Appendix F

Nebo Main Base OU 2 – Technical Assessment of Remedial Systems

APPENDIX F

F-1 TECHNICAL ASSESSMENT REPORT – NEBO NORTH GETS CONTINUED MAINTENANCE EVALUATION

Introduction

This Technical Memorandum has been prepared to document the evaluation of the Nebo Main Base Groundwater Extraction and Treatment System (GETS) that is maintained in "standby mode" as a contingency system for control of the Nebo North groundwater plume. This evaluation was completed in support of the 2012 Five-Year Review. This memorandum was prepared by AIS-TN&A JV (ATJV) for the Department of the Navy under Contract No. N62473-09-D-2610, contract task order 0013.

The contaminants of concern (COCs) consist of dissolved-phase volatile organic compounds (VOCs), primarily tetrachloroethene (PCE), trichloroethene (TCE), and 1,1-dichloroethene (1,1-DCE). The Nebo North groundwater plume is described in Section 3.5.9 of the main report. The selected remedy for the Nebo North plume is air sparge/soil vapor extraction (AS/SVE) of the source area, natural attenuation of the downgradient portions of the plume, and maintenance of a standby GETS as a contingency plume containment system in the event natural attenuation does not stop plume migration. The location of the GETS wells are shown on Figure F-1.1. The remedy is further described in Section 8.2 of the main report.

COC Plume Extent

The interpreted extents of the Nebo North plume for the years 2007 to 2011 are presented on Figure F-1.2. As can be seen, the PCE plume extent varies somewhat over time, but with the source treated to the extent feasible by the AS/SVE system, the overall plume extent diminished (based on the 2011 annual sampling data) (see technical assessment Table 8-2). Similarly, the TCE plume was stable until the 2011 annual sampling event when concentrations declined to below the maximum contamination limit (MCL).The Nebo North Plume is stable to diminishing, and the groundwater concentrations are generally declining (Graph F-1.1).

GETS Evaluation Process

The GETS has been maintained in standby mode as a contingency measure for the Nebo North plume; however, the GETS has not been operated since the 1998 ROD (Department of the Navy [DON], 1998) signing due to diminishing plume trends (ATJV, 2012). The location of the GETS wells are shown on Figure F-1.1.

The OUs 1 and 2 Record of Decision (ROD) (*see* Section 4.6) provided "trigger" for activation of the GETS:

> "*The monitoring plan will contain a statistical approach tor triggering activation and deactivation of the system in accordance with US and California EPA guidance developed for determining statistically significant changes in indicator parameter values…. The post-ROD monitoring plan, which will be a primary FFA document to be submitted to the regulatory agencies within one year of the signing of this ROD, will specify the wells that will be*

> *monitored to determine if an MCL has been exceeded, and the schedule and procedures for confirming that this excess is statistically significant as described above.*"

Since long-term monitoring data indicated a stable or shrinking plume, the "trigger" evaluation has not been previously performed.

The July 1998 Long-Term Groundwater Monitoring Plan (LTGMP), Appendix B "Statistical Approaches", Section B.3 "Evaluation of Plume Cleanup" describes the approach for statistically evaluating plume cleanup progress, and hence, deactivation of the Nebo North GETS. Essentially, the process is to graph well-specific contaminant concentrations over time and fit a multiple non-linear regression line to the data (Jacobs Engineering Group [JEG], 1998). The LTGMP states:

> *Two types of outcomes will be considered acceptable evidence that contaminant concentrations have reached the cleanup level and the remediation may be suspended. These outcomes are (EPA 1992b):*
>
> - *Contaminant concentrations have leveled off and the regression line has a slope equal to zero at an average contaminant concentration value that is at or below the MCL, or*
> - *The regression line has a negative slope and concentrations are below the MCL.*
>
> *To account for data variability, a Student's t-test will be performed to verify that the slope of the fitted regression line is not greater than zero at a 95% level of confidence.*
>
> *It should be noted that the above analysis will be applied for each individual sampling location. In-plume data will not be "pooled" to support these calculations.*
>
> *The same type of an approach will be used to determine if activation of the pump-and-treat system at the North Nebo plume is needed.*

Table 5-1 of the LTGMP specifies monitoring wells NS2-1, NS2-2, NS1-6, NWF-1, NNP-2, and MW-D (Figure F-1.1) should be monitored and the data evaluated for "fail-safe" pump-and-treat system activation. Monitoring frequency was set as quarterly in the LTGMP, but this was later reduced to semi-annual and then annual in subsequent sampling and analysis plans (JEG, 1998).

Evaluation of Trends in Groundwater Concentrations

Long-term monitoring data for PCE, TCE and 1,1-DCE from groundwater monitoring wells NS2-1, NS2-2, NS1-6, NWF-1, NNP-2, and MW-D were used to perform the statistical analyses required for system deactivation per the LTGMP, and in accordance with the ROD (DON, 1998; JEG, 1998). Analyses were performed according to the statistical methods presented in *Nondetects and Data Analysis* (Helsel, 2005). The analysis, including linear-

regression trend lines, calculation of the 95% confidence level is presented on Graph F-1.1. The following observations of the data are made:

- There have been no exceedances of the MCL the six-well data set since 2001.
- The data set included so many instances of non-detect concentrations of 1,1-DCE and TCE that trends were not able to be plotted for these two constituents for most of the wells.
- For PCE, concentrations show a declining trend, except for NWF-1 where a trend could not be calculated due to the infrequency of PCE detection in this well. In all but well MW-D, concentration trends are based largely on declining estimated concentrations between the reporting limit and detection limit. PCE concentrations in well MW-D decline from a concentration of 6 microgram per liter (µg/l) to below the reporting limit or not detected in five of the last six annual monitoring events, with the sixth year concentration being 1.1 µg/l.

Conclusions

PCE concentrations in the wells specified by the LTGMP show a decreasing trend or a history of concentrations below reporting limits. Concentrations for the TCE and 1,1-DCE also show a history of concentrations below reporting limits. Thus the fail-safe GETS system has not been needed to control the migration of the Nebo North plume since the signing of the 1998 ROD. Continued maintenance of the GETS system in standby mode will not likely be needed to provide plume control based on the historical COC concentration trends and overall plume migration pattern. Therefore, this system is recommended for deactivation and permanent decommissioning.

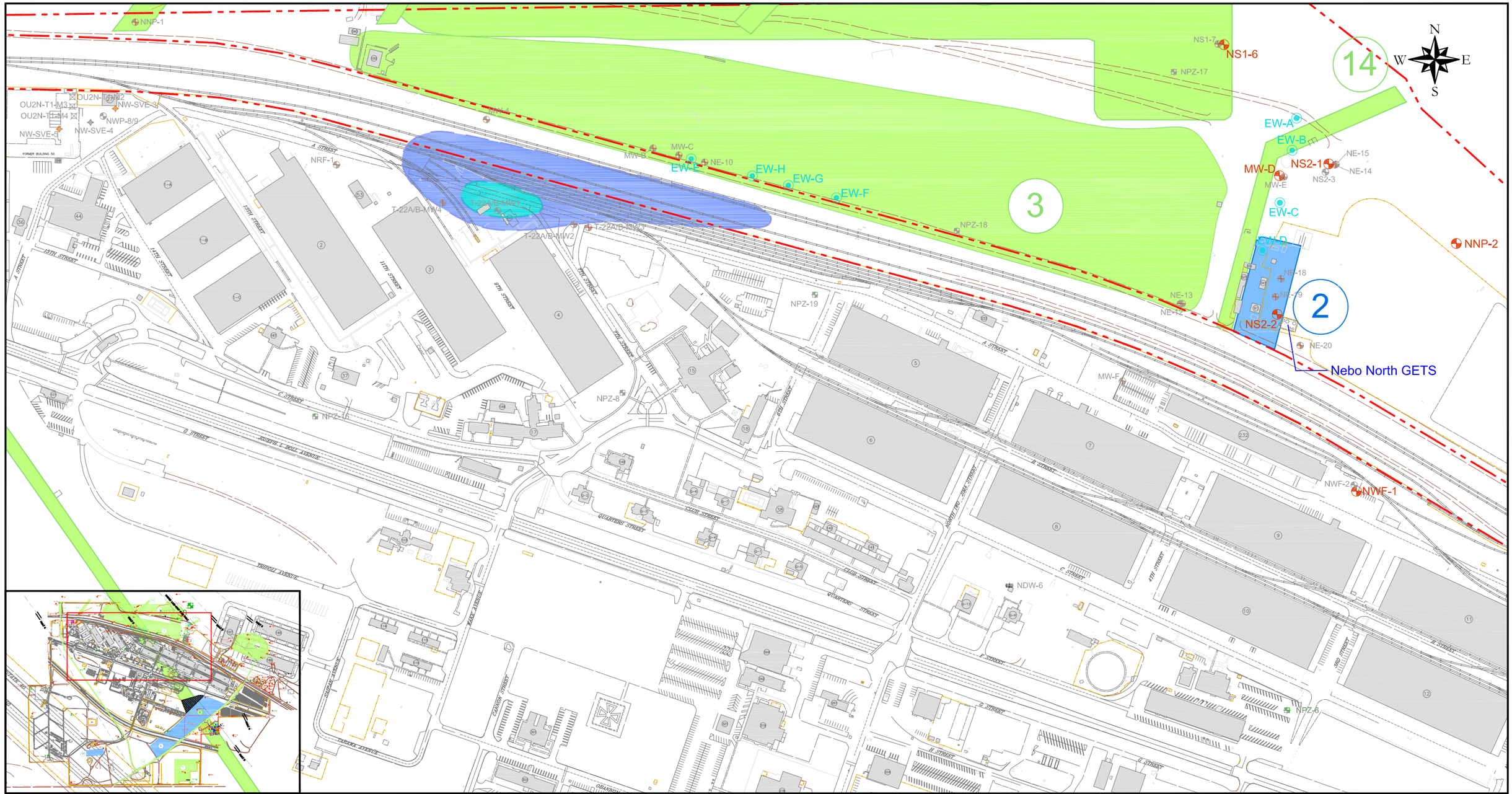
References

Department of the Navy (DON). 1998. Operable Units 1 and 2, Final Record of Decision Report. April.

Helsel, Dennis R. 2005. Nondetects and Data Analysis Statistics for Censored Environmental Data. Willey.

Jacobs Engineering Group (JEG). 1998. Draft Final OUs 1 – 6, Long-Term Groundwater Monitoring Plan, MCLB Barstow, Barstow, California. July.

AIS-TN&A JV (ATJV). 2012. Draft 2011 Annual Groundwater Monitoring Report Operable Units 1 and 2, Marine Corps Logistics Base, Barstow, California.



Legend

- Paved Road
- Dirt Road
- Railroad Tracks
- Fence Line
- Base Boundary
- 5 ug/L PCE Concentration Area
- 10 ug/L PCE Concentration Area
- MW-D — Groundwater Monitoring Well
- EW-B — Groundwater Extraction Well (Inactive)
- —5— Approximate PCE Isoconcentration Contour (ug/L)
- —10 Approximate PCE Isoconcentration Contour (ug/L)

Notes

1) GETS: Groundwater Extraction and Treatment System

Approximate Scale in Feet

0 350 700

Figure F-1.1
Nebo North Data Evaluation
and GETS Wells (November 2011)

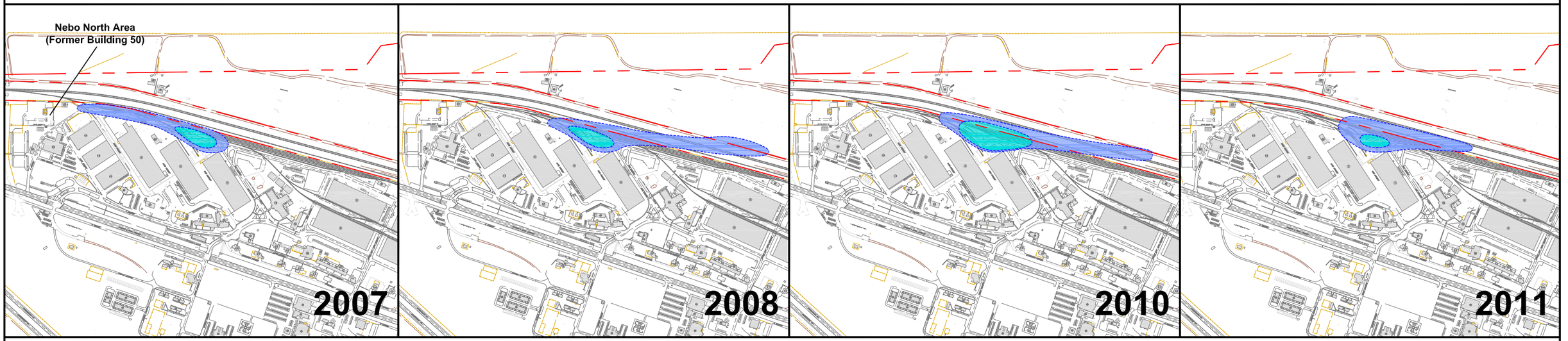
Nebo Main Base
Marine Corps Logistics Base
Barstow, California

AIS-TN&A Joint Venture

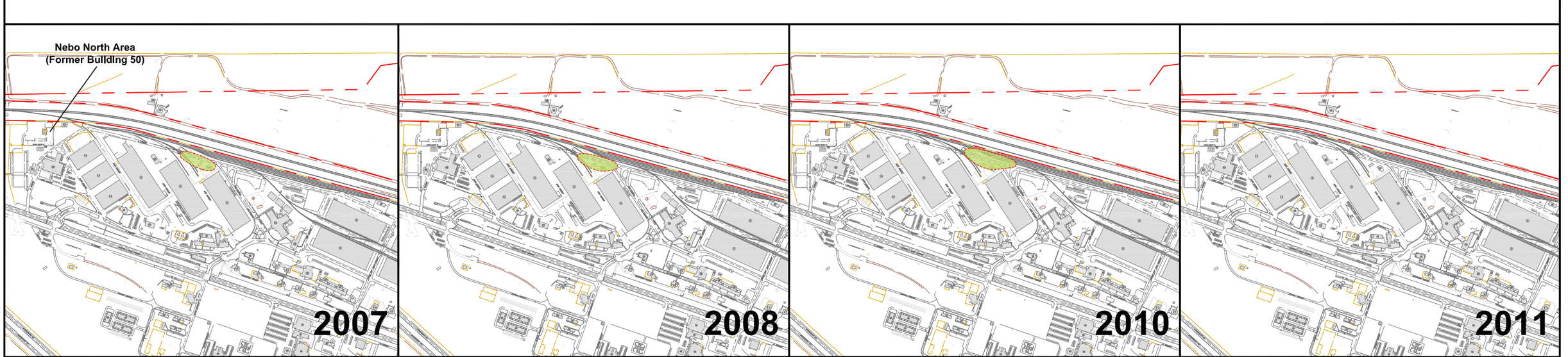
Date: June 13, 2012

File: Barstow_5yrRev.dwg

Tetrachloroethene



Trichloroethene



Legend

- Nebo Boundary
- 5 ug/L PCE Concentration Area
- 10 ug/L PCE Concentration Area
- 5 ug/L TCE Concentration Area
- 10 ug/L TCE Concentration Area

Notes

1. ug/L = Micrograms per Liter
   TCE = Trichloroethene
   PCE = Tetrachloroethene
2. The plume for 2009 (not shown) was essentially identical to the 2007, 2008, 2010, and 2011 plumes.

