DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND SOUTHWEST
1220 PACIFIC HIGHWAY
SAN DIEGO, CA 92132-5190

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February 28, 2014

Ms. Beatrice Griffey
California Environmental Protection Agency
California Regional Water Quality Control Board
Mitigation & Cleanup Unit
2375 Northside Drive, Suite 100
San Diego, CA 92108

Mr. Tayseer Mahmoud
California Environmental Protection Agency
Department of Toxic Substances Control
Brownfields and Environmental Restoration Program
5796 Corporate Avenue
Cypress, CA 90630

Mr. Martin Hausladen
U. S. Environmental Protection Agency
Region IX, Code SFD-8-3
75 Hawthorne Street
San Francisco, CA 94105-3901

SUBJECT: MEETING MINUTES FOR THE 112th FEDERAL FACILITIES AGREEMENT (FFA) MEETING DATED JANUARY 23rd, 2014, MARINE CORPS BASE CAMP PENDLETON

Dear Ms. Griffey, Mr. Mahmoud, Mr. Hausladen:

Enclosed are the minutes to the Marine Corps Base, Camp Pendleton Federal Facilities Agreement (FFA) Meeting Number 112, held on January 23rd, 2014. Should you have questions, please call Ms. Theresa Morley at (619) 532-1502.

Sincerely,

G. C. BORDENAVE, JR
By direction

Enclosures: (1) 112th FFA Meeting Minutes
(2) 112th FFA Meeting Agenda
(3) Sign in Sheet
(4) Deliverables/Fieldwork Spreadsheets
(5) FFA Schedule
(6) Site 21 Possible Alternatives
(7) Site 1115 Thermal Remediation Pilot Study
(8) Site 1115 Site 1 Pilot Study
(9) Site 1118 Extended Site Inspection Results
(10) Site 1119 RI/FS Alternatives

Copy to: CG, MCB Camp Pendleton (Attn: ACOS, Environmental Security - Mr. Luis Ledesma)

PARSONS

Contract No. N62583-11-D-0515, Delivery Order No. 0006
Document Control No. BATL-0515-0006-0013
Parsons Project No. 748590

PROJECT NOTE NO. 62

SUBJECT: **Marine Corps Base (MCB) Camp Pendleton Federal Facilities Agreement (FFA) Meeting (No. 112)**

DATE HELD: **January 23, 2014**

Attendees**:**

Theresa Morley (Naval Facilities Engineering Command Southwest [NAVFAC SW]), Adam Hill (NAVFAC SW), Tracy Sahagun (MCB Camp Pendleton), Joseph Murtaugh (MCB Camp Pendleton), John Chesnutt (United States Environmental Protection Agency [USEPA or EPA]), Letitia Moore (USEPA), Martin Hausladen (USEPA), Tayseer Mahmoud (California [Cal] EPA/Department of Toxic Substances Control [DTSC]), Kimberly Gettmann (DTSC), Bill Mabey (TechLaw), Steve Griswold (Parsons), Josh Sacker (Parsons), and Dan Griffiths (Parsons).

Attendees by teleconference: Susan Hulbert (NAVFAC SW), Captain John Torresala (USMC Western Area Counsel Office [WACO]) , Major Thomas Puckett (WACO), and Beatrice Griffey (San Diego Regional Water Quality Control Board [RWQCB or Water Board]).

Introduction and Status of Deliverables and Fieldwork

A meeting was held in the Galleria Park Hotel conference room in San Francisco, CA. The purpose of the meeting was to update the FFA Team (Team) on program status. Refer to attached sign-in sheet and agenda (attached).

Following introductions, Ms. Morley discussed the deliverables spreadsheet, the fieldwork spreadsheet, and the FFA schedule (attached). The following items were specifically mentioned during the deliverables summary discussion:

- Agency comments have been received on the shaded items, and the items marked as final will be removed on the next version of the deliverables spreadsheet.
- Item #1, the 22/23 Area Groundwater Record of Decision (ROD): Signature page is on its way to the RWQCB, and this document is scheduled to be addressed at the next RWQCB meeting.
- Item #3, Site 1115 Remedial Investigation/Feasibility Study (RI/FS): Thermal remediation was added to the FS, this required some additional time to incorporate into the document and to provide the responses to agency comments.

- Item #4, Site 1117 RI Work Plan: The Sampling and Analysis Plan (SAP) is being finalized with the Naval Installation Restoration Information Solution (NIRIS) Quality Assurance/ Quality Control (QA/QC) procedure.
- Item #8, Site 1116 Work Plan: Ms. Morley asked if the RWQCB comments were completed, and Ms. Griffey said that the letter is now in the mail.
- Item #9, Site 1122 Site Inspection Work Plan: There are habitat issues at Site 1122 (Pacific Pocket Mouse); responses to agency comments are currently being prepared.
- Item #10, Site 33 Source Removal Action Work Plan: Ms. Morley said that in addition to the planned excavation at the site, the Department of the Navy (DON) also would like to perform injection of bioremediation substrate at the site to better address contaminants in groundwater. After some discussion, it was agreed by the team that the injection can proceed, and that the DON will send a letter describing the planned approach for the bio-injection work.
- Item #15, Site 1120 RI Work Plan: Item #15, Site 1120 RI Work Plan: The FFA deliverable date to agencies was changed from 1/16/14 to 2/14/14.
- Item #16, Five Year Review: Mr. Chesnutt noted that the five-year timeframe is a statutory deadline. In answer to a question, Ms. Morley noted that 22/23 Area Groundwater will be wrapped into the next Five Year Review, and the Five Year Review will remain a Base-wide document.

Regarding the Field Work Spreadsheet (attached):

- Item #1, Zero Valent Zinc (ZVZ) Pilot Study: Ms. Morley said that the pilot study is back on track after the need for a contract mod. The 1,2,3-trichloropropane (TCP) was found to be too deep for a permeable reactive barrier (PRB), so injection wells will now be used at the site.
- Item #3, Test Well: Based on the recent well data at Chappo subbasin, the most favorable location for a new supply well is at the Air Station. A new well will be installed and used as a supply well if it passes the planned testing. There are some logistical challenges because of the presence of sensitive species in the planned pipeline route. The pipeline will likely either go around the most sensitive habitat, or may possibly be installed via directional drilling (trenchless). Mr. Hausladen asked if the remedy has a greater cost than planned, and Ms. Morley said that it still is within the planned budget.
- Item #8, Site 1D Field Work: When the soil gas data is available, it will be sent to the agencies along with proposed well locations.
- Item #9, Site 150 RI: Ms. Morley noted that seven feet of free product was found at the site as part of the recent field work.
- Item #11, Site 1122: Planned start date for fieldwork in mid to late Feb 2014.

Regarding the FFA Schedule (attached), it was noted that the date for the Site 6 (22/23 Area Groundwater) Land Use Control Remedial Design/Remedial Action Work Plan (LUC RD/RAWP) depends on the completion date of the ROD. Once it is signed by all parties, the schedule will be updated.

Site 21 Data and Possible Remedial Alternatives

Mr. Griffiths presented a brief site history, results of recent pilot studies, and likely remedial alternatives for the site (slides attached). Two groundwater pilot studies have been conducted at the site between 2009 and 2013. The studies demonstrated that enhanced in situ bioremediation is effective at the site. A draft feasibility study is scheduled to be delivered to the FFA Team on May 26, 2014, which will outline possible remedial alternatives for site groundwater. The RI Report for the site was completed in 2004, prior to the pilot studies.

Significant volatile organic compound (VOC) reductions were achieved in groundwater during the pilot study, which involved the injection of an emulsified mixture of soybean oil, sweet dairy whey, and pH buffer to create anaerobic conditions in the study areas.

Given the success of the pilot studies, an in situ remedy can likely achieve maximum contaminant level (MCLs) in groundwater within a reasonable timeframe. LUCs and long-term monitoring (LTM) would be implemented with any other remedy until unrestricted land use is achieved.

The pros and cons of potential remedial alternatives were discussed (refer to slides). For the remaining contamination in groundwater, potential remedies could include in situ bioremediation, thermal heating, or chemical oxidation.

Pilot Studies for Site 1115 Treatment Zones

Ms. Morley presented an evaluation of treatment technologies, and also outlined the plan to conduct a pilot study of in situ thermal conductive heating in the area of former underground storage tank (UST) Site 5/8/9/17 (slides attached). The advantages and disadvantages of treatment technologies were discussed, including excavation, dual-phase extraction, chemical oxidation, and thermal conductive heating.

The thermal conductive heating (TCH) process uses heated wells to heat the soil, water, and chemicals of concern (COCs) by means of thermal conduction to temperatures between 100 °C and 400 °C. As a result, the groundwater that surrounds the TCH wells is vaporized into steam. Multi-phase extraction (MPE) wells are used to extract soil vapor, steam, light non aqueous phase liquid (LNAPL), and groundwater during the heating process. Steam stripping is the primary driver of COC mobilization, especially in the saturated zone. Existing polyvinyl chloride (PVC) wells in the pilot study area will be removed prior to the installation of the TCH system because the PVC would melt.

Treatment of off-gas from the extraction wells includes a vapor-liquid separator, heat exchanger/condenser, proprietary C3 Technology (compression-cooling-condensation) to treat elevated vapor concentrations of gasoline range hydrocarbons and vapor Granular Activated Carbon (VGAC) filtration.

The objectives include removing LNAPL, reducing shallow groundwater COC concentrations to below MCLs, and ultimately achieving a vapor intrusion (VI) risk within the treatment footprint of less than 1×10^{-6}. Also, sufficient data will be obtained to optimize the design for full scale implementation of the TCH technology. The pilot study area will be a 40 by 40 foot area (1,600 square feet) within the area associated with the former UST Site 5/8/9/17. Upon completion of the pilot study, the data will be evaluated and presented in a report, including post-treatment VI risk. Mr. Chesnutt noted that at a site at Hunter's Point site, there was concern about the heating of a flame retardant that acts as a nerve agent when heated.

Ms. Morley also presented the plans for a second pilot study at the former Site 1 within Site 1115 (refer to slides). The Site 1 work will include excavating a 100 by 100 foot square area to approximately 26 feet below ground surface (bgs), and stockpiling soils separately into reusable clean overburden and contaminated soil that would be characterized for disposal. If funding is available, soils will be treated onsite and reused as backfill.

During excavation, dewatering, characterization, and disposal of groundwater will be carried out. In addition, oxygen release compound (ORC) or similar product will be added to the excavation backfill. The schedule for the Final Pilot Study Work Plan is July 2014. In addition, it was noted that the in situ chemical oxidation alternative will be implemented at TTZ-1D if funds are available.

Five-Year Review Discussion

Mr. Hill briefly discussed the Five-Year Review. The document is currently in transit to the agencies. This is the third Five-Year Review for the Base. Mr. Hill noted that Site 1D groundwater is now designated as Site 1121. The soils at Site 1D were addressed previously in OU 4. Ms. Moore asked if the Five-Year Review provides a roadmap of when each ROD was completed, and what sites are addressed in each ROD. Mr. Hill said yes, it does provide that information, and Ms. Morley noted that the Five-Year Review is now in an improved format that is more reader-friendly.

Site 1119 RI/FS Review of Alternatives

Mr. Griswold and Mr. Griffiths provided a summary discussion on the Site 1119 RI/FS, which is currently in agency review. Please refer to attached meeting slides.

The site was originally defined as the area around Base wells 26016 and 26018 because trichloroethene (TCE) was detected in those wells after installation and testing. Consequently, those wells are not currently used as supply wells. The purpose of the RI/FS is to determine the source of contamination of those wells and to outline potential remedial alternatives. A multi-phase investigation program was carried out, including sampling available existing wells in the groundwater subbasin, installing 26 new monitoring wells at eight locations to fill data gaps, a 41-point soil gas survey in the potential source area, and installation of an additional 10 wells in three locations in closer proximity to the source area.

The TCE plume was only found to be along the southeast edge of the aquifer, with the source being in the "Museum District" of buildings surrounding the railroad tracks near

the intersection of Vandegrift Road and Rattlesnake Canyon Road. Based on the results from monitoring wells 1119-MW9A/B/C/D, 1119-MW10A/B/C, and 1119-MW11A/B/C, the source appears to be primarily in the vicinity of Building 2611, and possibly Buildings 2621 and 2622. The size of the suspected source area (as defined by 500 micrograms per liter (µg/L) TCE contour) is approximately 450 feet long and 200 feet wide. A remedial design study of the source area will be needed to obtain detailed information on contaminant distribution and hydrogeologic conditions that could affect design parameters. Data collected to date are considered sufficient to identify and evaluate potential remedial options for the site.

There is a significant risk (1×10^{-3}) to a hypothetical domestic water user at the site, with TCE being the primary contributor to risk. Regarding potential migration of VOCs from soil gas to indoor air, two evaluations were conducted. For the evaluation of soil vapor data, the risk to industrial/commercial workers is 3×10^{-7} and 1×10^{-6} for residents. An alternative evaluation, which is likely overly conservative, provides a risk estimate based on the partitioning of VOCs from groundwater to soil vapor, and then to indoor air. This evaluation indicates a risk of 9×10^{-6} for residents and 1×10^{-6} for industrial/commercial workers. However, the buildings at Site 1119 have open crawl spaces under the buildings, resulting in an incomplete pathway. Therefore, estimated risk applies only to future slab-on-grade buildings.

Mr. Griffiths described the elements of the FS (refer to slides). Given the extent and depth of the plume above the MCL (approximately 2600 feet long and up to 80 feet thick), and the downgradient TCE concentrations (approximately 30 µg/L), the proposed active remedies are focused on the source area, which likely has TCE concentrations over 500 µg/L based on data to date, and is which is estimated to be approximately 450 feet long by 200 feet wide.

Alternative 2 (land use controls and long term monitoring) would be implemented together with any of the other selected alternatives. Alternatives 3 through 7 provide in situ cleanup of the source area, and Alternative 8 is a permeable reactive barrier downgradient of the source area to intercept contaminant migration.

The source area is divided into two zones, TTZ -1 and TTZ-2, in case two different technologies are determined to be appropriate for the two zones, and in case a phased approach is determined to be appropriate. Mr. Griffiths provided a discussion of the pros and cons of various technology alternatives, including the use of in situ reactive metals, chemical oxidation, bioremediation, or thermal desorption in the source area, and a downgradient PRB installed via injection wells. The discussion included an outline of the configurations of potential injection wells and the timeframes for each alternative. Dr. Mabey asked about the possibility of dense nonaqueous phase liquid (DNAPL) at the site, and Mr. Griffiths said that is not likely based on the current data given the observed concentrations relative to the solubility limit of TCE.

<u>Site 1118 Extended Site Inspection Results</u>

Mr. Hill provided the results of the recent Extended Site Inspection (ESI) fieldwork conducted at Site 1118, which consists of three subsites designated as Subsites 520400, 2664, and 21565 (refer to attached slides). The ESI Report is currently in

agency review, with comments due February 10. The purpose of this ESI was to investigate the extent and potential sources of VOCs in groundwater, soil, and soil gas.

Subbsite 2664: Six new monitoring wells were installed, and were sampled together with 12 existing wells. In addition, 5 dual-depth soil gas probes were installed and sampled, and soil samples were taken from the well borings. COCs were reported below project screening levels (PSLs), except for one naphthalene detection in soil adjacent to the former 2664 UST. The soil gas results indicate that three compounds are slightly above PSLs, but are not expected to impact groundwater. There were no differences in soil gas concentrations caused by seasonal variation.

Groundwater results indicate four VOCs are present slightly above PSLs, with a maximum tetrachloroethene (PCE) concentration of 2.3 µg/L. The distribution of detections in groundwater do not define a plume originating from the 2664 UST area. The risk estimates did not exceed 1×10^{-6} for industrial/commercial receptors, and the risk estimates for residents exceed 1×10^{-6} for PCE in groundwater and 1,3-butadiene in soil gas. The 1,3-butadiene is likely a false positive and not believed to be a site-related release. A re-sampling of soil gas in 2013 showed no 1,3-butadiene. The groundwater mound at the site is due to either a leaking water pipe or a fire hydrant. Based on the data collected, the site is considered adequately characterized and No Further Action is recommended for Subsite 2664.

Subsite 21565: The investigation included five monitoring wells, a passive soil gas survey, six dual-depth soil gas probes, and 8 soil samples. The passive soil gas survey shows TCE concentrations highest near soil gas probe SG-3 and in the area between former Building 21564 and Boat Basin. This was an area used for vehicle maintenance, degreasing operations, and vehicle washing. These results are consistent with soil gas concentrations and distribution from sample analyses.

Results indicate that although concentrations of *cis*-1,2- dichloroethene (DCE), TCE, and vinyl chloride were reported in soil above PSLs, and TCE, PCE, chloroform, and benzene were reported in soil gas above PSLs, these constituents were not detected in groundwater at concentrations above their respective PSLs. Risk estimates exceed 1×10^{-6} for both hypothetical residents and for industrial/commercial workers. The source of VOCs is unknown but is presumed to be from former Building 21564, which was reportedly used for vehicle maintenance activities.

Based on the sampling results and risk assessment, an interim removal action is recommended to address the relatively high soil gas concentrations of TCE in the vicinity of 21565-SG-3 and 21565-MW-8.

Dr. Gettmann noted that the concentrations of COCs in soil are not reported in the correct units on Slide 20. Mr. Mahmoud asked why no data is plotted closer to the Boat Basin shoreline in Slide 19, showing the passive soil gas survey results. Mr. Hill said that no Gore Sorbers were installed any closer to the shoreline at the site.

Subbsite 520400: Eight soil samples were collected from seven soil gas and well borings, soil gas was collected from 10 co-located shallow and deep probes and one dual-depth probe, and groundwater was sampled from four monitoring wells. VOCs were detected in soil and soil gas above PSLs, but no chlorinated VOCs were detected

in groundwater. However, the fuel additives 1,2-dichloroethane (DCA), methyl tert-butyl ether (MTBE), lead, and toluene were reported in groundwater below the PSLs.

The detections of chloroform, bromodichloromethane, and dibromochloromethane reported above PSLs in wells MW-10 and MW-12 are likely the result from watering trees or possible leakage from the water lines. The limited number and low concentrations of VOCs indicate that a dilute dissolved-phase plume is not migrating offsite.

Risk estimates for industrial/commercial workers did not exceed 1×10^{-6}. For residents, the total risk estimate exceeded 1×10^{-6} from assumed exposure to 1,3-butadiene in indoor air from soil gas. However, this compound is likely a false positive and is not believed to be a site-related release. The reported concentrations of VOCs, fuel constituents, and fuel additives in soil gas will not impact groundwater at concentrations exceeding PSLs. It is recommended that additional investigation be conducted at this subsite to delineate the observed soil and soil gas concentrations reported above the respective PSLs in the sample at 520400-SG-2.

Dr. Mabey asked, with regard to the 1,3-butadiene detections, if the soil gas canisters were certified clean from the lab, and Mr. Hill said that they should have been as this is a standard quality control procedure.

Schedule for Next FFA Meeting

The next FFA Meeting is scheduled to be held in Pasadena at Parsons' office on May 15, 2014.

MCB Camp Pendleton
112th FFA Meeting Agenda
Galleria Park Hotel
191 Sutter Street
San Francisco, CA 94104

January 23rd, 2014

0900 – 0915	**Welcome and Introductions (Navy)**
0915 – 0945	**Project Deliverables, FFA Schedule Update and Planned/In Progress Field Work Status (Navy)**
0945 – 1000	**Discussion of ZVZ Pilot Study – 22/23 Area Groundwater (Navy)**
1000 – 1015	**Break**
1015 – 1045	**Present Site 21 Monitoring Data and Possible Alternatives for the site (Parsons)**
1045 – 1130	**Pilot Studies for Site 1115 Treatment Zones (Navy)**
1130 – 1230	**Lunch**
1230 – 1300	**Extended Site Inspection Results for Site 1118 (Navy)**
1300 – 1345	**Site 1119 RI/FS Review of Alternatives (Parsons)**
1345 – 1400	**Five Year Review Update (Navy)**
1400 – 1415	**Meeting Conclusion and Action Items (Navy)**

PARSONS

CLIENT NAVFAC
SUBJECT FFA MEETING 1/2th
JOB NO.
BY
CKD.
SHEET OF
DATE 1/23/14
REVISION

SIGN IN SHEET

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Capt Torresala *	USMC	On Conf. call
Beatrice Griffy *		
Susan Hulbert *		
Maj. Thomas Puckett *	USMC	

On conf. call

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MCB Camp Pendleton Deliverables Spreadsheet

Date: 1/23/14

				Date Due	Agency Comments	Response Received From:		
Item	**Document**	**Contractor**	**Status**	**to Agencies**	**Due By**	**EPA**	**DTSC**	**RWQCB**
1	ROD for 22/23 Area Groundwater	Parsons	Signature page in transit	5/8/12	7/9/12	**25-Jun**	**27-Jun**	**9-Jul**
2	RI Work Plan for Site 150 - 21 Area Boat Basin	Trevet	FINAL	4/22/13	6/21/13	**NC**	**19-Jun**	**22-May**
3	RI/FS for Site 1115 - FSSG Lot * due date 21 July (RWQCB request)	Noreas/Parsons	Responding to agency comments	4/30/13	7/1/13	**NC**	**27-Jun**	**7-Aug**
4	RI Work Plan for Site 1117 - 16/17 Area Groundwater	Trevet	Finaliizing	5/6/13	7/5/13	**NC**	**2-Jul**	**12-Aug**
5	Annual Groundwater Monitoring Report - Site 7 Box Canyon	Trevet	FINAL	6/11/13	8/12/13	**NC**	**NC**	**13-Aug**
6	Work Plan to Install Wells & Monitor Groundwater - 22/23 Area GW	Tidewater	FINAL	8/30/13	10/29/13	**NC**	**28-Oct**	**14-Oct**
7	Plume Removal Action Completion Report - Site 33 (52 Area Armory)	Shaw	Responding to agency comments	9/27/13	11/26/13	**NC**	**18-Nov**	**13-Dec**
8	Work Plan for Additional Investigation - Site 1116 (14 Area GW)	TriEco	With agencies	10/29/13	12/30/13	**NC**	**19-Dec**	
9	Site Inspection Work Plan for Site 1122 (Shot Fall Zone)	AMEC	Responding to agency comments	11/22/13	12/20/13	**NC**	**31-Dec**	**3-Jan**
10	Source Removal Action Work Plan - Site 33 (52 Area Armory)	ECM	With agencies	11/30/13	1/28/14		**16-Jan**	
11	RA Performance Monitoring Work Plan - Site 1114 (41 Area Arroyo)	TriEco	With agencies	12/9/13	2/7/14			
12	Extended Site Inspection Report - Site 1118 (21, 26, 52 Area GW)	ECM	With agencies	12/12/13	2/10/14			
13	Remedial Investigation/Feasibility Study Report - Site 1119	Parsons	With agencies	12/19/13	2/17/14			
14	Extended Site Inspection Report - Site 62 (Asphalt Batch Plant)	SDVJV	With agencies	1/6/14	3/7/14			
15	Remedial Investigation Work Plan - Site 1120 (Ag Fields)	Tidewater	Navy review	2/14/14				
16	Five Year Review	Navy	In production	1/21/14	3/21/14			
17	Tier II SAP for Site 1116 Performance Monitoring (14 Area GW)	ECM	Navy review	1/24/14	3/25/14			
18	Pilot Study Work Plan for TTZ-2L and TTZ-2S - Site 1115 (FSSG Lot)	ECC-Insight	Preparing pre-draft	2/21/14				
19	Annual Post Closure Maintenance Report - Site 7 (Box Canyon)	Trevet	Preparing pre-draft	2/22/14				
20	Pilot Study Work Plan for TTZ-1S - Site 1115 (FSSG Lot)	Tidewater	Preparing pre-draft	3/18/14				
21	Removal Action Completion Report - Site 1114 (41 Area Arroyo)	Trevet	When field work is complete	3/20/14				

Agencies have commented

MCB Camp Pendleton Fieldwork Spreadsheet **Date: 1/23/14**

Item	Field Work	Planned Start Date	Planned Completion Date
1	Field Work for 22/23 Area Groundwater ZVZ Pilot Study	Geochem/sampling Jan 2014 Install new wells Mar 2014	
2	EISB Pilot Study - 22/23 Area GW	9/30 - begin injections	complete
3	Install Test Well - 22/23 Area GW	22-Jan-14	late April
4	22/23 Area LTM Baseline Sampling	10-Mar-14	21-Mar-14
5	Removal Action Site 1114	8/5 mobilize	complete
6	Removal Action Site 1116	1491 EISB Pilot Test 24 Feb - 23 Mar 14112 Pilot Test 10-14 March	2015
7	Complete Site 62	end of Sep	
8	RI Field Work - Site 1D	1st phase of field work complete	
9	Remedial Investigation - Site 150	18-20 Nov Soil/Groundwater Sampling Jan 2014 Soil Gas Sampling	April (2nd); July (3rd); October (4th)
10	Remedial Investigation - Site 1117	mid Feb 2014	2nd sampling July 2014

Date: 1/23/14

				RTC Approved		
Item	**Document**	**Contractor**	**RTCs to agencies**	**EPA**	**DTSC**	**RWQCB**
1	RI/FS for Site 1115 - FSSG Lot	Noreas		N/A		
2	RI Work Plan for Site 1117 - 16/17 Area Groundwater	Trevet	2nd RTCs to DTSC 12/17; 2nd RTCs to RWQCB 12/20	N/A	17-Dec	20-Dec
3	Work Plan to Install Wells & Monitor Groundwater - 22/23 Area GW	Tidewater	12/5/2013	N/A	11-Dec	18-Dec
4	Plume Removal Action Completion Report - Site 33 (52 Area Armory)	Shaw				
5						
6						

FFA Schedule for Draft Documents – January 23, 2014

Original schedule was agreed to by all FFA signatories at the May 17, 2011 FFA meeting. Updates are made every four months, prior to the FFA meetings. Dates marked with an asterisk are tentative, based on funding and subject to change. Once funding becomes available for a site, the date will be updated and the asterisk removed. Items in italics represent field work and are not enforceable.

