Appendix M. Evaluation of Groundwater Chemical Migration to the Aquatic Environment

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Acronyms and Abbreviations

µg/L	microgram per liter
Bay	San Francisco Bay
BGMP	Basewide Groundwater Monitoring Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPC	chemical of potential concern
DDT	dichloro-diphenyl-trichloroethane
FS	feasibility study
HGAL	Hunters Point groundwater ambient level
PCB	polychlorinated biphenyl
RI	remedial investigation
RWQCB	Regional Water Quality Control Board, San Francisco Bay Region
SVOC	semi-volatile organic compound
TCE	trichloroethene
TIZ	tidal influence zone
TPH	total petroleum hydrocarbons
TtEMI	Tetra Tech EM, Inc.
VOC	volatile organic compound

Section M1. Introduction

This appendix evaluates which chemicals could potentially migrate to San Francisco Bay (the Bay) from Parcel E-2 A-aquifer groundwater at concentrations that exceed saltwater aquatic evaluation criteria. As a conservative measure, Parcel E-2 B-aquifer data were also compared to saltwater aquatic criteria; however, B-aquifer groundwater discharges into permeable zones underlying the Bay and does not result in direct exposures to aquatic receptors in the Bay. This screening level evaluation supplements the "Nature and Extent of Chemicals in Groundwater" evaluation presented in Section 5 of the remedial investigation/feasibility study [RI/FS] report, and is organized as follows:

- M1: Introduction
- M2: Aquatic Evaluation Methodology
- M3: Aquatic Evaluation Results
- M4: Conclusions and Recommendations

This screening level evaluation is considered preliminary because it does not account for attenuation of chemicals in groundwater migrating toward shore or for groundwater near the shore mixing with Bay water prior to discharging into the Bay. Therefore, the direct comparison screening of groundwater data against saltwater aquatic criteria is used primarily as a tool in identifying chemicals of ***potential*** concern (COPCs) in groundwater that may pose a risk to aquatic receptors in the Bay. A quantitative analysis that would identify chemicals of concern and specify risk-based remediation goals cannot be prepared until a method for comparing groundwater data to saltwater aquatic criteria, in a manner that accounts for chemical attenuation and the near-shore mixing process, has been agreed to by the Navy and the regulatory agencies.

Section M2. Aquatic Evaluation Methodology

To provide the most conservative evaluation of which chemicals in A-aquifer groundwater might potentially migrate to the Bay at concentrations above saltwater aquatic criteria, a thorough analysis was conducted of the existing data, including data collected during past investigations (i.e., the RI, the groundwater data gaps investigation, and the ongoing basewide groundwater monitoring program [BGMP, see subsection 3.5 of the RI/FS]). The data evaluation included both A- and B-aquifer data. As stated in Section M1, B-aquifer data were evaluated; as a conservative measure, even though the migration of chemicals in B-aquifer groundwater do not result direct exposures to aquatic receptors in the Bay. The steps involved in the aquatic evaluation are described below.

M2.1. COMPILATION OF GROUNDWATER DATA

As part of the nature and extent evaluation for Parcel E-2 groundwater (Section 5 of the RI/FS), all groundwater monitoring data collected at Parcel E-2 from 1990 to March 2005 were compiled and grouped in tabular form, by chemical category (i.e., anions, metals, organochlorine pesticides and polychlorinated biphenyls [PCBs], semi-volatile organic compounds [SVOCs], volatile organic compounds [VOCs], and petroleum hydrocarbons). Appendix J of the RI/FS contains the tables that list comprehensive analytical results for samples collected between 1990 and April 2005.

This aquatic evaluation utilized data collected from early 1995 to April 2005 (when the data set was "locked" for the purposes of performing the nature and extent evaluation and risk assessments). Data prior to 1995 was not utilized because anomalous chemical concentrations, particularly for metals, were detected throughout Parcel E-2 during this time period. The precise source of the anomalous concentrations was not identified; however, potential sources include improper sampling and field filtering techniques. Regardless, monitoring results from sampling performed since 1995 have demonstrated that the chemical concentrations prior to 1995 can be considered anomalous. For future monitoring rounds, groundwater chemical concentrations in two key areas (the PCB Hot Spot and Metal Slag Area) are anticipated to be reduced, relative to the data set presented in this evaluation, because recently-completed excavations have removed potential source material in the areas.

M2.2. IDENTIFICATION OF CHEMICAL DETECTIONS IN GROUNDWATER

For the nature and extent evaluation of Parcel E-2 groundwater, the chemical data were analyzed to establish the extent of detectable concentrations of chemicals in Parcel E-2 groundwater. Subsection 5.6 of the RI/FS summarizes the detections by chemical category. All monitoring well data were evaluated to identify all chemical concentrations exceeding reporting limits at Parcel E-2. Quantitative data, such as

the number, location, range of reporting limits, and magnitude and frequency of detections, are presented in the tables in Section 5 and Appendix J of the RI/FS. It should be noted that the laboratory reporting limits for current, routinely used analytical methods are greater than the aquatic criteria for the following chemicals (or chemical groups):

- cyanide
- sulfide
- 2-chloronaphthalene
- organochlorine pesticides
- PCBs

As a result, the screening criteria established in the BGMP Sampling and Analysis Plan (TtEMI, 2004c) were set at the Project-Required Quantitation Limits. Consistent with this approach, chemicals evaluated in this appendix were detected at concentrations greater than the laboratory reporting limit and exceeding the aquatic criterion. As a conservative measure, chemicals that were identified and quantified at concentrations below the laboratory reporting limit, but greater than the aquatic criterion, were also presented for informational purposes.

M2.3. SELECTION OF AQUATIC EVALUATION CRITERIA

Saltwater aquatic criteria have been identified for other studies conducted at Hunters Point Shipyard; specifically, the Parcel D FS and Parcel E RI, both of which are being prepared concurrent with the Parcel E-2 RI/FS. Table M-1 summarizes the saltwater aquatic criteria considered in this evaluation. As with the selection of remedial investigation evaluation criteria for soil and groundwater, the most conservative (lowest) saltwater aquatic criterion for each chemical was used in this evaluation, with the exception of metals in A-aquifer groundwater. For metals in A-aquifer groundwater, the appropriate Hunters Point groundwater ambient level (HGAL) (PRC Environmental Management, Inc., 1996) was selected as the aquatic evaluation criterion, unless an aquatic criterion exceeding the HGAL existed. In such a case, the most conservative (lowest) saltwater aquatic criterion above the HGAL was used as the aquatic evaluation criterion. A summary of HGALs is provided in Table M-2.

Petroleum hydrocarbons are not classified as a hazardous substance under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, Title 42 United States Code Section 9601[14]), and are therefore excluded from consideration under the CERCLA process unless it is commingled with hazardous substances regulated under the CERCLA program. A screening evaluation was conducted to identify areas where petroleum hydrocarbons are commingled with other organic and inorganic compounds that are regulated under CERCLA. The aquatic criterion used in this evaluation is based on the Hunters Point site-specific methodology established under the petroleum program (Tetra Tech EM, Inc. [TtEMI], 2004a). This methodology sums all total petroleum hydrocarbon (TPH) categories (gasoline-range, diesel-range, and motor-oil range) and compares it against a total TPH

criterion which ranges from 1,400 to 20,000 micrograms per liter (µg/L), depending on the distance from the shoreline.