N
W E
S

Approximate Scale in Feet

0 1,000 2,000

Figure F-1.2
Nebo North Historical Groundwater
PCE and TCE Extents, 2007 - 2011

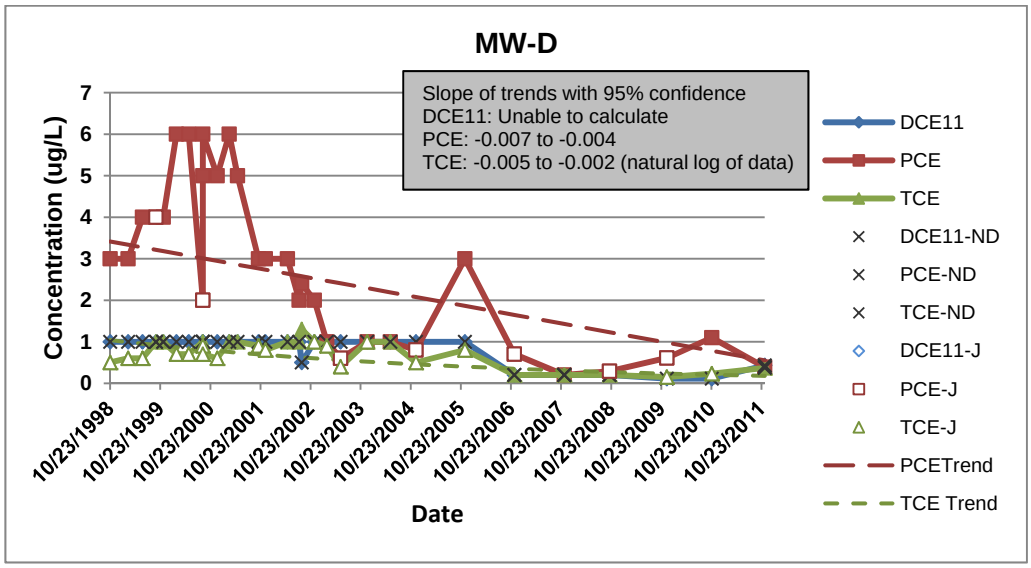
Nebo Main Base
Marine Corps Logistics Base
Barstow, California

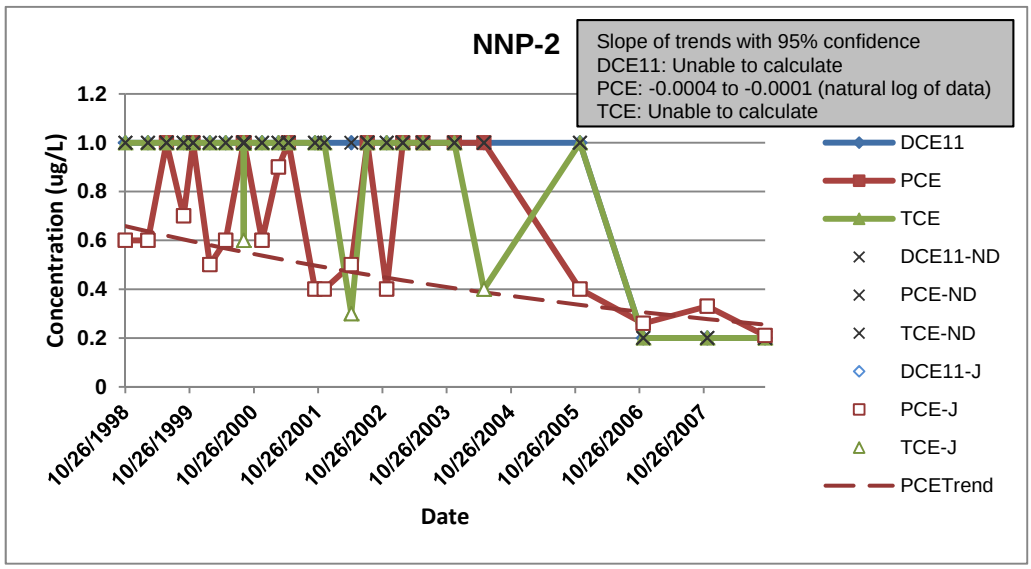
AIS-TN&A Joint Venture

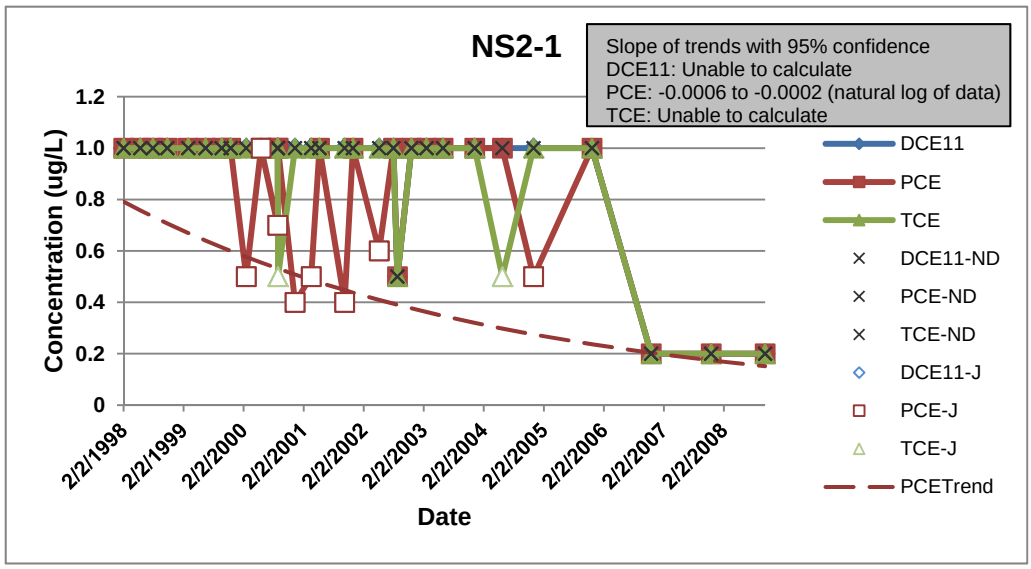
Date: June 7, 2012

File: Barstow_A11.dwg

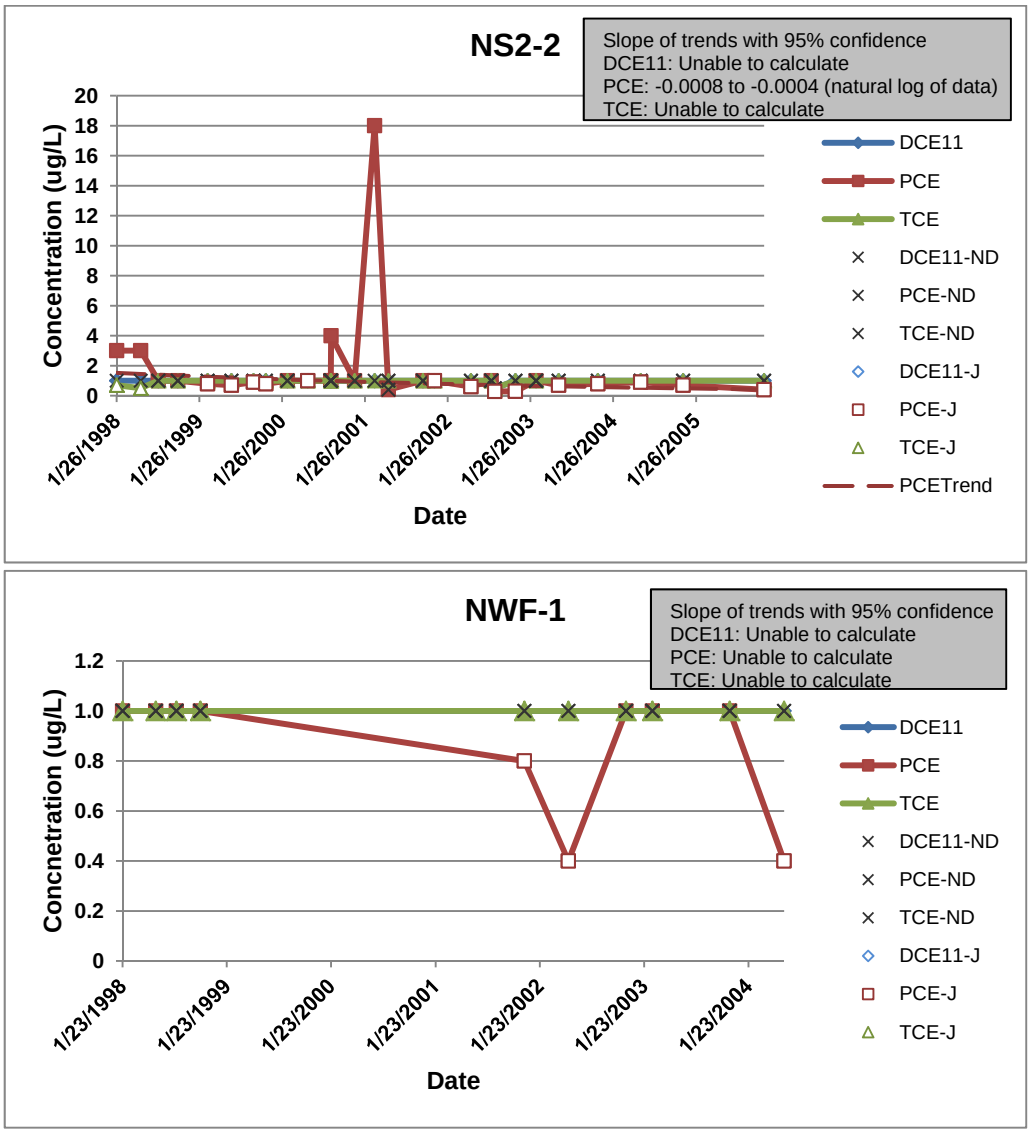
Graph F-1.1
Nebo North GETS Analysis
Nebo Main Base, MCLB Barstow, CA







Graph F-1.1
Nebo North GETS Analysis
Nebo Main Base, MCLB Barstow, CA



DCE11 = 1,1-dichloroethene
GETS = groundwater extraction and treatment system
J = estimated result
MCLB = Marine Corps Logistics Base
ND = not detected
PCE = tetrachloroethene
TCE = trichloroethene
ug/L = micrograms per liter
Note: trend line equations calculated by maxim likelyhood estimation as described in Helsel, 2005

APPENDIX F

TECHNICAL ASSESSMENT REPORT - CAOC 38 (OU 2) REMEDIAL ACTION PERFORMANCE EVALUATION

Technical Memorandum F-2 – Nebo South Groundwater Plume Evaluation

Introduction

This Technical Memorandum has been prepared to document the evaluation of the Nebo South (CAOC 6) groundwater plume. This evaluation was completed in support of the 2012 Five-Year Review. This memorandum was prepared by AIS-TN&A JV (ATJV) for the Department of the Navy under Contract No. N62473-09-D-2610, contract task order 0013.

The contaminants of concern (COCs) consist of dissolved-phase volatile organic compounds (VOCs), primarily trichloroethene (TCE), tetrachloroethene (PCE), and, 1,1-dichloroethene. The Nebo South groundwater plume is described in Section 3.5.9 of the main report. The selected remedy for this plume is air sparge/soil vapor extraction (AS/SVE) systems for groundwater and vadose zone VOC mass removal as described in Section 8.2 of the main report. A description of CAOC 6 is provided in Section 3.5.5, and a review of the selected remedy (NFA with land use controls) is provided in Section 8.4. The ROD for OU 2 covering groundwater and vadose zone remediation at Nebo South was signed in 2006, and implemented in the interim remedy (DON, 2006).

COC Plume Extent

The interpreted extents of the Nebo South PCE and TCE plumes for select years from 2007 to 2011 are presented on Figure F-2.1. The TCE plume decreased to below the maximum concentration limit (MCL) during the reviewing period, and the plume extent also decreased significantly. Additionally, the Nebo South PCE and 1,1-DCE plume has been below MCL before the beginning of the reviewing period.

COC Groundwater Concentrations

Groundwater concentrations from select groundwater monitoring wells used to monitor the Nebo South plume are presented on Graph F-2.1. The groundwater COC concentrations presented in this graph show that PCE and 1,1-DCE concentrations are below MCL throughout the review period from 2007 to 2011. TCE have been reduced to below or slightly above MCL. Off-base COC concentrations have remained below the respective MCLs since at least 2006.

A quantitative analysis of the characteristics of the TCE plume was performed to reveal trends. Graph F-2.2 shows the TCE trends in maximum and average groundwater concentrations across the plume, the area of the plume, and sample counts of the total number of samples and the number of samples exceeding the MCL. The maximum and average plume concentration for TCE has decreased since 2005. The calculated plume area between 2005 and 2011 indicates a decreasing plume extent. Although the number of wells sampled has varied from 15 to 33, the number of wells with TCE concentrations in excess of the MCL has declined from 9 to 3 during the same period. To account for the variable total

number of TCE samples, the ratio of wells exceeding MCL to the total number of wells sampled was calculated. The ratio of wells exceeding the MCL to the total number of wells sampled has declined throughout the period between 2005 and 2011.

Remedial System Performance Evaluation

Treatment and control of the Nebo South plume is performed through an air sparging/soil vapor extraction (AS/SVE) system.