Site 6 (Site number is for funding purposes only) – 22/23 Area Groundwater

This site consists of VOC plumes in the groundwater under the 22 and 23 Areas. Various industrial activities have historically taken place in the 22 and 23 Areas. An RI/FS was completed in January 2011. The Proposed Plan outlined the various alternatives from the FS and proposed the preferred alternative which is a combination of alternatives 2, 3 and 4. Alternative 2 includes Land Use Controls and Long-Term Monitoring, Alternative 3 involves an Alternate Water Supply and Alternative 4 is Source Area Treatment via In-Situ Technologies. A public comment period and public meeting for the Proposed Plan were held in July/August 2011. A Record of Decision is being routed for signature by the agencies. To evaluate the effectiveness of the remedies proposed for Alternative 4, two pilot studies are in progress: a Zero Valent Zinc (ZVZ) Permeable Reactive Barrier is planned for the TCP plume; and, Enhanced InSitu Bioremediation (EISB) is planned for the TCE plume. The DoN has finalized work plans for both pilot studies and to test locations to cite the replacement production well.

– Proposed Plan	complete
– Geotechnical and Design Information for ZVZ PRB Pilot Study	complete
– *Implementation of ZVZ PRB Pilot Study*	*in progress*
– **Record of Decision**	**5/8/2012**
– **Well Siting Study Sampling and Analysis Plan**	**complete**
– *Field Work for Well Siting Study*	*in progress*
– Work Plan for Enhanced InSitu Bioremediation (EISB)	complete
– *Field Work for EISB Pilot Study*	*in progress*
– Work Plan to Install Wells and Conduct Groundwater Monitoring	complete
– Land Use Control Implementation Plan	1/11/2014
– Tech Memo to Implement Alternate Water Supply	3/31/2014
– EISB Pilot Study for TCE Report	2015*
– ZVZ Pilot Study for TCP Report	2015*

Extension for Record of Decision requested to incorporate multiple Navy and Marine Corps comments and for Sampling and Analysis Plan to accommodate changes in Navy Quality Assurance Officer

****POST ROD Site 7 – Box Canyon Landfill**

This site is a CAMU situated above an old municipal landfill. This site is post-ROD. The selected remedy was an EvapoTranspiration (ET) cap with land use controls. The site must be fenced and signed. Annual inspections are made in relation to the monitoring systems, cover maintenance, drainage/erosion control,

cracks, settlement and movement and vegetation growth. Additionally, groundwater monitoring wells are sampled every year and gas probes are sampled according to the percent of methane in the probe. The groundwater monitoring results and the annual maintenance activities are summarized in annual reports. The methane results are emailed to the FFA team monthly. A Gas Collection and Control System (GCCS) was recently installed and has reduced methane concentrations to below compliance standards.

– Memo to File for Site 7 (pv panels)	complete
– *Field Work for Non Methane Organic Compounds*	*complete*
– Memo To File	complete
– Report for Non Methane Organic Compounds	complete
– Annual Post Closure Maintenance Report (for CY13)	2/22/2014
– Annual Groundwater Monitoring Report	7/3/2014
– Five Year Review	4/16/2014

12 Area Site 13 – Former Building 1280 and 1283

This site is the site of a former UST and has some low level concentrations of VOCs in groundwater. An RI/FS has been completed. Due to an impending construction project through the site, contaminated soil and groundwater were removed from the area to be impacted by construction. A year of groundwater monitoring has been completed and a Project Completion Report is complete. The report recommends further action for the site. An interim action is planned to install a Soil Vapour Extraction system and monitor groundwater for a year.

– Groundwater Monitoring Report	complete
– **Project Completion Report for Soil and Groundwater**	**complete**
– Post SVE Groundwater Monitoring Report	2015*
– Proposed Plan	2016*
– Record of Decision	2017*

Dates changed as a result of the May 10, 2012 FFA Meeting

Site 21 – 14 Area Surface Area Impoundment

This site was a former oxidation pond near a maintenance facility which has some low levels of VOCs in groundwater. A Remedial Investigation has been completed for the site, but not a Feasibility Study. Currently a pilot study to evaluate the effectiveness of in-situ bioremediation of chlorinated solvents at low concentrations in groundwater is complete. A Technical Memorandum reporting on the effectiveness of the first year of the pilot study was finalized, as was the Pilot Study Addendum for the second phase of work, currently underway.

– Pilot Study Tech Memo	complete
– Site 21 Pilot Study Work Plan Addendum	complete

- *Second Phase of Pilot Study Field Work* — *in progress*
- **Feasibility Study** — **5/26/2014**
- **Proposed Plan** — **11/15/2014***
- **Record of Decision** — **11/15/2015***

Dates were changed as a result of the September 15, 2011 FFA meeting

Site 33 – 52 Area Armory

Gun cleaning in the armory contributed to a PCE plume downgradient of the armory. A Remedial Investigation and Feasibility Study have been completed for this site. An Engineering Evaluation/Cost Analysis and Non-Time Critical Action Memorandum have also been completed. The selected remedy was excavation of the source material, and treatment of groundwater from the site. An interim Removal Action was completed, concentrating on the worst part of the plume. An additional Removal Action is planned for the source area.

- Removal Action Work Plan for plume — complete
- *Plume Removal Action (geophysical work started 15 Nov 11)* — *complete*
- Plume Removal Action Completion Report — 9/27/2013
- Removal Action Work Plan for source — 11/30/2013
- *Source Removal Action* — *5/7/2014**
- Groundwater Monitoring Report — 2014*
- Source Removal Action Completion Report — 2015*
- Proposed Plan — 2015*
- Record of Decision — 2016*

Site 150 – 21 Area, Location 1

This site became an IR site after a discovery investigation conducted based on information gained from a former Marine stationed at Camp Pendleton. During the discovery investigation, one location had vinyl chloride in soil gas that exceeded risk screening criteria. Field work for the Site Inspection has located groundwater contamination. This site is in the Remedial Investigation phase.

- *Site Inspection Field Work* — *complete*
- Site Inspection Report — complete
- **Remedial Investigation Work Plan** — **complete**
- ***Field Work for Remedial Investigation*** — ***in progress***
- **Remedial Investigation Report** — **2015***
- Proposed Plan — 2016*
- Record of Decision — 2017*

Dates changed (RI added) as a result of the SI field work

SITE CLOSED Site 1003 (Site number is for funding purposes only) – Site 1D Groundwater

This site was a former burn ash site and has undergone a Remedial Investigation and Feasibility Study for soil only. A ROD was signed documenting the selected remedy consisting of excavation and off-base disposal of contaminated soil. During the remedial action a cell with 90 drums and drum fragments containing liquid and solid chemicals was discovered. The drums were removed but the material in the drums had reached groundwater. A Remedial Action Closure Report (RACR) was completed to close out the soil portion of the site, but the groundwater contamination remains to be addressed. As an interim measure, until funding could be secured for further investigation, 650,000 gallons of the groundwater was pumped from the site, treated and disposed of in the base sanitary sewer system. This lowered the concentrations of contaminants in groundwater, however, additional work is planned under a new site, IR Site 1121 Site 1D Groundwater. This site is for soil only; and was closed through the ROD and the RACR.

- Data Gap Analysis for Groundwater Work Plan — complete
- *Data Gap Analysis Field Work* — *complete*
- Data Gap Analysis Report — complete

SITE CLOSED Site 1111 – 26 Area Ash and Debris Disposal Area

This burn ash site was remediated and four quarters of groundwater monitoring have been completed. The site was revegetated and a report was written summarizing the actions that had been completed to date, and why the site qualified for unrestricted land use. A No Further Action Record of Decision (ROD) was signed on April 19, 2013.

- Proposed Plan for No Further Action — complete
- Record of Decision for NFA — complete

Site 1114 – 41 Area Arroyo

This site was created to investigate the PCE concentrations in one well that used to be associated with IR Site 9 (closed). A Site Inspection was carried out and described low-level concentrations of TPH and vinyl chlorides in soil gas and groundwater. A Remedial Investigation was conducted to validate the findings of the SI and to complete a risk assessment for the site. The EPA did not agree with the proposed NFA, so an interim Removal Action is in progress to address elevated concentrations in groundwater.

- Remedial Investigation Report — complete
- **Engineering Evaluation/Cost Analysis & Action Memorandum** — **complete**
- **Removal Action Work Plan** — **complete**
- ***Removal Action*** — ***in progress***
- **Work Plan for Performance Monitoring** — **12/9/2013**
- **Removal Action Completion Report** — **3/20/2014**
- Performance Monitoring Report — 2015*
- Proposed Plan — 2015*

- Record of Decision 2016*

  Dates were changed as a result of EPA's disagreement with site closure

  Dates were changed as a result of the Government shutdown

Site 1115 – 13 Area FSSG Lot

There are two plumes underneath the parking lot at this site, one shallow and one deep, containing chlorinated solvents and benzene. A pilot study to evaluate the effectiveness of in-situ bioremediation of chlorinated solvents in groundwater was completed. The technology was successful at reducing contaminant concentrations, but the site geology limited its effectiveness. A Technical Memorandum detailing the pilot study is complete. A work plan to collect more data is final and the results have been included in a Remedial Investigation/Feasibility Study that is currently under review. The Feasibility Study identified remedial alternatives for various Target Treatment Zones (TTZs) throughout the site. Pilot studies are planned to address the different plumes and contaminants at the site.

- Tech Memo complete
- **Work Plan to collect additional data for site** **complete**
- ***Field Work to collect additional data*** ***complete***
- **Remedial Investigation/Feasibility Study Report** **4/30/2013**
- Pilot Study Work Plan for TTZ-2L and TTZ-2S 2/21/2014
- Pilot Study Work Plan for TTZ-1S 3/18/2014
- *Field Work for TTZ-2L and TTZ-2S Pilot Study* *6/19/2014**
- *Field Work for TTZ-1S Pilot Study* *2014**
- Pilot Study Report for TTZ-1S 2015*
- Pilot Study Report for TTZ-2L and TTZ-2S 2016*
- Proposed Plan 2017*
- Record of Decision 2018*

  Dates were changed as a result of the September 15, 2011 FFA meeting

Site 1116 – 14 Area Groundwater

Nine USTs were transferred from the UST Program to the IR Program due to low-levels of chlorinated solvents. A Site Inspection was completed and six of the sites do not warrant further action under the IR Program. The three other sites will be remediated. An Engineering Evaluation/Cost Analysis (EE/CA) and Action Memo has been completed for this site. A Removal Action Work Plan, with a report detailing the results of a limited investigation to close data gaps as an appendix, is complete. The removal action will address the mainly petroleum sources at the old USTs, along with Dual-Phase Extraction (DPE) at one site and an Enhanced Insitu Bioremediation (EISB) pilot study at another site. The limited investigation that was conducted in 2012 indicated that the TCE plumes at the site are not likely associated with the USTs. Therefore, additional investigation will be conducted to delineate the TCE plumes and to find a source, if possible.

- EE/CA and Action Memorandum (3 subsites – Moving Forward) complete

– Expanded Site Inspection WP	(3 subsites – Moving Forward)	complete
– *Field Work for Site Inspection*	*(3 subsites – Moving Forward)*	*complete*
– **Expanded Site Inspection Report**	**(3 subsites – Moving Forward)**	**appendix to RAWP**
– **Removal Action Work Plan (RAWP)**	**(3 subsites – Moving Forward)**	**complete**
– ***Interim Removal Action***	***(3 subsites – Moving Forward)***	***in progress***
– Additional Investigation Work Plan		10/29/2013
– Performance Monitoring SAP		1/24/2014
– *Additional Investigation Field work*		*2014**
– Additional Investigation Report		2014*
– Removal Action Completion Report	(3 subsites – Moving Forward)	2015*
– Proposed Plan		2015*
– Record of Decision		2016*

Dates were changed as a result of the September 17, 2012 FFA meeting.

Site 1117 – 15/16 Area Groundwater

Six USTs were transferred from the UST Program to the IR Program due to low-levels of chlorinated solvents. The agencies have reviewed the Site Inspection Report recommending the site move into the Remedial Investigation phase. A Remedial Investigation Work Plan is with the agencies for review.

– *Field Work for Site Inspection*	*complete*
– Site Inspection Report	complete
– **Remedial Investigation Work Plan**	**5/6/2013**
– ***Remedial Investigation Field Work***	***2/13/2014***
– **Remedial Investigation Report**	**2014***
– Proposed Plan	2015*
– Record of Decision	2016*

Remedial Investigation added based on agency comments on Site Inspection

Site 1118 – 21/26/52 Area Groundwater

Three USTs were transferred from the UST Program to the IR Program due to low-levels of chlorinated solvents. The Site Inspection report was reviewed by the regulatory agencies and additional work, including a soil gas investigation, is needed to verify if no further action is appropriate for these sites. Field work for an Extended Site Inspection Work Plan is complete and a report detailing the findings is being prepared.

– **Extended Site Inspection (ESI) Work Plan**	**complete**
– *Field Work for Site Inspection*	*complete*
– Extended Site Inspection Report	12/16/2013
– Proposed Plan	2015*
– Record of Decision	2016*

Dates changed as a result of document quality issues

Site 1119 – 26 Area Groundwater

This site was created to investigate the source or sources of chlorinated solvents in the 26 Area production wells. Field work for the Remedial Investigation has been completed. TCE had been discovered at two of the wells and further investigation is needed to delineate extent of contamination and to locate the source, if possible. An addendum to the Remedial Investigation Work Plan and field work are complete, and the Remedial Investigation/Feasibility Study Report is in progress.

– *Field Work for Remedial Investigation*	*complete*
– **Work Plan Addendum to Delineate Source**	**complete**
– ***Additional RI Field Work***	***complete***
– **RI/FS Report**	**12/19/2013**
– Proposed Plan	2014*
– Record of Decision	2015*

Dates changed as a result of the Jan 19, 2011 FFA meeting

Site 62 – Asphalt Batch Plant

This site was created when a transformer containing PCBs tipped over and spilled. A Site Inspection was performed, however data was missing and further investigation was needed. An Extended Site Inspection Work Plan and field work have been completed. A report documenting all work completed to date is in progress.

– Extended Site Inspection Work Plan	complete
– ***Field Work for Extended Site Inspection***	***complete***
– **Extended Site Inspection Report**	**1/6/2014**
– Proposed Plan	2014*
– Record of Decision	2015*

Dates changed as a result of the September 17, 2012 meeting

Site 1120 – Stuart Mesa Pesticide Maintenance Areas

This site was created in 2012 to address pesticide contamination due to agricultural maintenance activities. A Phase II Environmental Assessment was completed for this site in support of real estate agreement closure. The Environmental Assessment is analogous to a Site Inspection, so this site enters the Installation Restoration Program at the Remedial Investigation stage.

– Remedial Investigation Work Plan	1/16/2014
– *Remedial Investigation Field Work*	*2014**
– Remedial Investigation Report	2015*
– Proposed Plan	2016*
– Record of Decision	2017*

Site 1121 – Site 1D Groundwater

This site was created in 2012 to differentiate Site 1D groundwater from Site 1D soil, which was closed with a previous remedial action and Record of Decision. There is a plume consisting of elevated concentrations of VOCs, metals, and pesticides. A Remedial Investigation is currently in progress.

– Remedial Investigation Work Plan	complete
– ***Remedial Investigation Field Work***	***12/15/2013***
– Remedial Investigation Report	2014*
– Proposed Plan	2015*
– Record of Decision	2016*

Dates were changed as a result of the Government shutdown

Site 1122 – Shot Fall Zone

This site was created in 2013 to address lead and Polycyclic Aromatic Hydrocarbon contamination due to overshot from skeet range activities off base. Limited soil samples were collected that indicated elevated levels of lead, so the site will come into the Installation Restoration Program at the Site Inspection stage.

– **Site Inspection Work Plan**	**11/22/2013**
– *Site Inspection Field Work*	*1/15/2014*
– Site Inspection Report	5/5/2014
– Proposed Plan	2016*
– Record of Decision	2017*

Dates changed as a result of the Government shutdown

MCB CAMP PENDLETON SITE 21 PROJECT UPDATE

23 January 2014

112th FFA Meeting

PARSONS

SITE 21

Investigation History

- **2004 - OU 5 RI**
- **2005 - Draft OU 5 FS**
  - before Final FS, decided to conduct supplemental investigation, including pond
- **2008 - Technical Memorandum**
  - included SPAWAR Results for pond and obtained new round of VOC data
- **2009 to 2011 - Initial Pilot Study in Deep Groundwater Zone**
- **2012 - Pilot Study Technical Memorandum**
  - Success!
- **2012 to 2013 - Expanded Pilot Study**
- **2014 - Upcoming Site 21 FS**

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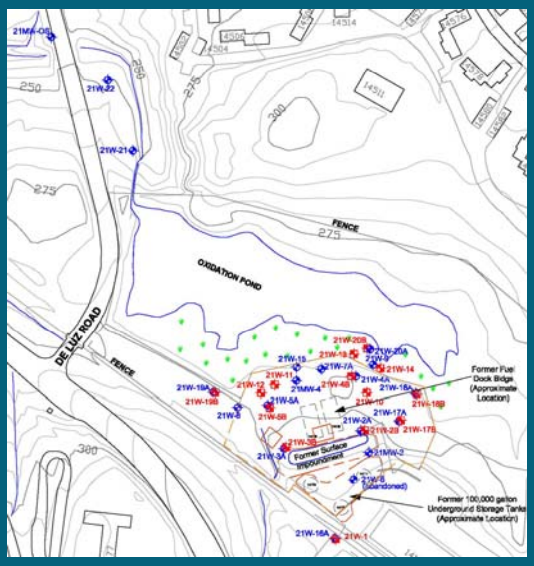
SITE 21

2004 RI Conclusions/Recap

- **Groundwater at the site is contaminated with VOCs greater than MCLs.**
- **VOCs in site groundwater estimated to persist above MCLs for decades if no action.**
- **No detected contaminants in monitoring wells downgradient of the pond.**



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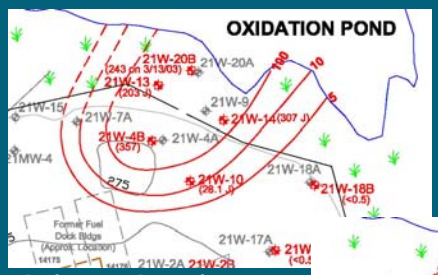
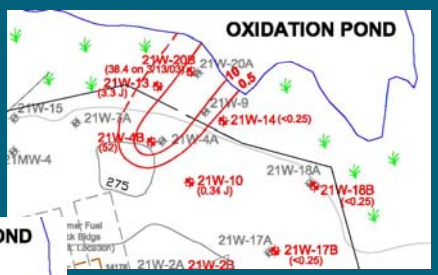
SITE 21

2004 RI Conclusions/Recap

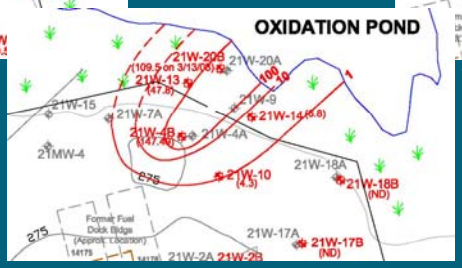
- **Evidence of biodegradation in localized plume areas. *Cis*-1,2-DCE, *trans*-1,2-DCE, and vinyl chloride are present where TCE concentrations are highest.**



TCE in Deep Groundwater



Vinyl Chloride in Deep Groundwater



Total 1,2-DCE (*cis*- and *trans*-) in Deep Groundwater

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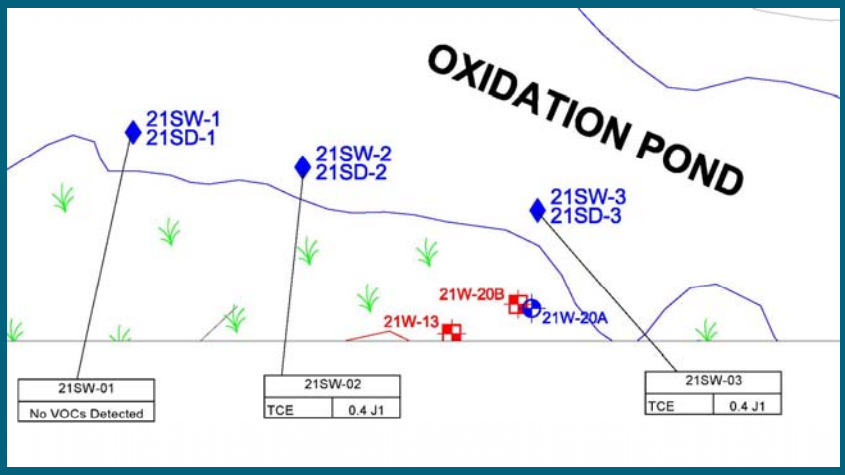
SITE 21