M2.4. DATA EVALUATION

The goal of the data evaluation was to determine which target COPCs in groundwater potentially migrate to the Bay at concentrations that exceed aquatic evaluation criteria. Sampling results were posted to assess the lateral, vertical, and temporal extent of chemicals in groundwater and to identify areas where groundwater chemicals exceed aquatic evaluation criteria.

The data evaluation was focused on A-aquifer wells located within the tidal influence zone (TIZ) (Figure M-1), consistent with past requests from the Regional Water Quality Control Board (RWQCB) (RWQCB, 2006). The TIZ was defined as the area where the maximum tidal fluctuation exceeds 0.10 foot in the A-aquifer based on data collected during the Phase III groundwater data gaps investigation (TtEMI, 2004b). It should be noted that the TIZ, which is defined by groundwater level (pressure) responses to tidal fluctuations in the Bay, is not the same as the tidal mixing zone, where the Bay water flows in and out during a tidal cycle so that A-aquifer groundwater physically mixes with the Bay water. Past studies have shown that the TIZ extends farther inland than the tidal mixing zone (TtEMI, 2004b); therefore, the data evaluation presented herein is adequately conservative to assess potential exposure to aquatic receptors in the Bay. For completeness, the evaluation also compares concentrations in A-aquifer wells located inland of the TIZ and B-aquifer wells against the corresponding aquatic criterion.

In addition, the magnitude of the exceedances relative to aquatic evaluation criteria was used to help refine the evaluation. Figures M-2 through M-21 present data, in both the A- and B-aquifers, for each chemical (or, in the case of PCBs and petroleum hydrocarbons, group of chemicals) which has at least one detected concentration exceeding the corresponding aquatic evaluation criterion. For wells with data that exceed aquatic evaluation criteria, a data table is included to display the magnitude and temporal distribution of those exceedances.

The aquatic evaluation was performed for the following analyte groups: anions, metals, pesticides and PCBs, SVOCs, VOCs, and petroleum hydrocarbons. If potential contamination was identified in groundwater, the maps were further used to determine if the potential contamination:

- is short-lived or persistent over time (for example, whether or not the concentrations that exceed aquatic evaluation criteria have been detected during the last four sampling rounds)
- is invariable, increasing, or decreasing over time
- is present over a contiguous area, or is scattered, occurring in single unrelated locations
- significantly exceeds the aquatic evaluation criteria (that is, greater than 10 times the criteria)

Evaluation of the data based on these factors, using a weight-of-evidence approach, was used to identify target COPCs that may warrant further evaluation. The data evaluation was focused on the following A-aquifer wells located within the TIZ: IR01MWI-8, IR01MW62A, IR01MW63A, IR01MWI-7,

IR01MWI-9, IR01MW48A, IR01MWI-3, IR01MW43A, and IR01MW44A (Figure M-1). These tidally influenced wells are more indicative of potential chemical migration to the Bay compared to A-aquifer wells located inland of the TIZ and B-aquifer wells. With the exception of well IR01MWI-9, all A-aquifer wells within the TIZ are part of the well network used in the BGMP (TtEMI, 2004c).

Of the tidally influenced wells at Parcel E-2, wells IR01MWI-3, IR01MW43A, and IR01MW44A show the most persistent and elevated chemical concentrations in groundwater. Groundwater chemical concentrations in these wells, which are located within the PCB Hot Spot, are anticipated to be reduced during future monitoring rounds because the recently-completed PCB Hot Spot excavation has removed potential source material; however, additional monitoring is required to verify this presumption. Therefore, the evaluation provided in Section M3 conservatively identifies COPCs that warrant further monitoring and evaluation to assess the potential impact to the Bay.

The results of the aquatic evaluation are included in Section M3.

Section M3. Aquatic Evaluation Results

The following subsections describe the results of the graphical analysis of each chemical that exceeds its corresponding aquatic evaluation criterion at least once. Subsections are organized by chemical group (i.e., anions, metals, pesticides/PCBs, SVOCs, VOCs, or petroleum hydrocarbons).

M3.1. ANIONS

The anions exceeding aquatic evaluation criteria include un-ionized ammonia, cyanide, and sulfide. It should be noted that the laboratory reporting limits for current, routinely used analytical methods are greater than the aquatic evaluation criteria for some anions, including cyanide and sulfide. Thus, sample concentrations exceeding the aquatic evaluation criterion but less than the reporting limit were not included in the data analysis, unless they were estimated and reported by the laboratory. The analysis of the selected anion data revealed the following:

Un-ionized Ammonia (Figure M-2)***:*** At Parcel E-2, the oxygenation state of groundwater is reducing and most nitrogen present at the site is ionized ammonia (NH_4^+, also referred to as the ammonium ion), and some is un-ionized ammonia (the gas ammonia, NH_3, which dissolves readily in water and forms ammonium hydroxide, NH_4OH). Ammonification of nitrogen occurs during the decomposition of organic compounds, including naturally occurring organic matter and organic waste material. Ionized ammonia is generally harmless to aquatic life whereas un-ionized ammonia is toxic to aquatic life. The relationship between ionized and un-ionized ammonia is governed by the following equilibrium reaction:

$$NH_3 + H_2O \leftrightarrow NH_4OH \leftrightarrow NH_4^+ + OH^- \qquad \text{(M-1)}$$

where,

NH_3	=	ammonia gas (un-ionized; dissolves readily in water to form NH_4OH)
H_2O	=	water
NH_4OH	=	ammonium hydroxide (un-ionized)
NH_4^+	=	ammonium ion
OH^-	=	hydroxyl ion

The equilibrium reaction for ammonia is dependent on water quality parameters that are measured in the field, specifically pH, temperature, and salinity. In general, the concentration of un-ionized ammonia (as a percentage of total ammonia concentration) increases with increased pH levels and temperature (Horne and Goldman, 1994).

Un-ionized ammonia (calculated from total ammonia results and other field parameters [pH, temperature and specific conductance]) was detected at concentrations exceeding the aquatic criterion (25 µg/L) in 14 A-aquifer wells and 5 B-aquifer wells at Parcel E-2. Un-ionized ammonia concentrations within Parcel E-2 fluctuate considerably from one sampling round to another. Some results are not consistent with the preceding sampling event, and some results are not consistent with the results from the same season of the preceding year. Because un-ionized ammonia concentrations are calculated using field parameters, the potential exists for error to be introduced into the results.