Historical CAOC 16 AS/SVE system performance, as indicated by the rate of total VOCs removed and cumulative totals, is presented on Graph F-2.3. The rate of COC removal has flattened significantly since start-up. Since about 2006 the extraction rate appears relatively unchanged. A slight up-tick in mass removal rates in late 2011 is likely due to the recently replaced air compressor, which has improved system uptime and general functioning.

Conclusions

The Nebo South plume has decreased in extent during the review period. Additionally, COC concentrations have decreased (both maximum and average), and the number of wells exceeding MCLs has declined. Remedial performance of the AS/SVE system has generally declined in effectiveness in recent years, although installation of a new air compressor in late 2011 appears to have resulting in a slight increase in mass removal.

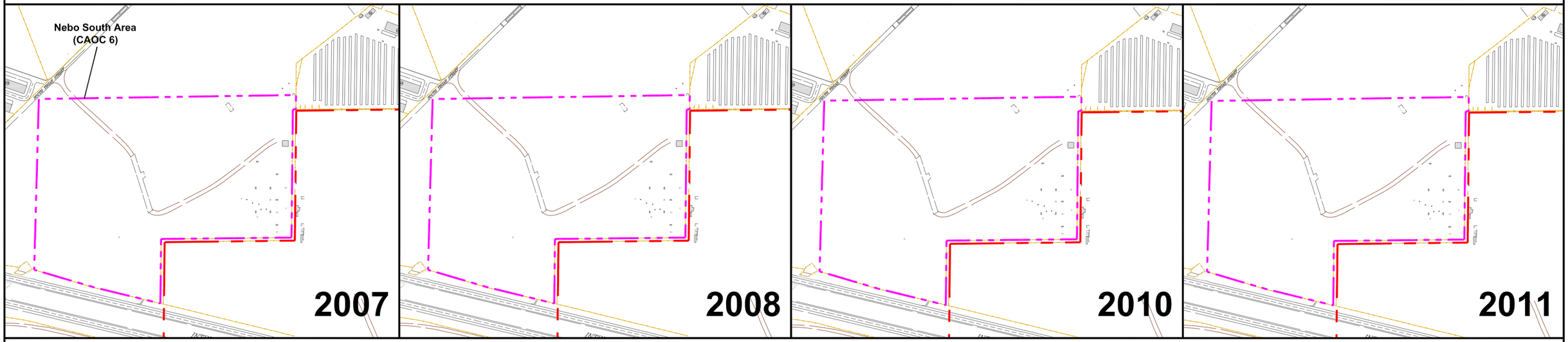
References

Oneida Total Integrated Enterprises, LLC. (OTIE). 2011. 2010 Annual Groundwater Monitoring Report Operable Units 1 and 2, Marine Corps Logistics Base, Barstow, California. 25 July.

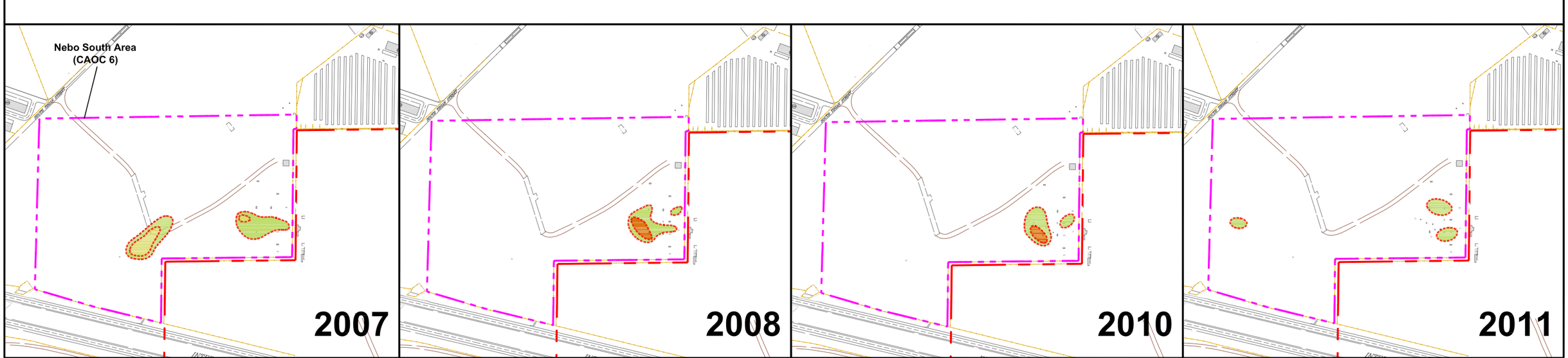
Oneida Total Integrated Enterprises, LLC. (OTIE). 2012. 2011 Annual Groundwater Monitoring Report Operable Units 1 and 2, Marine Corps Logistics Base, Barstow, California. 18 May.

Naval Facilities Engineering Command, Southwest Division (DON). 2006. Final Record of Decision, Nebo South Groundwater – Operable Unit 2, Marine Corps Logistics Base, Barstow, California. 20 September.

Tetrachloroethene



Trichloroethene



Legend

- Nebo Boundary
- Nebo South Land Use Control Boundary
- 5 ug/L PCE Concentration Area
- 10 ug/L PCE Concentration Area
- 5 ug/L TCE Concentration Area
- 10 ug/L TCE Concentration Area

Notes

1) ug/L = Micrograms per Liter
   TCE = Trichloroethene
   PCE = Tetrachloroethene

N
W E
S

Approximate Scale in Feet

0 500 1,000

Figure F-2.1
Nebo South Historical Groundwater
PCE and TCE Extents, 2007 - 2011

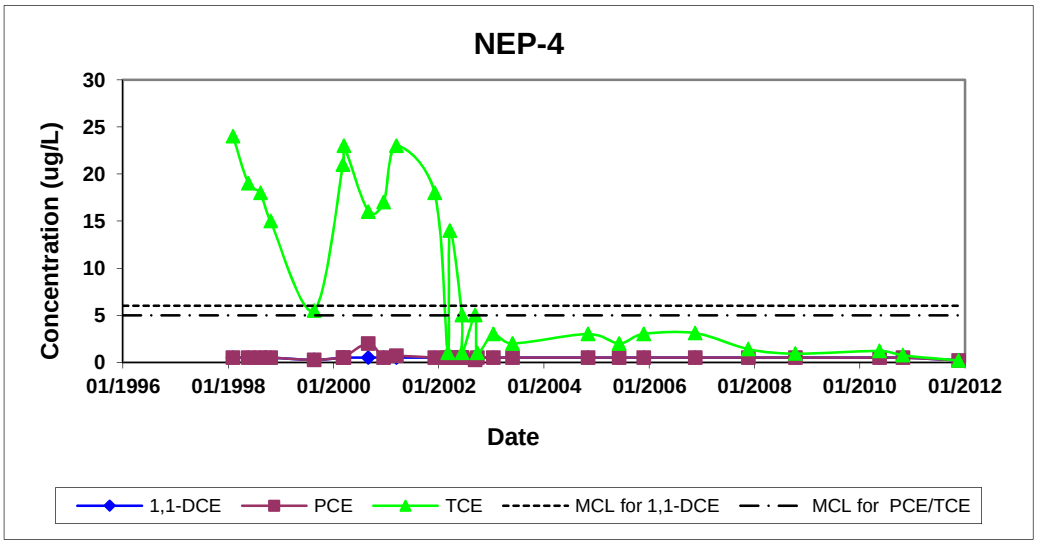
Nebo Main Base
Marine Corps Logistics Base
Barstow, California

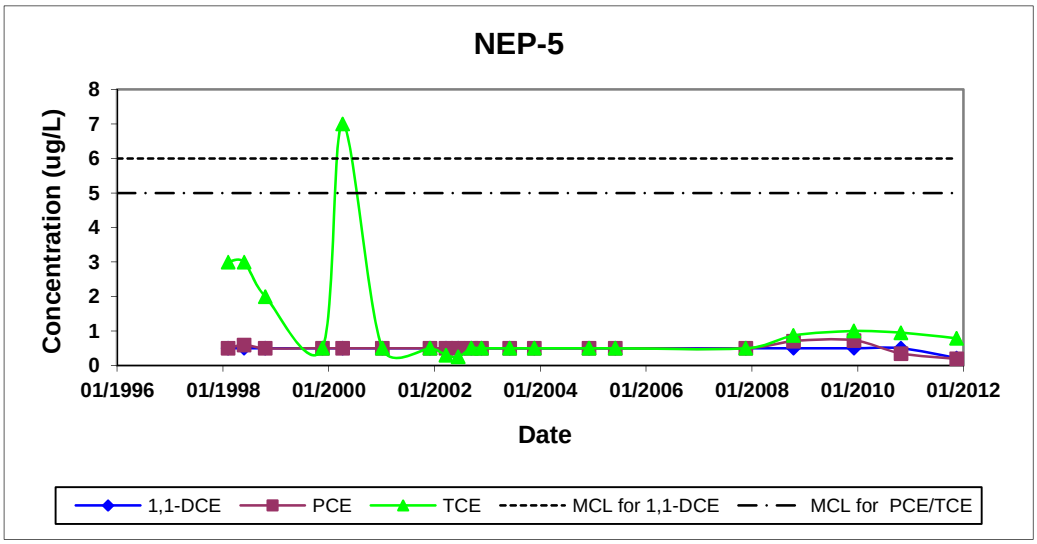
AIS-TN&A Joint Venture

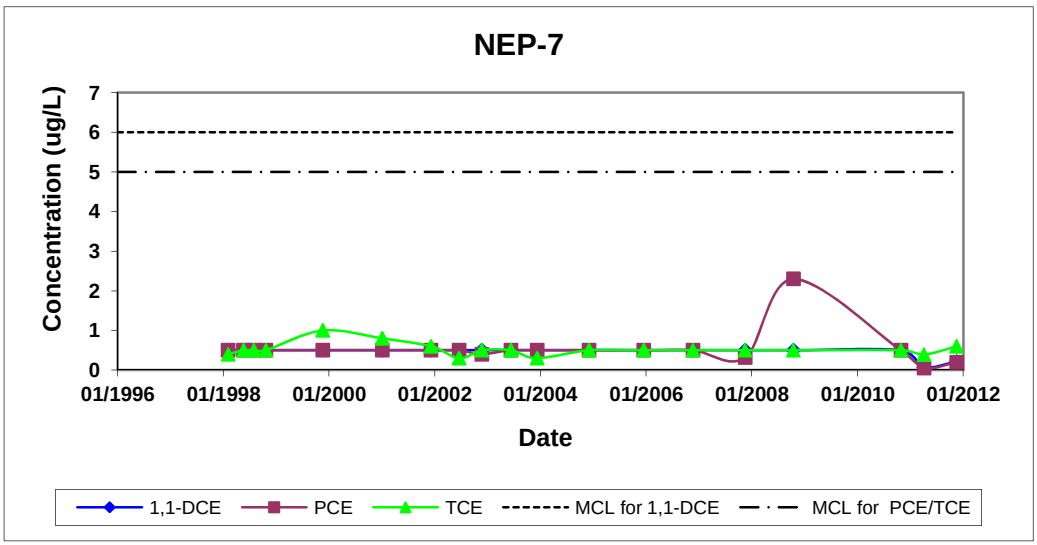
Date: June 7, 2012

File: Barstow_A11.dwg

Graph F-2.1
Historical Groundwater and Soil Vapor Analytical Data
Nebo Main Base, MCLB Barstow, California







Graph F-2.1
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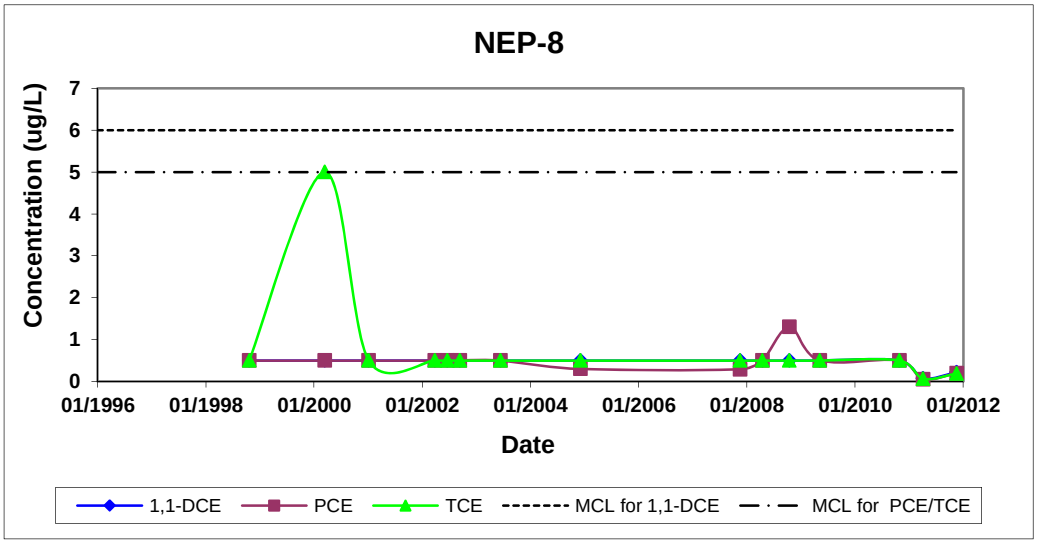
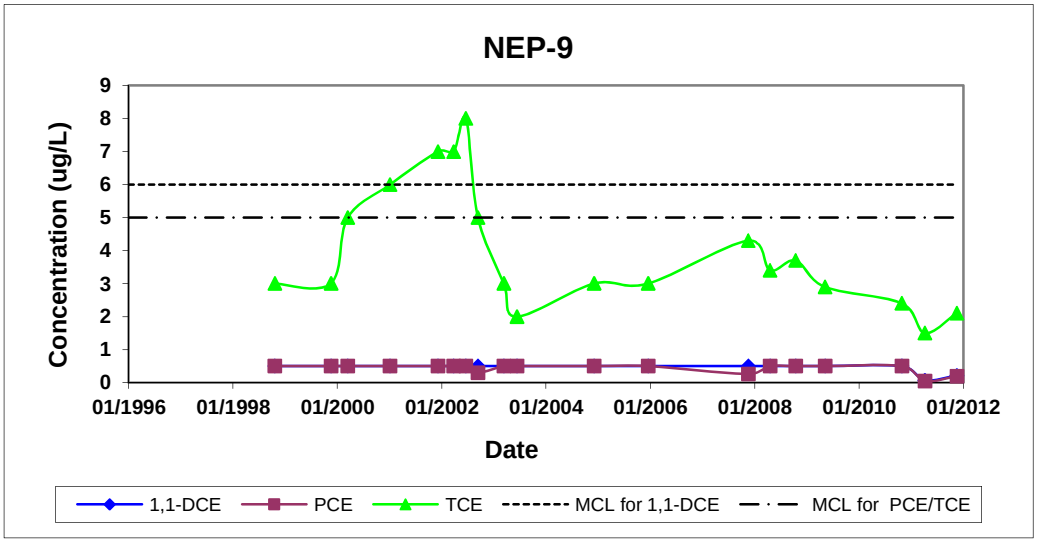
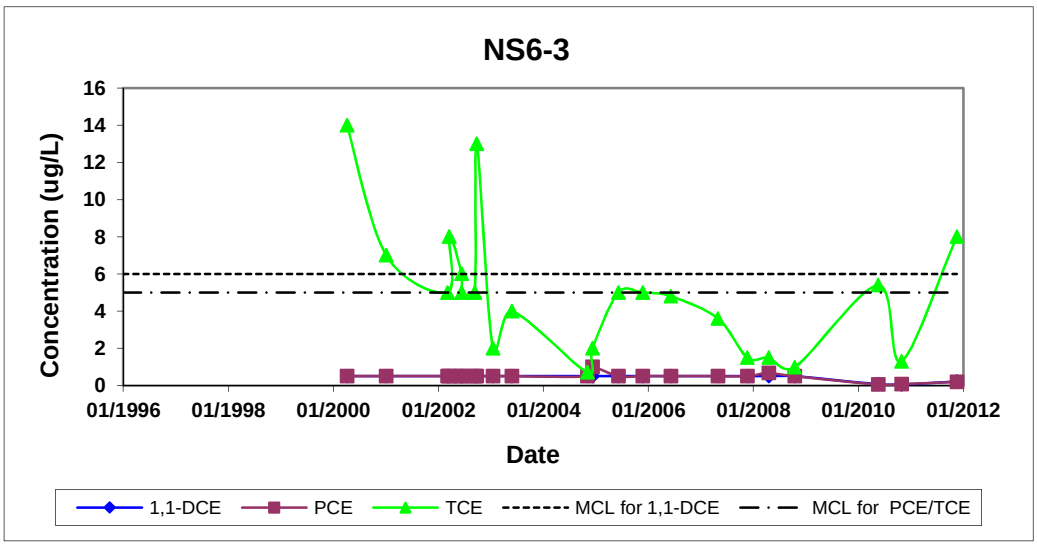
Nebo Main Base, MCLB Barstow, California