2004 RI Conclusions/Recap

- **TCE detected in the pond at 0.4 µg/L. Modeling indicates that TCE and BTEX will continue to migrate into the pond from groundwater (max TCE and BTEX in the pond estimated at 2.25 and 0.82 µg/L).**



TCE Detected in Surface Water

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SITE 21

2004 RI Conclusions/Recap (continued)

- **RME risks from surface water to a hypothetical adult and child recreationist are 2 x 10^{-8} and 9 x 10^{-9}, respectively.**
- **Groundwater present under Site 21 would not be considered a potential source of drinking water based on the sustainable yield and TDS criteria in SWRCB Resolution 88-63.**

Looking North

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SITE 21

2004 RI Conclusions/Recap (continued)

- **Although highly unlikely, the RME risk to a hypothetical adult domestic water user are 5 x 10^{-3}, with TCE (3 x 10^{-3}) and Vinyl Chloride (1 x 10^{-3}) the primary contributors. The maximum route-specific adult hazard index was estimated to be 68, with TCE (66) the primary contributor. The maximum child hazard index was 160.**
- **Ecological risk assessment: No chemicals in sediments or surface water at concentrations that pose a hazard to ecological receptors. No further action necessary with respect to ecological resources.**

Oxidation Pond

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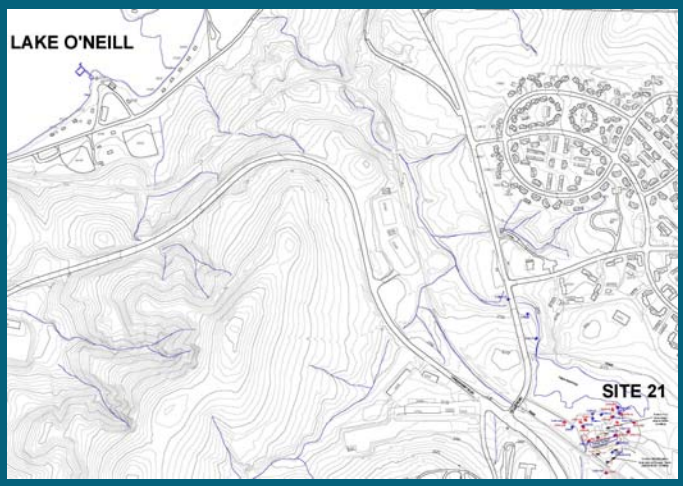
SITE 21

Groundwater

- **Site is ~1 mile upstream from the Santa Margarita River groundwater basin, and ~2 miles hydraulically upstream of Base production well.**
- **Upland plateau vs. river valley alluvial groundwater basin.**



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SITE 21

Groundwater (continued)

- **Site is in an elevated valley that has been dammed to form the pond.**

Channel Downstream of Spillway

End of Channel

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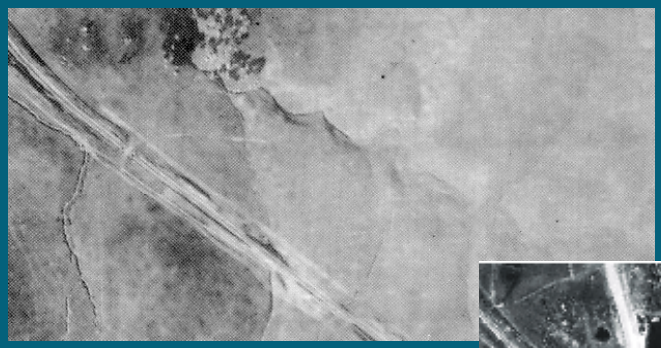
SITE 21

Groundwater (continued)



1928: Location of Future Pond

1953: Oxidation Pond

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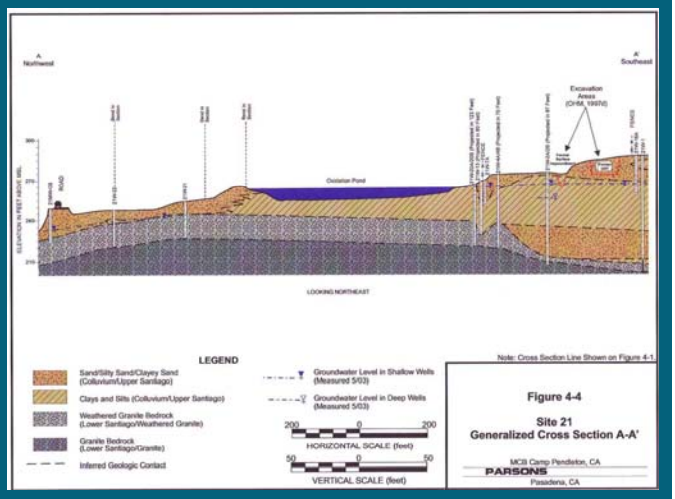
SITE 21

Groundwater (continued)

- **Pond affects hydraulic flow; acts to hinder flow south of the pond.**
- **North of the pond, groundwater flows along bedrock surface down-valley to the north toward Santa Margarita River.**
- **No migration of groundwater impacts downgradient of the pond detected.**
- **Given elapsed time since the release, downgradient migration considered unlikely.**



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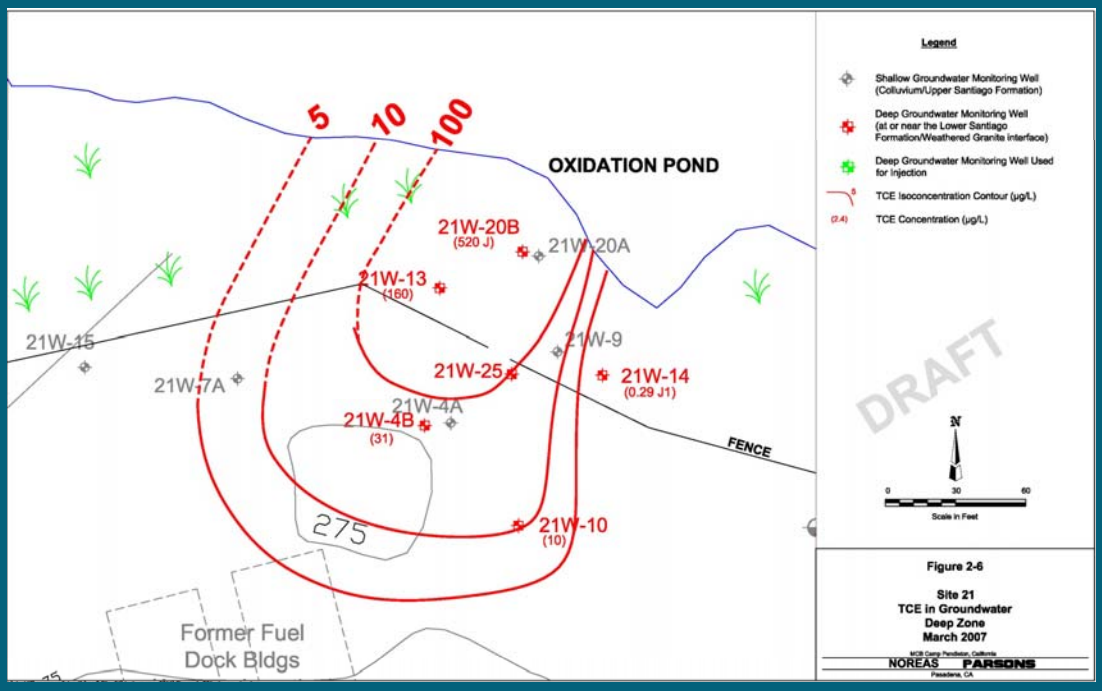
SITE 21 DEEP TCE RESULTS - 2007



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SITE 21 INITIAL PILOT STUDY

Fieldwork Summary

- **November 2009: Well installation**
- **November 2009: Baseline sampling event**
- **December 2009: Substrate injection**
- **Performance Monitoring Events:**
  - June 2010
  - September 2010
  - December 2010
  - May 2011

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SITE 21 BRUSH REMOVED APRIL 2011

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SITE 21 INITIAL PILOT STUDY

Injected Materials

- **Soybean Oil: Long term non-soluble organic substrate expected to drive dechlorination for about 3 years.**
- **Sweet Dairy Whey: Short term soluble substrate to deplete geochemical demand over first 6 months.**
- **pH Buffer: Maintain groundwater pH above 6 for at least 12-18 months.**
- **Site Groundwater: Match natural geochemistry to avoid shocking the system and avoid the "dilution effect" to reduce performance uncertainty.**

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SITE 21 INITIAL PILOT STUDY

Observations

- **2,468 gallons of substrate and water were successfully injected into the aquifer (31 to 46 ft bgs)**
- **Injection pressure was <20 psi**

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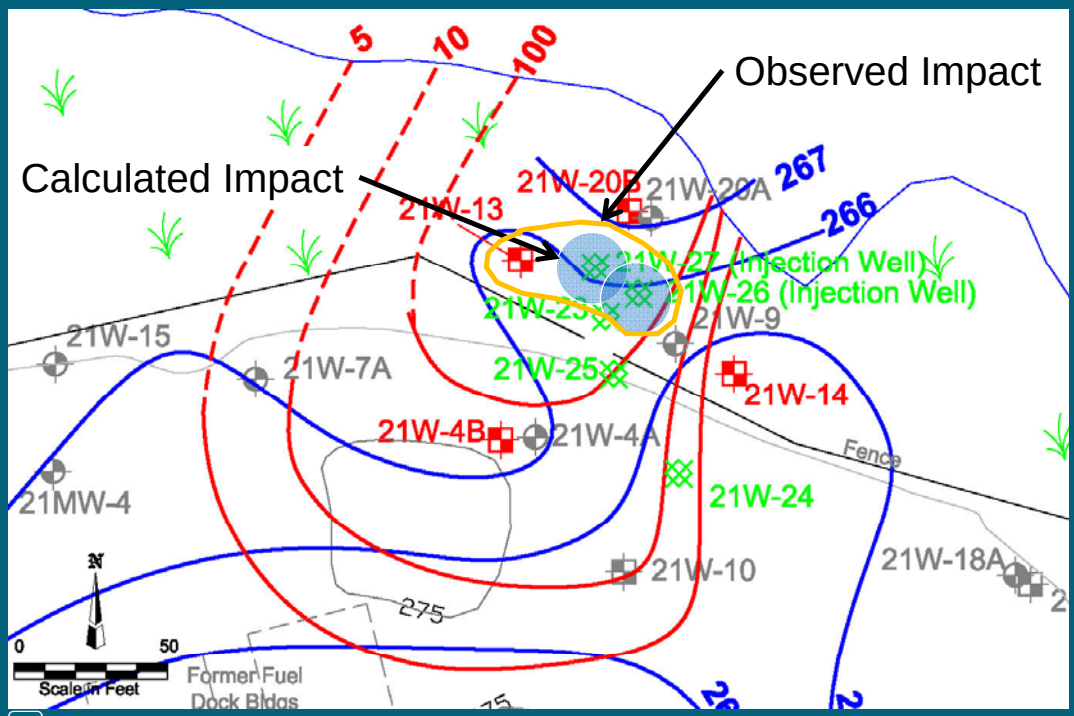
SITE 21 INITIAL PILOT



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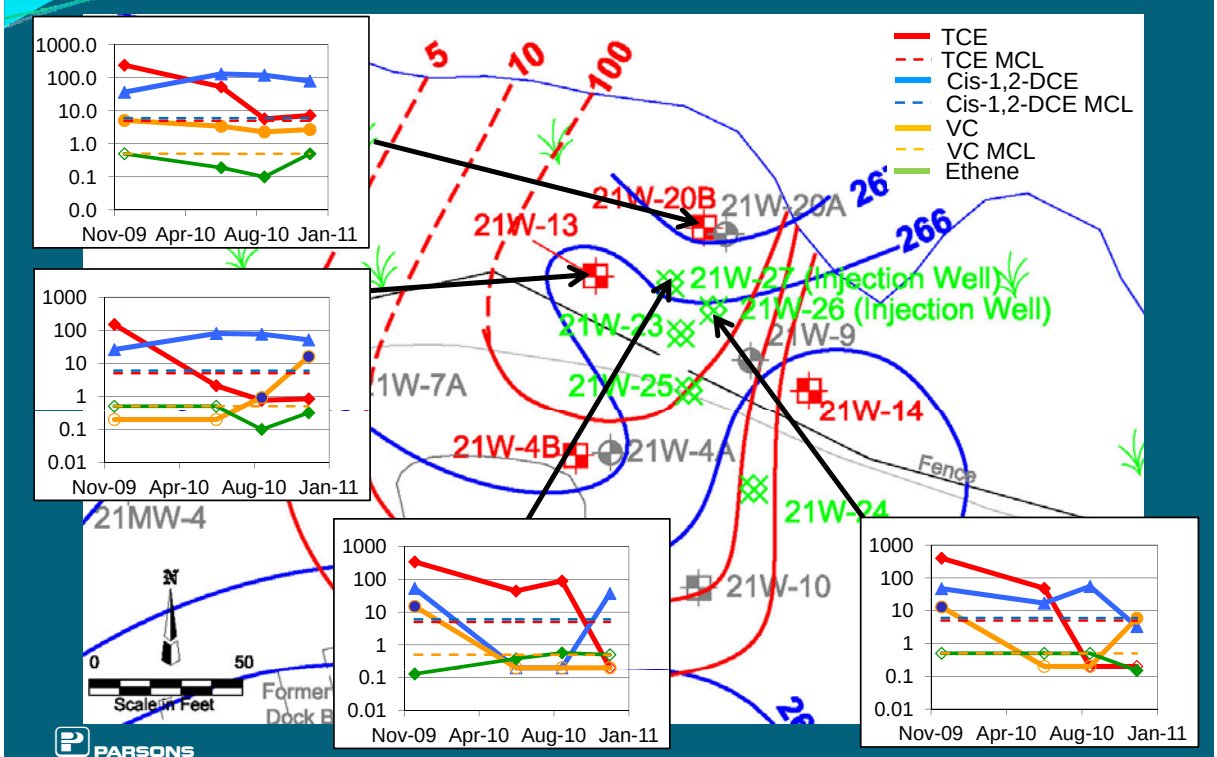
Initial Pilot Substrate Distribution

SITE 21 INITIAL PILOT RESULTS



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SITE 21 INITIAL PILOT STUDY

First Year Conclusions

- **Complete dechlorination of TCE to ethene was induced in the study area.**
- **Significant chlorinated volatile organic carbon (CVOC) molar mass reductions achieved within and down gradient from the study area (>90% CVOC molar mass loss in 3 wells and >40% molar mass loss in 3 more wells).**
- **Near-neutral pH was maintained through month 12.**
- **Dissolved organic carbon (DOC) migrated beyond area impacted during injection by month 6 and contracted back to the injection area by month 12.**
- **Anaerobic conditions induced over a large area and high DOC concentrations persist in the injection wells. However, DOC concentrations at 21W-13, 21W-20B, and 21W-23 declined to <20 mg/L by month 12.**
- **Initial pilot test is a success!**
- **DON decided to conduct expanded pilot study to test whether reductive dechlorination would work at lower TCE concentrations.**

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SITE 21 EXPANDED PILOT STUDY

Expanded Pilot

- **Work plan completed and approved – Spring 2012**

Primary Objectives:

- **Determine if EAB can be applied in plume areas of lower CVOC concentration.**
- **Revise the substrate mixture to reduce whey loading and increase Soybean oil loading to:**
  - Reduce initial pH bounce
  - Extend substrate lifespan
  - Optimize application design

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SITE 21 EXPANDED PILOT STUDY

- May 2012 - New wells installed and baseline groundwater samples collected and analyzed.
- September 2012 - Expanded injection complete at wells 21W-4B, 21W-25, 21W-28, and 21W-29
- Substrate consisted of emulsified vegetable oil (EVO), pH buffer, dairy whey, and site groundwater.

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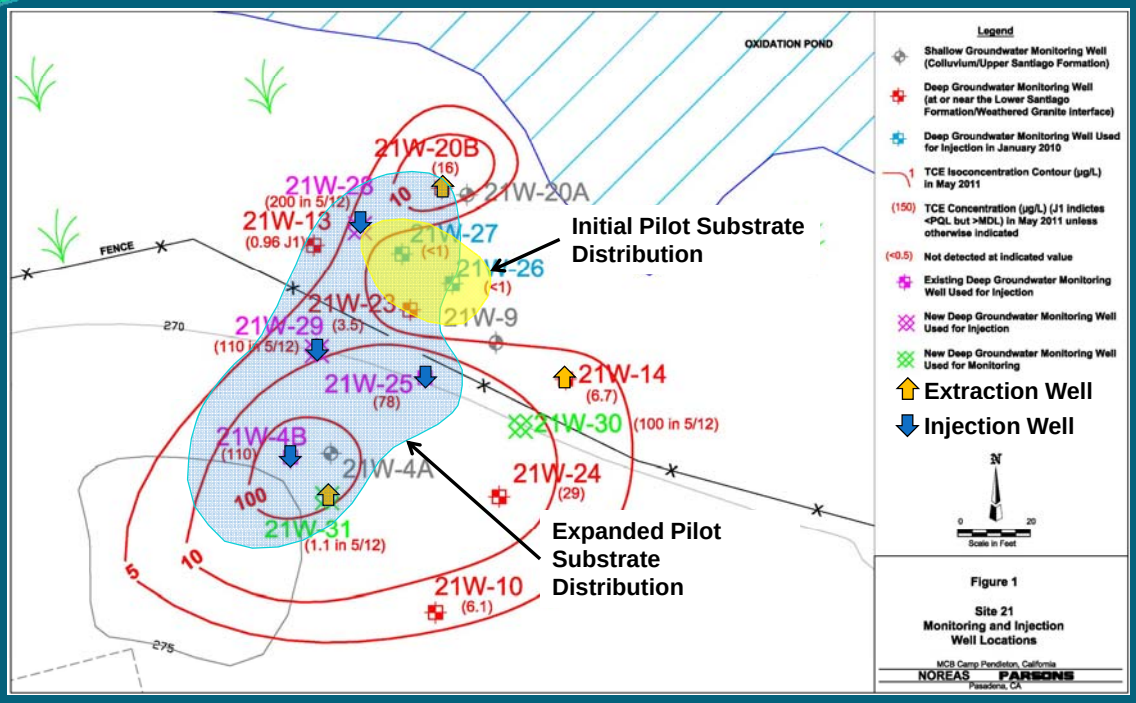
SITE 21 EXPANDED PILOT STUDY INJECTION



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SITE 21 EXPANDED PILOT STUDY

Injection Details:

- **Groundwater was extracted from site monitoring wells using submersible pumps and placed in two 500 gallon storage tanks. Monitoring wells used for groundwater extraction included: 21W-13, 21W-14, 21W-18B, 21W-20B, 21W-23, 21W-26, 21W-27, 21W-30, and 21W-31.**
- **EVO and dairy whey were added directly to the tanks containing extracted groundwater then mixed using diaphragm pump.**
- **pH buffer was added in-line using a dosimeter.**
- **Injection volumes in individual wells were adjusted to accommodate for actual hydraulic conditions encountered during the field effort.**

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SITE 21 EXPANDED PILOT STUDY

Injection Details:

- **Hydraulic communication was verified in the field by water level measurements in monitoring wells in proximity to the injection wells and/or the presence of substrate in extraction wells.**
- **Hydraulic communication was observed in wells 21W-13, 21W-20B, 21W-23, 21W-26, 21W-27, 21W-30, and 21W-31.**
- **Substrate was uniformly distributed through the entire treatment area based on locations where hydraulic communication was observed.**

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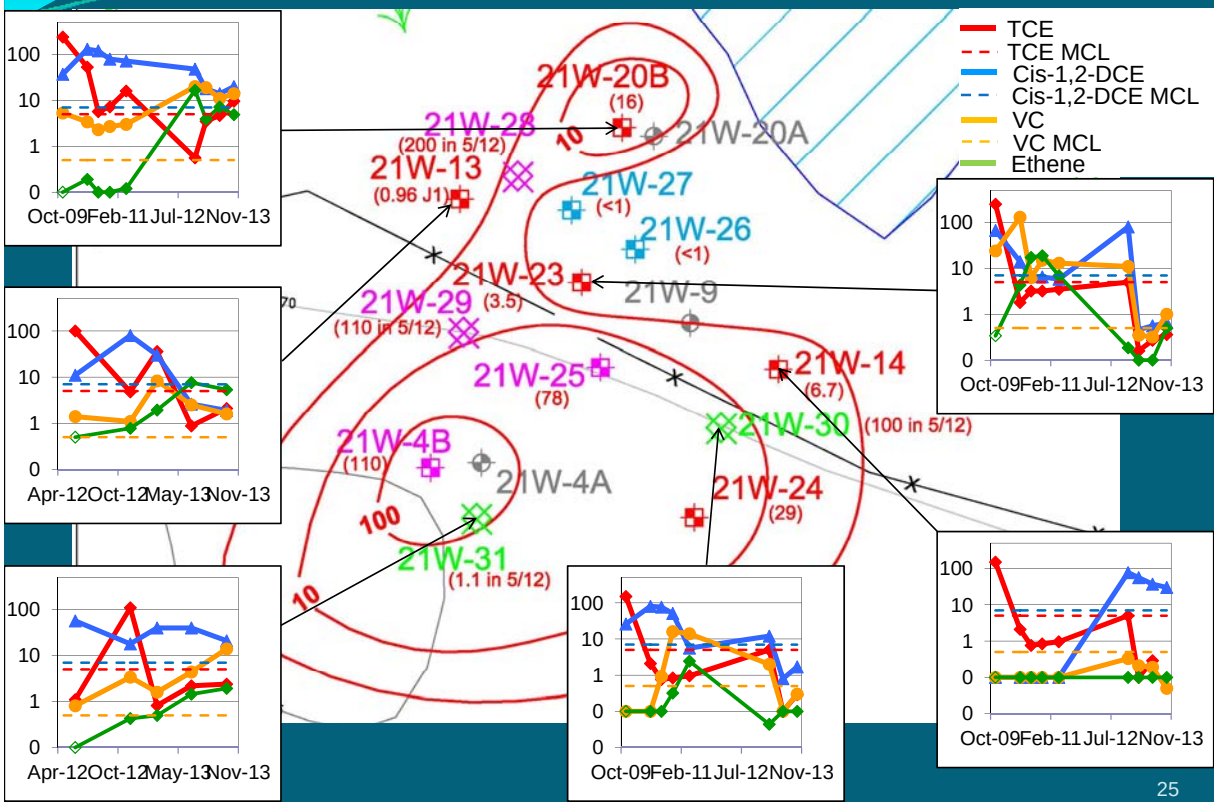
SITE 21 EXPANDED PILOT RESULTS



SITE 21 EXPANDED PILOT STUDY

Conclusions

- **Complete dechlorination of TCE to ethene was induced throughout the initial and expanded study areas.**
- **Significant CVOC molar mass reductions achieved within and down gradient from the study area with little accumulation of intermediate products (*cis*-1,2-DCE + vinyl chloride).**
- **Improved pH control with near neutral maintained through month 12.**
- **High DOC concentrations more consistent through time with higher final concentrations at month 12.**
- **Anaerobic conditions induced over a large area and high DOC concentrations persist within the treatment area.**
- **EAB is a demonstrated technology at Site 21.**

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SITE 21 NEXT STEP

2014 Feasibility Study!

- **Update nature and extent with recently collected site data.**
- **Evaluate remedies for:**
  - Shallow Groundwater – petroleum impacts
  - Deep Groundwater – chlorinated solvent impacts
- **Update Risk evaluations using new datasets and expected future land use as appropriate.**

