers to DTSC Project Management for decisions regarding Questions A and C. With respect to Question B, there have been no widespread significant changes to the ERA process, nor in exposure or toxicity guideline values that were in-place at the time of final remedy selection, that would significantly alter conclusions about exposures of ecological receptors to soil, soil vapor, or groundwater.	Comment acknowledged. Comment acknowledged.
ERAS–HERO–DTSC Cal Center, Edward A. Fendick, PhD – Specific Comments									
1.								LF013 has a remedial action objective for soil to maintain the integrity of the soil cover over the landfill contents and over a portion of a wastewater pipeline to prevent direct exposure of ecological receptors and people to landfill contaminants. LF013 also has administrative land-use control (LUC) restrictions prohibiting sensitive-receptor land uses and preventing intrusive or soil-disturbing activities to minimize exposure of people to volatile organic compounds (VOCs) in soil vapor and from groundwater. ERAS defers to DTSC Project management for conclusions about the maintenance of cover integrity (recognizing there are resulting implications for ecological protectiveness). Groundwater at LF013 is addressed as part of CG044 (see Specific Comment #3).	Comment acknowledged.
2.								OT017, SD032, ST018, TU509 have LUCs to restrict land uses and prevent intrusive or soil-disturbing activities to minimize exposure of people to VOCs in soil vapor and from groundwater. LUCs, however, are not recognized by ecological receptors and exposures of ecological receptors (e.g., burrowing mammals) to soil vapor at OT017 and ST018 are possible; SD032 and TU509 are in developed areas that have no ecological habitat. However, based on ERAS's institutional knowledge, adverse effects to populations of burrowing mammals from exposure to VOCs in burrow air at OT017 and ST018 are unlikely to be significant. Groundwater at OT017 and at ST018 is addressed as part of CG041 and groundwater at SD032 is addressed as part of CG044 (see Specific Comment #3); groundwater at TU509 is addressed under a separate regulatory process.	Comment acknowledged.

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ERAS–HERO–DTSC Cal Center, Edward A. Fendick, PhD – Specific Comments *(continued)*									
3.								Remedial action objectives for CG041 and CG044 include (a) reduce and/or monitor reductions in concentrations of COCs in groundwater to support restoration of groundwater to designated beneficial uses (domestic, municipal, agricultural, and industrial supply) and (b) restrict potential exposure to COCs in groundwater (including exposure via vapor intrusion into overlying structures in some areas). Components of remedies to meet these remedial action objectives are multiple (e.g., enhanced attenuation, concentration monitoring, and hotspot treatment) but details are not critical with respect to ERA. Additionally, there are LUCs to prevent use of groundwater and to prohibit activities which might hinder the implementation of the remedy components. until concentrations are at such levels to allow for unrestricted use and unlimited exposure. Lastly and independent of the above, pathways for exposure of ecological receptors to groundwater are incomplete.	Comment acknowledged.

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Notes:

Comments must be actionable (“add the following text:…”, “delete…”, “change text to:”) Place only one comment per row.
Classify comment as C, M, S, or A:

- C – Critical: Critical comments will result in a critical issue. Provide convincing support.
- M – Major: Major comments are significant concerns that may result in a major issue. This category may be used with a general statement of concern followed by a detailed comment on the specific entries in the document that, considered in total, constitute the concern.
- S – Substantive: An entry in the document that appears to be or is potentially unnecessary, misleading, incorrect, or confusing.
- A – Administrative: Administrative comments correct inconsistencies between different sections, typographical and grammatical errors.