Graph F-2.1
Historical Groundwater and Soil Vapor Analytical Data
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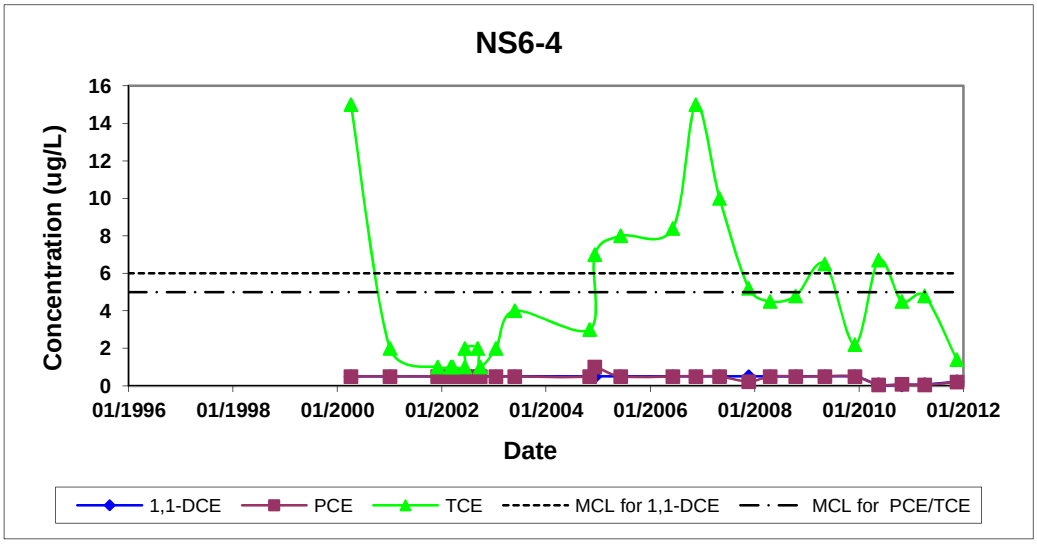

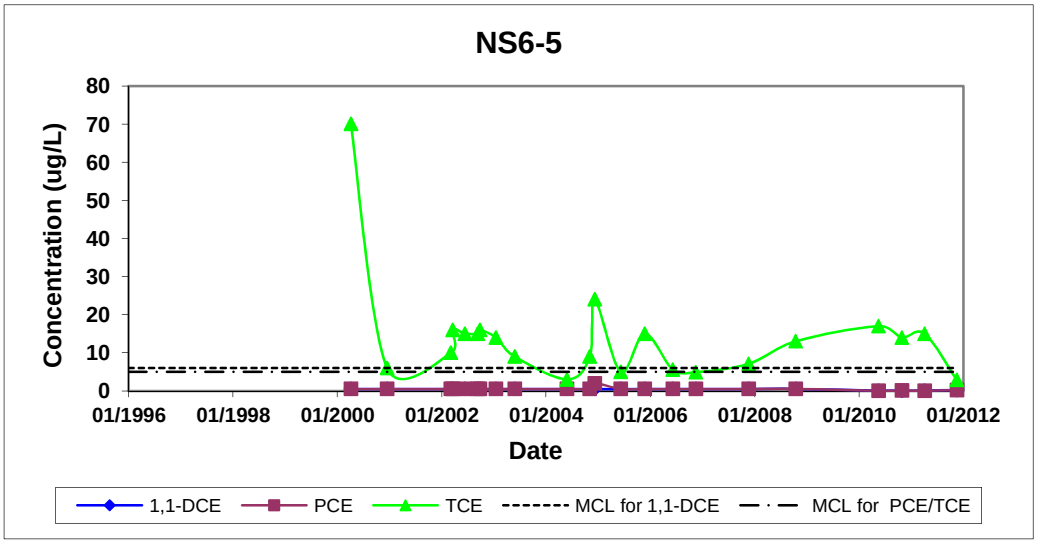

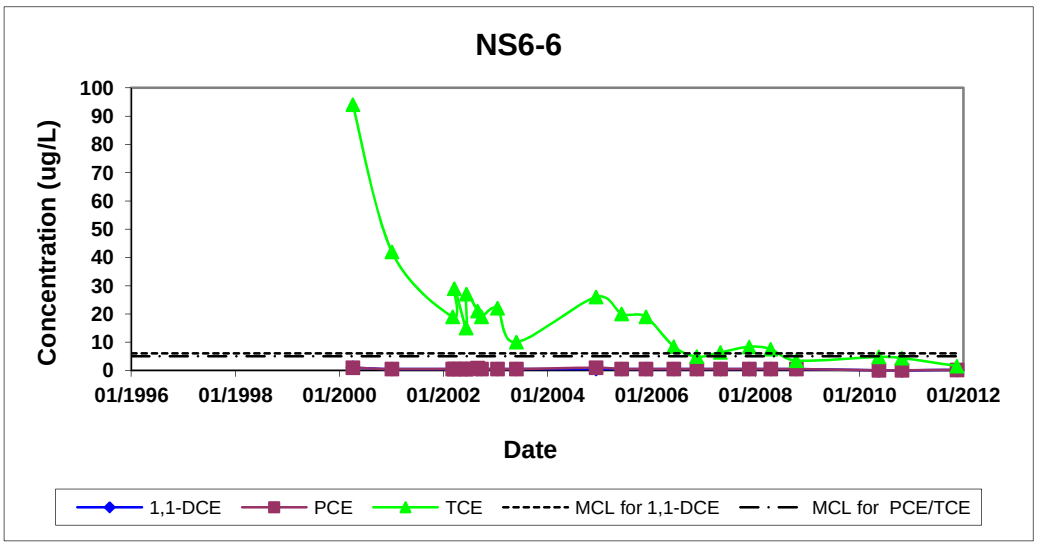

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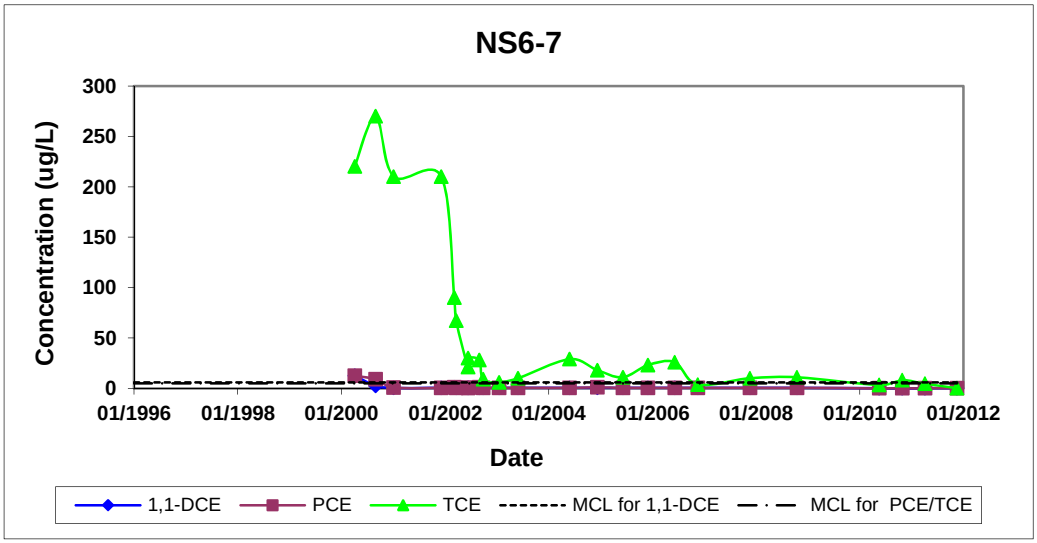
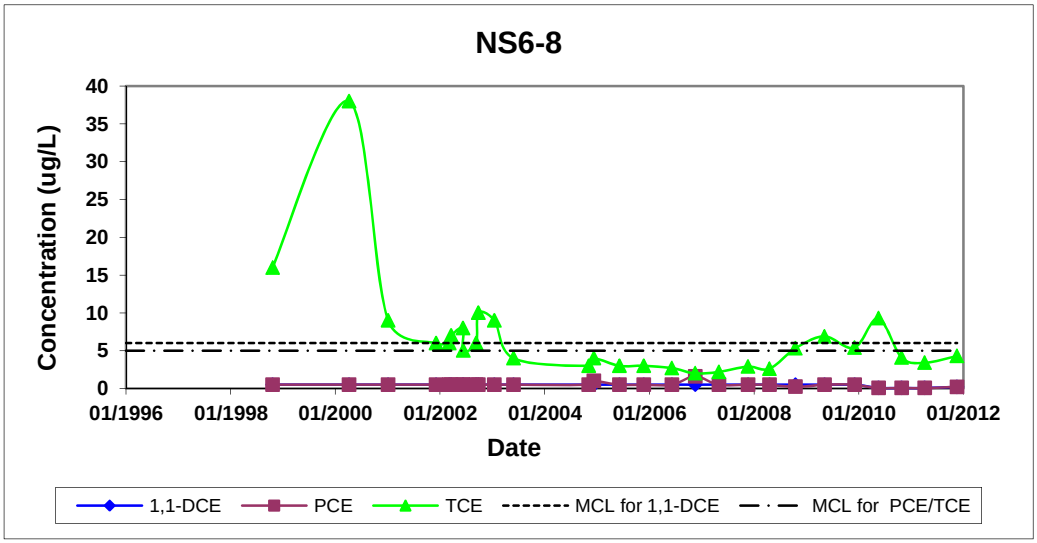
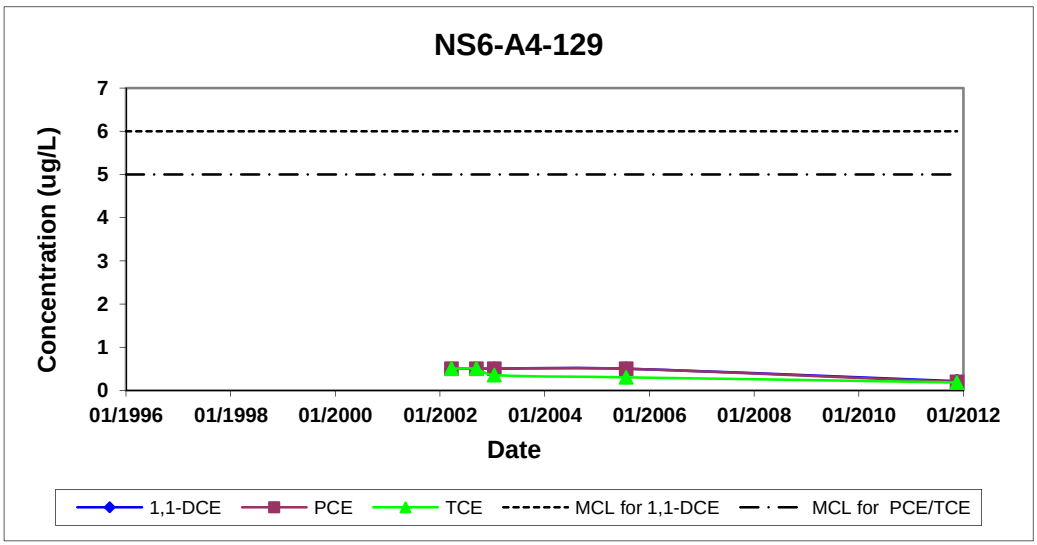
Nebo Main Base, MCLB Barstow, California