Of the 19 wells where concentrations exceeding the aquatic criterion have been detected, three are located within the A-aquifer TIZ (IR01MW48A, IR01MWI-3, and IR01MW43A) and one is located in the B-aquifer within 150 feet of the shoreline (IR01MW47B). Detections exceeding the aquatic criterion in wells along the shoreline are persistent in wells IR01MW48A and IR01MW47B. Well IR01MW48A has consistently had concentrations exceeding the aquatic criterion since July 2002. Detections in well IR01MW48A have ranged from approximately 4 to 31 times the aquatic criterion. Well IR01MWI-3 had two detections exceeding the aquatic criterion in 2002, which have not recurred over two subsequent sampling events in 3 years. The first detectable concentration exceeding the aquatic criterion in well IR01MW43A occurred in March 2005. The detection was 20 times the aquatic criterion. Well IR01MW47B has consistently detected concentrations exceeding the aquatic criterion in the three most recent sampling events since September 2004, with detections ranging from approximately four to five times the aquatic criterion. The extent of un-ionized ammonia in groundwater along the Bay shoreline is not adequately delineated by concentrations below the aquatic criterion along the shoreline of Parcel E-2 in wells IR01MW48A, IR01MWI-3, IR01MW43A, and IR01MW47B, where elevated concentrations of un-ionized ammonia in A-aquifer groundwater may migrate to the Bay, and elevated concentrations in B-aquifer groundwater may migrate to permeable zones underlying the Bay. Therefore, un-ionized ammonia is a COPC that warrants further monitoring and evaluation to assess the potential impact to the Bay.

Cyanide (Figure M-3)***:*** Cyanide, a carbon-nitrogen chemical unit which combines with many organic and inorganic compounds, was detected at concentrations exceeding the aquatic evaluation criterion (1 µg/L) in six A-aquifer and three B-aquifer Parcel E-2 monitoring wells. The highest concentrations of cyanide were from samples collected from wells within the extent of landfill waste. Of the nine wells where cyanide was detected at concentrations exceeding the aquatic criterion, one well is a tidally influenced well (IR01MW48A). The tidally influenced well (IR01MW48A) had a single detection of cyanide that exceeded the aquatic criterion in September 2002. Detections exceeding the aquatic criterion did not recur in four sampling events over two and a half years. A near-shore B-aquifer well (IR01MW47B) had a single sample that exceeded the aquatic criterion in December 2004 (the first cyanide detection in this well). The extent of cyanide in groundwater near the Bay shoreline is adequately delineated by concentrations below the laboratory reporting limits except at well IR01MW47B, where elevated concentrations of cyanide in groundwater may be migrating to permeable zones underlying the Bay.

Consistent with conceptual site model (Section 6 of the RI/FS), discharges to permeable zones underlying the Bay do not result in direct exposures to aquatic receptors in the Bay. The single detection in this well's sampling history may be anomalous, but further data collection is required to confirm this presumption. In addition, elevated concentrations of cyanide have been detected in A-aquifer wells throughout the Parcel E-2 Landfill. Therefore cyanide, although not a COPC for aquatic receptors in the Bay, warrants further monitoring as part of the groundwater monitoring program for the landfill.

Sulfide (Figure M-4)***:*** Sulfide was detected at concentrations exceeding the aquatic evaluation criterion (2 µg/L) in 16 A-aquifer wells and 1 B-aquifer well. Of these 17 wells, 4 are located within the A-aquifer TIZ (IR01MW48A, IR01MWI-3, IR01MW43A, and IR01MW44A). The remaining wells are almost all concentrated within the extent of the landfill waste and adjacent area. Well IR01MW48A had four detections exceeding the aquatic criterion between July 2002 and September 2004, ranging from 290 to 6500 times the aquatic criterion. Detections of sulfide exceeding the aquatic criterion in these wells did not recur in two subsequent sampling events within 6 months. Well IR01MWI-3 exhibited a single detection exceeding the aquatic criterion in August 2002 that has not recurred over three subsequent sampling events over a three-year period. The detection measured in August 2002 was 165 times the aquatic criterion. Sulfide was detected at concentrations exceeding the aquatic criterion at well IR01MW43A three times between September 2004 and March 2005, with detections ranging from 5500 to 18,500 times the aquatic criterion. Well IR01MW44A exhibited a single detection exceeding the aquatic criterion in September 2004, which did not recur in two subsequent sampling events over six months. The detection in September 2004 was approximately 7500 times the aquatic criterion. The extent of sulfide in groundwater is adequately delineated by concentrations below the laboratory reporting limits except at wells IR01MWI-3, IR01MW48A, IR01MW43A, and IR01MW44A, where elevated concentrations of sulfide in groundwater have been detected recently and may be migrating to the Bay. Therefore, sulfide is a COPC that warrants further monitoring and evaluation to assess the potential impact to the Bay.

M3.2. METALS

Maps were created for the following metals because their concentrations exceeded aquatic criteria in the A- or B-aquifers: cadmium, copper, lead, mercury, nickel, and zinc. Results from the analysis of metals concentrations revealed the following:

Cadmium (Figure M-5)***:*** Cadmium was detected at concentrations exceeding the aquatic criterion (8.8 µg/L) in one A-aquifer well (IR01MW366A) between 2001 and 2004. The well is located within the extent of the landfill waste, over 500 feet from the shoreline. Based on data from monitoring wells to the south and east, the potential for cadmium migration from this location is very low. The most recent detected cadmium concentration exceeding the aquatic criterion in well IR01MW366A occurred in June 2004. The detection at that time was 1.1 times the aquatic criterion. No wells along the shoreline show

detections of cadmium exceeding the aquatic criterion. Based on this information, cadmium is not considered a COPC that potentially impacts the Bay.

Copper (Figure M-6)***:*** Copper was detected at concentrations exceeding the A-aquifer aquatic criterion (28.0 µg/L) in three A-aquifer wells and the B-aquifer aquatic criterion (3.1 µg/L) in four B-aquifer wells. Four of the seven wells are located within the landfill waste, at least 300 feet from the shoreline with the highest detected concentrations of copper detected over 500 feet from the shoreline. Copper was detected at concentrations exceeding the aquatic criterion in tidally influenced well IR01MW44A. This well exhibited a single detection that occurred somewhat recently (June 2004) that was approximately 92 times the aquatic criterion. The well has not exhibited any other detections exceeding the aquatic criterion over three subsequent sampling events in 9 months. A near-shore B-aquifer well (IR01MW53B) had a single sample that slightly exceeded the aquatic criterion (by less than 20 percent) in September 2004. The potential for copper migration from well IR01MW53B is very low because: 1) the result exceeded the aquatic criterion by less than 20 percent; 2) the result did not recur during two subsequent sampling events in December 2004 and March 2005; and 3) discharges of copper concentrations (exceeding the aquatic criterion) in groundwater to the permeable zones underlying the Bay do not result in direct exposures to aquatic receptors in the Bay. The extent of copper in groundwater is adequately delineated by concentrations below the aquatic criterion except at well IR01MW44A. Groundwater chemical concentrations in this well are anticipated to be reduced during future monitoring rounds because the recently-completed PCB Hot Spot excavation has removed potential source material; however, additional monitoring is required to verify this presumption. Therefore, copper is a COPC that warrants further monitoring and evaluation to assess the potential impact to the Bay.

