15 October 2019

Mr. Darren Rector
Remedial Program Manager
AFCEC/CZOW
6451 B Street, Bldg. 2535
Beale Air Force Base, CA 95903-1708

FINAL REVISED NOTICE OF APPLICABILITY, GENERAL ORDER NO. R5-2015-0012, PLUME CG041-509, BEALE AIR FORCE BASE, YUBA COUNTY

The Air Force Civil Engineer Center (AFCEC) has submitted *Revised Plume CG041-509 Corrective Action Optimization Technical Memorandum* (Tech Memo) (CH2M Hill, 2019) dated 13 September 2019. The Tech Memo proposes the injection of blended sodium persulfate and calcium peroxide (Klozur CR) to promote in situ chemical oxidation (ISCO) of petroleum hydrocarbons in groundwater at Plume CG041-509. The Tech Memo has been reviewed by Central Valley Regional Water Quality Control Board (Central Valley Water Board) staff and serves as the basis for preparation of this tentative revised Notice of Applicability (NOA) under General Order Waste Discharge Requirements (WDRs) No. R5-2015-0012, *General Waste Discharge Requirements for In-situ Groundwater Remediation and Discharge of Treated Groundwater to Land*. The project was previously assigned Order No. R5-2015-0012-012 in September 2015 for injection of oxygen releasing compound (ORC) to promote enhanced bioremediation of Plume CG041-509. The corrective action is being optimized to include ISCO to treat light non-aqueous phase liquid (LNAPL) and dissolved-phase petroleum hydrocarbon contamination. The NOA is being revised to allow flexibility for ISCO or enhanced bioremediation treatment in the future. The project is assigned Order No. R5-2015-0012-057.

Project Location:

The project is located at 15301 Warren Shingle Road, Beale AFB, California
Assessor's Parcel Number: Not applicable
Township 15N, Range 5E

Project Description:

Plume CG041-509 is located at the Base medical clinic at Beale Air Force Base in Yuba County, California. The clinic was constructed in the late 1950's. Three 8,000-gallon underground storage tanks (USTs) stored diesel fuel for the clinic's backup generators.

One UST was removed in 1998, and the other two in 2009. Investigations at the site identified petroleum hydrocarbons as diesel (TPH-D) and benzene in soil and groundwater.

A Corrective Action Plan (CAP) was developed in 2015 for overlying Site TU509 which included soil and groundwater remediation activities. The CAP selected excavation as the remedy for vadose zone soil. The selected alternative for groundwater consists of enhanced bioremediation, LNAPL removal, and land use controls to prevent groundwater usage. Approximately 717 tons of smear zone soil were excavated during January 2015. Three perforated polyvinyl chloride (PVC) pipes were installed in the bottom of the excavation at approximately 6 feet below ground surface (bgs) prior to backfilling to allow for ORC injection.

Contaminant concentrations initially decreased after soil excavation partially removed smear zone contamination and was followed by ORC treatment of groundwater in 2015 but rebounded in 2017 and 2018. The water level in the source area typically fluctuates between approximately 10 feet bgs in the summer to less than 5 feet bgs in the winter. Time-series plots for benzene and naphthalene show seasonal variations with higher concentrations occurring in summer and lower concentrations occurring in winter. Rebounding TPH-D, benzene, and naphthalene concentrations are likely due to the presence of LNAPL within the lower smear zone in the source area. It is our understanding that AFCEC would like the flexibility of performing ISCO or ORC treatment in the future, though the planned ISCO treatment is anticipated to be a one-time event.

Blended sodium persulfate and calcium peroxide (Klozur CR) will be injected through three subsurface horizontal perforated pipes that were installed at the bottom of the former soil excavation. A total of 10 batches will be injected for a total volume of 3,000 gallons containing 4,280 pounds of oxidant (17 percent by weight). Three batches will be injected into the northern and middle injection pipes and four batches will be injected into the southern injection pipe. To facilitate vertical dispersal of the oxidant through the smear zone, oxidant will be injected during the dry season when groundwater levels are low.

The existing remedy is being administered under General Order WDRs No. R5-2015-0012 and associated Monitoring and Reporting Program (MRP) Order No. R5-2015-0012-012. A groundwater monitoring program for the optimized remedy is presented as Table 1 in the Tech Memo. TPH-D, benzene, toluene, ethylbenzene, and xylenes (BTEX), naphthalene, dissolved metals (chromium and manganese), and total dissolved solids (TDS) will be monitored in seven treatment and transition zone wells. Five downgradient compliance wells and two upgradient background wells will be monitored for dissolved metals (chromium and manganese) and TDS.