Graph F-2.1
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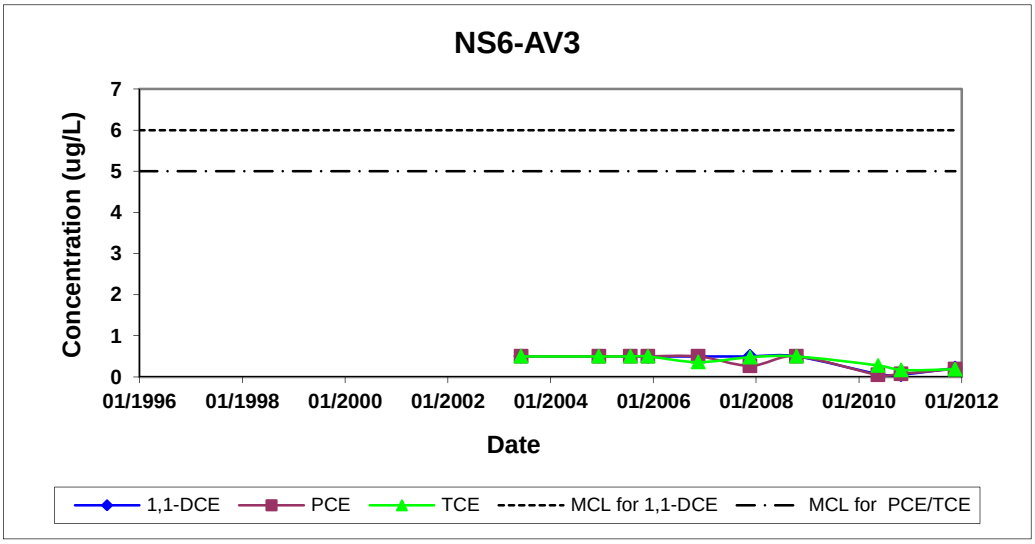
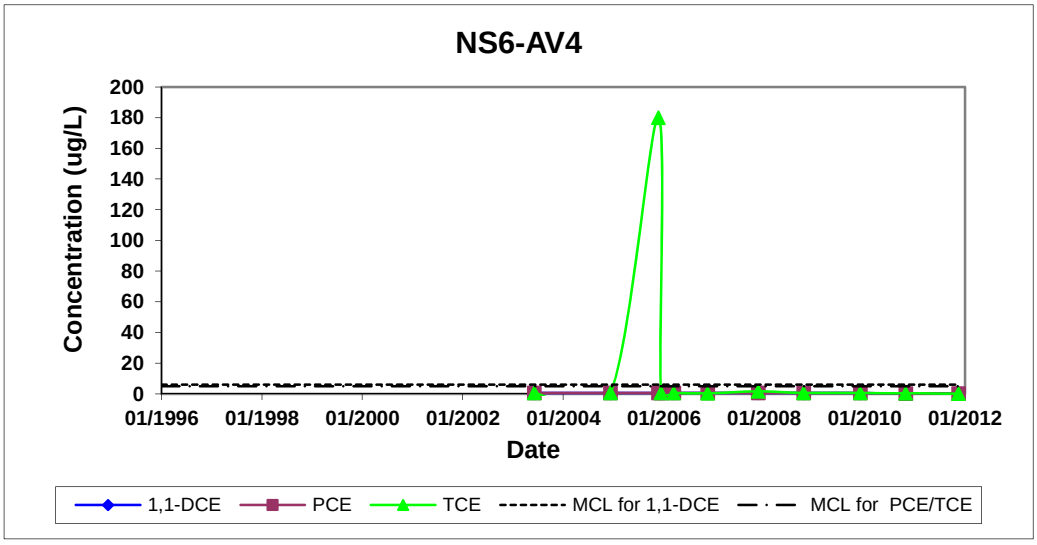
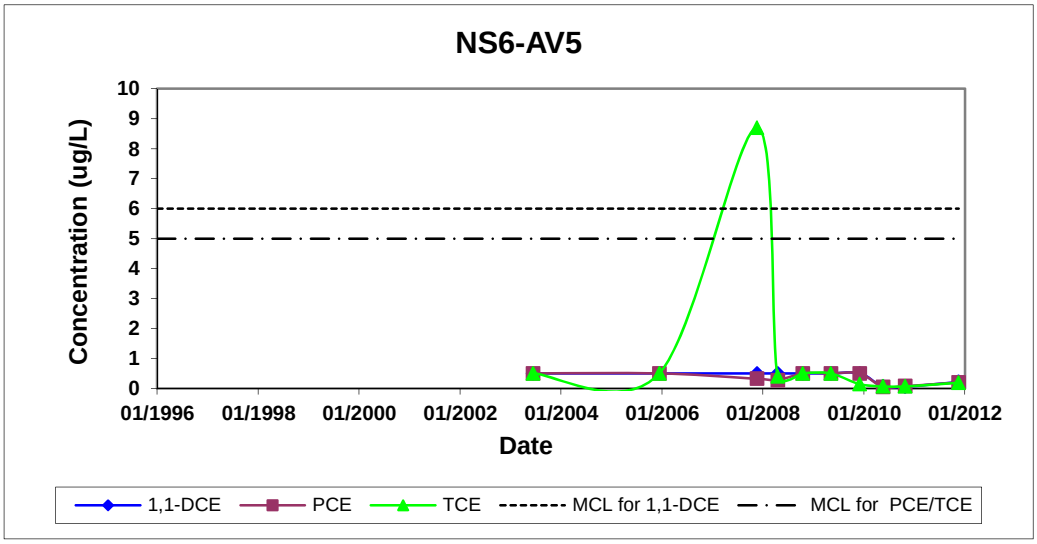
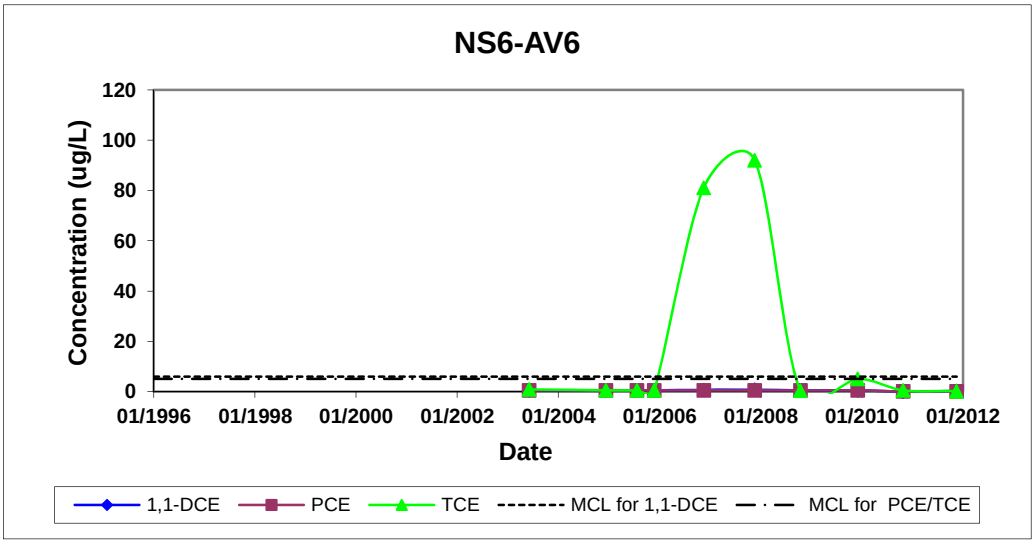
Nebo Main Base, MCLB Barstow, California

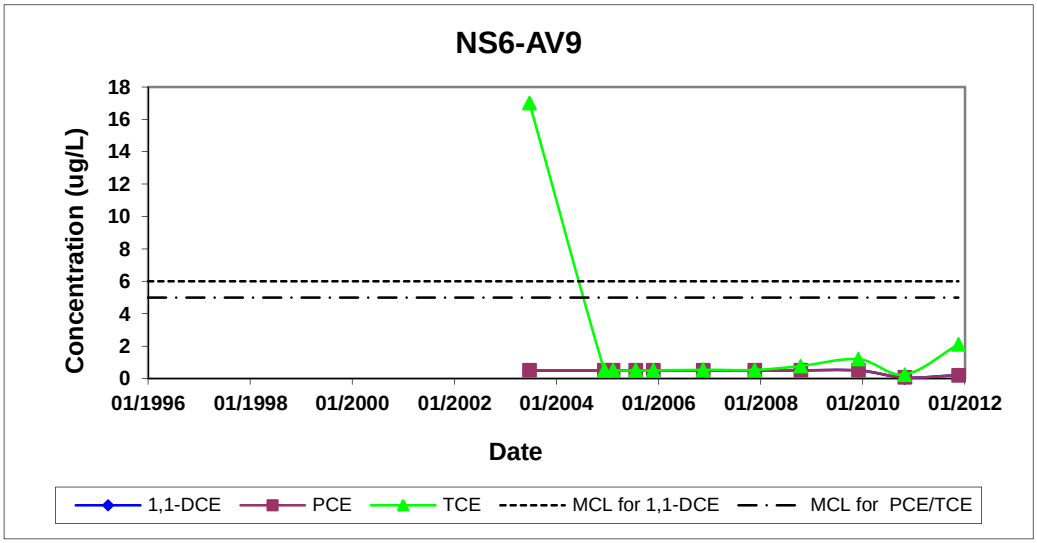


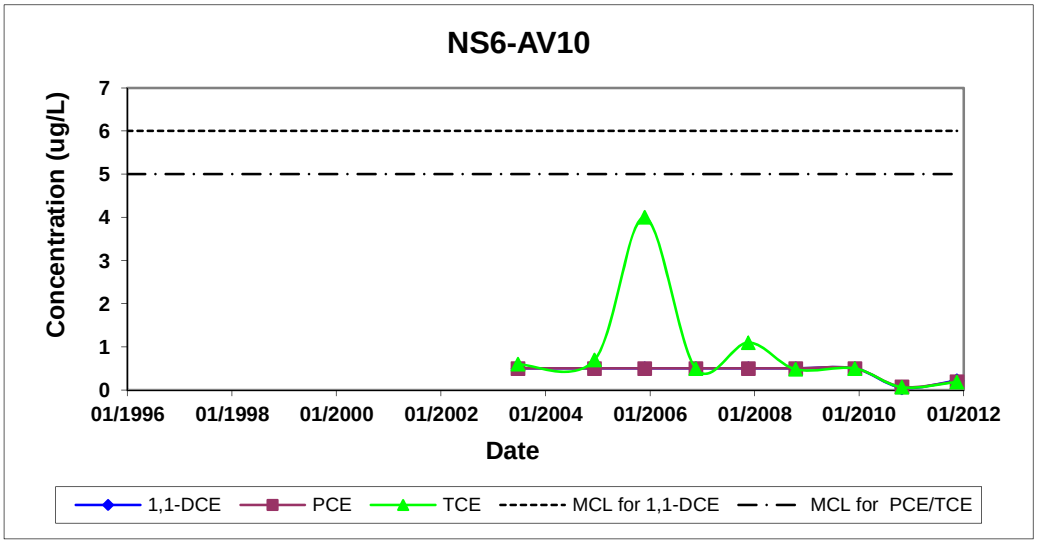




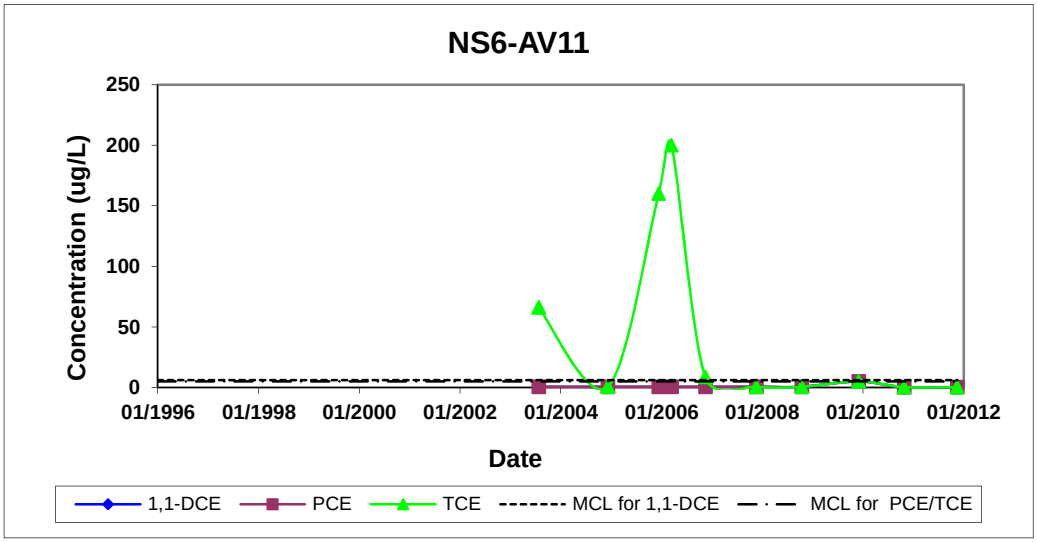
Graph F-2.1
Historical Groundwater and Soil Vapor Analytical Data
Nebo Main Base, MCLB Barstow, California