Lead (Figure M-7)***:*** Lead concentrations exceeded the A-aquifer aquatic criterion (14.44 µg/L) in six A-aquifer wells and the B-aquifer aquatic criterion (8.1 µg/L) in two B-aquifer wells. Detections exceeding the aquatic criterion are not persistent over time and are widely distributed across the site. The highest detected concentrations of lead occurred over 500 feet from the Parcel E-2 shoreline. Three tidally influenced A-aquifer wells showed detections of lead exceeding the aquatic criteria (IR01MW62A, IR01MW43A, and IR01MW44A). Well IR01MW62A had one detected concentration that exceeded the A-aquifer aquatic criterion in June 2004; however, concentrations in three subsequent sampling events over nine months were below the evaluation criterion. In addition, lead was not detected in samples collected from two wells located within 150 feet of well IR01MW62A. In IR01MW43A, the detected concentrations exceeding the A-aquifer aquatic criterion occurred in September and November 2004, were approximately one to two times the aquatic criterion, and did not recur in the March 2005 sampling event. Well IR01MW44A had one detected concentration that exceeded the A-aquifer aquatic criterion in June 2004; however, concentrations in three subsequent sampling events over nine months were below the evaluation criterion. The extent of lead in groundwater is adequately delineated by concentrations below the aquatic criterion except in wells IR01MW43A and IR01MW44A. Groundwater chemical concentrations in these wells are anticipated to be reduced in the future because the recently-completed

PCB Hot Spot excavation has removed potential source material; however, additional monitoring is required to verify this presumption. Therefore, lead is a COPC that warrants further monitoring and evaluation to assess the potential impact to the Bay.

Mercury (Figure M-8)***:*** Mercury concentrations exceeded the A-aquifer aquatic criterion (0.6 µg/L) in two A-aquifer wells. One of the two wells that had detections exceeding the aquatic criterion (IR01MW366A) is located within the extent of the landfill waste and is over 500 feet from the shoreline. Well IR01MW366A shows persistent detections exceeding the aquatic criterion, ranging from 3 to 542 times the aquatic criterion. However, based on data from monitoring wells to the south and east, the potential for mercury migration from this location is very low. Well IR01MW44A is a tidally influenced well which in June 2004 contained mercury at a concentration of 7.2 µg/L, or 12 times the aquatic criterion. During the three monitoring events since June 2004, neither well IR01MW44A, nor any other tidally influenced well had a detection of mercury exceeding the aquatic criterion (over three or more sampling events). The extent of mercury in groundwater is adequately delineated by concentrations below the aquatic criterion except at well IR01MW44A. Groundwater chemical concentrations in this well are anticipated to be reduced in the future because the recently-completed PCB Hot Spot excavation has removed potential source material; however, additional monitoring is required to verify this presumption. Therefore, mercury is a COPC that warrants further monitoring and evaluation to assess the potential impact to the Bay.

Nickel (Figure M-9)***:*** Nickel concentrations exceeded the A-aquifer aquatic criterion (96.5 µg/L) in six A-aquifer wells, and the B-aquifer aquatic criterion (8.2 µg/L) in one B-aquifer well. Of those wells, one A-aquifer well (IR01MWI-3) is located within the TIZ and one B-aquifer well (IR01MW53B) is located in the B-aquifer within 150 feet of the shoreline. Well IR01MWI-3 had a single detection exceeding the aquatic criterion in March 1996, which was approximately three times the aquatic criterion, and never recurred in five subsequent sampling events over nine years. Well IR01MW53B had detections that exceeded the B-aquifer aquatic criterion on two occasions: a concentration in September 2002 that was eight times the aquatic criterion, and a concentration in December 2004 that was slightly greater (12 percent) than the aquatic criterion. Well IR75MW05B, which is located upgradient of Parcel E-2, also shows persistent detections exceeding the aquatic criterion; this finding suggests that concentrations of nickel in downgradient B-aquifer wells (such as IR01MW53B) may not be attributed to Navy activities. Regardless, discharges of nickel concentrations (exceeding the aquatic criterion) in groundwater to the permeable zones underlying the Bay do not result in direct exposures to aquatic receptors in the Bay. The remaining five A-aquifer wells with detected concentrations of nickel exceeding the aquatic criterion are each located over 350 feet from the shoreline, and nickel concentrations in these wells range from one to two times the aquatic criterion. Based on this information, nickel is not considered a COPC that potentially impacts the Bay.

Zinc (Figure M-10)***:*** Zinc was detected in six A-aquifer wells at concentrations exceeding the aquatic criterion (81 µg/L). Of these six wells, three are within the A-aquifer TIZ (IR01MWI-3, IR01MW43A,

and IR01MW44A). Well IR01MWI-3 had a single detection exceeding the aquatic criterion in March 1996, which was approximately four times the aquatic criterion, and never recurred in five subsequent sampling events over nine years. Well IR01MW43A had a single detection exceeding the aquatic criterion in November 2004 that was approximately 1.7 times the aquatic criterion, which did not recur in one subsequent sampling event in March 2005. The detections exceeding the aquatic criterion in IR01MW44A are somewhat consistent, with three detections exceeding the aquatic criteria out of the past five sampling events. Detections at well IR01MW44A ranged from 1.7 to 24.4 times the aquatic criterion. The extent of zinc in groundwater is adequately delineated by concentrations below the aquatic criterion except in wells IR01MW43A and IR01MW44A. Groundwater chemical concentrations in these wells are anticipated to be reduced in the future because the recently-completed PCB Hot Spot excavation has removed potential source material; however, additional monitoring is required to verify this presumption. Therefore, zinc is a COPC that warrants further monitoring and evaluation to assess the potential impact to the Bay.

M3.3. PESTICIDES AND POLYCHLORINATED BIPHENYLS

Maps were created for the following pesticides and PCBs (as they have been detected at concentrations that exceed their respective aquatic criteria): 4,4'-dichloro-diphenyl-trichloroethane (DDT), alpha-chlordane, endosulfan I, endosulfan II, endrin, gamma-chlordane, heptachlor, heptachlor epoxide and total PCBs. Results from the analysis of pesticide and PCB concentrations revealed the following:

4,4'-DDT (Figure M-11)***:*** 4,4'-DDT was detected at concentrations exceeding the aquatic criterion (0.001 µg/L) in six A-aquifer wells. The wells exhibiting the highest detected concentrations of 4,4'-DDT are located within the landfill area, at least 300 feet from the shoreline. Two of the six wells exhibiting detections exceeding the aquatic criterion are tidally influenced wells (IR01MWI-3 and IR01MW44A). Well IR01MWI-3 exhibited detectable concentrations of 4,4'-DDT exceeding the aquatic criterion in March 2001 and August 2002, which were 20 and 25 times the aquatic criterion, respectively. This well has not exhibited any detections exceeding the aquatic criterion in three sampling events since August 2002. Well IR01MW44A, which is located within the PCB Hot Spot removal area, had a single detection exceeding the aquatic criterion in March 2001, which was 30 times the aquatic criterion, and did not recur in six subsequent sampling events over four years. None of the tidally influenced wells have detected concentrations of 4,4'-DDT exceeding the aquatic criterion since August 2002. The extent of 4,4'-DDT in groundwater is adequately delineated by concentrations below the laboratory reporting limits, except at well IR01MWI-3 where concentrations have been detected greater than the aquatic criterion within the past four sampling rounds. Groundwater chemical concentrations in this well are anticipated to be reduced in the future because the recently-completed PCB Hot Spot excavation has removed potential source material; however, additional monitoring is required to verify this presumption. Therefore, 4,4'-DDT is a COPC that warrants further monitoring and evaluation to assess the potential impact to the Bay.