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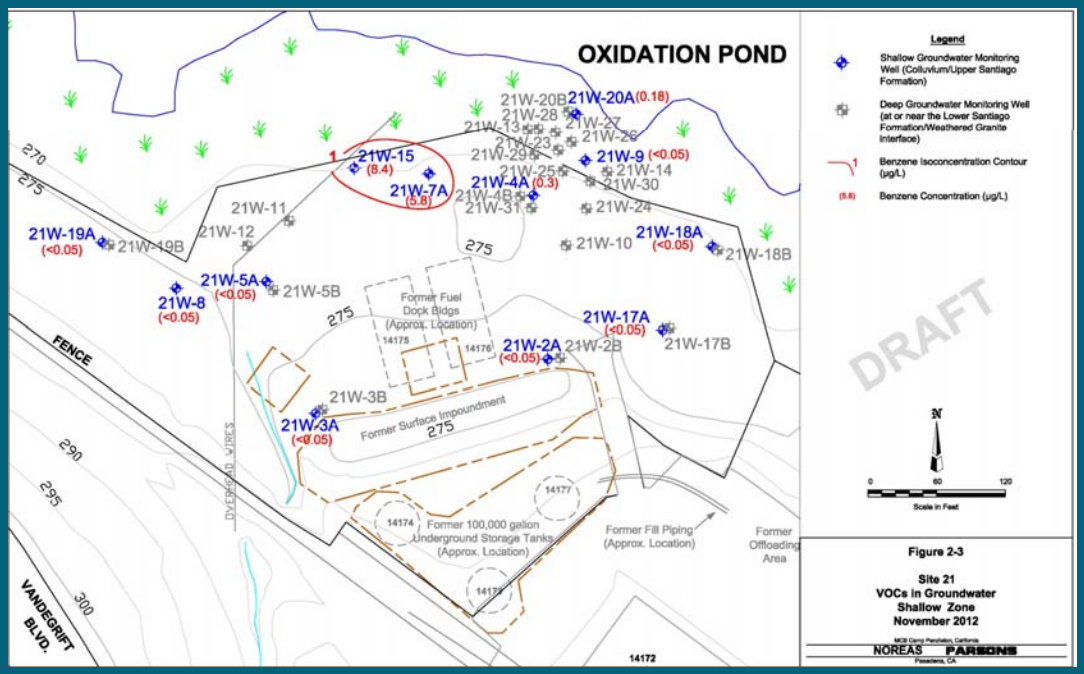
SITE 21 SHALLOW BENZENE RESULTS



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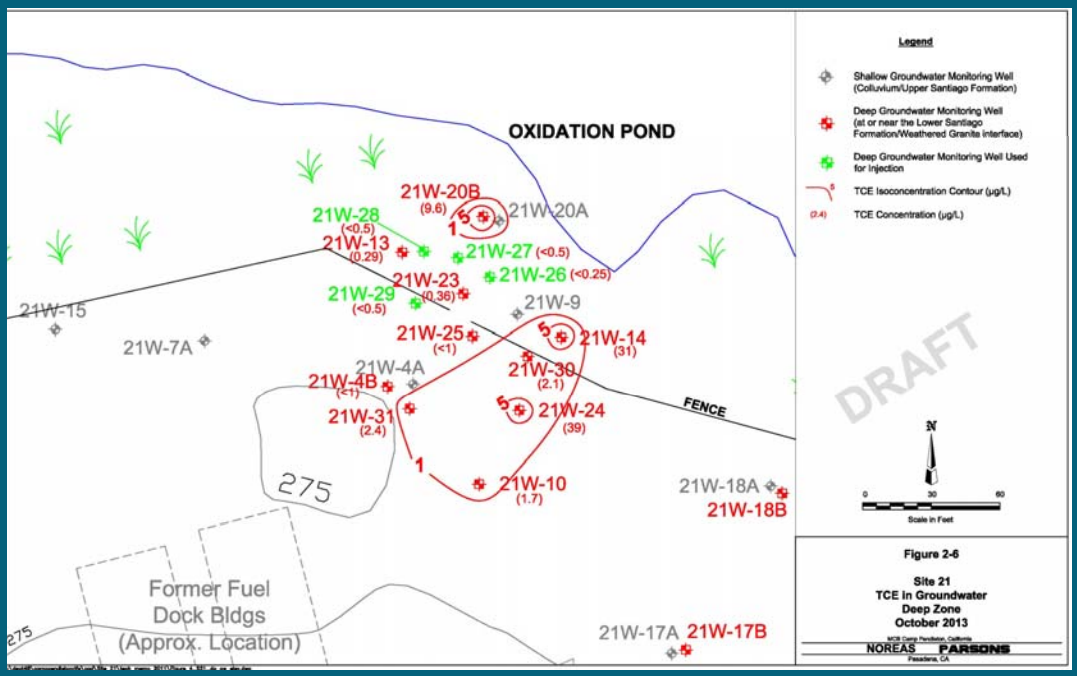
SITE 21 DEEP TCE RESULTS



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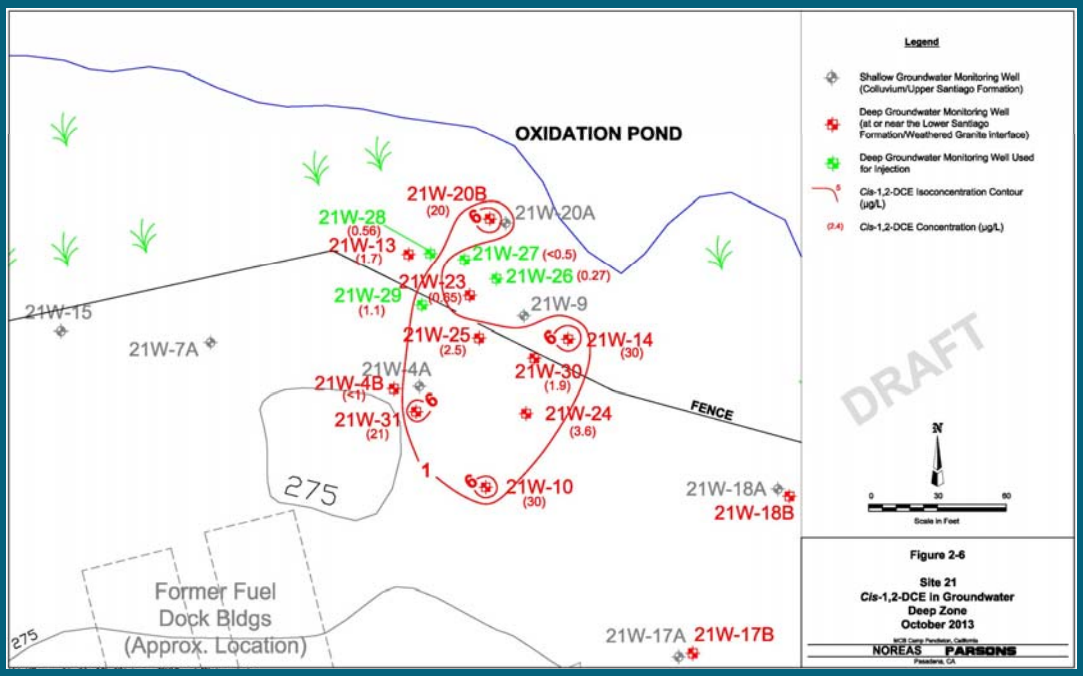
SITE 21 DEEP *CIS*-1,2-DCE RESULTS



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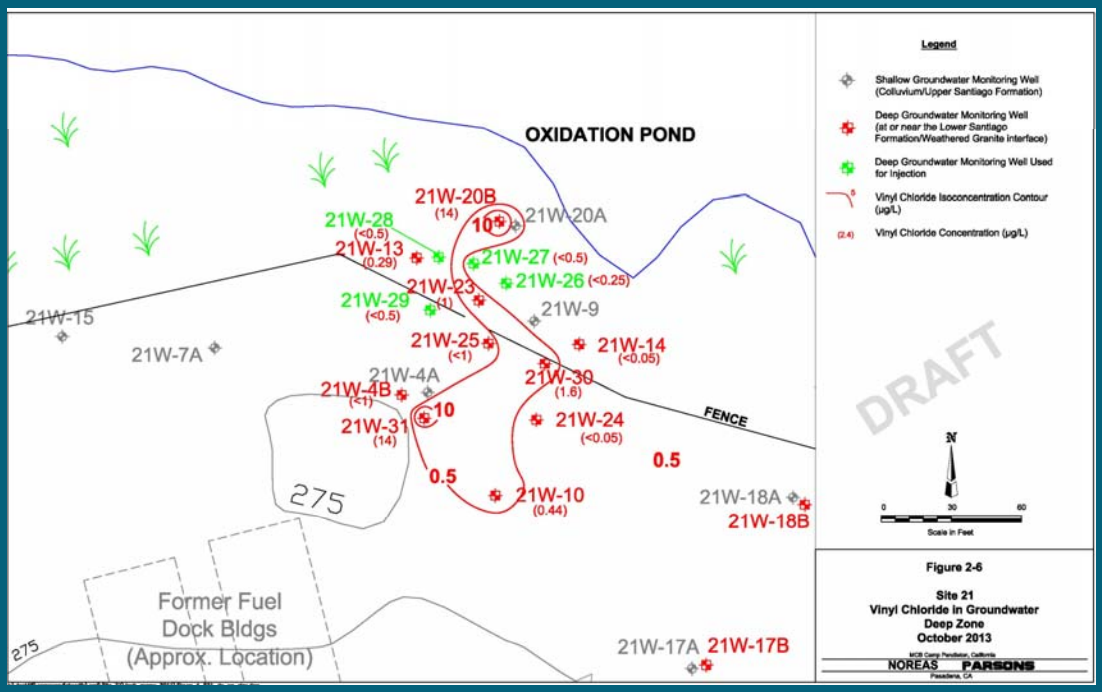
SITE 21 DEEP VINYL CHLORIDE RESULTS



PARSONS

SITE 21 FEASIBILITY STUDY

2014 Feasibility Study

- **Given the significant VOC reductions achieved to date during the groundwater pilot study, an in situ remedy can likely achieve MCLs in deep groundwater within a reasonable timeframe.**
- **Alternative 2 (LUCs and LTM) would be implemented and would provide protection of human health via land use controls, with long term monitoring to track concentration changes in the plume while it attenuates.**
- **Given the limited remaining impacted area in shallow groundwater, potential remedies could include thermal, chemical oxidation, or MNA.**

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SITE 21 FEASIBILITY STUDY

Remedial Alternatives

- **Alternative 1: No Action**
- **Alternative 2: Land Use Controls and Long Term Monitoring**
  - Land use controls would preclude the installation of water supply wells at the site, and also require that any future construction within the footprint of the plume be evaluated for potential vapor intrusion risk.
  - A long-term groundwater monitoring program involves monitoring groundwater quality to track chemical concentrations and possible movement, provide early warning of potential impacts to downgradient receptors, and evaluate the attenuation of contamination in and downgradient of the VOC plumes.
  - When implemented alone, this alternative relies on natural subsurface physical and biological attenuation processes such as dispersion, degradation, sorption, diffusion, and volatilization to reduce VOC concentrations over time.
  - 20 year timeframe for costing purposes.

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SITE 21 FEASIBILITY STUDY

Other Possible Remedial Alternatives for Deep Groundwater

- **In Situ Treatment via In Situ Reactive Metals (ZVI)**
  - Advantages:
    - Known to effectively treat CVOCs
    - One step reaction does not produce intermediate products
    - Reactants are non-hazardous/non-toxic
    - ZVI has a relatively long lifespan
  - Disadvantages:
    - Performance relies on direct contact between ZVI and CVOCs
    - Difficult to emplace
    - Application would require mixing across shallow and deep zones

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SITE 21 FEASIBILITY STUDY

Other Possible Remedial Alternatives for Deep Groundwater

- **Source Area Treatment via In Situ Chemical Oxidation**
  - Advantages:
    - Known to effectively treat CVOCs
    - One step reaction does not produce intermediate products
  - Disadvantages:
    - Performance relies on direct contact between oxidant and CVOCs
    - Short lifespan requires multiple injections
    - Soil fracturing would likely be required to achieve required contact within reactant lifespan

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SITE 21 FEASIBILITY STUDY

Other Possible Remedial Alternatives for Deep Groundwater

- **Source Area Treatment via In Situ Enhanced Bioremediation**
  - Advantages:
    - Known to effectively treat CVOCs
    - Demonstrated effectiveness at Site 21
    - Low cost, sustainable technology
    - Operational requirements match the natural groundwater conditions
  - Disadvantages:
    - Slower performance than more aggressive technologies (e.g., chemical oxidation)
    - Intermediate products are produced (but don't persist)
    - Causes secondary water quality impacts (odor, ferrous iron, TDS, etc)

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SITE 21 FEASIBILITY STUDY

Other Possible Remedial Alternatives for Deep Groundwater

- **In Situ Treatment via Thermal Desorption with Enhanced Bioremediation**
  - Advantages:
    - Known to effectively treat CVOCs
    - VOC mass is directly removed rather relying on in-situ destruction
    - Effective for all volatile COCs (CVOCs and petroleum constituents)
    - Some effectiveness for low permeability soils
  - Disadvantages:
    - Effective vapor removal (SVE) required
    - Would drive COCs up into the shallow zone
    - High energy cost – low sustainability scoring

PARSONS

SITE 21

PARSONS

MCBCP
Site 1115 Pilot Study

In-Situ Thermal Conductive Heating

MCBCP SITE 1115
EVALUATION OF TREATMENT TECHNOLOGIES

Draft RI/FS Alternatives

- Excavation
- Dual Phase Extraction
- In-Situ Chemical Oxidation

To reduce the current and long-term VI risk, treatment technologies will need to reduce the current COPC concentrations in groundwater including the adsorbed phase, remove LNAPL and potential pockets of DNAPL, and significantly reduce vadose zone COPC concentrations that will act as a continuing source of COPCs to groundwater and soil gas.

MCBCP SITE 1115
EVALUATION OF TREATMENT TECHNOLOGIES

Excavation

Approximately 11,000 yds^3 of vadose soils and LNAPL-bearing smear zone soils

Advantages

- Effective at removing LNAPL/soils with high TPH in the vadose zone

Disadvantages

- Impact to MCBCP operations, H&S concerns
- Will not treat contaminated groundwater unless saturated aquifer material is dewatered and removed
- If additional contamination requires excavation, additional clean overburden must be removed in addition to layback material, increasing costs and impacts to site operations

MCBCP SITE 1115
EVALUATION OF TREATMENT TECHNOLOGIES

Dual Phase Extraction

Advantages

- Removes VOCs and LNAPL in soil and groundwater
- Scalable

Disadvantages

- Difficulties with low permeability soils resulting in limited ROI and poor recovery
- Long remedial time frames
- Limited effectiveness on groundwater and would only treat dissolved phase COPCs

MCBCP SITE 1115
EVALUATION OF TREATMENT TECHNOLOGIES

Dual Phase Extraction

- Disadvantages (cont.)
  - Difficulties extracting COPC vapors from low permeability vadose and saturated zone clay and silt layers/lenses, increasing the likelihood of rebound
  - Limited effect on SVOCs
  - May leave isolated pools of LNAPL

MCBCP SITE 1115
EVALUATION OF TREATMENT TECHNOLOGIES

In-Situ Chemical Oxidation

Advantages

- Effective at treating many Site 1115 COPCs
- Scalable

Disadvantages

- Heterogeneous geology including low permeability clays and silts makes oxidant distribution and contact with CPOCs is problematic
- Very high COPC concentration and possible residual pockets of NAPL in the vadose and saturated zones
- The presence of LNAPL

MCBCP SITE 1115
EVALUATION OF TREATMENT TECHNOLOGIES

In-Situ Chemical Oxidation

- Disadvantages (cont.)
  - High TOD in the vadose and saturated zones may require up to 420 pounds of persulfate per cubic yard of treatment zone
  - Potential for back diffusion (rebound) of COPCs from low permeable clay layers
  - Difficulties injecting oxidants into clay and silt aquifer layers/lenses with low permeability, which increases the likelihood of rebound
  - Limited longevity of the oxidant resulting in COPC rebound

MCBCP SITE 1115
EVALUATION OF TREATMENT TECHNOLOGIES

In-Situ Thermal Conductive Heating

Thermal conductive heating (TCH) combines LNAPL removal, vadose zone treatment, and groundwater treatment in a single process.

Advantages

- Effectively removes LNAPL
- Effectively treats vadose zone soils
- Effectively treats dissolved and adsorbed COPCs in groundwater
- Effective in low permeability and heterogeneous soils
- The soil heating serves to stimulate biologic activity that acts as a polishing agent to degrade remaining organic COPCs

MCBCP SITE 1115
EVALUATION OF TREATMENT TECHNOLOGIES

In-Situ Thermal Conductive Heating

- Advantages (cont.)
  - Highly scalable and treatment can be limited to specific zones of interest
  - Very short treatment times (approximately 90 days)
  - Utilizes natural gas or propane reducing energy requirements compared to resistive heating
- Disadvantages
  - Energy intensive

MCBCP SITE 1115
IN-SITU THERMAL CONDUCTIVE HEATING

Process Description

- The process utilizes TCH wells to heat the soil, water, and COPCs by means of thermal conduction to temperatures between 100°C and 400°C.
- As soil temperatures increase, COPCs and a portion of water contained in the soil matrix is vaporized
- Groundwater that surrounds the TCH wells is vaporized into steam.
- Multi-phase extraction (MPE) wells are used to maintain negative pressure in the target treatment zone during the heating process.
- Soil vapor, steam, LNAPL, and groundwater are extracted from the subsurface through MPE wells.

MCBCP SITE 1115
IN-SITU THERMAL CONDUCTIVE HEATING

- **Process Description (cont.)**
- Co-located vacuum extraction wells are located at each TCH heater well to provide pneumatic control during the heating and MPE phases of the project
- Horizontal vacuum extraction points are located on the ground surface, in gravel and under concrete (for purpose of surface vapor insulation), to provide pneumatic control of the upper most heated zone.
- Temperature and pressure monitored using subsurface monitoring points

MCBCP SITE 1115
IN-SITU THERMAL CONDUCTIVE HEATING

Process Description – COPC Removal

NAPL and COPCs will be mobilized and removed through:

- Reductions in LNAPL surface tension that reduces adhesion forces with the saturated soil
- Reductions in LNAPL viscosity that improves mobility and facilitates LNAP removal
- Increases in COPC vapor pressures that improves volatility
- Steam stripping that removes COPCs concurrently with NAPL as groundwater is raised to boiling temperatures

Steam stripping is the primary driver of COPC mobilization, especially in the saturated zones

MCBCP SITE 1115
IN-SITU THERMAL CONDUCTIVE HEATING

Process Description – Off-Gas Treatment

Treatment of off-gas from MPE and co-located vapor extraction wells includes the following:

- Separation of vapors and liquids in vapor-liquid separators
- Primary cooling of off-gas in a heat exchanger where condensable components are recovered
- Secondary cooling of off-gas heat exchanger after the vacuum pump
- C3 Technology (compression-cooling-condensation) module; this module will be online only when elevated COPC vapor concentrations (gasoline range hydrocarbons) are present
- Vapor Granular Activated Carbon (VGAC) filtration with sacrificial activated carbon (used when elevated diesel range hydrocarbons are present)

MCBCP SITE 1115
IN-SITU THERMAL CONDUCTIVE HEATING

Process Description – Fluid Treatment

Treatment of LNAPL and groundwater from MPE wells and condensable products from the above off-gas treatment includes:

- Vapor/Liquid Separators
- Heat Exchangers
- Liquid Phase Separator Tank for NAPL removal
- Liquid Phase Chemical Storage Tank for NAPL
- Liquid Granular Activated Carbon (LGAC) filtration with sacrificial activated carbon
- Discharge to sanitary sewer (Publicly Owned Treatment Works [POTW]) following testing of the water.

MCBCP SITE 1115
PILOT STUDY

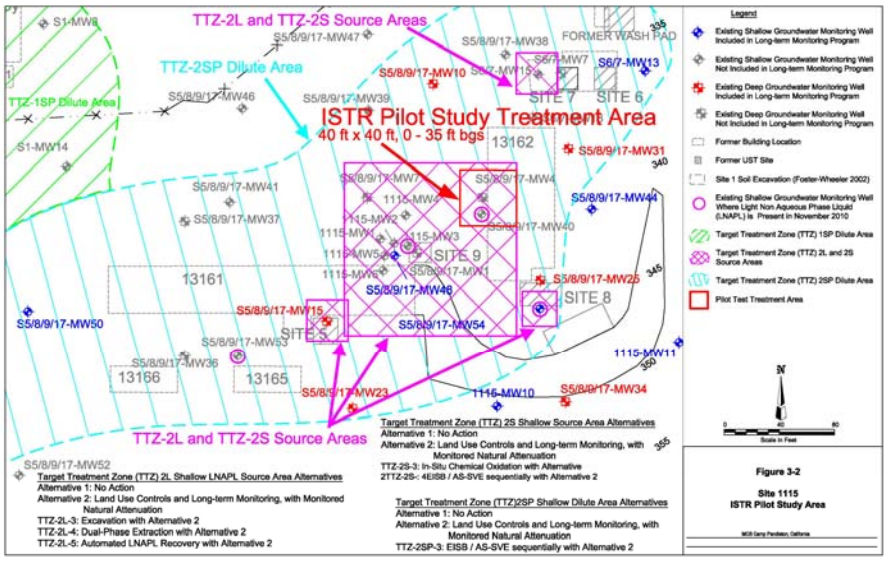
Objectives

- Assess the effectiveness of TCH at removing LNAPL from the Pilot Study area
- Assess the effectiveness of TCH at reducing shallow groundwater COPC concentrations to below MCLs and ultimately achieving a VI risk within the treatment footprint of less than 1 x 10^{-6}
- Obtain sufficient data to evaluate and optimize the design for full scale implementation of the TCH technology to other locations.