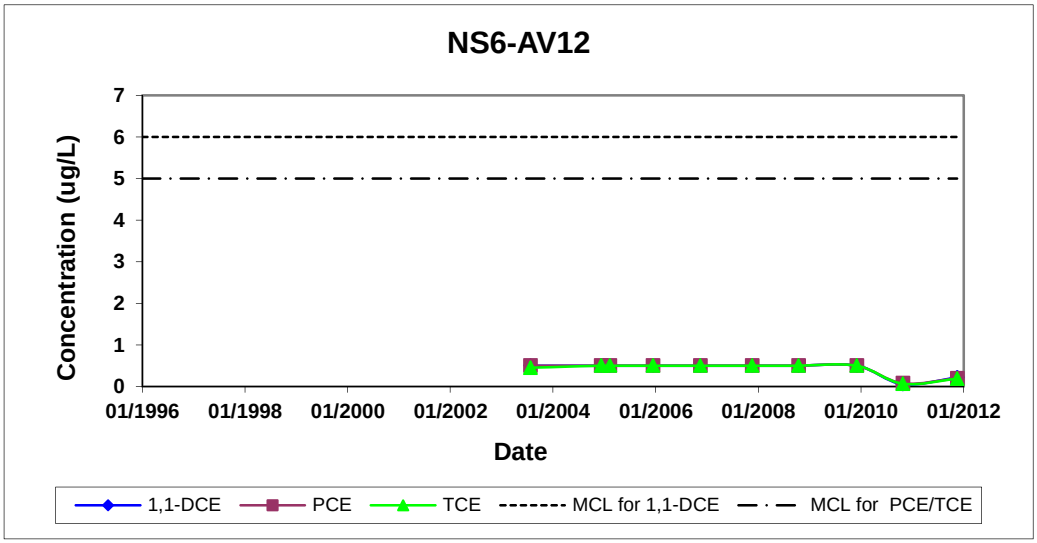


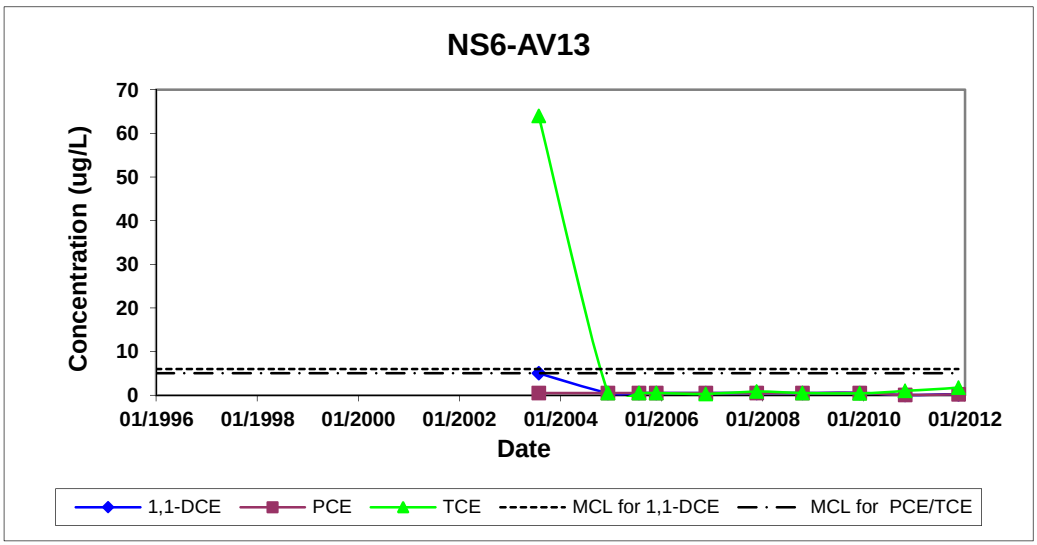




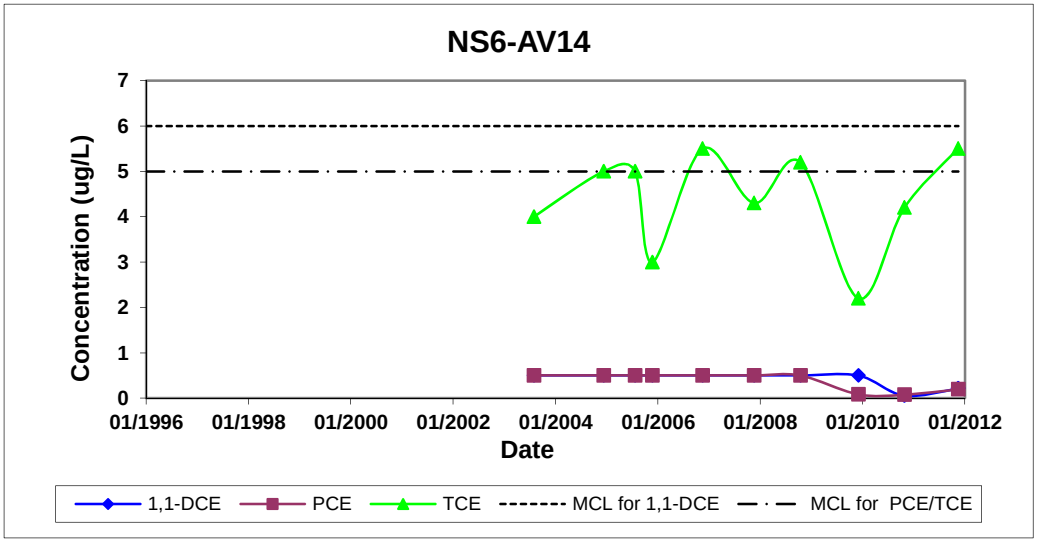
Graph F-2.1
Historical Groundwater and Soil Vapor Analytical Data
Nebo Main Base, MCLB Barstow, California

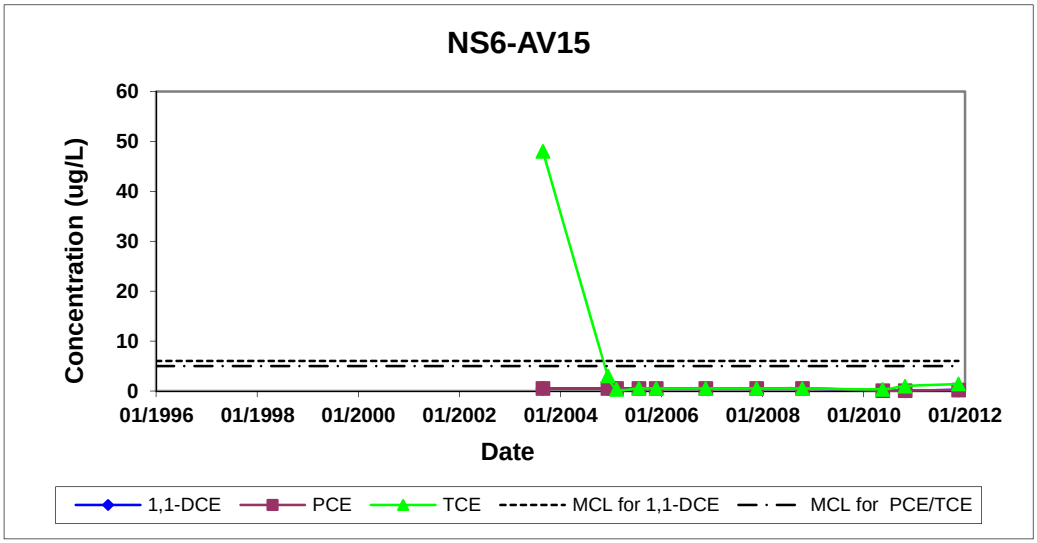


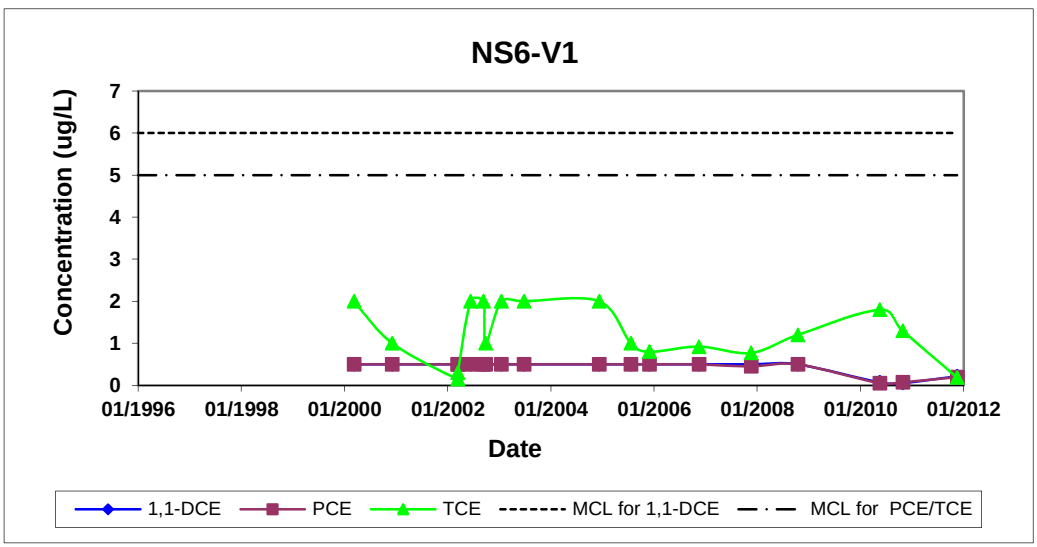




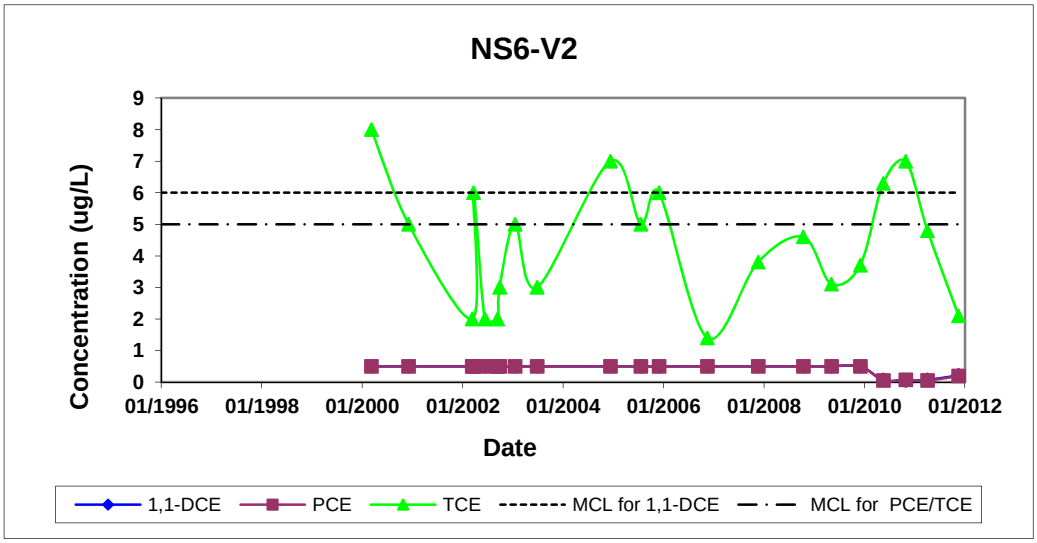
Graph F-2.1
Historical Groundwater and Soil Vapor Analytical Data
Nebo Main Base, MCLB Barstow, California

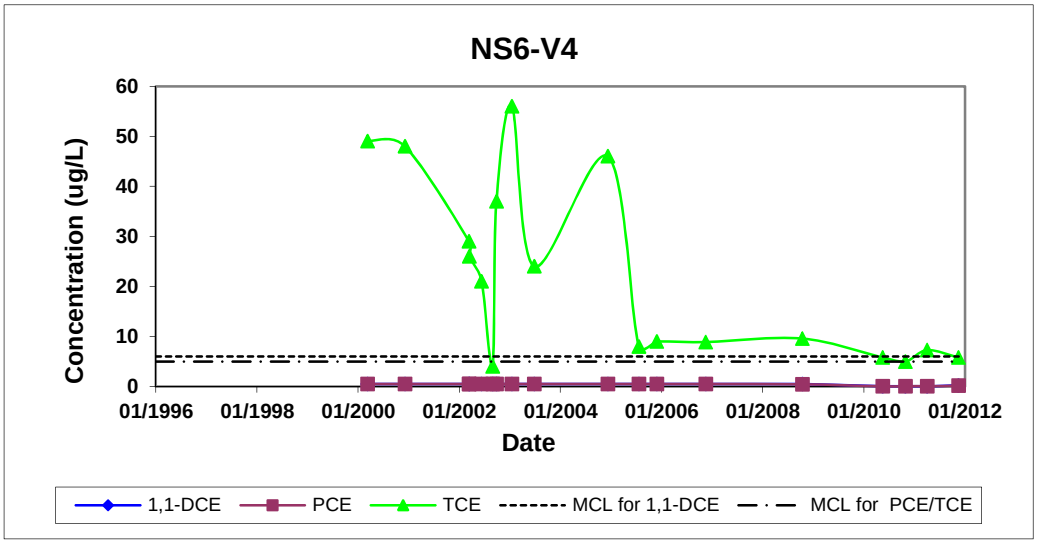


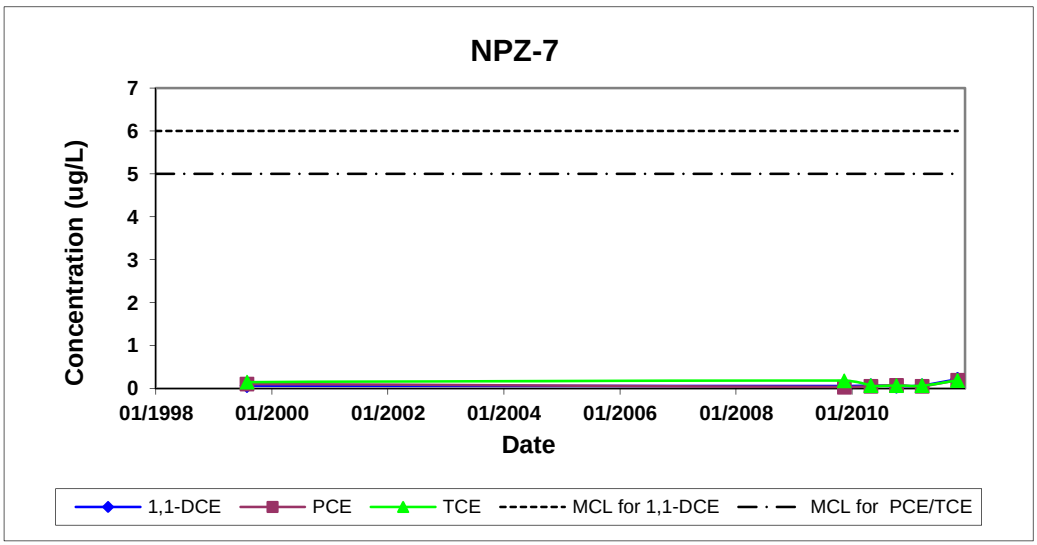




Graph F-2.1
Historical Groundwater and Soil Vapor Analytical Data
Nebo Main Base, MCLB Barstow, California