As part of this Order, groundwater monitoring will be performed in accordance with the attached MRP to confirm the injectants are not adversely impacting groundwater quality, and to monitor progress of the remedy. Prior to injection, baseline concentrations will be developed for dissolved chromium, dissolved manganese, and TDS using analytical data from the monitoring well network. The 95 percent upper prediction limit (UPL) or limit of quantitation (LOQ) if the analyte is not detected will be used as the baseline concentration to determine trigger concentrations for each analyte. Analysis of

hexavalent chromium may be requested by the Central Valley Water Board if increases in dissolved chromium are observed in the downgradient compliance wells.

General Information:

1. The project will be operated in accordance with the requirements contained in the General Order No. R5-2015-0012, and in accordance with the information provided in *Revised Plume CG041-509 Corrective Action Optimization Technical Memorandum* and specified in this Notice of Applicability.

2. Injection of materials into the groundwater at Plume CG041-509, other than ORC, blended sodium persulfate and calcium peroxide (Klozur CR), or other materials specified in the contingency plan, is prohibited.

3. Failure to abide by the conditions of the General Order could result in an enforcement action as authorized by provisions of the California Water Code.

4. AFCEC shall comply with attached Monitoring and Reporting Program Order No. R5-2015-0012-057 and any revisions thereto as ordered by the Executive Officer.

5. AFCEC shall comply with the Contingency Plan as follows:

Contingency Plan:

The General Order requires a Contingency Plan for corrective actions should water quality exceed the requirements of this Order at the points of compliance. The General Order prohibits concentrations of dissolved chromium, dissolved manganese, or TDS more than 20 percent greater than their respective background or baseline levels, or exceedances of water quality limits at points of compliance. Baseline concentrations of dissolved chromium, dissolved manganese, and TDS will be determined prior to the injections following the procedures described previously. If a dissolved chromium, dissolved manganese, or TDS concentration in a downgradient compliance well exceeds a trigger level, then a confirmation sample will be collected. If an exceedance in a downgradient compliance well is confirmed, a corrective action work plan will be submitted to the Central Valley Water Board for approval. One or more of the following corrective actions would be considered:

- Increased monitoring frequency
- Expanded monitoring network

- Injection of reducing compound (such as sodium thiosulfate) or metals treatment compound (calcium polysulfide) to reduce concentrations of any dissolved chromium or manganese mobilized by oxidation of the aquifer matrix

- Hydraulic control of amendments in the target treatment zone.

All contingency measures agreed to by the Central Valley Water Board and AFCEC will be fully implemented within 6 months of detecting one of these conditions.

Please note that General Order WDRs No. R5-2015-0012 and associated *Standard Provisions and Reporting Requirements for Waste Discharge Requirements* remain unchanged and are therefore not included with this letter. A Notice of Termination (NOT) will subsequently be issued to the Air Force to terminate existing WDRs Order No. R5-2015-0012-012 for Plume CG041-509.

If you have any questions or comments regarding this letter, please contact Mark Clardy at (916) 464-4719 or by email at Mark.Clardy@waterboards.ca.gov.

Original signed by Gerald Djuth for

ANDREW ALTEVOGT
Assistant Executive Officer

Attachment: Monitoring and Reporting Program Order No. R5-2015-0012-057

REFERENCE

CH2M Hill. 2019. *Revised Plume CG041-509 Corrective Action Optimization Technical Memorandum, Beale Air Force Base, California.* September.

cc: Mr. Jay Wilburn, CH2M Hill, Sacramento, CA (via email)
Ms. Hiral Doshi, Department of Toxic Substances Control, Sacramento, CA (via email)
Mr. Dominique Forrester, Department of Toxic Substances Control, Sacramento, CA (via email)

MWC R:\RB5\R5SSections\Cleanup\Units\Federal Cleanup\Mark Clardy\Beale 2019\
Basewide Groundwater\Site CG041\CG041-059\Final Rev CG041-059 NOA.docx

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

MONITORING AND REPORTING PROGRAM ORDER NO. R5-2015-0012-057
FOR
IN-SITU GROUNDWATER REMEDIATION

PLUME CG041-509
BEALE AIR FORCE BASE, YUBA COUNTY

The Air Force Civil Engineering Center (AFCEC) plans to remediate groundwater impacted by historical releases of diesel-range petroleum hydrocarbons at the Beale Air Force Base (AFB) medical clinic located at 15301 Warren Shingle Road (Plume CG041-509) in Yuba County California. The Discharger proposes to inject blended sodium persulfate and calcium peroxide into the subsurface to promote in situ chemical oxidation (ISCO) or oxygen releasing compound (ORC) to enhance bioremediation of the diesel-impacted groundwater.