MCBCP SITE 1115
PILOT STUDY AREA

Location

40-ft by 40-ft area (1,600 square ft) within the area associated with the UST Site 5/8/9/17

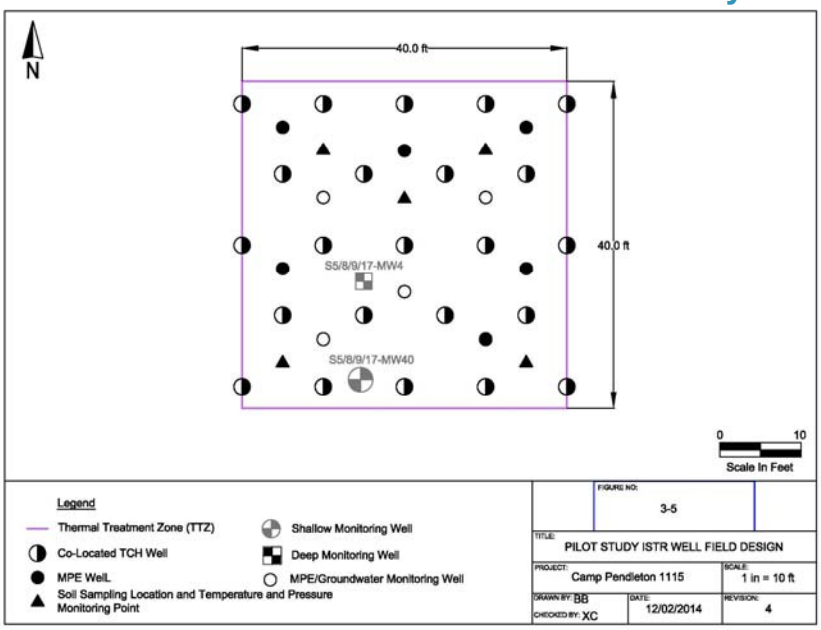


MCBCP SITE 1115
PILOT STUDY

Location Rational

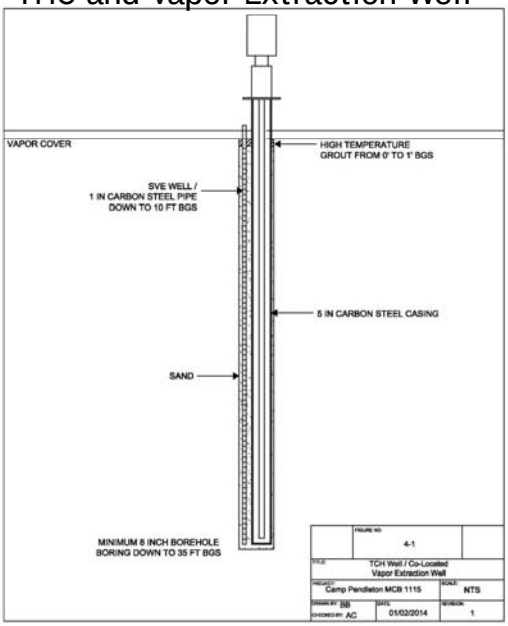
- Recent data indicates free product (LNAPL) is present in monitoring well S5/8/9/17-MW40.
- Monitoring wells S5/8/9/17-MW4 and S5/8/9/17-MW40 have VOC concentrations exceeding California MCLs and RLs, and at levels resulting in a potential VI risk.
- The Pilot Study treatment area footprint is located upgradient of other NAPL impacted areas, reducing the possibility of groundwater contaminants migrating into the pilot area during and after treatment and potentially biasing the Pilot Study results
- The area around well S5/8/9/17-MW48 and 1115-MW3 had in situ injection pilot tests performed in 2009 and 2010. Partial treatment of contaminants in those areas may have occurred, making those areas less suitable for providing representative results for the TCH Pilot Study

MCBCP SITE 1115
Pilot Study Well Layout

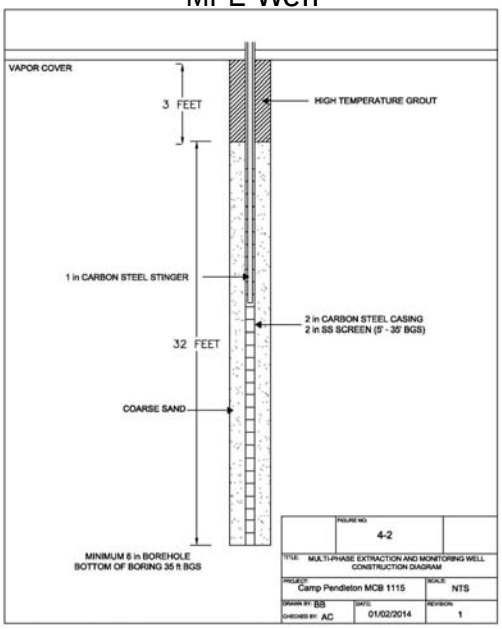


MCBCP SITE 1115
Well Details

THC and Vapor Extraction Well



MPE Well



MCBCP SITE 1115
PILOT STUDY

Pre-Treatment Soil Characterization

- Soil samples will be collected from five (5) soil borings located within the Pilot Study treatment area.
- Soil sample locations coincident with pressure/temperature monitoring locations.
- Three (3) soil samples will be collected from each soil boring at approximately 1 foot below the water table, at the groundwater/vadose zone interface, and 1 to 3 ft above the water table.
- The vertical sample intervals are to characterize COPC concentrations within the smear zone.
- Each soil sample will be analyzed for TPH-g, TPH-d and VOCs.

MCBCP SITE 1115
PILOT STUDY

- **Pre-Treatment Groundwater Characterization**

- Prior to TCH, existing monitoring wells must be abandoned. PVC wells will be damaged and may release vinyl chloride when heated.
- Four (4) MPE wells will be utilized as groundwater monitoring wells.
- MPE well completions are compatible with high temperatures.
- Wells will be sampled for COPCs to characterize groundwater prior to TCH.

MCBCP SITE 1115
PILOT STUDY

TCH System Operation and Monitoring

- **Start Up Phase:** During this period, the extraction and effluent treatment system is operated, and compliance is documented. Heaters are periodically tested and operated.
- **TCH heat-up phase:** The TCH heaters are used to raise the temperature to the target temperatures while maintaining hydraulic and pneumatic control using the vapor, MPE and effluent treatment system.
- **Treatment phase:** The TCH heaters are used to maintain the temperature at the target temperatures while maintaining hydraulic and pneumatic control using the vapor, MPE and effluent treatment system.
- **Cool-down phase:** The extraction and effluent treatment system will continue to operate after the heaters are shutdown to remove any remaining steam from the subsurface.

MCBCP SITE 1115
PILOT STUDY

Post-Treatment Soil and Groundwater Characterization

- Post-treatment soil sampling will be conducted as soon as possible after ISTR system shutdown and a sufficient cool-down period
- Five (5) soil borings will be advanced to collect post-treatment soil samples from locations immediately adjacent to the pre-characterization samples.
- Three (3) soil samples will be collected from each boring coincident with the pre-treatment soil samples.
- Post-treatment groundwater samples will be collected from the four MPE/monitoring wells to evaluate changes in LNAPL thickness and COPC concentrations as a result of TCH treatment

MCBCP SITE 1115
PILOT STUDY

Data Evaluation

- Mass removed in vapor phase (influent to C3 Technology and VGAC)
- Vapor emissions compliance (effluent from second VGAC vessel)
- Mass removed as COPCs and NAPL
- Pressure, temperature, and flow will be used to construct the mass balance relationship of water, air, and contaminants extracted from the subsurface
- An energy balance will be evaluated for the TTZ that accounts for injected power, heat losses, rates of heating, steam produced by boiling groundwater, and energy extracted with the vacuum system
- Percent reduction in COPC concentration in soil
- Percent reduction in COPC concentration in groundwater
- Post-treatment VI risk.

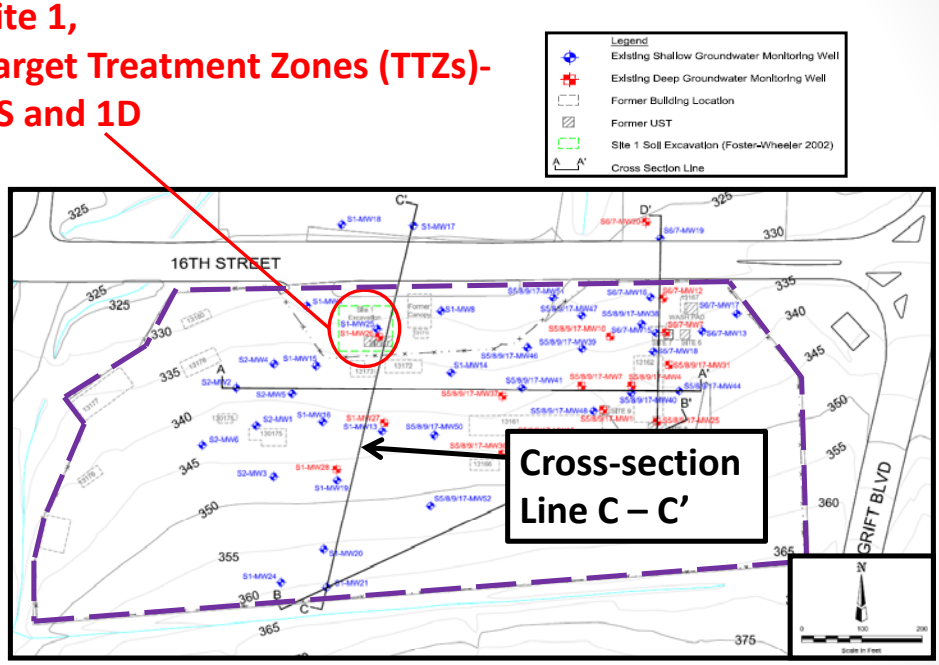
Pilot Study
for
IR Site 1115, Site 1

TTZ-1S and TTZ-1D Source Areas

TIDEWATER INC

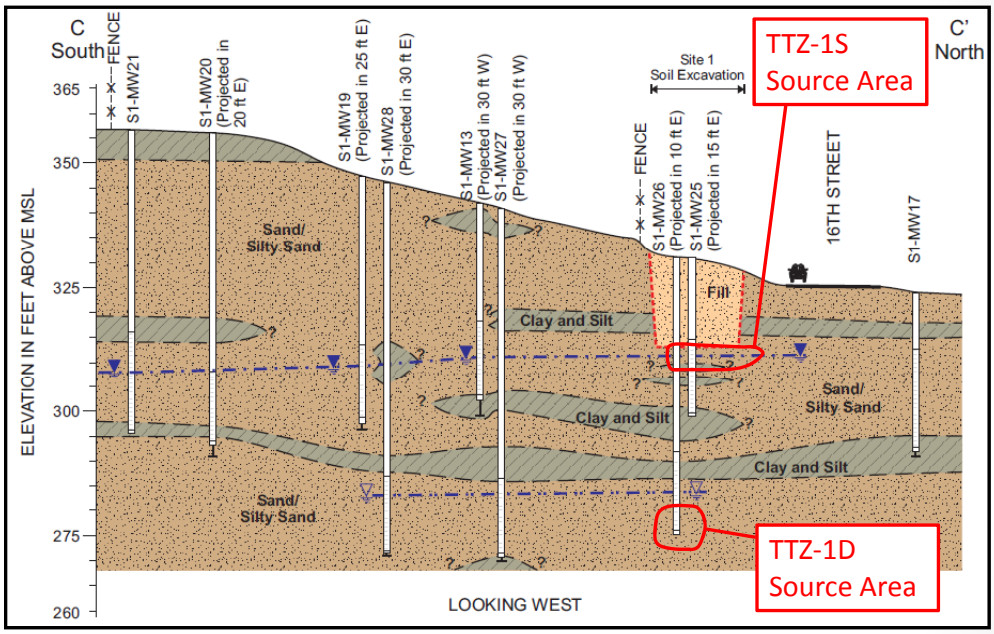
Pilot Study for IR Site 1115, Site 1

Site 1,
Target Treatment Zones (TTZs)-
1S and 1D



TIDEWATER INC

Pilot Study for IR Site 1115, Site 1



Target Treatment Zone (TTZ)-1S or 1D

TIDEWATER INC

Pilot Study for IR Site 1115, Site 1

TTZ-1S Source Area Excavation

- Destroy existing monitoring wells within TTZ-1S Source Area footprint.
- Excavate 100 feet x 100 feet square area to approximately 26 feet bgs.
  a) Approximately 20 feet of backfill
  b) Approximately 6 feet of contaminated smear zone
- Stockpile clean overburden for reuse as backfill (0 to 20 feet bgs).
- Stockpile contaminated soil from smear zone and characterize for disposal (20 to 26 feet bgs). If funding available, will perform on-site soil treatment and reutilize as backfill.

TIDEWATER INC

Pilot Study for IR Site 1115, Site 1
TTZ-1S Source Area Excavation

- Perform dewatering, characterization, and disposal of groundwater during excavation activities.
- Apply Oxygen Release Compound (ORC) or similar product to excavation backfill.
- Grade, compact, and re-asphalt surface.
- Reinstall monitoring wells within excavation footprint.

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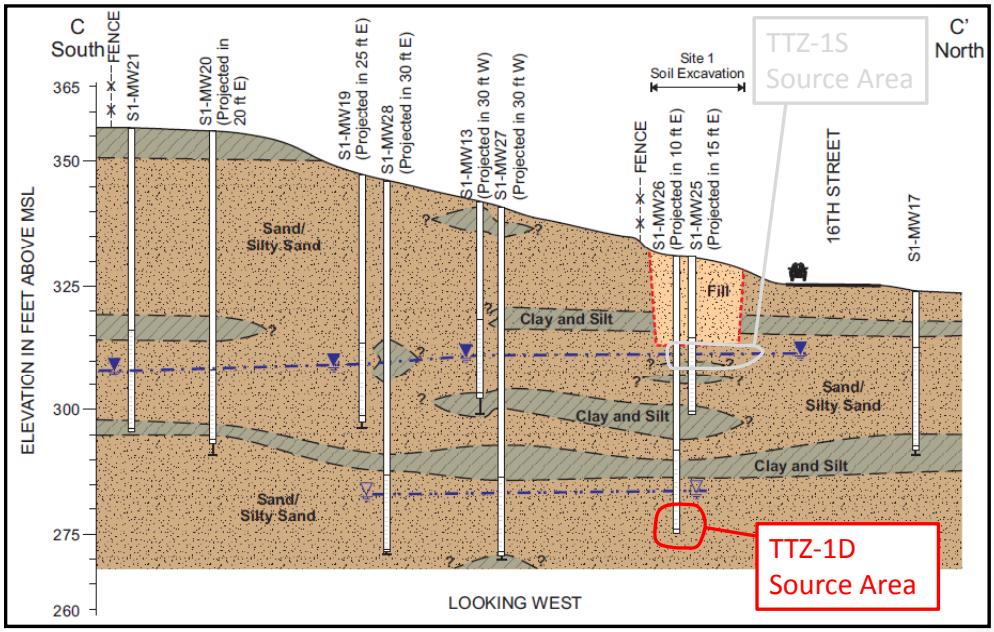
Pilot Study for IR Site 1115, Site 1



Target Treatment Zone (TTZ)-1S or 1D

TIDEWATER INC

Pilot Study for IR Site 1115, Site 1
TTZ-1D In-Situ Chemical Oxidation
(optional treatment if funding is available)

- Design and install well network.
- Implement treatment.
- Conduct performance monitoring.
- Prepare documentation.

TIDEWATER INC

Pilot Study for IR Site 1115, Site 1
Schedule

• Final Pilot Study Work Plan	July 2014
• Field Activities – Completion of TTZ-1S Excavation	September 2014
• Field Activities – Completion of Optional TTZ-1D Chemical Injection and Performance Monitoring	March 2015
• Final Pilot Study Report (Report to Include Excavation and Chemical Injection Results)	August 2015

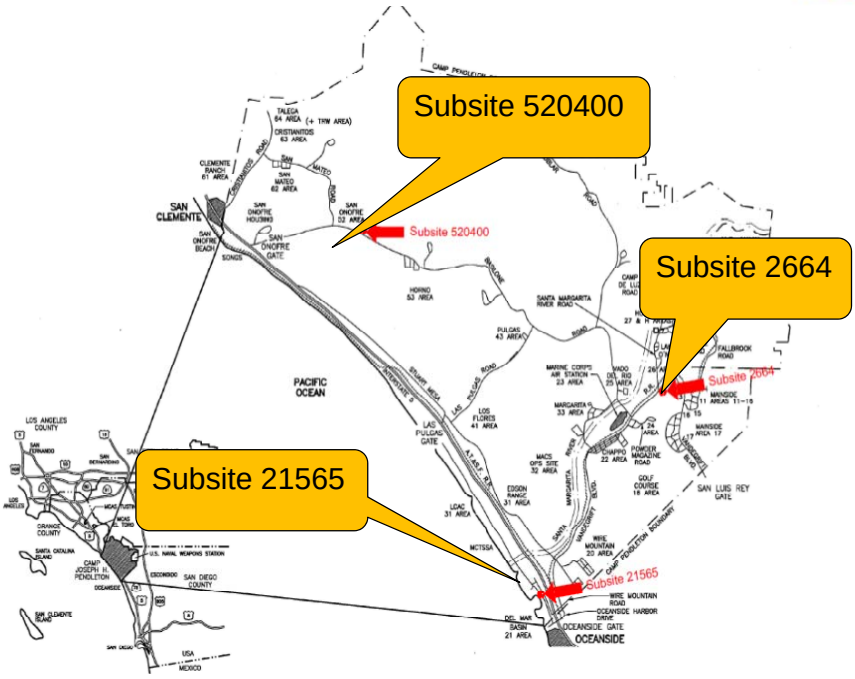
TIDEWATER INC

IR SITE 1118 ESI

IR SITE 1118 EXTENDED SITE INSPECTION RESULTS

JANUARY 23, 2014, FFA MEETING

IR SITE 1118 ESI



IR SITE 1118 ESI

Introduction

- March 2007 – Three UST sites in Areas 21, 26, and 52 were transferred to the IR Program and designated as Site 1118.
- We now refer to the UST sites as "Subsites" of Site 1118.
- 2010 – Site Inspection investigated previously identified CERCLA VOCs in soil and groundwater at three Subsites.
- February 2011 – SI Report recommended additional investigations for Subsites 2664, 21565 and 520400.
- 2013 – ESI conducted to investigate the extent and potential sources of VOCs in groundwater, soil, and soil gas.

IR SITE 1118 ESI

Objectives

- Delineate distribution and magnitude of non-petroleum (CERCLA) VOCs in soil, soil gas, and groundwater based on conclusions and recommendations of 2010 SI.
- Evaluate potential sources of non-petroleum-related (CERCLA) VOCs at each Subsite.
- Define areas where concentrations exceed established project screening levels (PSLs).
- Resolve data gaps.
- Perform a soil gas study.
- Perform a vapor intrusion risk assessment at each Subsite.

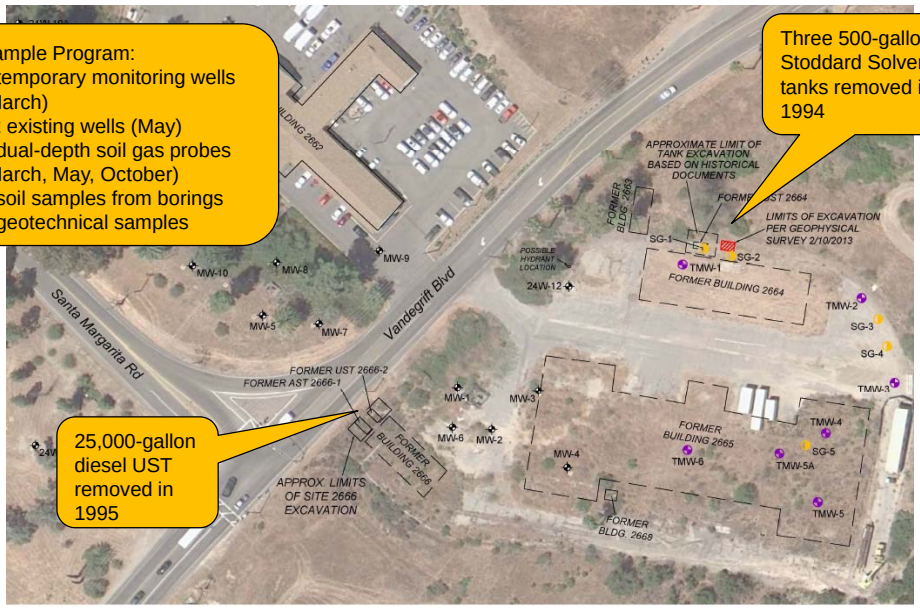
IR SITE 1118 ESI

Field Implementation

- Subsite 2664 – Install/sample temporary wells to delineate potential groundwater impacts.
- Subsite 21565 – Conduct passive soil gas survey to identify subsurface VOCs and place sample locations.
- All Subsites:
  - Install/sample dual-depth temporary soil gas probes to characterize soil gas and identify potential sources.
  - Collect soil for chemical/geotechnical analyses.
  - Install/sample permanent monitoring wells to delineate potential groundwater impacts.
  - Use data to complete a Johnson-Ettinger (JE) model to assess the risk from indoor vapor intrusion.

IR SITE 1118 ESI

Subsite 2664 Site Layout
Former MCB Laundry and Dry Cleaning Facility



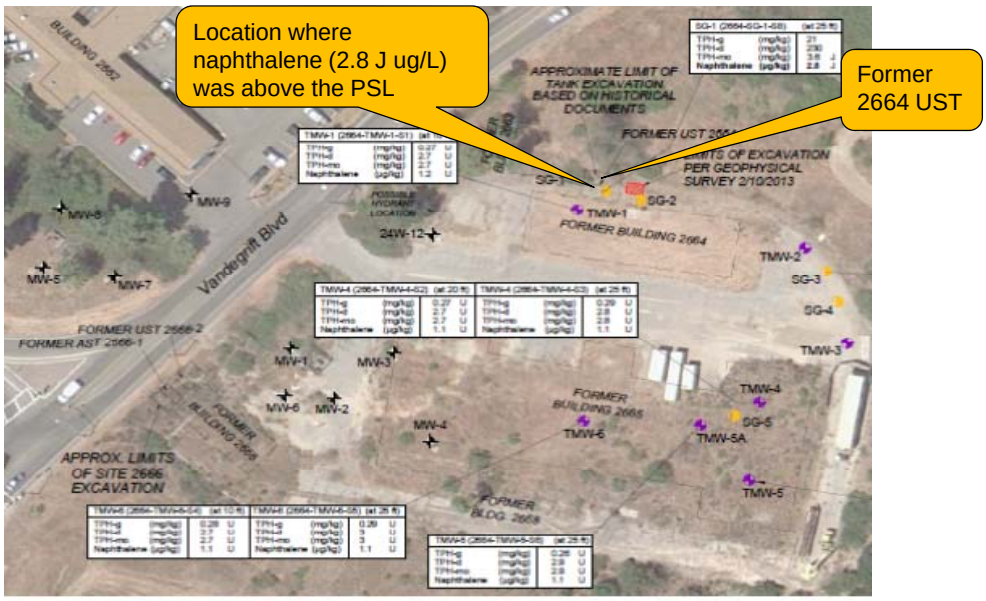
IR SITE 1118 ESI

Subsite 2664 - Soil

- Soil Investigation – March 2013:
  - 8 samples collected from 6 soil gas and well borings.
  - Sample depths ranged from 10 to 25 feet bgs.
- Results:
  - Geology - Artificial fill and alluvium underlain by fine-grained sandstones and siltstone of the La Jolla Group. Relative thickness of units varied across the site.
  - TCE and VOCs reported at low levels below PSLs.
  - Only one VOC exceeded the PSL - Naphthalene reported in sample collected near former UST.
  - Low concentrations of VOCs cause no impacts to groundwater.