Alpha-chlordane (Figure M-12)***:*** Detected concentrations of alpha-chlordane exceeded the aquatic criterion (0.004 µg/L) in two A-aquifer wells at Parcel E-2. One of the two wells where concentrations exceeded the aquatic criterion is a tidally influenced well (IR01MW44A). The second well exhibiting detected concentrations in excess of the aquatic criterion is located within the extent of the landfill waste, over 500 feet from the shoreline (IR01MW366A). In well IR01MW366A, there was only a single detection exceeding the aquatic criterion in March of 1996, which has not recurred during four sampling events over in two and a half years. Tidally influenced well IR01MW44A exhibited detectable concentrations of alpha-chlordane exceeding the aquatic criterion in March 2001, and September 2002, which were both approximately 2.5 times the aquatic criterion. There have been no detections of alpha-chlordane in well IR01MW44A in four sampling events since October 2002. The extent of alpha-chlordane in groundwater is adequately delineated by concentrations below the laboratory reporting limits. Based on this information, alpha-chlordane is not considered a COPC that potentially impacts the Bay.

Endosulfan I (Figure M-13)***:*** Endosulfan I was only detected once at Parcel E-2. The detection appeared in an A-aquifer well (IR01MW366A) located in the eastern portion of the landfill waste, over 500 feet from the shoreline. The single detection, measured in March 1996, exceeded the aquatic criterion (0.0087 µg/L) by a factor of 3.4. Based on data from monitoring wells to the south and east, the potential for endosulfan I migration from this location is very low. No endosulfan I was detected in Parcel E-2 tidally influenced wells (since 1996). Based on this information, endosulfan I is not considered a COPC that potentially impacts the Bay.

Endosulfan II (Figure M-14)***:*** Endosulfan II was detected at concentrations exceeding the aquatic criterion (0.0087 µg/L) in three tidally influenced A-aquifer wells (IR01MWI-3, IR01MW43A, and IR01MW44A). All three of these tidally influenced wells are located within the PCB Hot Spot removal area. Well IR01MWI-3 exhibited detected concentrations of endosulfan II exceeding the aquatic criterion in March 1996 and August 2002 that were 9.2 and 1.8 times the aquatic criterion, respectively. Detections have not occurred in IR01MWI-3 in three sampling events during the two and a half years following the August 2002 detection. Wells IR01MW43A and IR01MW44A both had detected concentrations of endosulfan II in March 1996 that were 9.2 times the aquatic criterion. Detections did not recur in wells IR01MW43A and IR01MW44A in the seven to eight sampling events conducted since March 1996. The extent of endosulfan II in groundwater is adequately delineated by concentrations below the laboratory reporting limits, except at well IR01MWI-3 where concentrations have been detected greater than the aquatic criterion within the past four sampling rounds. Groundwater chemical concentrations in this well are anticipated to be reduced in the future because the recently-completed PCB Hot Spot excavation has removed potential source material; however, additional monitoring is required to verify this presumption. Therefore, endosulfan II is a COPC that warrants further monitoring and evaluation to assess the potential impact to the Bay.

Endrin (Figure M-15)***:*** Endrin was detected at concentrations exceeding the aquatic criterion (0.0023 µg/L) in three A-aquifer wells at Parcel E-2. One of the three wells showing detections exceeding the aquatic criterion is a tidally influenced well (IR01MWI-3), while the remaining two wells are located along the northern edge of the parcel, in the landfill area (over 700 feet from the shoreline). Well IR01MWI-3 is located in the PCB Hot Spot removal area. A single detection occurred in March 2001 that was 17.4 times the aquatic criterion, but detectable concentrations have not recurred in this well in four subsequent sampling events over four years. As discussed in subsection M2.1, groundwater chemical concentrations in the PCB Hot Spot are anticipated to be reduced during future monitoring rounds because recently-completed excavations have removed potential source material. The extent of endrin in groundwater is adequately delineated by concentrations below the laboratory reporting limits, thus endrin is not considered a COPC that potentially impacts the Bay.

Gamma-chlordane (Figure M-16)***:*** Gamma-chlordane was detected at concentrations exceeding the aquatic criterion (0.004 µg/L) in three A-aquifer wells at Parcel E-2. All three wells are located within the A-aquifer TIZ in the PCB Hot Spot removal area (IR01MWI-3, IR01MW43A, and IR01MW44A). No other wells at the site have shown detections of gamma-chlordane exceeding the aquatic criterion. Well IR01MWI-3 exhibited detections of concentrations exceeding the aquatic criterion in March 2001 and August 2002 that were 9 and 2.5 times the aquatic criterion, respectively. Gamma-chlordane has not been detected at well IR01MWI-3 in excess of the aquatic criterion in three sampling events since August 2002. Well IR01MW43A exhibited detections of concentrations exceeding the aquatic criterion in four of six sampling events between March 1996 and June 2004, with detections ranging from 7.5 to 25 times the aquatic criterion. Detections of concentrations exceeding the aquatic criterion have not occurred at IR01MW43A in three sampling events since June 2004. Well IR01MW44A exhibited detections of concentrations exceeding the aquatic criterion in two consecutive sampling events from March 1996 to March 2001, with detections ranging from 5 to 10.5 times the aquatic criterion. No detections have recurred in IR01MW44A in six sampling events since March 2001. The extent of gamma-chlordane in groundwater is adequately delineated by concentrations below the laboratory reporting limits, with the exception of wells IR01MW43A and IR01MWI-3 where concentrations have been detected greater than the aquatic criterion within the past four sampling rounds. Groundwater chemical concentrations in this well are anticipated to be reduced in the future because the recently-completed PCB Hot Spot excavation has removed potential source material; however, additional monitoring is required to verify this presumption. Therefore, gamma-chlordane is a COPC that warrants further monitoring and evaluation to assess the potential impact to the Bay.

Heptachlor (Figure M-17)***:*** Heptachlor was detected at concentrations exceeding the aquatic criterion (0.0036 µg/L) in five A-aquifer wells at the site. Two of the wells are located over 600 feet from the shoreline (IR01MW05A and IR01MWI-2). Three of the eight wells are Parcel E-2 tidally influenced wells (IR01MWI-3, IR01MW43A, and IR01MW44A). All three wells are located within the PCB Hot Spot removal area. Well IR01MWI-3 had a single detection exceeding the aquatic criterion in August

2002 that was 1.9 times the aquatic criterion. There have been no detections of heptachlor exceeding the aquatic criterion in well IR01MWI-3 in three subsequent sampling events over two and a half years. Heptachlor was detected at concentrations exceeding the aquatic criterion at well IR01MW43A in July and September 2002. The detections were 22.5 and 15.6 times the aquatic criterion, respectively. There have been no detections of heptachlor exceeding the aquatic criterion in well IR01MW43A in four subsequent sampling events over two and a half years. Well IR01MW44A exhibited detected concentrations exceeding the aquatic criterion in March 1996 and March 2001 that were 2.8 and 2.2 times the aquatic criterion, respectively. There have been no detections of heptachlor exceeding the aquatic criterion in well IR01MW44A in six subsequent sampling events over four years. None of the tidally influenced wells have exhibited a detection of heptachlor exceeding the aquatic criterion since September of 2002. The extent of heptachlor in groundwater is adequately delineated by concentrations below the laboratory reporting limits, with the exception of well IR01MWI-3 where concentrations have been detected greater than the aquatic criterion within the past four sampling rounds. Groundwater chemical concentrations in this well are anticipated to be reduced in the future because the recently-completed PCB Hot Spot excavation has removed potential source material; however, additional monitoring is required to verify this presumption. Therefore, heptachlor is a COPC that warrants further monitoring and evaluation to assess the potential impact to the Bay.