This Monitoring and Reporting Program (MRP) describes requirements for monitoring compliance with groundwater limitations and the progress of groundwater remediation for Plume CG041-509 at Beale AFB. This MRP is issued pursuant to Water Code Section 13267. The Discharger shall not implement any changes to this MRP unless and until a revised MRP is issued by the Executive Officer. As appropriate, California Regional Water Quality Control Board, Central Valley Region (Central Valley Water Board) staff shall approve specific sample station locations prior to implementation of sampling activities.

Sample collection and analysis shall follow standard EPA protocol and sample analyses shall be completed by a California State-certified laboratory. All samples should be representative of the volume and nature of the discharge or matrix of material sampled. The time, date, and location of each grab sample shall be recorded on the sample chain of custody form.

GROUNDWATER MONITORING

The treatment compounds will be injected into a series of three subsurface horizontal pipes that were installed at the bottom of a former remedial soil excavation (Figure 1). There are fourteen (14) monitoring points associated with the treatment area as shown on Figure 1. As listed in Table 1, the monitoring well network consists of three treatment zone wells, four transition zone wells, five compliance wells, and two background wells. The groundwater monitoring program for these wells shall follow the schedule below. Monitor wells with free phase petroleum product or visible sheen shall be monitored, at a minimum, for product thickness and depth to water.

The monitoring wells shall be sampled according to the schedule in Table 1 and the samples analyzed by the methods in Table 2, as follows:

Table 1: Sampling Frequency and Constituent Suite

Well Number[1]	Constituent[2]	Frequency[3]	Monitoring Objective
MW-1A, MW-1B, MW-2A	Total Petroleum Hydrocarbons as Diesel (TPH-D), Benzene, Toluene, Ethylbenzene, Xylenes (BTEX), Naphthalene, Dissolved chromium, Dissolved manganese, Total Dissolved Solids (TDS)	Semiannual	Treatment Zone[4]
MW-6A, MW-6B, HUST012AMW, HUST012BMW	TPH-D, Naphthalene, Dissolved chromium, Dissolved manganese, TDS	Semiannual	Transition Zone[5]
BCC012AMW, BCC012BMW, BCC013AMW, BCC013BMW, BCC016MW	Dissolved chromium, Dissolved manganese, TDS	Semiannual	Compliance[6]
BCC009AMW, BCC009BMW	Dissolved chromium, Dissolved manganese, TDS	Semiannual	Background[7]

[1] Well numbers and locations as shown on Figure 1.
[2] Constituent analytical methods are listed in Table 2.
[3] Semi-annual sampling occurs 1st and 3rd quarters.
[4] Wells used to evaluate in-situ remediation progress inside the treatment zone.
[5] Wells sampled to evaluate migration of pollutants within the transition zone.
[6] Wells used to determine compliance with groundwater limitations.
[7] Wells used to develop background concentrations.

Table 2: Analytical Methods

Constituent	Method[8]	Maximum Practical Quantitation Limit (µg/L)[9]
BTEX, Naphthalene	EPA 8020 or 8260B	0.5
TPH-D	EPA 8015-E	500
Dissolved chromium	EPA 6010	10
Dissolved manganese	EPA 6010	10
Total Dissolved Solids	EPA 160.1	10,000

FIELD SAMPLING

In addition to the above sampling and laboratory analyses, field sampling and analysis shall be conducted each time a monitor well or extraction well is sampled. The sampling and analysis of field parameters shall be as specified in Table 3.

Table 3: Field Sampling Requirements

Parameters	Units	Practical Quantitation Limit	Analytical Method
Groundwater Elevation	Feet, Mean Sea Level	0.01 feet	Measurement
Oxidation-Reduction Potential	Millivolts	10 millivolts	Field Meter
Electrical Conductivity	uhmos/cm	50 µS/cm[2]	Field Meter
Dissolved Oxygen	mg/L	0.2 mg/L	Field Meter
pH	pH Units (to 0.1 units)	0.1 units	Field Meter
Temperature	ºF/ºC	0.1 ºF/ºC	Field Meter

All wells that are purged shall be purged until pH, temperature, conductivity and dissolved oxygen are within 10% of the previous value.