IR SITE 1118 ESI

Subsite 2664 March 2013 Soil Results



IR SITE 1118 ESI

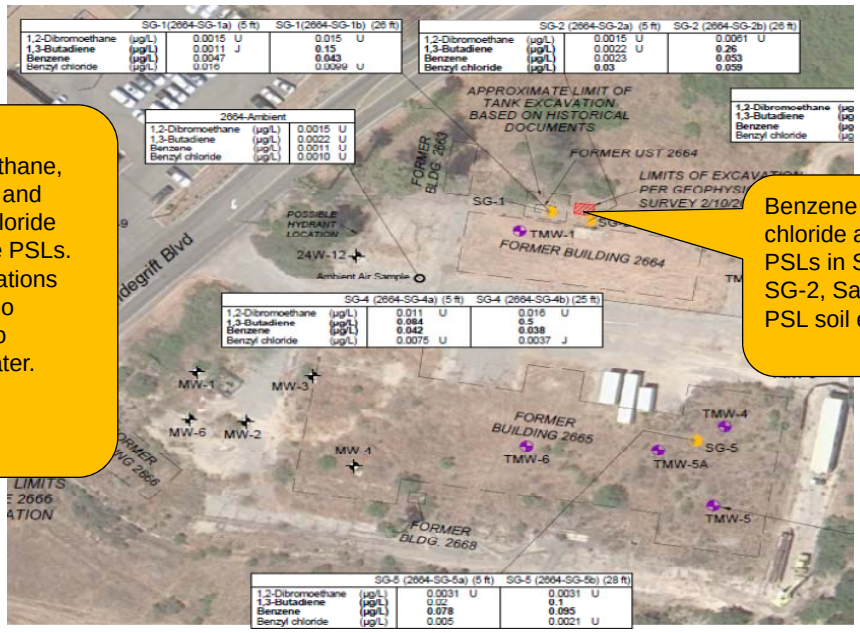
Subsite 2664 – Soil Gas

- Soil Gas Investigation – March, May, October 2013
  - 5 dual-depth probes installed at 5 feet bgs and just above water table (maximum depth 28 feet bgs).
  - May and October events conducted to account for seasonal variation.
- Results
  - Site has been characterized.
  - 1,2-dibromoethane, benzene, and benzyl chloride slightly above the PSLs.
  - Not expected to cause impacts to groundwater.
  - No impacts on soil gas concentration and distribution from seasonal variation.

IR SITE 1118 ESI

Subsite 2664 March 2013 Soil Gas Results

1,2-dibromoethane, benzene, and benzyl chloride above the PSLs. Concentrations are low; no impacts to groundwater.



Benzene and benzyl chloride above the PSLs in SG-1 and SG-2, Same area as PSL soil exceedance.

IR SITE 1118 ESI

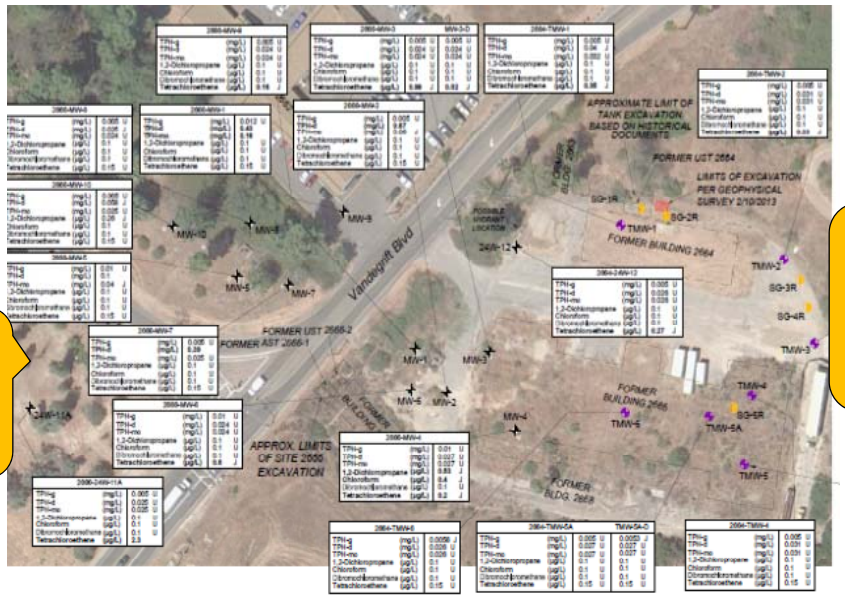
Subsite 2664 - Groundwater

- Groundwater Investigation
  - Data used to delineate plume extent in vicinity of Buildings 2664 and 2665.
  - Install /sample 6 temporary wells at Subsite 2664 in March.
  - Conduct site-wide sampling of 12 existing wells in May.
  - Groundwater flow is to the southwest.
- Results
  - Based on a review of the results, groundwater conditions are adequately characterized.
  - PCE, dibromochloromethane, 1,2-dichloropropane, and chloroform reported slightly above PSLs.
  - PCE concentrations (<1 µg/L) and distribution do not define a plume originating form the former UST 2664 area.

IR SITE 1118 ESI

Subsite 2664 May 2013 Groundwater Results

Maximum PCE concentration (2.3 µg/L)

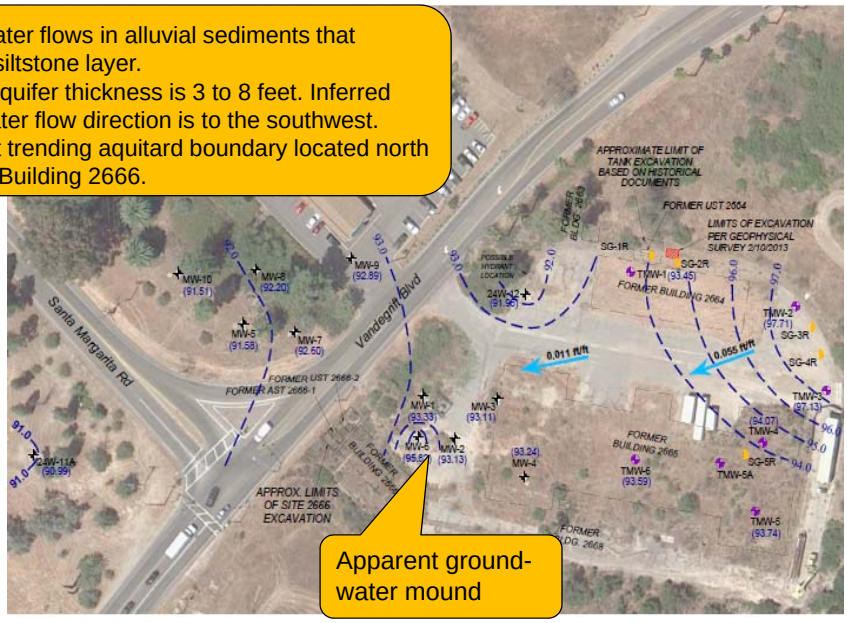


PCE concentrations slightly exceeded PSL in 7 wells; ranged from 0.16 J to 0.99 J µg/L

IR SITE 1118 ESI

Subsite 2664 May 2013 Groundwater Contours

Groundwater flows in alluvial sediments that overlie a siltstone layer.
Shallow aquifer thickness is 3 to 8 feet. Inferred groundwater flow direction is to the southwest.
East-west trending aquitard boundary located north of former Building 2666.



Apparent ground-water mound

IR SITE 1118 ESI

Subsite 2664 – Risk Summary

- For industrial/commercial workers, the total risk estimates did not exceed the point of departure.
- For residents, the total risk estimates for residents exceed the point of departure due to assumed exposures to the following chemicals:
  - Groundwater potable water use
    - PCE (2×10^{-5} using Cal Modified toxicity values)
  - Vapor intrusion from soil gas
    - 1,3-Butadiene (2×10^{-6} using Cal Modified toxicity values); likely a false positive; not believed to be present due to site-related release.
- Noncancer hazards for residents and industrial/commercial workers did not exceed the threshold value of 1.

IR SITE 1118 ESI

Subsite 2664 - Conclusions

- While TPH compounds and naphthalene were reported in one soil sample, they were not reported in groundwater samples. Likely that TPH and naphthalene in soil will not be a source of any future exceedances in groundwater.
- Soil gas concentrations for a few VOCs are slightly above respective PSLs; however, only butadiene (not a site contaminant) is the risk driver.
- Groundwater concentrations for TPH and a few VOCs (including PCE) do not indicate the presence of a COPC plume.
- Calculated cancer risk values are either below the risk management range (soil) or within the risk management range for carcinogens (soil gas, groundwater). Calculated HI values are well below 1, and do not indicate potential noncarcinogenic effects.

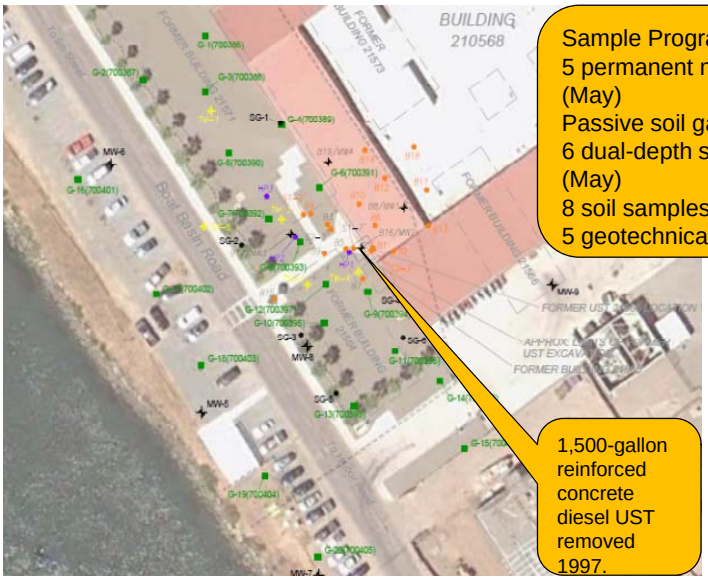
IR SITE 1118 ESI

Subsite 2664 - Recommendations

- The team agreed that Tiers II and III were not needed as the reported concentrations of soil, soil gas, and groundwater from Tier I were low and the extent of impacts had been delineated.
- The October 2013 soil gas sampling event results are in general similar to or less than the May 2013 soil gas sampling results. The non-detect to relatively low concentrations of the COPCs in soil, soil gas, and groundwater do not seem to indicate the presence of a source area at the site.
- No Further Action is recommended for Subsite 2664.

IR SITE 1118 ESI

Subsite 21565 Site Layout



Sample Program:
5 permanent monitoring wells (May)
Passive soil gas survey (May)
6 dual-depth soil gas probes (May)
8 soil samples from borings
5 geotechnical samples

1,500-gallon reinforced concrete diesel UST removed 1997.

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Subsite 21565 – Passive Soil Gas Survey

Passive Soil Gas Survey:

- Color contour surface presents qualitative concentration data
- Data used to delineate areas of elevated VOCs, identify potential source areas, and show plume extent.
- Passive diffusion samplers placed at 20 locations.

Results (TCE)

- Concentrations highest near soil gas probe SG-3 and in the area between former Building 21564 and Boat Basin.
- Shows rapid lateral decreases in concentration.
- Area used for vehicle maintenance, degreasing operations, and vehicle washing.
- Results consistent with soil gas concentrations and distribution from sample analyses.

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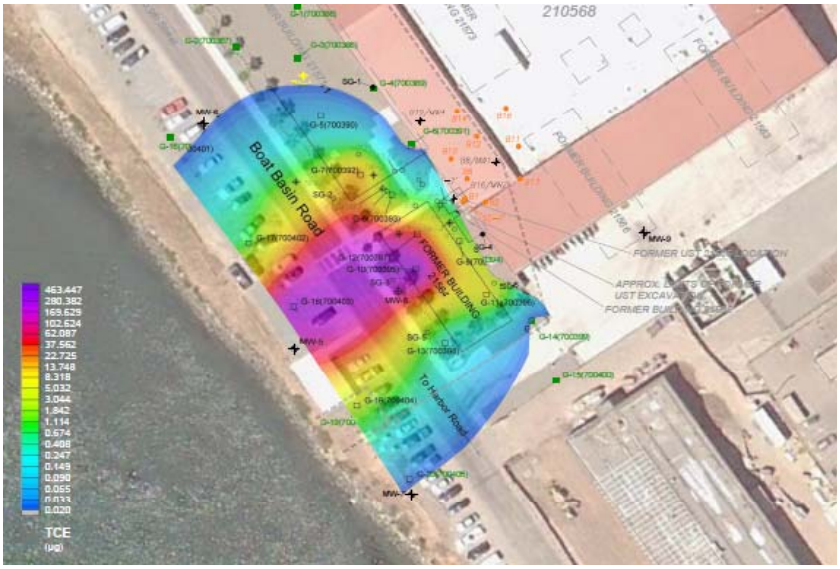
Subsite 21565 – Passive Soil Gas Survey Results



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Subsite 21565 Soil

- Soil Investigation:
  - 8 samples collected from 8 soil gas and well borings.
  - Sample depths ranged from 3 to 9 feet bgs.
- Results:
  - Geology – 3 to 7 feet of fill (fine to medium silty sand) over varying thicknesses of silty fine-grained sand and silt (beach/bay deposits).
  - TCE, cis-1,2-DCE, and vinyl chloride reported above PSLs; correspond to high soil gas results.
  - TCE concentrations ranged from 0.83 µg/L at SG-3 to 78 µg/kg at MW-8. Cis-1,2-DCE exceeded PSL at MW-8. Vinyl chloride exceeded PSL at MW-5.

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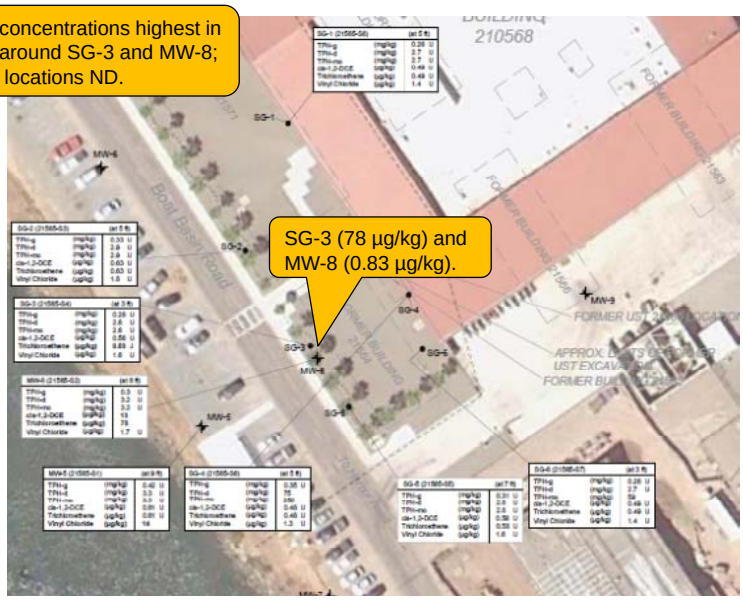
Subsite 21565 May 2013 Soil Results

TCE concentrations highest in area around SG-3 and MW-8; other locations ND.



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Subsite 21565 Soil Gas

- Groundwater Investigation
  - 6 dual-depth probes installed at 5 feet bgs and just above water table (maximum depth 8 feet bgs).
- Results
  - TCE above PSL at locations SG-2 through SG-6. Concentrations at SG-3 were high (720/810 µg/L); PCE, benzene, and chloroform exceeded PSLs at SG-3. This is same area where TCE exceeded PSL in soil.
  - TCE and PCE concentrations decrease to northwest and southeast along road and toward Building 210568 to northeast. Concentrations around periphery of building ranged from 0.013 to 21 µg/L.
  - Source may be related to former maintenance/degreasing operations. Distribution indicates UST not the source.

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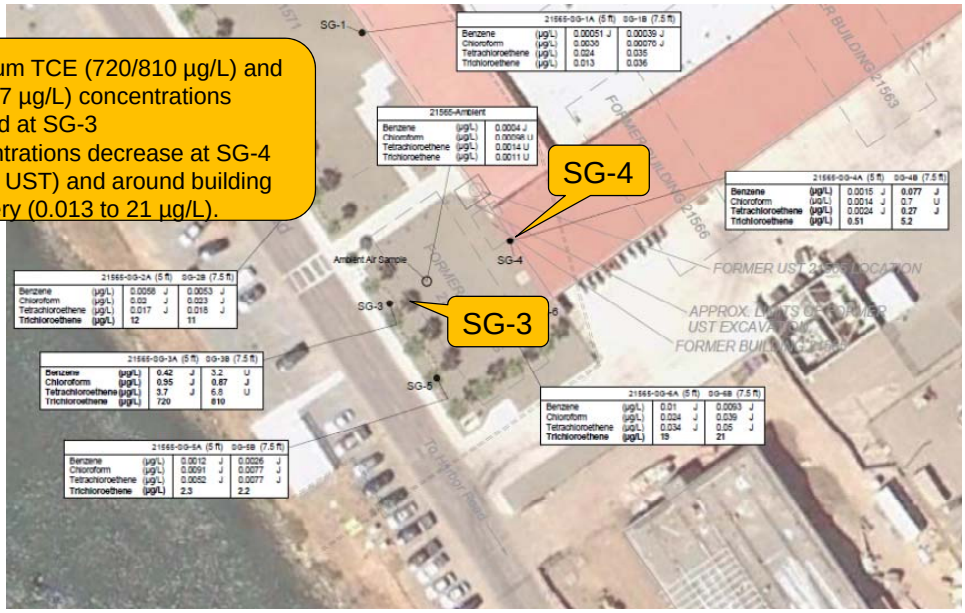
Subsite 21565 May 2013 Soil Gas Results

Maximum TCE (720/810 µg/L) and PCE (37 µg/L) concentrations reported at SG-3
Concentrations decrease at SG-4 (former UST) and around building periphery (0.013 to 21 µg/L).



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Subsite 21565 Groundwater

- Groundwater Investigation
  - Install and sample 5 permanent wells in May.
  - Groundwater flow is to the southwest.
- Results
  - None of the analytes exceeded the PSLs.
  - Although elevated concentrations of cis-1,2-DCE, TCE, and vinyl chloride were reported in soil, and TCE, PCE, chloroform, and benzene were reported in soil gas, these constituents were not detected in groundwater at concentrations above the respective PSLs.

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Subsite 21565 May 2013 Groundwater Elevation Contours

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Subsite 21565 – Risk Summary

- For industrial/commercial workers, the total risk exceeded the point of departure from assumed exposure to TCE in indoor air due to vapor intrusion from soil gas (1 x 10^{-5}).
- For residents, the total risk for residents exceeded the point of departure due to the following assumed exposures:
  - Vapor intrusion from soil gas
    - TCE (2 x 10^{-4} using USEPA and Cal Modified toxicity values)
  - Swimming
    - Vinyl chloride (4 x 10^{-5} using USEPA and Cal Modified toxicity values.
- Noncancer hazards for residents and industrial/commercial workers exceeded the threshold value of 1 due to assumed exposures to TCE in indoor air.

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Subsite 21565 Conclusions

- TCE, cis-1,2-DCE, and vinyl chloride reported in soil at concentrations above PSLs where results from the soil gas samples and/or the passive soil gas survey are high.
- Soil gas results based on the samples collected from the soil gas probes are consistent with the passive soil gas results.
- Source of VOCs is unknown but is presumed to be from Building 21565 area, reportedly used for vehicle maintenance activities.

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Subsite 21565 Recommendations

- Based on the sampling results and risk assessment, an interim removal action is recommended to address the relatively high soil gas concentrations of TCE in the vicinity of 21565-SG-3 and 21565-MW-8.

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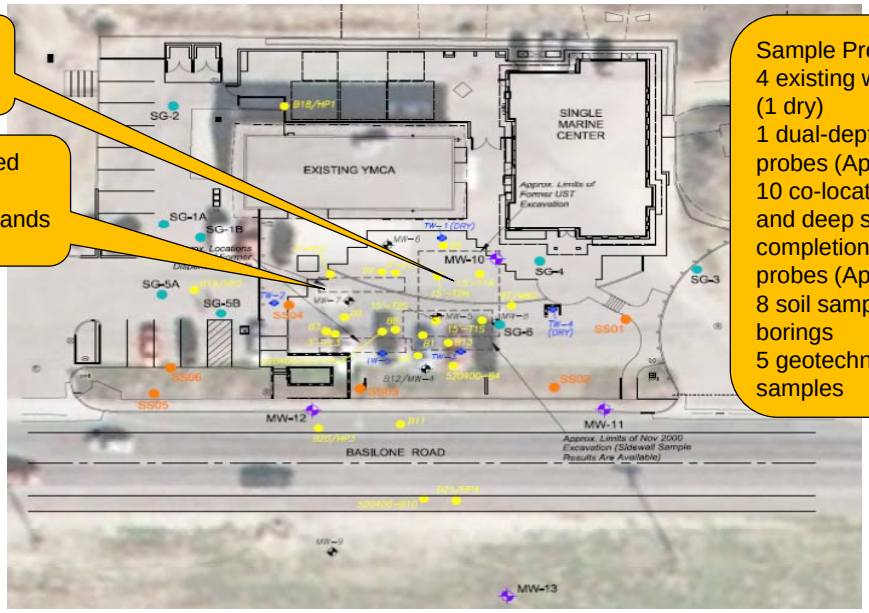
Subsite 520400 Site Layout
Former 52 Area Marine Corps Exchange Gasoline Station

UST/piping removed in 2000

USTs supplied gasoline to dispenser islands



Sample Program:
4 existing wells (April) (1 dry)
1 dual-depth soil gas probes (April)
10 co-located shallow and deep single completion soil gas probes (April)
8 soil samples from 7 borings
5 geotechnical samples

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Subsite 520400 Soil

- Soil Investigation:
  - 8 samples collected from 7 soil gas and well borings.
  - Sample depths ranged from 5 to 24 feet bgs.
- Results:
  - Geology – 25 to 35 feet of alluvium consisting mostly of clayey sands and silty sands with local fills to 12 feet. A gravelly sand layer commonly lies between 17 and 28 feet.
  - At SG-2, located north of the existing YMCA building, 1,2,4-trimethylbenzene, 1,4-dichlorobenzene, ethylbenzene, and naphthalene were reported at low concentrations above the PSLs in the soil sample collected from 24 feet bgs. TPH-d concentration at this location was reported at 4,200 mg/kg, above the respective ESL. Strong odor was noted in this soil sample.

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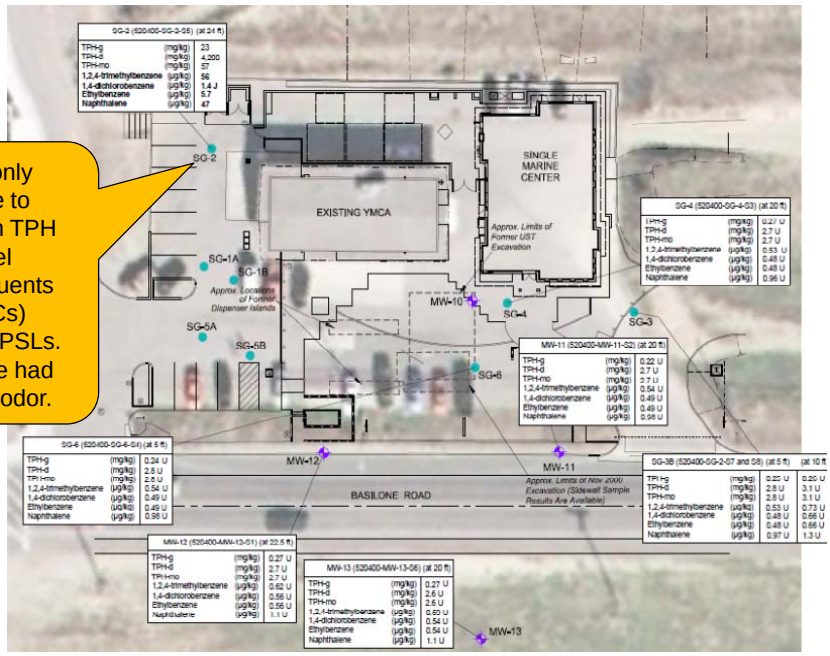
Subsite 520400 April 2013 Soil Results

SG-2 only sample to contain TPH and fuel constituents (4 VOCs) above PSLs. Sample had strong odor.