Heptachlor Epoxide (Figure M-18)***:*** Heptachlor epoxide was detected at concentrations exceeding the aquatic criterion (0.0036 µg/L) in two A-aquifer wells (IR01MW05A and IR01MW44A) at Parcel E-2. IR01MW05A is located within the extent of landfill waste, over 700 feet from the shoreline. Based on data from monitoring wells to the south and east, the potential for heptachlor epoxide migration from this location is very low. IR01MW44A is a Parcel E-2 tidally influenced well located at the southern edge of the PCB Hot Spot removal area. The detections exceeding the aquatic criterion in this well occurred sporadically in March 2001 and in September 2004, and were 2.8 and 18.3 times the aquatic criterion. Well IR01MW44A has not had concentrations that exceed the aquatic criterion in two sampling events since September 2004. The extent of heptachlor epoxide in groundwater is adequately delineated by concentrations below the laboratory reporting limits, except at well IR01MW44A. Groundwater chemical concentrations in this well are anticipated to be reduced in the future because the recently-completed PCB Hot Spot excavation has removed potential source material; however, additional monitoring is required to verify this presumption. Therefore, heptachlor is a COPC that warrants further monitoring and evaluation to assess the potential impact to the Bay.

Total PCBs (Figure M-19)***:*** Total PCBs were detected at concentrations exceeding the aquatic criterion (0.03 µg/L) in six A-aquifer wells at Parcel E-2. Two of these six wells (IR01MW03A and IR01MW367A) are located at the northern edge of the parcel, over 800 feet from the Bay. Based on data from monitoring wells to the south and east, the potential for PCB migration from these locations is very low. Three of the remaining four wells are tidally influenced wells located within the PCB Hot Spot removal area (IR01MW38A, IR01MWI-3, IR01MW43A, and IR01MW44A). The detections exceeding

the aquatic criterion are persistent in two of the tidally influenced wells (IR01MW43A and IR01MW44A), which show recurring detections that exceed the aquatic criterion between 1996 and 2005. Detections exceeding the aquatic criterion in well IR01MW43A ranged from 22 to 240 times the aquatic criterion, while those in well IR01MW44A ranged from approximately 33 to 193 times the aquatic criterion. In tidally influenced well IR01MWI-3, concentrations exceeding the aquatic criterion were detected in March 1996 and March 2001 that were 100 and 10 times the aquatic criterion, respectively. There were no further detections of PCBs in well IR01MWI-3 in four sampling events from 2001 to 2005. An additional well with detected PCB concentrations greater than the aquatic criterion is located within the landfill waste less than 200 feet from the shoreline but outside of the TIZ (IR01MW38A). In well IR01MW38A, a single detection exceeding the aquatic criterion was measured in June 2004 that was 17 times the aquatic criterion. There were no further detections of PCBs in well IR01MWI-3 in three sampling events between June 2004 and March 2005. The extent of PCBs in groundwater is adequately delineated by concentrations below the laboratory reporting limits, except in inland well IR01MW38A and tidally influenced wells IR01MW43A and IR01MW44A. Groundwater chemical concentrations in these tidally influenced wells are anticipated to be reduced in the future because the recently-completed PCB Hot Spot excavation has removed potential source material; however, additional monitoring is required to verify this presumption. Therefore, PCBs are COPCs that warrant further monitoring and evaluation to assess the potential impact to the Bay.

M3.4. SEMI-VOLATILE ORGANIC COMPOUNDS

The groundwater evaluation presented in Section 5 of the Parcel E-2 RI/FS confirms that numerous SVOCs were detected in Parcel E-2 groundwater. However, no SVOC concentrations at Parcel E-2 exceeded the corresponding saltwater aquatic evaluation criteria and thus no SVOCs are considered COPCs that potentially impact the Bay.

M3.5. VOLATILE ORGANIC COMPOUNDS

The groundwater evaluation presented in Section 5 of the Parcel E2 RI/FS document confirms that numerous VOCs have been detected in Parcel E-2 groundwater. However, trichloroethene (TCE) was the only VOC detected at concentrations exceeding the saltwater aquatic evaluation criteria. Results from the analysis of TCE concentrations revealed the following:

Trichloroethene (Figure M-20)**:** TCE was detected at concentrations exceeding its aquatic criterion (400 µg/L) in one A-aquifer well at Parcel E-2. Well IR01MW48A is a tidally influenced well that exhibited a single detection of TCE at a concentration exceeding the aquatic criterion in July 2002. The concentration at that time was 1.1 times the aquatic criterion. This concentration has not recurred in five subsequent sampling events over two and a half years. The extent of TCE in groundwater is adequately delineated by concentrations below the aquatic criterion, and TCE is not considered a COPC that potentially impacts the Bay.

M3.6. PETROLEUM HYDROCARBONS

The sum of total petroleum hydrocarbon (TPH) fractions was used to evaluate petroleum hydrocarbon concentrations in groundwater, and to assess the potential impact to the Bay. Results from the analysis of total TPH concentrations revealed the following:

Total TPH (Figure M-21) has been detected at concentrations exceeding aquatic evaluation criteria which, as discussed in subsection M2.3, are dependent on well distance from the Parcel E-2 shoreline. The distance-dependent aquatic evaluation criteria are shown in Figure M-21. Total TPH concentrations exceeded their distance-dependant aquatic criteria in two tidally influenced wells (IR01MWI-3 and IR01MW43A) located within the PCB Hot Spot removal area. Well IR01MWI-3 demonstrates inconsistent detections throughout its sampling history, and recent detections in December 2004 and March 2005 exceeded the aquatic criterion for a well between 0 and 50 feet from the shoreline (1,400 µg/L). The detections at IR01MWI-3 range from 1.3 to 7.9 times the aquatic criterion. Well IR01MW43A shows more persistent and increasing total TPH concentrations exceeding the aquatic evaluation criterion for a well between 50 and 100 feet from the shoreline (2,100 µg/L). The detections at IR01MW43A range from 1.05 to 7.8 times the aquatic criterion. The most recent detection at IR01MW43A is the highest concentration measured for that well. The extent of total TPH in groundwater is adequately delineated by concentrations below the aquatic criteria, except at wells IR01MWI-3 and IR01MW43A. Groundwater chemical concentrations in these wells are anticipated to be reduced in the future because the recently-completed PCB Hot Spot excavation has removed potential source material; however, additional monitoring is required to verify this presumption. Therefore, petroleum hydrocarbons are COPCs that warrant further monitoring and evaluation to assess the potential impact to the Bay.