Field test instruments (such as those used to test pH and dissolved oxygen) may be used provided that:

1. The operator is trained in proper use and maintenance of the instruments;
2. The instruments are calibrated prior to each monitoring event;
3. Instruments are serviced and/or calibrated by the manufacturer at the recommended frequency; and

[8] Or an equivalent EPA Method that achieves the maximum Practical Quantitation Limit.
[9] All concentrations between the Method Detection Limit and the Practical Quantitation Limit shall be reported as an estimated value.

4. Field calibration reports are submitted as described in item (b) of the "Reporting" section of this MRP.

IN-SITU DISCHARGE MONITORING

The Discharger shall monitor daily the discharge of water and amendments that are injected into the groundwater according to the requirements specified in Table 4. Each amendment addition shall be recorded individually, along with information regarding the time period over which the amendment was injected into the aquifer.

Table 4: Discharge Monitoring Requirements

Parameters	Units	Type of Sample
Injected Volume	gallons per day	Meter
Amendment(s) Added	pounds per day	Measured

AMENDMENT ANALYSIS

Prior to use, amendments shall be analyzed for the constituents listed in Table 5. The analysis should be done on a mixture of the amendment and deionized water at the estimated concentration that would be injected during the project.

Table 5: Amendment Analytical Requirements

Constituent	Method[10]	Maximum Practical Quantitation Limit (µg/L)[11]
Volatile Organic Compounds	EPA 8020 or 8260B	0.5
General Minerals[12]	Various	Various
Metals, Total and Dissolved[13]	EPA 200.7, 200.8	Various
Total Dissolved Solids	EPA 160.1	10,000
pH	meter	NA
Electrical Conductivity	meter	NA

[10] Or an equivalent EPA Method that achieves the maximum Practical Quantitation Limit.
[11] All concentrations between the Method Detection Limit and the Practical Quantitation Limit shall be reported as an estimated value.
[12] General Minerals include: alkalinity, potassium, chloride, sulfate, total hardness, nitrate, nitrite, ammonia.
[13] Metals include arsenic, barium, cadmium, calcium, total chromium, copper, iron, lead, manganese, magnesium, mercury, molybdenum, nickel, selenium and silica.

ESTABLISHMENT OF BASELINE CONCENTRATION VALUES

The Discharger shall develop baseline values for concentrations of dissolved chromium, dissolved manganese, and total dissolved solids in groundwater following the procedures found in CCR Section 20415(e)(10). The Discharger shall include the baseline data in the Remedial Action Summary Report.

REPORTING

When reporting the data, the Discharger shall arrange the information in tabular form so that the date, the constituents, and the concentrations are readily discernible. The data shall be summarized in such a manner as to illustrate clearly the compliance with this Order. The results of any monitoring done more frequently than required at the locations specified in the Monitoring and Reporting Program shall also be reported to the Central Valley Water Board.

As required by the California Business and Professions Code Sections 6735, 7835, and 7835.1, all reports shall be prepared by a registered professional Civil Engineer or Geologist or their subordinate and signed by the registered professional.

After completion of injection activities, the Discharger shall submit a Remedial Action Summary Report which includes the results of baseline monitoring. Post-injection monitoring results will be submitted in semiannual reports under the Beale AFB basewide groundwater monitoring program. All reports shall be submitted electronically and shall conform to the requirements of the California Code of Regulations, Title 23, Division 3, Chapter 30.

The semiannual reports shall be submitted electronically by the 1st day of the second month following the end of each semiannual event (**1 April and 1 October**) or a date approved in writing by Central Valley Water Board staff, until such time as the Executive Officer determines that the reports are no longer necessary.