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Subsite 520400 Soil Gas

- Groundwater Investigation
  - 1 dual-depth probe/10 co-located shallow and deep probes installed at 5 feet bgs and just above water table (maximum depth 25 feet bgs).
- Results
  - Benzene, benzyl chloride, bromodichloromethane, 1,2-dibromoethane, chloroform, naphthalene, and PCE exceeded PSLs.
  - At SG-2, bromodichloromethane, chloroform, naphthalene, and PCE reported above PSLs; co-located with soil exceedances.
  - Benzene and 1,2-dibromoethane reported above PSL in the sample collected at 25 feet bgs at SG-1/deep sample at SG-4.

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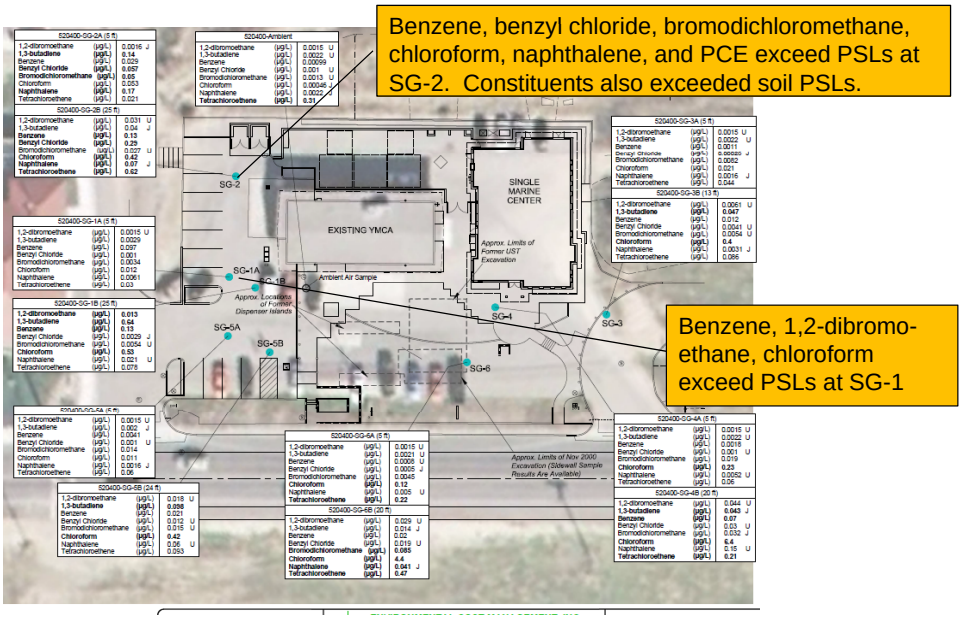
Subsite 520400 April Soil Gas Results



IR SITE 1118 ESI

Subsite 520400 Groundwater

- Groundwater Investigation
  - Install and sample 4 permanent wells in May; well 520400-MW13 dry.
  - Groundwater flow direction to south.
- Results
  - No chlorinated VOCs detected in groundwater.
  - Fuel additives 1,2-dichloroethane, MTBE, lead and toluene were reported below the PSLs.
  - Chloroform, bromodichloromethane, and dibromochloromethane reported above PSLs in wells MW-10 and MW-12 likely result from watering trees or possible leakage from the water lines.
  - Limited number and low concentrations of VOCs indicate a dilute dissolved-phase plume is not migrating offsite.

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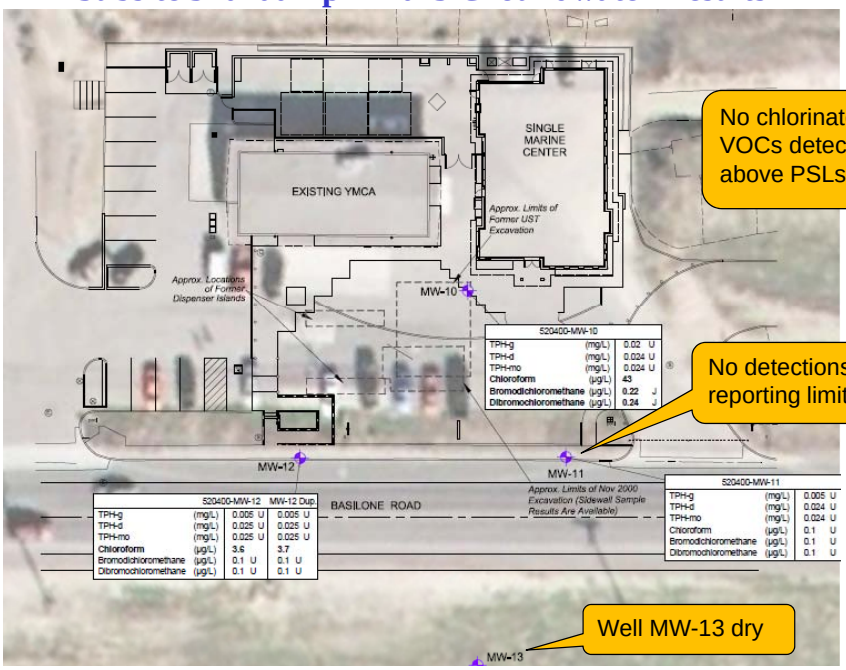
Subsite 520400 April 2013 Groundwater Results



No chlorinated VOCs detected above PSLs

No detections above reporting limit in MW-11

Well MW-13 dry

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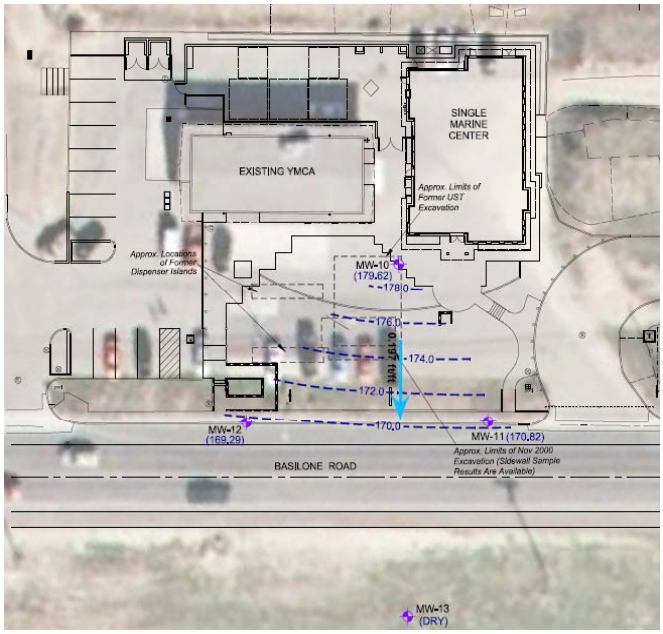
Subsite 520400 April 2013 Groundwater Elevation Contours (April)



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Subsite 520400 – Risk Summary

- For industrial/commercial workers, the total risk estimates did not exceed the point of departure.
- For residents, the total risk estimates for residents exceeded the point of departure due to assumed exposures to the following chemicals:
  - Vapor intrusion from soil gas
    - 1,3-Butadiene (2×10^{-6} using USEPA toxicity values and 1×10^{-5} using Cal Modified toxicity values).
    - Detection of this compound is likely a false positive; not believed to be present due to site-related release.
- Noncancer hazards for residents and industrial/commercial workers did not exceed the threshold value of 1.

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Subsite 520400 Conclusions

- At SG-2, detection of PCE and fuel-related VOCs in soil gas, the detection of a few fuel-related VOCs and relatively high TPH-d in soil, and the strong odor observed during soil sample collection indicate past releases in this vicinity.
- The distribution and low-level concentrations of VOCs, fuel constituents, and fuel additives reported in soil gas indicate minimal potential for migration of constituents in soil gas.
- Reported concentrations of VOCs, fuel constituents, and fuel additives in soil gas will not be a source of future exceedance in groundwater.

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Subsite 520400 Recommendations

- It is recommended that additional investigation be conducted to delineate the observed soil and soil gas concentrations reported above the respective PSLs in the sample at 520400-SG-2.

IR SITE 1118 ESI

QUESTIONS?

MCB CAMP PENDLETON SITE 1119 PROJECT UPDATE

23 January 2014

112th FFA Meeting

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Site Discovery

- Originally defined as groundwater in the vicinity of Base wells 26016 and 26018.
- Previous groundwater detections in 26016 included 11 micrograms per liter (µg/L) of TCE during a constant discharge test conducted by CDM in 2008 and 0.51 µg/L of TCE in a USGS sample at 65 ft bgs collected in 2009.
- USGS testing at 26016 also reported 1,2,3-TCP at 0.0064 µg/L in the 80-foot depth specific sample. Low level *cis*-1,2-DCE was also detected at 65 ft bgs (0.45 µg/L). No other analytical results have indicated the presence of 1,2,3-TCP in wells 26016 or 26018.
- Sampling at production well 26018 has indicated multiple TCE detections, including a maximum detection of 2.6 µg/L collected by FMD in 2009, and 2.1 µg/L from a discharge sample collected by the USGS in 2009.

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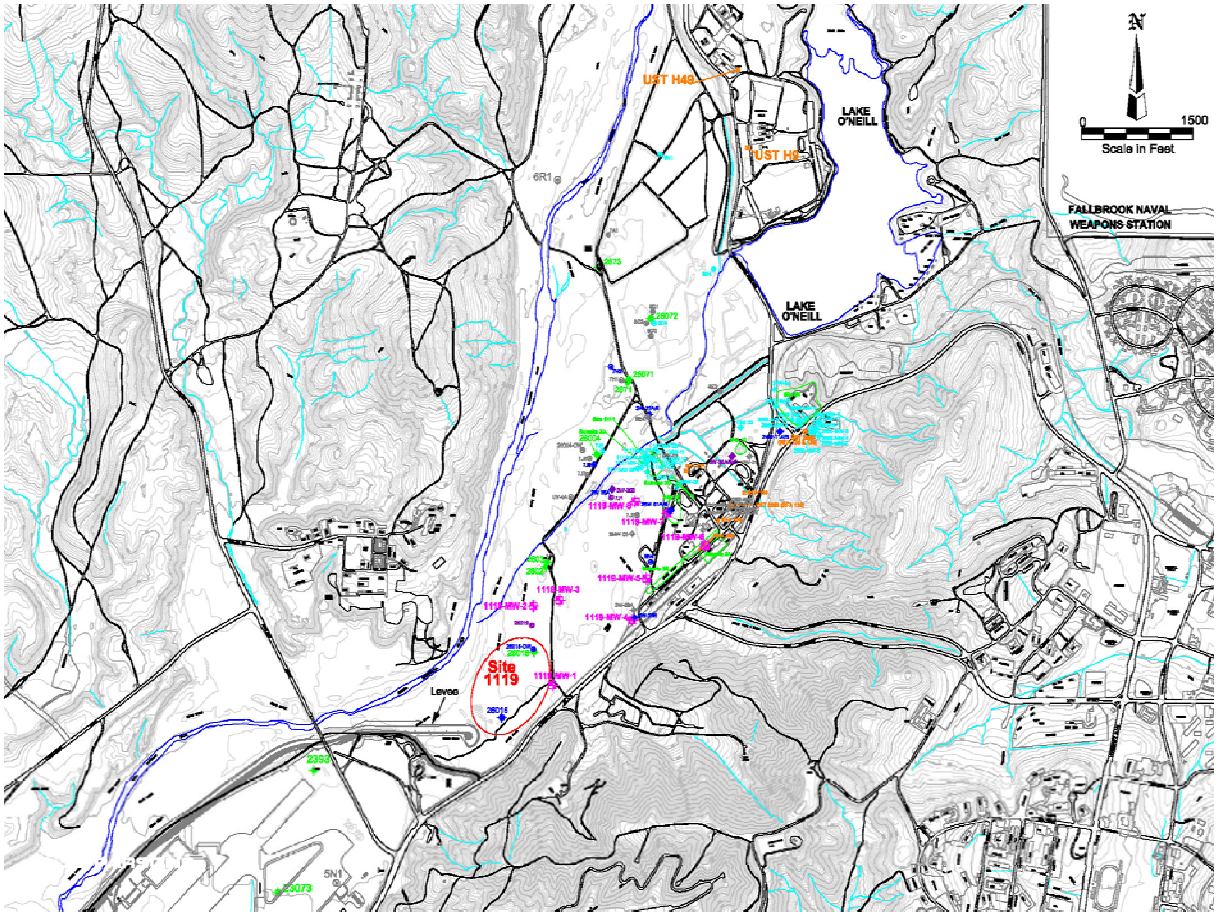

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First Phase Fieldwork Summary (July to December 2011)

- Measured water levels in 47 existing wells. Pulled old pumps to sample. Sampled 12 existing wells and collected groundwater samples at 26016 and 26018-OW using passive diffusion bags (PDBs) and hydrasleeves.
- Well locations 1119-MW1 through 1119-MW8 determined based on initial groundwater sampling results and review of data from Stetson Engineers, including depth to bedrock and alluvial thickness maps. Summary e-mail sent to Team.

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First Phase Fieldwork Summary (July to December 2011) (continued)

- Based on review of additional well data provided at Base meeting, two additional existing OWR wells (7J1 and 26019) were sampled using passive diffusion bags (PDBs) and hydrasleeves.
- Installed 26 new monitoring wells at 8 locations.
- Collected groundwater samples from the 26 new wells and 4 existing wells that could not be sampled during the breeding season (bringing the total to 78 groundwater samples collected from discrete well screens and PDBs and hydrasleeves).

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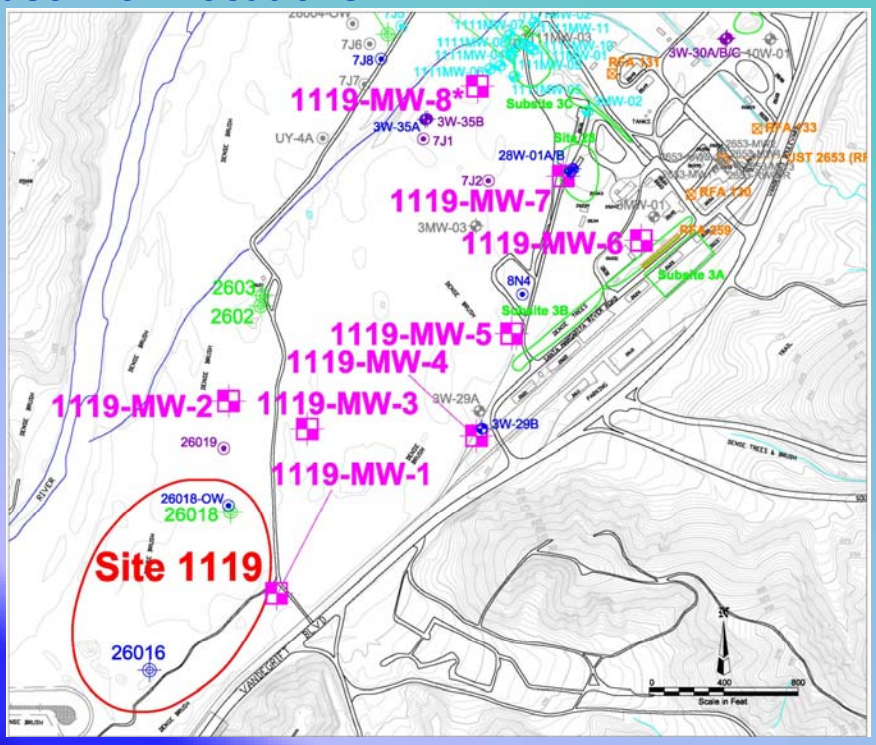
First Phase Well Locations



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First Phase Results

- TCE detected in new monitoring wells 1119-MW-1 and 1119-MW-4 at multiple depths.
- TCE concentrations generally highest in middle to lower portion of aquifer.
- Highest concentrations along southeast edge of valley (i.e., southeast edge of aquifer), limited to downstream of Rattlesnake Canyon.
- Possible source area at "Museum District."
- Higher concentrations historically detected in Well 26016 than in 26018; Well 26016 is closer to southeast edge of valley.
- Former IR, UST, and RFA sites in a large upgradient portion of the basin are not contributing sources.

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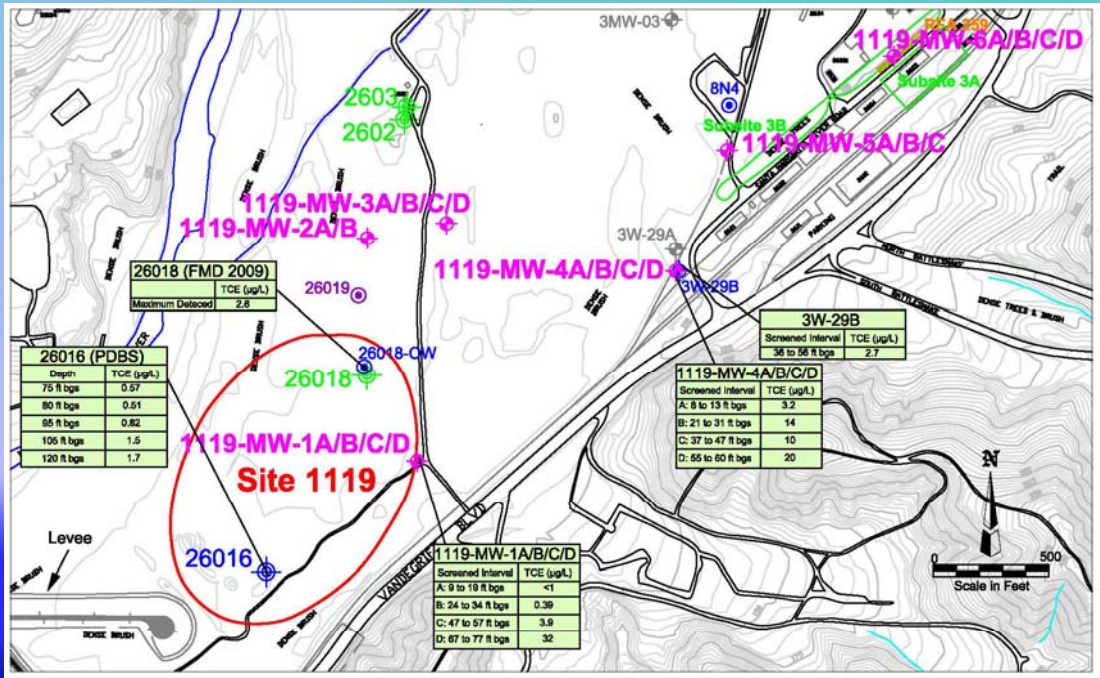
First Phase - 2011 TCE Detections



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Second Phase Fieldwork Summary (April to August 2013)

- Soil gas survey (41 points) conducted in suspected source area.
- Based on the soil gas survey results, installed 10 new monitoring wells at 3 locations. Maximum total depth of the deepest new monitoring well is 86 feet bgs.
- Possible source area near Building 2611.

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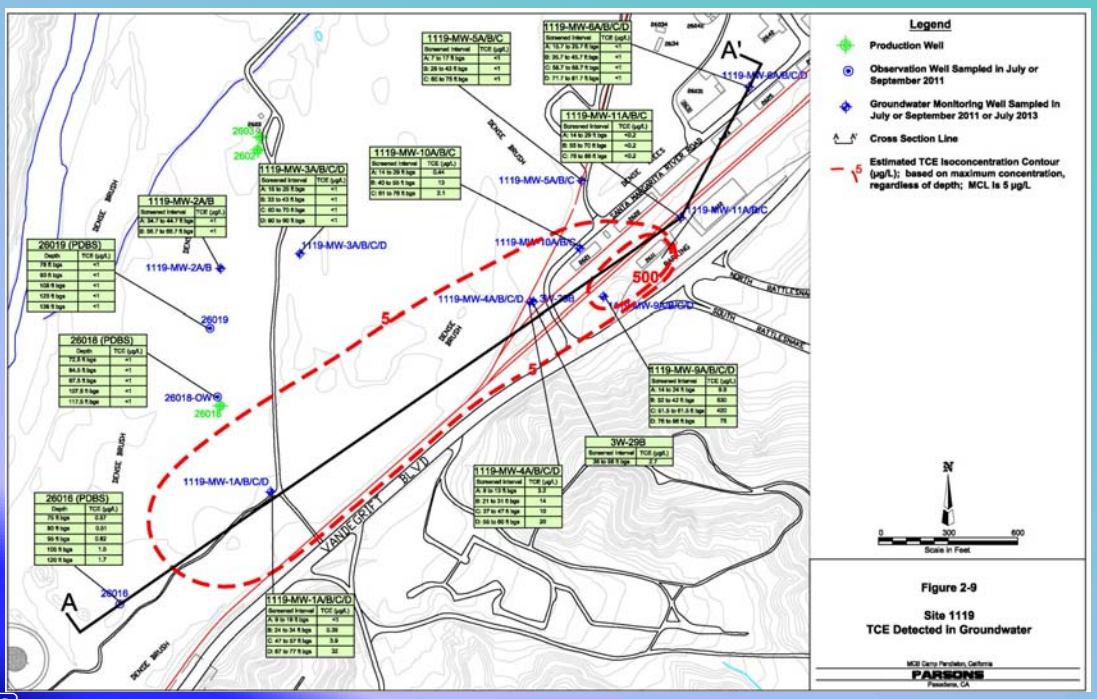
2011 and 2013 TCE Detections



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Conceptual Site Model

- Upper Ysidora subbasin (UYS) is an alluvium-filled valley.
- Groundwater flow is toward the southwest.
- Depth to bedrock in the UYS up to 150 feet based on available logs.
- Depth to bedrock in potential source area between 80 feet to 90 feet bgs.
- At leading edge, depth to bedrock is approximately 77 feet bgs (1119-MW-1D).
- Bedrock consists of both Santiago Formation (La Jolla Formation) and granite, depending on location.
- Migration from source area (near Building 2611) has resulted in COCs throughout much of the vertical thickness of the aquifer.