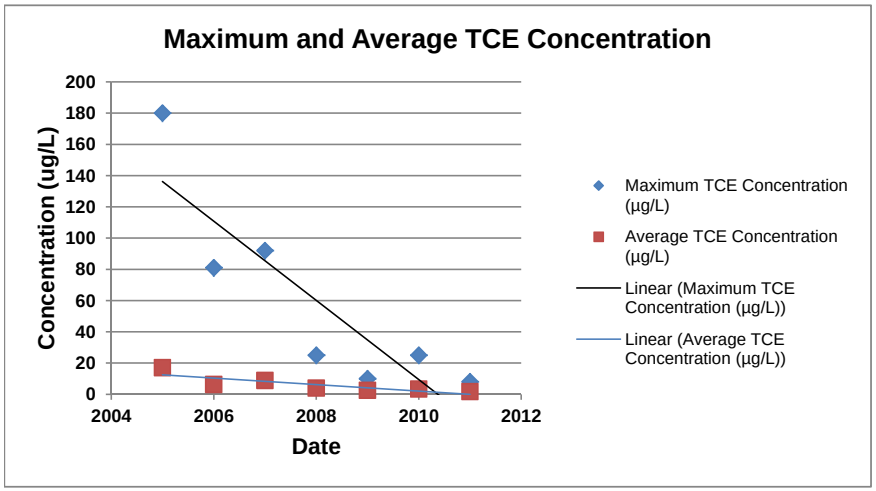


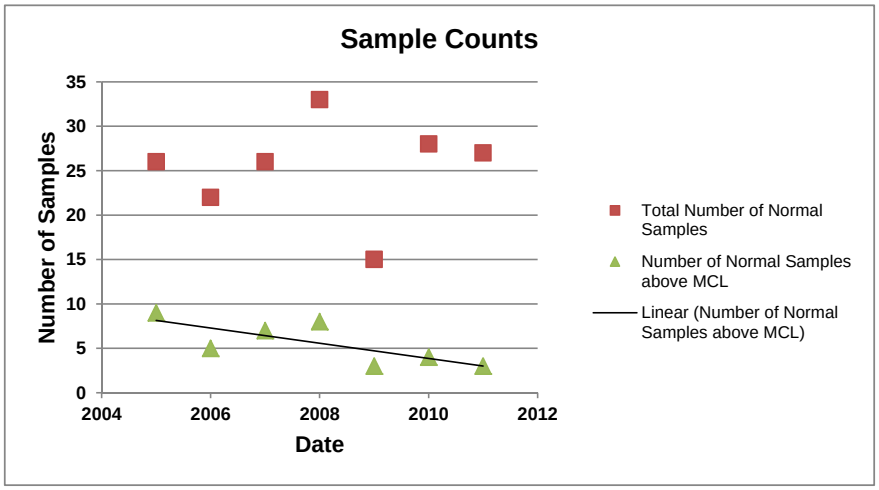


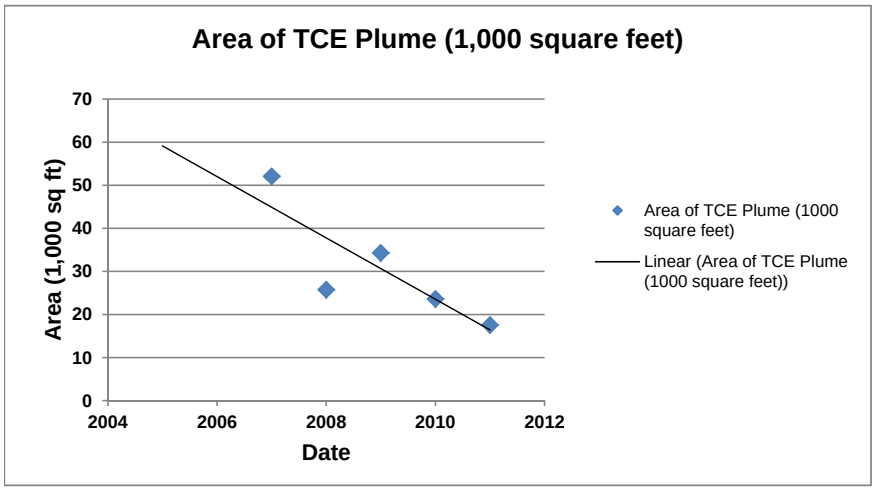


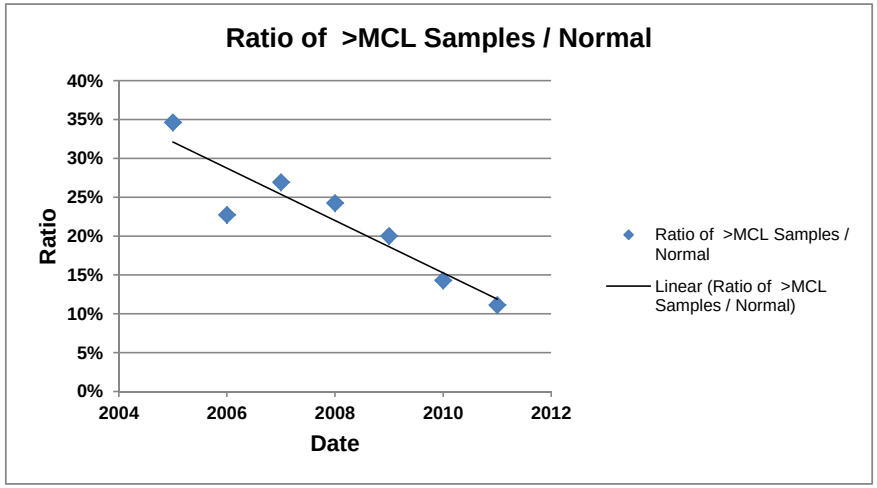
Graph F-2.2
Nebo South Plume: TCE Statistics
Nebo Main Base, MCLB Barstow, CA

	2005	2006	2007	2008	2009	2010	2011
Maximum TCE Concentration (µg/L)	180	81	92	25	10	25	8
Average TCE Concentration (µg/L)	17.07	6.23	8.83	3.89	2.51	3.27	1.71
Total Number of Normal Samples	26	22	26	33	15	28	27
Number of Normal Samples above MCL	9	5	7	8	3	4	3
Area of TCE Plume (1000 square feet)	NA	NA	52.08	25.73	34.27	23.59	17.55

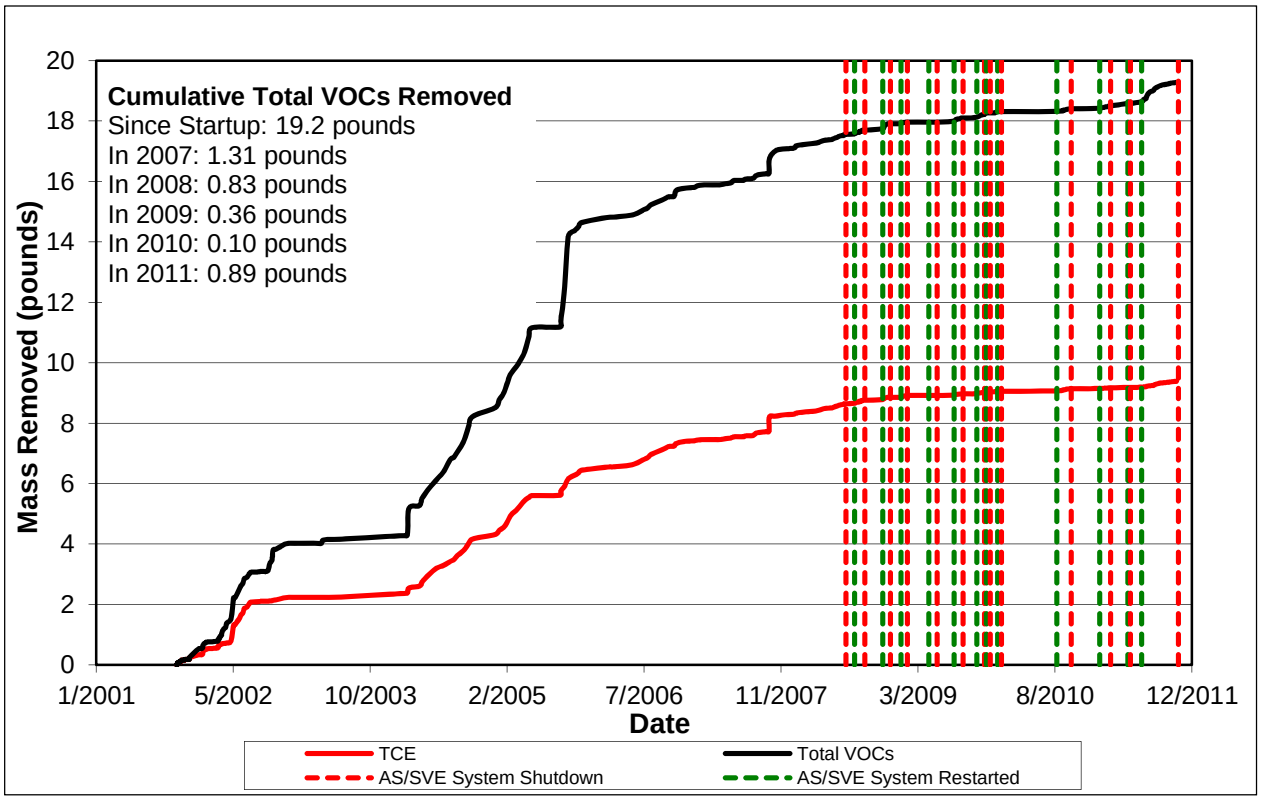








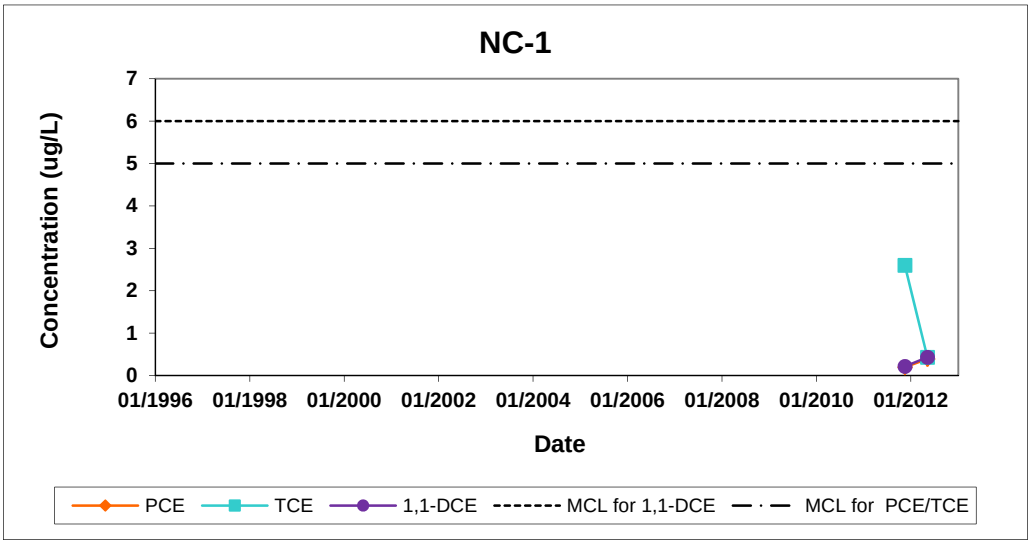
Graph F-2.3
Historical CAOC 6 AS/SVE System Performance
Nebo Main Base, MCLB Barstow, CA

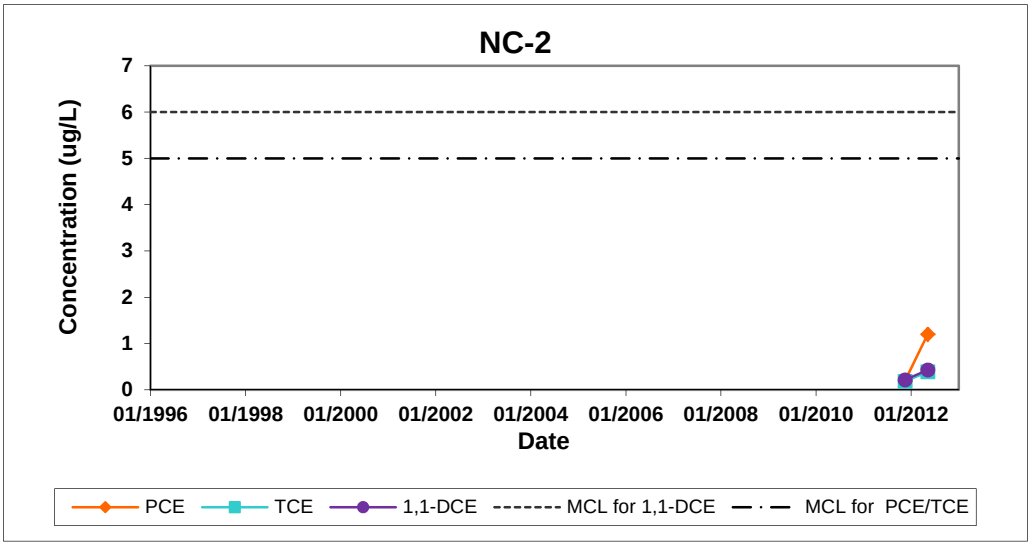


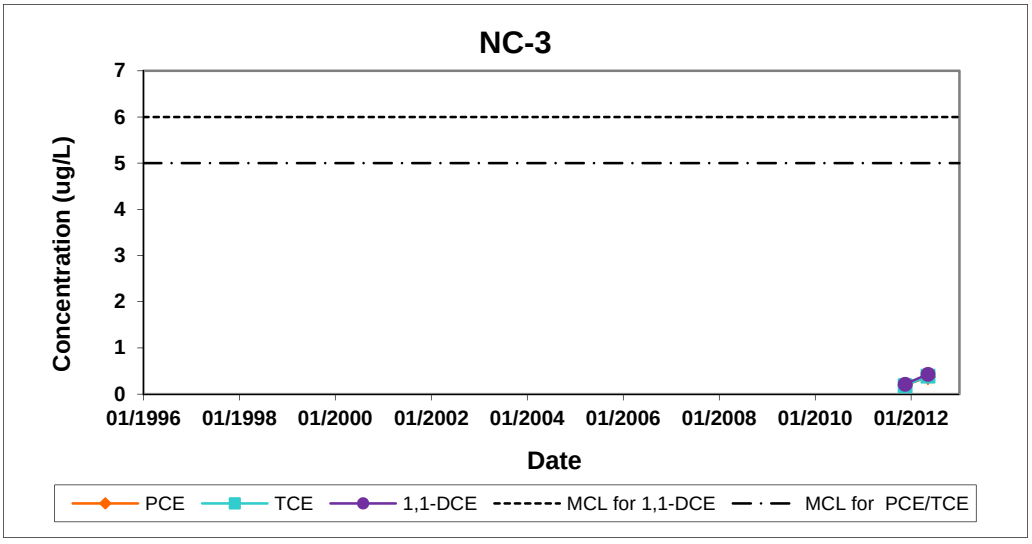
Notes:
AS/SVE = air sparging/soil vapor extraction
VOCs = volatile organic compounds; TCE = trichloroethene