Each semiannual report shall include the following minimum information:

(a) a description and discussion of the groundwater sampling event and results, including trends in the concentrations of pollutants and groundwater elevations in the wells, how and when samples were collected, and whether the pollutant plume(s) is delineated;

(b) field logs that contain, at a minimum, water quality parameters measured before, during, and after purging, method of purging, depth of water, volume of water purged, etc.;

(c) groundwater contour maps for all groundwater zones, if applicable;

(d) pollutant concentration maps for all groundwater zones, if applicable;

(e) a table showing well construction details such as well number, groundwater zone being monitored, coordinates (longitude and latitude), ground surface elevation, reference elevation, elevation of screen, elevation of bentonite, elevation of filter pack, and elevation of well bottom;

(f) a table showing historical lateral and vertical (if applicable) flow directions and gradients;

(g) cumulative data tables containing the water quality analytical results and depth to groundwater;

(h) a copy of the laboratory analytical data report;

(i) the status of any ongoing remediation, including an estimate of the cumulative mass of pollutant removed from the subsurface, system operating time, the effectiveness of the remediation system, and any field notes pertaining to the operation and maintenance of the system; and

(j) if applicable, the reasons for and duration of all interruptions in the operation of any remediation system, and actions planned or taken to correct and prevent interruptions.

An Annual Report shall be submitted to the Central Valley Water Board by **1 October** of each year. This report shall contain an evaluation of the effectiveness and progress of the investigation and remediation. The Annual Report may be substituted for the second semi-annual monitoring report as long as it contains all of the information required for that report plus that required for the Annual Report. The Annual Report shall contain the following minimum information:

(a) both tabular and graphical summaries of all data obtained during the year;

(b) groundwater contour maps and pollutant concentration maps containing all data obtained during the previous year;

(c) a discussion of the long-term trends in the concentrations of the pollutants in the groundwater monitoring wells;

(d) an analysis of whether the pollutant plume is being effectively treated;

(e) a description of all remedial activities conducted during the year, an analysis of their effectiveness in removing the pollutants, and plans to improve remediation system effectiveness;

(f) an identification of any data gaps and potential deficiencies/redundancies in the monitoring system or reporting program; and

(g) if desired, a proposal and rationale for any revisions to the groundwater sampling plan frequency and/or list of analytes.

A letter transmitting the monitoring reports shall accompany each report. Such a letter shall include a discussion of requirement violations found during the reporting period, and actions taken or planned for correcting noted violations, such as operation or facility modifications. If the Discharger has previously submitted a report describing corrective actions and/or a time schedule for implementing the corrective actions, reference to the previous correspondence

will be satisfactory. The transmittal letter shall contain the penalty of perjury statement by the Discharger, or the Discharger's authorized agent, as described in the Standard Provisions General Reporting Requirements Section B.3.