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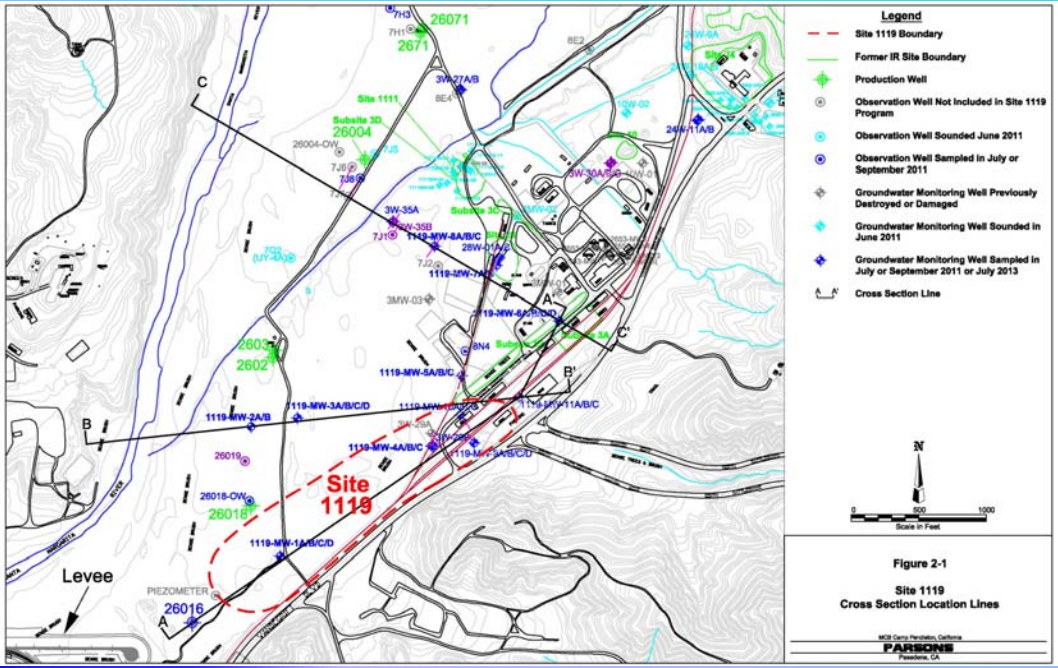
Conceptual Site Model (Continued)



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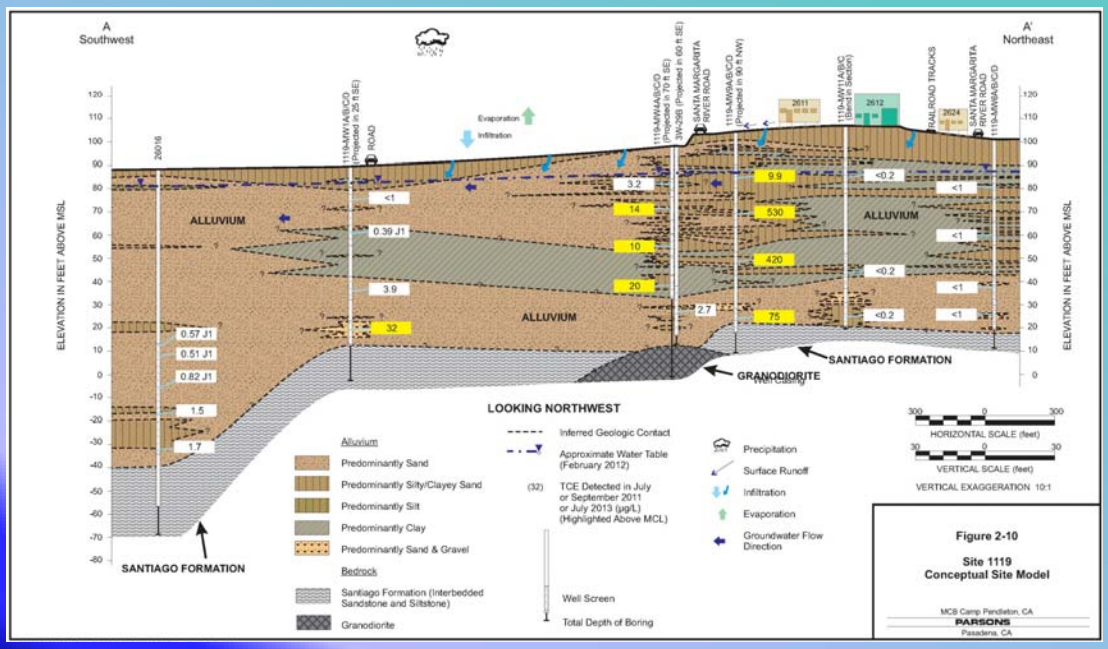
Conceptual Site Model (Continued)



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Summary of Nature and Extent

- TCE is the only chemical in groundwater that exceeds federal or state MCL (maximum 530 µg/L).
- TCE concentrations are highest in close proximity to the possible source area. Highest TCE detections at depth of 30 to 60 feet bgs in 1119-MW-9B and 1119-MW-9C.
- Detectable concentrations of TCE are limited to the southwest edge of the valley (southeast edge of aquifer), downstream of identified source area.
- Former sites in a large upgradient portion of the subbasin are not contributing sources.
- Aquifer is weakly aerobic and generally pH neutral.
- Natural biological destruction of TCE is not a significant factor at the site.

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Summary of Nature and Extent

- 1,2,3-Trichloropropane (TCP) was detected in a single 80-foot groundwater sample from Base test well 26016 by the U.S. Geological Survey (USGS) in 2009 at a concentration of 0.0064 µg/L (below the California Department of Health Services response level of 0.5 µg/L, and above notification level of 0.005 µg/L). However, 1,2,3-TCP was not subsequently detected in 2011 in this well, nor in any of the other 57 wells sampled as part of the Site 1119 investigation.
- Extent of the Site 1119 TCE plume above the MCL is approximately 2,500 feet long by 600 feet wide, and approximately 80 feet deep
- Two wells (26016 and 26018) just beyond the leading edge of the plume were originally planned as drinking water wells, but these wells are not being used as drinking water sources due to the presence of contaminants.

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Summary of Nature and Extent

- Suspected source area close to Building 2611; currently defined as the area of TCE concentrations exceeding 500 µg/L, between 1119-MW-9 and 1119-MW-11
- The size of the suspected source area (defined by 500 µg/L TCE contour) is approximately 450 feet long and 200 feet wide.
- A remedial design study of the source area will be needed to obtain detailed information on contaminant distribution and hydrogeologic conditions that could affect design parameters. Data collected to date are considered sufficient to identify and evaluate potential remedial options for the site.

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Risk Assessment

- TCE is the primary contributor to risk (1×10^{-3}) to a hypothetical domestic water user.
- Evaluation of the potential migration of VOCs from soil gas to indoor air indicates risk of 1×10^{-6} for residents and 3×10^{-7} for industrial/commercial workers.
- Evaluation of the potential migration of VOCs from groundwater to indoor air indicates risk of 9×10^{-6} for residents and 1×10^{-6} for industrial/commercial workers .
- Measured soil gas concentrations are below residential screening levels for TCE in soil gas, and the existing industrial/commercial buildings at Site 1119 have open crawl spaces, resulting in an incomplete pathway. Therefore, estimated risk applies only to future slab-on-grade buildings.

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Risk Assessment (continued)

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Feasibility Study

- Given the extent and depth of the plume above the MCL, and the downgradient TCE concentrations (approximately 30 µg/L), active remedies are focused on the source area.
- Alternative 2 (LUCs and LTM) would be implemented together with any other selected alternative and would provide protection of human health via land use controls, with long term monitoring to track concentration changes in the plume while it attenuates.
- Five alternatives (3, 4, 5, 6, and 7) provide in situ cleanup of source area .
- Alternative 8 (PRB) could be applied downgradient of the source area to intercept contaminant migration.
- Source area divided into two zones: TTZ -1 and TTZ-2 in case two different technologies are determined to be appropriate for the two zones, and in case a phased approach is determined to be appropriate.

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Feasibility Study (Continued)

- Based on the distribution of TCE in 1119-MW-9, the highest concentrations (530 µg/L and 420 µg/L) are roughly in the middle of the aquifer (30 to 60 feet bgs) in the source area. This middle zone of the aquifer is defined as TTZ-2.
- TTZ-1 is the portion of the source zone where the highest concentrations of TCE in groundwater are likely; estimated to be 50 by 100 feet, at a depth of 10 to 30 feet bgs.
- If COC mass is significantly reduced in the source area (Alternatives 3 through 7), less mass available to be transported downgradient in the aquifer.
- Following source area treatment, TCE concentrations would continue to decrease throughout the plume through natural attenuation processes, while being subject to land use controls and long-term monitoring. Because there is little of biologically mediated attenuation of TCE in the downgradient plume, these natural attenuation processes are likely limited to dispersion, diffusion, sorption, and volatilization.

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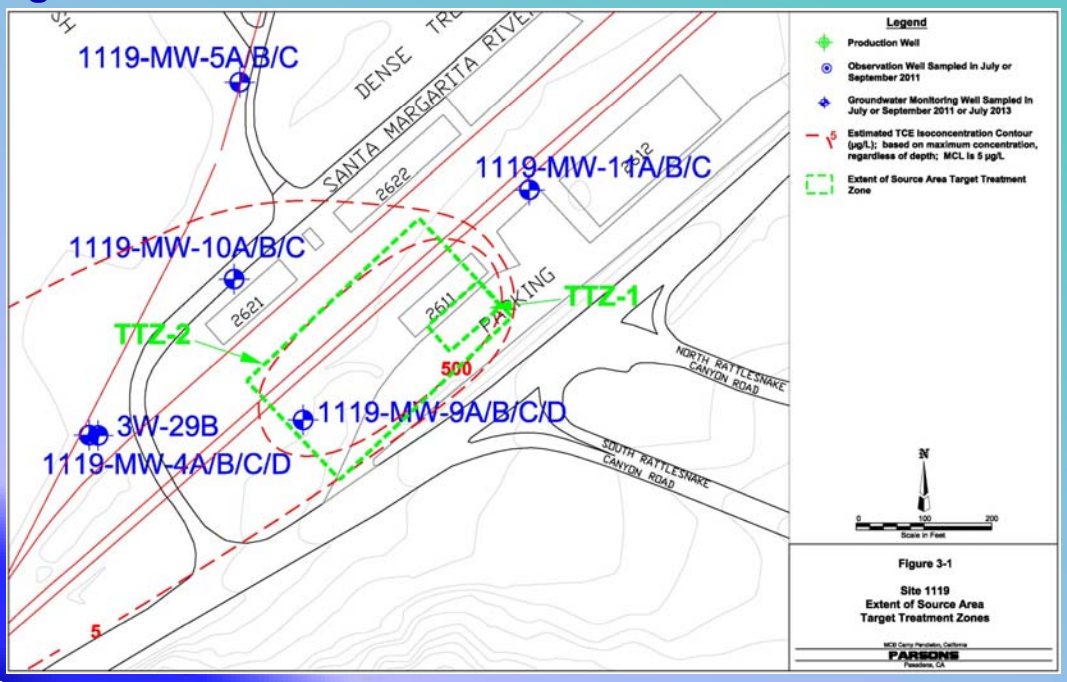
Target Treatment Zones



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Remedial Alternatives

- Alternative 1: No Action
- Alternative 2: Land Use Controls and Long Term Monitoring
  - Land use controls would preclude the installation of water supply wells at the site, and also require that any future construction within the footprint of the plume be evaluated for potential vapor intrusion risk.
  - A long-term groundwater monitoring program involves monitoring groundwater quality to track chemical concentrations and possible movement, provide early warning of potential impacts to downgradient receptors, and evaluate the attenuation of contamination in and downgradient of the VOC plumes.
  - When implemented alone, this alternative relies on natural subsurface physical and biological attenuation processes such as dispersion, degradation, sorption, diffusion, and volatilization to reduce VOC concentrations over time. However, relying on these mechanisms alone will likely not result in chemical concentrations declining significantly in a reasonable timeframe, given the concentrations present in the source area.
  - 30 year timeframe for costing purposes.

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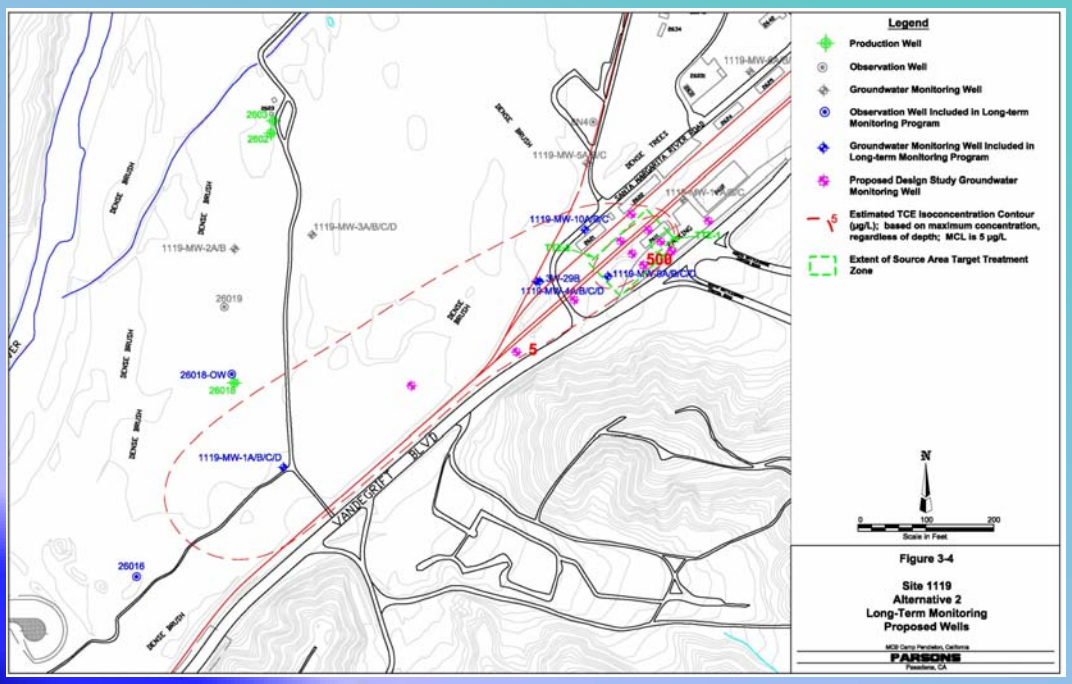
Alternative 2: Land Use Controls and Long-Term Monitoring



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Remedial Alternatives

- Alternative 3: Source Area Treatment via In Situ Reactive Metals
  - Involves injection of reactive metals to destroy contaminant mass across the source area.
  - Chemical amendments would be introduced via 690 locations at two depths (1380 injection wells) as a liquid solution injected in a grid pattern in the plume source area (controlled-release carbon, zero valent iron (ZVI) particles, and nutrients to stimulate chemical and microbiological dechlorination in groundwater).
  - A design study will be conducted to provide additional source area characterization and initial performance testing prior to the full-scale implementation of this technology.
  - Two injection events needed to achieve required mass reduction in the source area within 12 years.

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Remedial Alternatives

- Alternative 4: Source Area Treatment via In Situ Chemical Oxidation
  - In situ chemical oxidation (ISCO) via a grid of 188 locations injection wells at two depths (376 injection wells); reagent would consist of persulfate, together with chelated metal catalyst (chelated trivalent iron, Fe-EDTA) activation.
  - Three injection events needed to achieve required mass reduction in the source area within 10 years.
  - Would include a recirculation push-pull system to enhance distribution of the reagents and increase the effective radius of influence.
  - A design study would be conducted to provide additional source area characterization prior to the implementation of this technology at the site.

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Remedial Alternatives

- Alternative 5: Source Area Treatment via In Situ Enhanced Bioremediation
  - Involves the installation and operation of an in situ bioremediation system at 29 locations at two depths (58 wells) to destroy contaminant mass in groundwater of the source area.
  - Mixture of organic substrate(s) and groundwater geochemistry modifiers in order to induce geochemical and microbial conditions that are conducive to the biotic degradation of site chemicals.
  - Three injection events needed to achieve required mass reduction in the source area within 10 years.
  - Need to drive the aquifer from moderately aerobic to reducing conditions.
  - A design study would be conducted to provide additional source area characterization prior to the implementation of this technology at the site.

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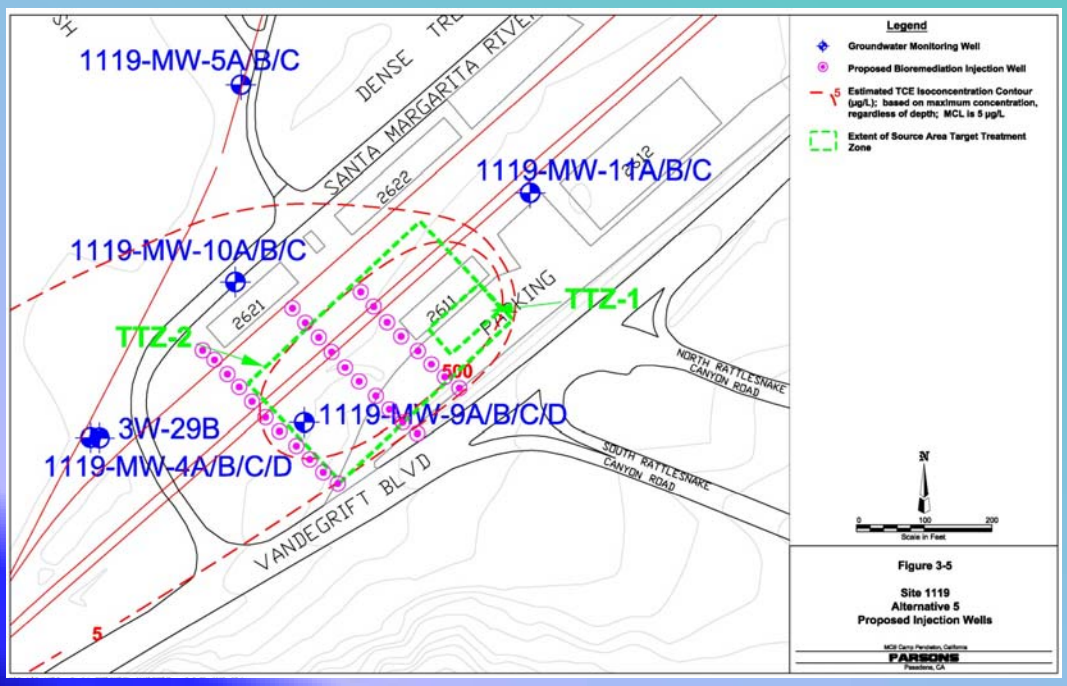
Alternative 5: In Situ Enhanced Bioremediation



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Remedial Alternatives

- **Alternative 6: Source Area Treatment via In Situ Thermal Desorption with Chemical Oxidation**
  - Involves heating a portion of the aquifer in the source area to boiling temperatures by means of thermal conduction from 70 heated steel well casings.
  - Groundwater that surrounds each gas thermal conductive (GTC) well is vaporized into steam, allowing for the removal and treatment of the water vapor and COCs via soil vapor extraction (SVE) from the vadose zone.
  - GTC heating is considered to be applicable and cost-effective in TTZ-1, but the remainder of the source area (TTZ-2) would use in situ chemical oxidation (per Alternative 4).
  - A design study would be conducted to provide source area characterization prior to installation of this technology at the site.
  - Expected to achieve planned mass reduction in TTZ-1 within 1 year; for TTZ-2, three chemical oxidation injection events needed at 175 locations at two depths (350 wells) to achieve required mass reduction in TTZ-2 the source area within 10 years.

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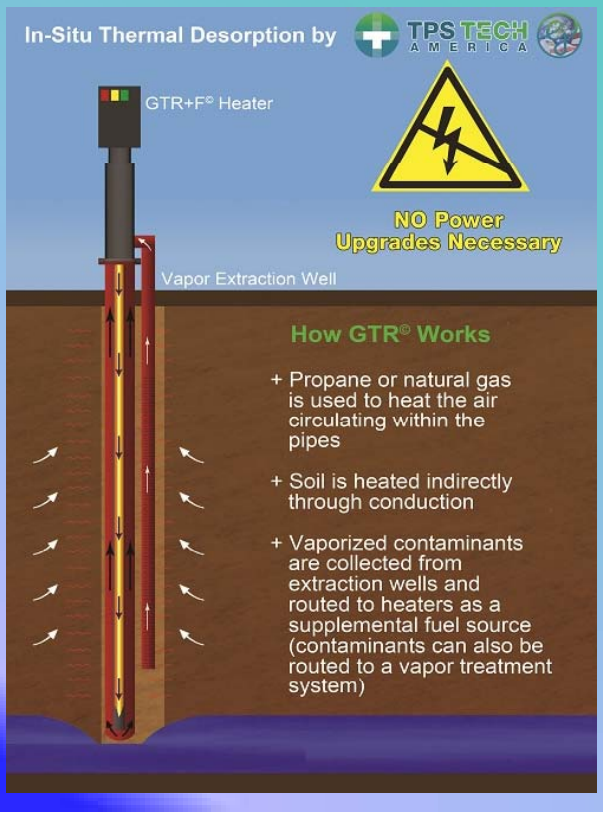
GTR© Thermal Remediation



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Remedial Alternatives

- **Alternative 7: Source Area Treatment via In Situ Thermal Desorption with Enhanced Bioremediation**
  - **As with Alternative 6, involves heating a portion of the aquifer in the source area to boiling temperatures by means of thermal conduction from 70 heated steel well casings, but this alternative will use in situ bioremediation for TTZ-2 (per Alternative 5).**
  - **Expected to achieve planned mass reduction in TTZ-1 within 1 year; for TTZ-2, three in situ bio-injection events needed at 21 locations at two depths (42 wells) to achieve required mass reduction in TTZ-2 the source area within 10 years.**

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Remedial Alternatives

- **Alternative 8: Reactive Barrier Installed via Injection Wells Downgradient of the Source Area**
  - Involves the installation and operation of an in situ bioremediation system in a linear configuration perpendicular to groundwater flow and downgradient of the source area (i.e., PRB).
  - Injection at nine locations, four depths at each location (36 total wells).
  - Designed to destroy contaminant mass in groundwater that leaves the source area and passes through the reactive zone before travelling further downgradient. Requires injection of a mixture of organic substrates and groundwater geochemistry modifiers to induce geochemical and microbial conditions that are conducive to the biotic degradation of site chemicals.
  - This alternative would not address the highest concentrations in the source area directly (as compared to Alternatives 3 through 7, but it would prevent downgradient migration of chemicals from the source area.
  - Would need to be maintained indefinitely due to the expected persistence of the TCE source area. FS includes eight reinjection events over 30 years.

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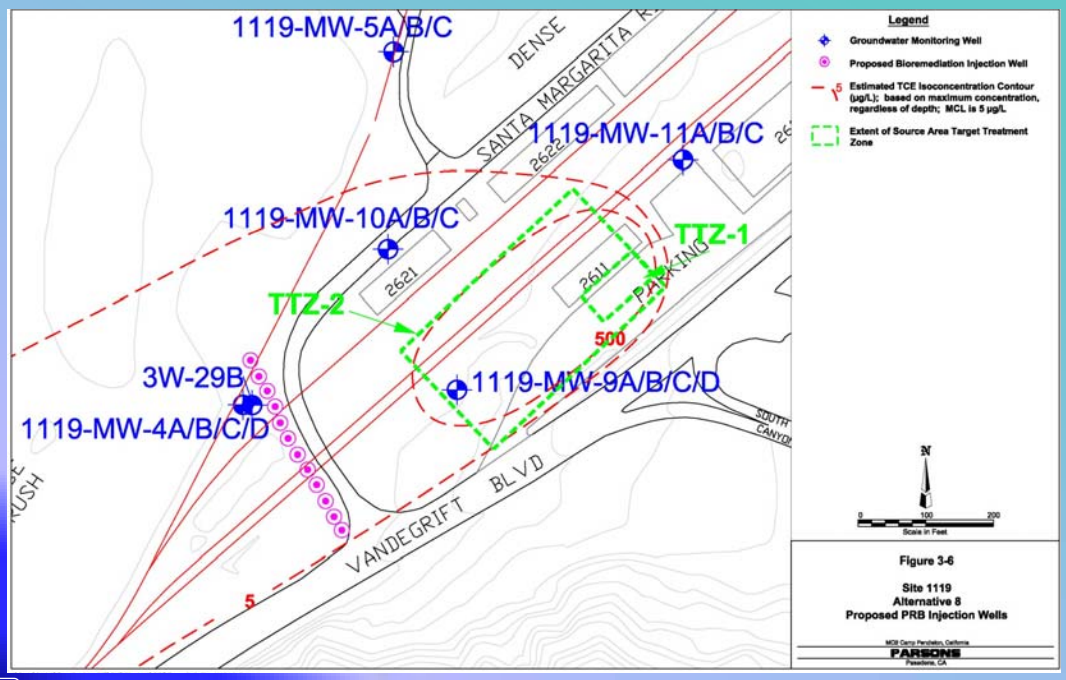
Alternative 8: Reactive Barrier



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