Section M4. Conclusions and Recommendations

Table M-3 identifies the COPCs that may potentially impact the Bay, based on the aquatic evaluation performed herein. The summary table also lists the tidally influenced wells where further monitoring and evaluation is recommended to assess the potential impact to the Bay. The primary tidally influenced wells of concern are located within the PCB Hot Spot, where a recently-completed excavation has removed potential source material. The excavation activities required the removal of these wells; however, they are planned to be replaced in early 2007. Future monitoring from these wells, to be performed under the BGMP, are anticipated to demonstrate reduced concentrations of COPCs in A-aquifer groundwater.

This evaluation involved a direct comparison between chemical concentrations measured in groundwater and saltwater aquatic criteria. Because chemical concentrations attenuate as groundwater migrates toward the shore and mixes with Bay water prior to discharging into the Bay, this comparison is used primarily as a tool in identifying COPCs in groundwater that may pose a risk to aquatic receptors in the Bay. A quantitative analysis that would identify chemicals of concern and specify risk-based remediation goals cannot be prepared until a method for comparing groundwater data to saltwater aquatic criteria, in a manner that accounts for chemical attenuation and the near-shore mixing process, has been agreed to by the Navy and the regulatory agencies.

Section M5. References

Horne, Alexander J. and Charles R. Goldman. 1994. Limnology. Second Edition. McGraw-Hill, Inc. pp. 142-143.

PRC Environmental Management, Inc. 1996. "Estimation of Hunters Point Shipyard Groundwater Ambient Levels Technical Memorandum." September 16.

Regional Water Quality Control Board (RWQCB), San Francisco Bay Region. 2006. Letter Regarding Groundwater Criteria, Points of Compliance, and Next Steps for Hunters Point Shipyard. Letter from James Ponton, RWQCB. To Keith Forman, Department of the Navy, Base Realignment and Closure Program Management Office West. March 16.

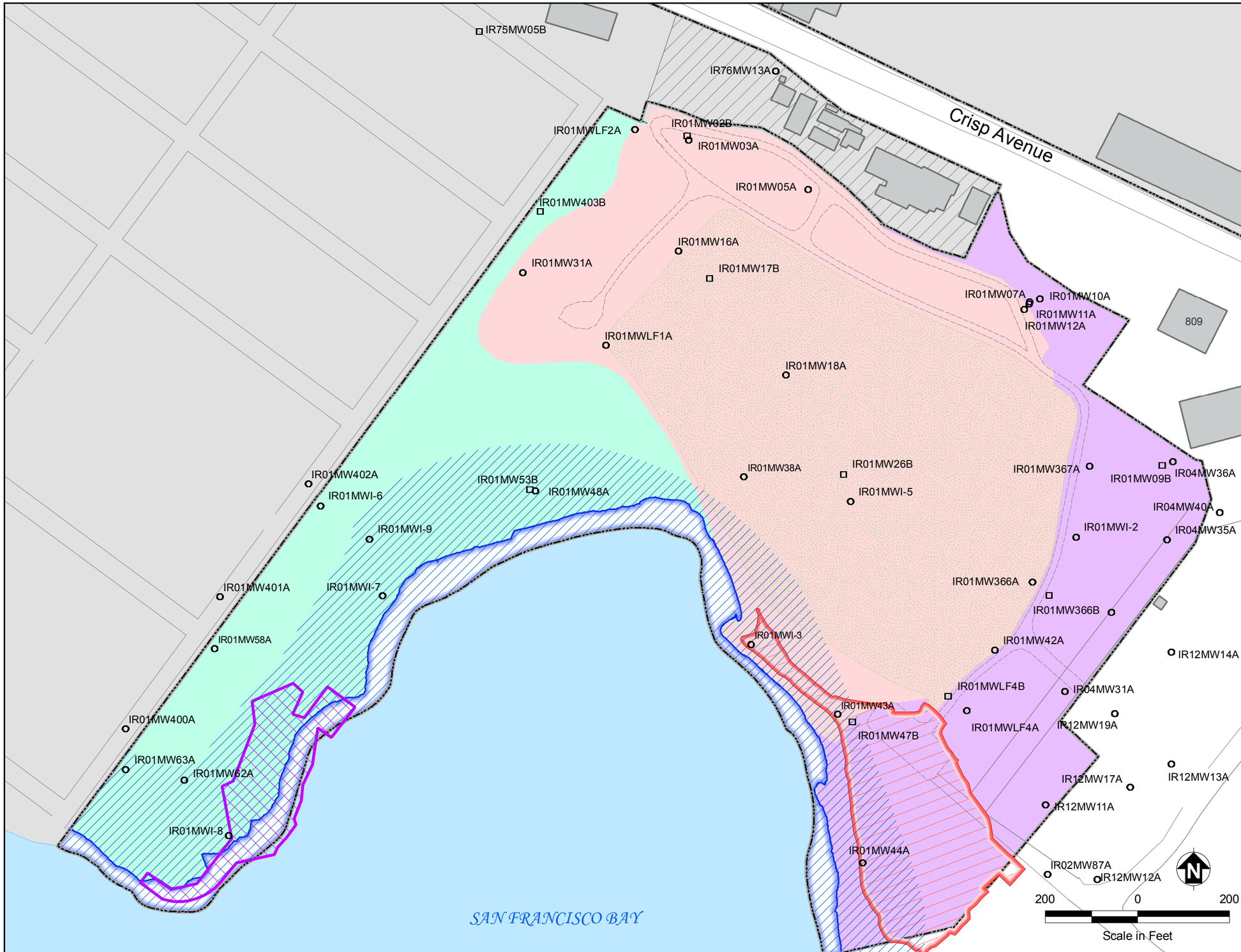
Tetra Tech EM, Inc. (TtEMI). 2004a. "Draft Addendum to the Final Petroleum Hydrocarbon Corrective Action Plan, Parcel B, Hunters Point Shipyard, San Francisco, California." April 15.

TtEMI. 2004b. "Revised Final Parcel E Groundwater Summary Report, Phase III Groundwater Data Gaps Investigation, Hunters Point Shipyard, San Francisco, California." May 11.

TtEMI. 2004c. "Final Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan), Basewide Groundwater Monitoring Program, Hunters Point Shipyard, San Francisco, California." August 20.

Figures

Figure M-1. Tidally Influenced Wells at Parcel E-2



LEGEND

- A-aquifer Well
- B-aquifer Well
- Road
- Gravel Road
- Metal Slag Area (final boundary)
- PCB Hot Spot (final boundary)
- Limit of Landfill Cap
- Parcel Boundary
- Building
- UCSF Compound
- Landfill Area
- Adjacent Area
- Panhandle Area
- Shoreline Area
- San Francisco Bay
- Non-Navy Property
- Tidal Influence Zone (Maximum Tidal Fluctuation ≥ 0.10 foot)

Notes:

The tidal influence study was conducted May 20 to June 3, 2002.

Reference

Tetra Tech EM, Inc. 2003. Final Parcel E Groundwater Summary Report, Phase III Groundwater Data Gaps Investigation, Hunters Point Shipyard, San Francisco, California. October 17.