Graph F-3.1
Historical Groundwater Analytical Data
for Piezometer NPZ-14, Tank 197 Wells, and CAOC 10.38/10.39 Unit 7 Wells

Nebo Main Base, MCLB Barstow, CA

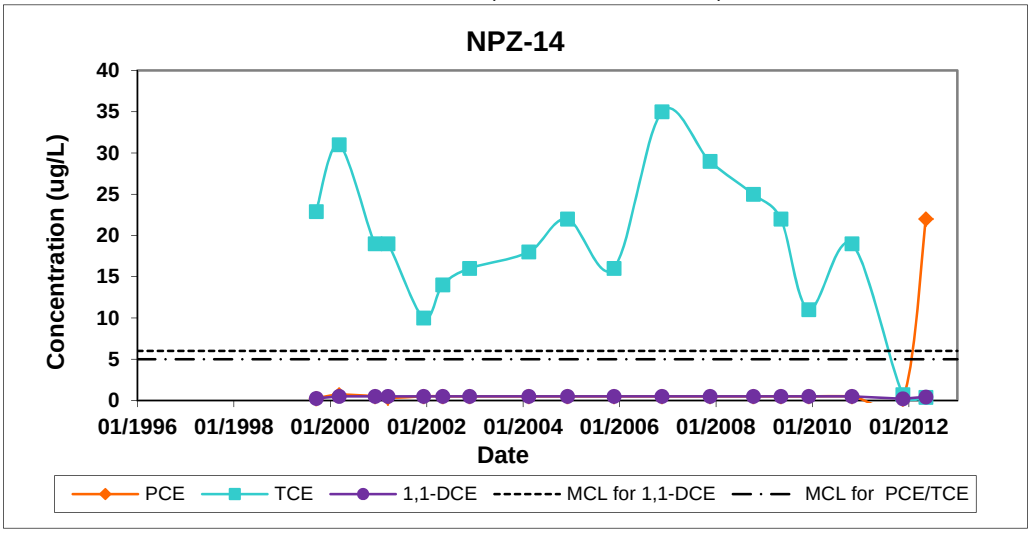


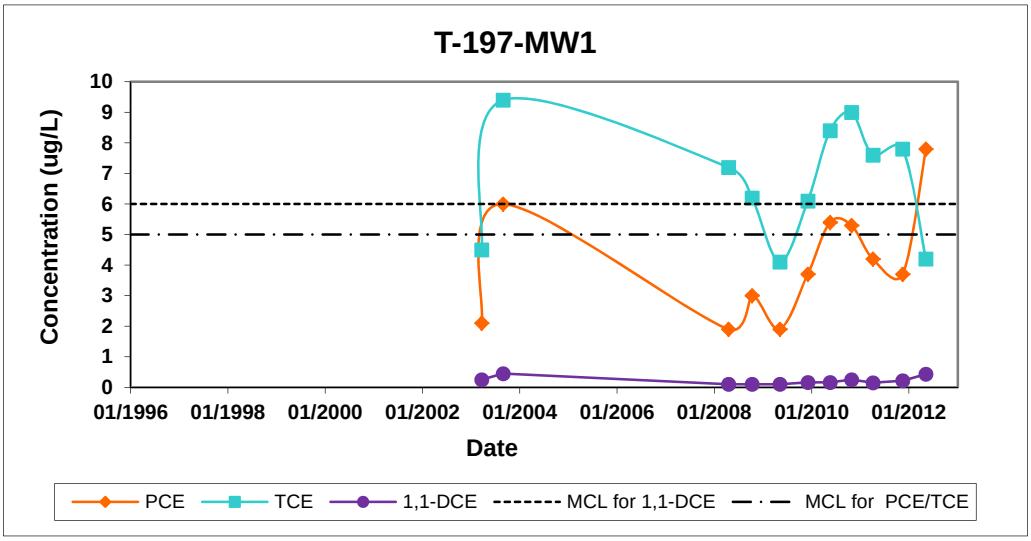


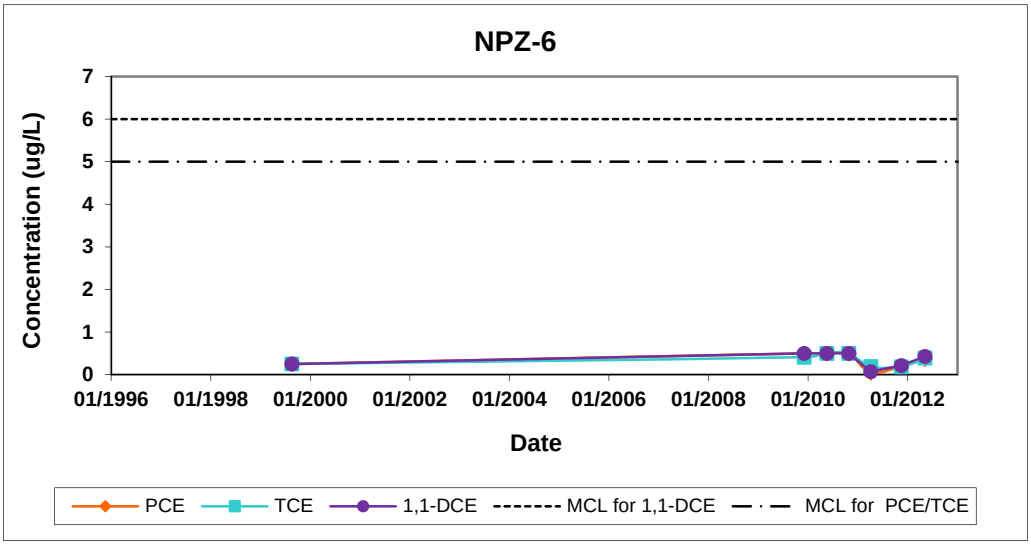


Graph F-3.1
Historical Groundwater Analytical Data
for Piezometer NPZ-14, Tank 197 Wells, and CAOC 10.38/10.39 Unit 7 Wells

Nebo Main Base, MCLB Barstow, CA

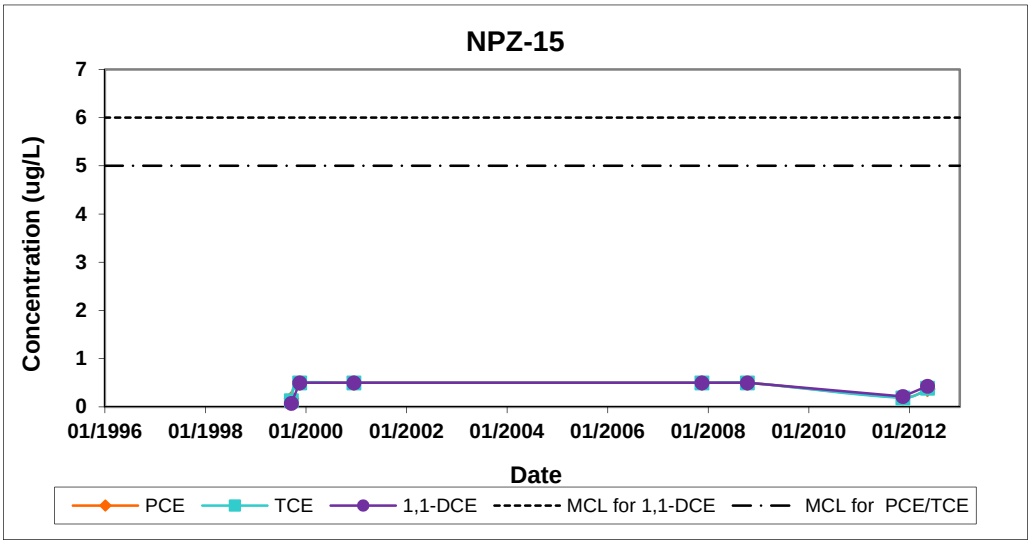


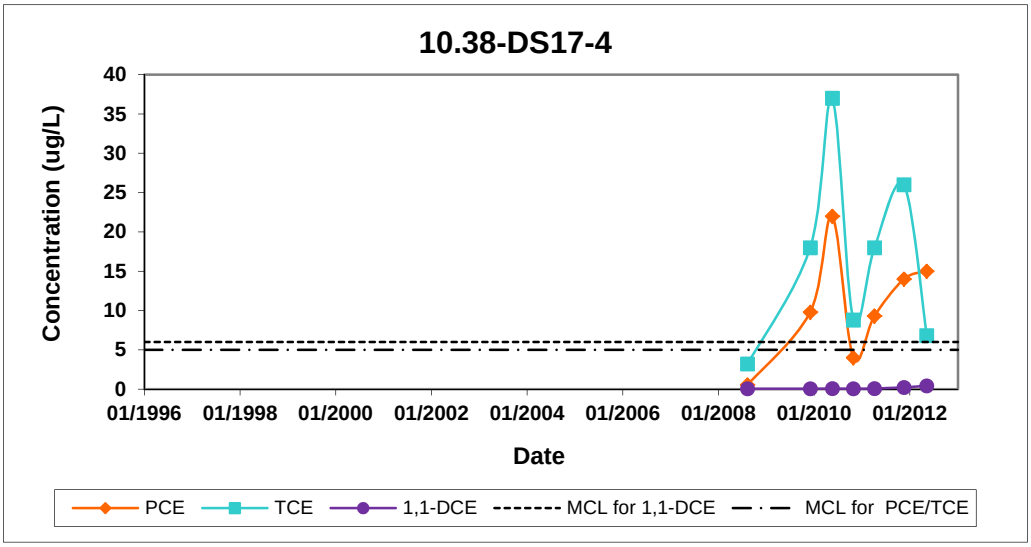


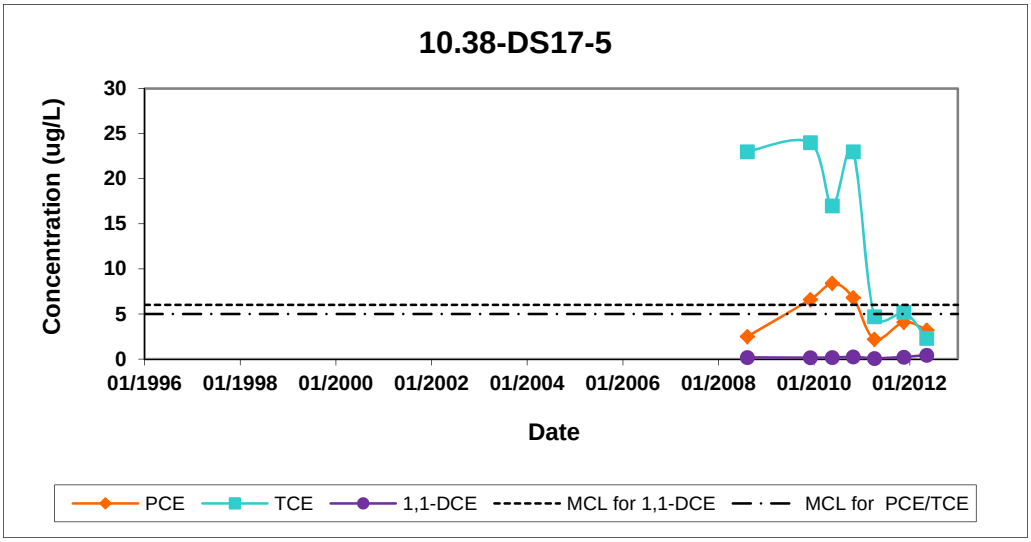


Graph F-3.1
Historical Groundwater Analytical Data
for Piezometer NPZ-14, Tank 197 Wells, and CAOC 10.38/10.39 Unit 7 Wells

Nebo Main Base, MCLB Barstow, CA

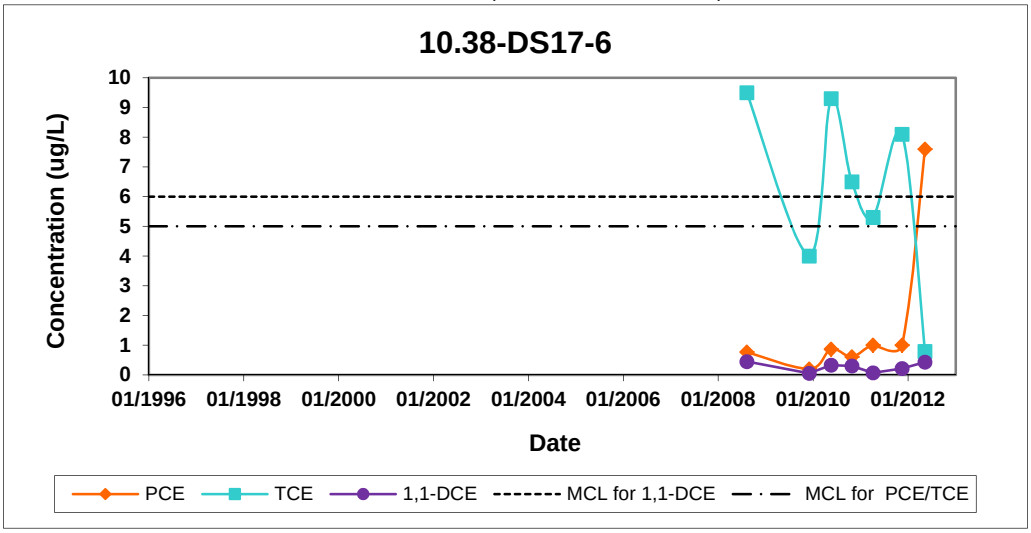






Graph F-3.1
Historical Groundwater Analytical Data
for Piezometer NPZ-14, Tank 197 Wells, and CAOC 10.38/10.39 Unit 7 Wells

Nebo Main Base, MCLB Barstow, CA



Notes:

1. Wells NC-1, NC-2, and NC-3 are newly installed wells, and the first sampling event was in 2011.
2. Preliminary data is used for last sampling event in May 2012.