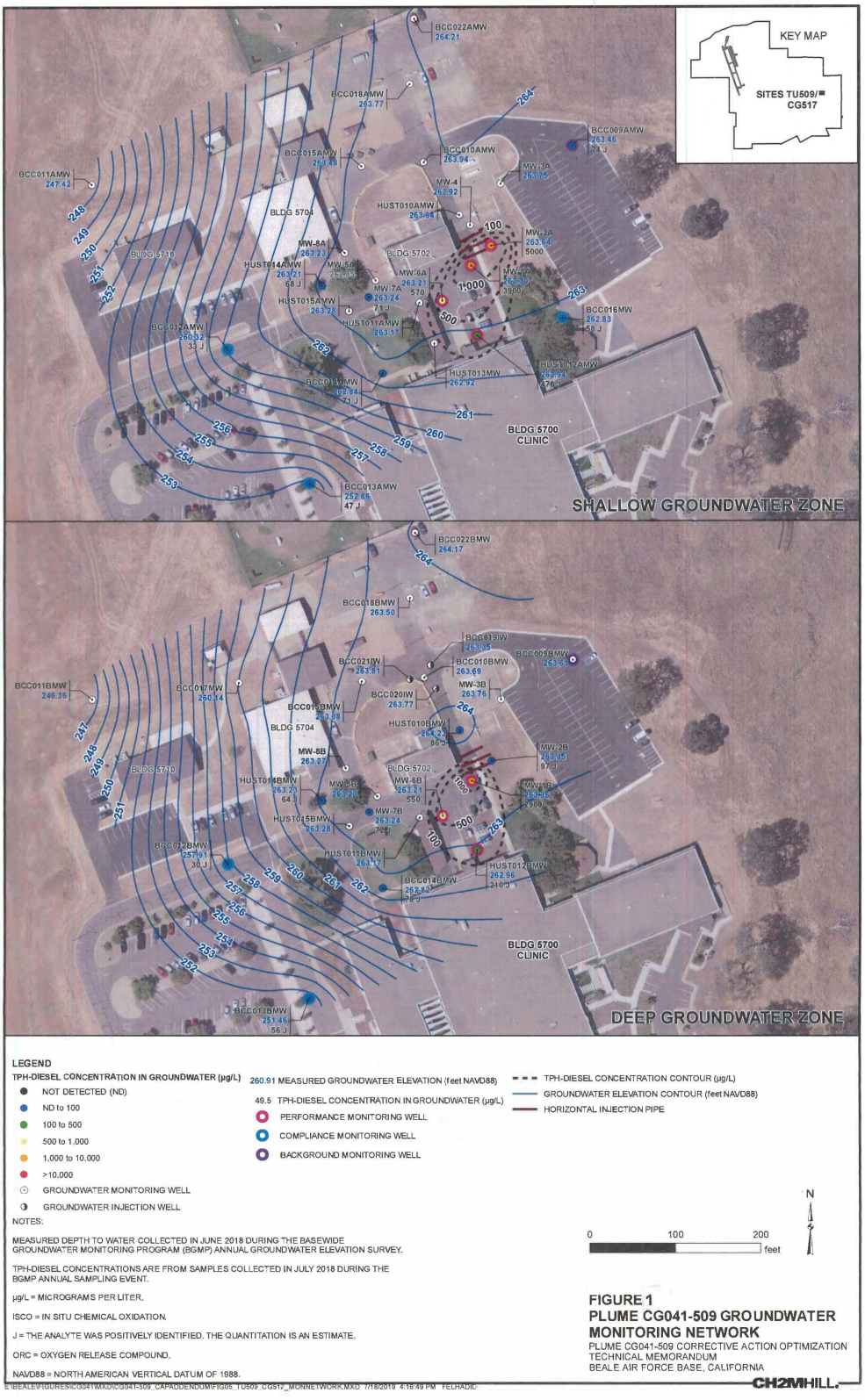
The Discharger shall implement the above monitoring program on the first day of the month following adoption of this Order.

Ordered by:

Original signed by Gerald Djuth for
ANDREW ALTEVOGT, Assistant Executive Officer

15 October 2019
(Date)

10/15/19: MWC


KEY MAP
SITES TU509/CG517
SHALLOW GROUNDWATER ZONE
DEEP GROUNDWATER ZONE
BLDG 5700 CLINIC
BLDG 5702
BLDG 5704
BLDG 5710
LEGEND
TPH-DIESEL CONCENTRATION IN GROUNDWATER (µg/L)
NOT DETECTED (ND)
ND to 100
100 to 500
500 to 1,000
1,000 to 10,000
>10,000
GROUNDWATER MONITORING WELL
GROUNDWATER INJECTION WELL
260.91 MEASURED GROUNDWATER ELEVATION (feet NAVD88)
49.5 TPH-DIESEL CONCENTRATION IN GROUNDWATER (µg/L)
PERFORMANCE MONITORING WELL
COMPLIANCE MONITORING WELL
BACKGROUND MONITORING WELL
TPH-DIESEL CONCENTRATION CONTOUR (µg/L)
GROUNDWATER ELEVATION CONTOUR (feet NAVD88)
HORIZONTAL INJECTION PIPE
NOTES:
MEASURED DEPTH TO WATER COLLECTED IN JUNE 2018 DURING THE BASEWIDE GROUNDWATER MONITORING PROGRAM (BGMP) ANNUAL GROUNDWATER ELEVATION SURVEY.
TPH-DIESEL CONCENTRATIONS ARE FROM SAMPLES COLLECTED IN JULY 2018 DURING THE BGMP ANNUAL SAMPLING EVENT.
µg/L = MICROGRAMS PER LITER.
ISCO = IN SITU CHEMICAL OXIDATION.
J = THE ANALYTE WAS POSITIVELY IDENTIFIED. THE QUANTITATION IS AN ESTIMATE.
ORC = OXYGEN RELEASE COMPOUND.
NAVD88 = NORTH AMERICAN VERTICAL DATUM OF 1988.
N
0 100 200 feet
FIGURE 1
PLUME CG041-509 GROUNDWATER MONITORING NETWORK
PLUME CG041-509 CORRECTIVE ACTION OPTIMIZATION TECHNICAL MEMORANDUM
BEALE AIR FORCE BASE, CALIFORNIA
CH2MHILL