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Hunters Point Shipyard, San Francisco, California

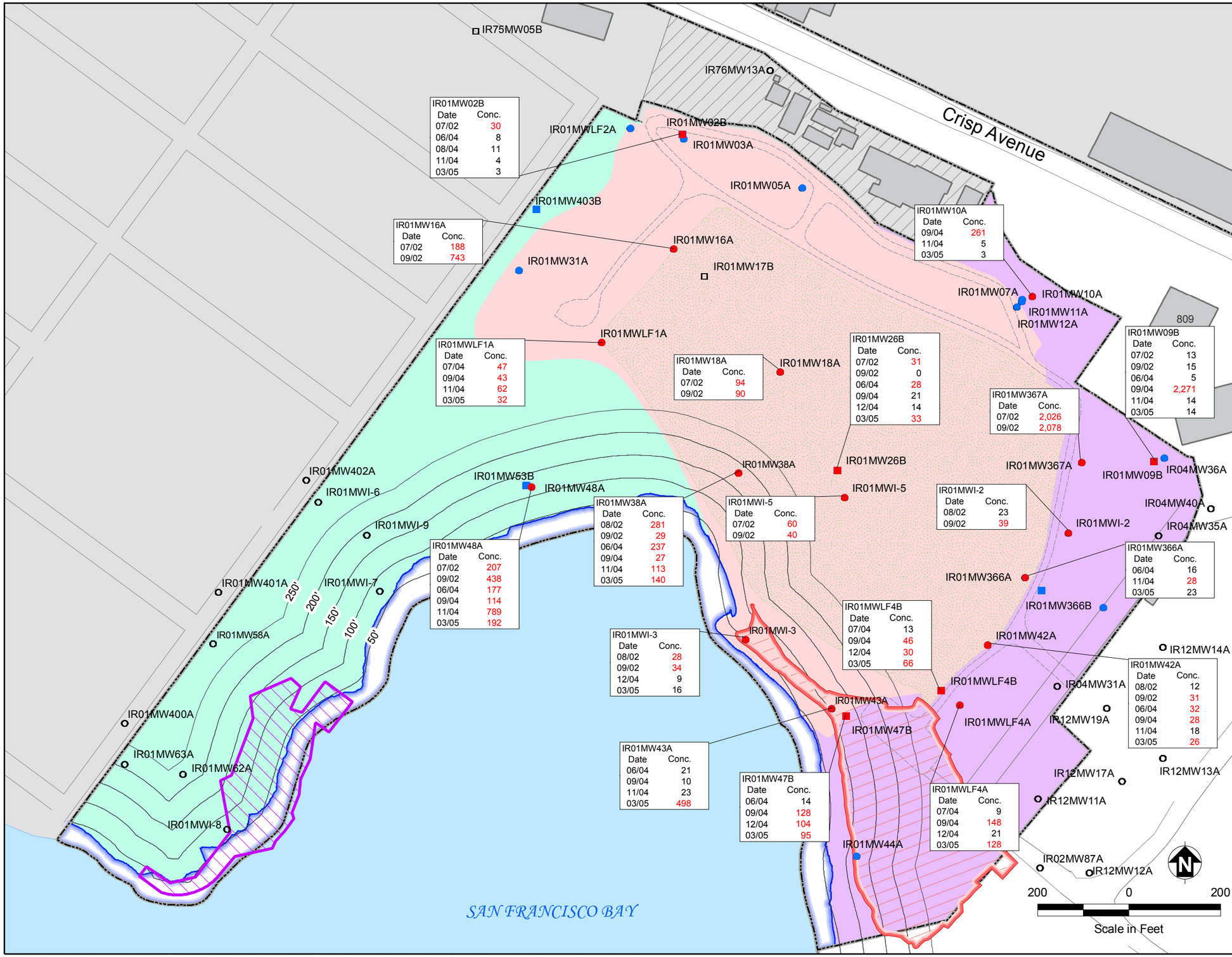
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE M-1

TIDALLY INFLUENCED WELLS AT PARCEL E-2

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Section 4\Water\Aquatic\TidallyInfluenced.mxd



IR01MW02B

Date	Conc.
07/02	30
06/04	8
08/04	11
11/04	4
03/05	3

IR01MW16A

Date	Conc.
07/02	188
09/02	743

IR01MW10A

Date	Conc.
09/04	261
11/04	5
03/05	3

IR01MWLF1A

Date	Conc.
07/04	47
09/04	43
11/04	62
03/05	32

IR01MW18A

Date	Conc.
07/02	94
09/02	90

IR01MW26B

Date	Conc.
07/02	31
09/02	0
06/04	28
09/04	21
12/04	14
03/05	33

IR01MW09B

Date	Conc.
07/02	13
09/02	15
06/04	5
09/04	2,271
11/04	14
03/05	14

IR01MW367A

Date	Conc.
07/02	2,026
09/02	2,078

IR01MW38A

Date	Conc.
08/02	281
09/02	29
06/04	237
09/04	27
11/04	113
03/05	140

IR01MWI-5

Date	Conc.
07/02	60
09/02	40

IR01MWI-2

Date	Conc.
08/02	23
09/02	39

IR01MW48A

Date	Conc.
07/02	207
09/02	438
06/04	177
09/04	114
11/04	789
03/05	192

IR01MW366A

Date	Conc.
06/04	16
11/04	28
03/05	23

IR01MWLF4B

Date	Conc.
07/04	13
09/04	46
12/04	30
03/05	66

IR01MWI-3

Date	Conc.
08/02	28
09/02	34
12/04	9
03/05	16

IR01MW42A

Date	Conc.
08/02	12
09/02	31
06/04	32
09/04	28
11/04	18
03/05	26

IR01MW43A

Date	Conc.
06/04	21
09/04	10
11/04	23
03/05	498

IR01MW47B

Date	Conc.
06/04	14
09/04	128
12/04	104
03/05	95

IR01MWLF4A

Date	Conc.
07/04	9
09/04	148
12/04	21
03/05	128

- A-aquifer Well
- B-aquifer Well
- Not Analyzed for Analyte
- Analyte Not Detected
- Analyte Exceeds Reporting Limit
- Analyte Exceeds Criterion
- Road
- Gravel Road
- Metal Slag Area (final boundary)
- PCB Hot Spot (final boundary)
- Limit of Landfill Cap
- Parcel Boundary
- Building
- UCSF Compound
- Landfill Area
- Adjacent Area
- Panhandle Area
- Shoreline Area
- San Francisco Bay
- Non-Navy Property
- 50' Distance from Shoreline (in feet)

Notes:

Results are shown for locations where data has exceeded the aquatic criterion.
Red text indicates results that exceed the aquatic criterion.
Where results are shown as non-detect (<), the reporting limit follows.

Conc. = concentration
µg/L = microgram per liter

Aquatic criterion for un-ionized ammonia = 25 µg/L
Source: San Francisco Bay Basin Plan, annual median concentration

IR01MWLF1A — Well ID

Date	Conc
07/04	2.1
09/04	8.4
11/04	2.5
03/05	0.57

Sample Date (mm/yy) — Chemical Concentration (µg/L)

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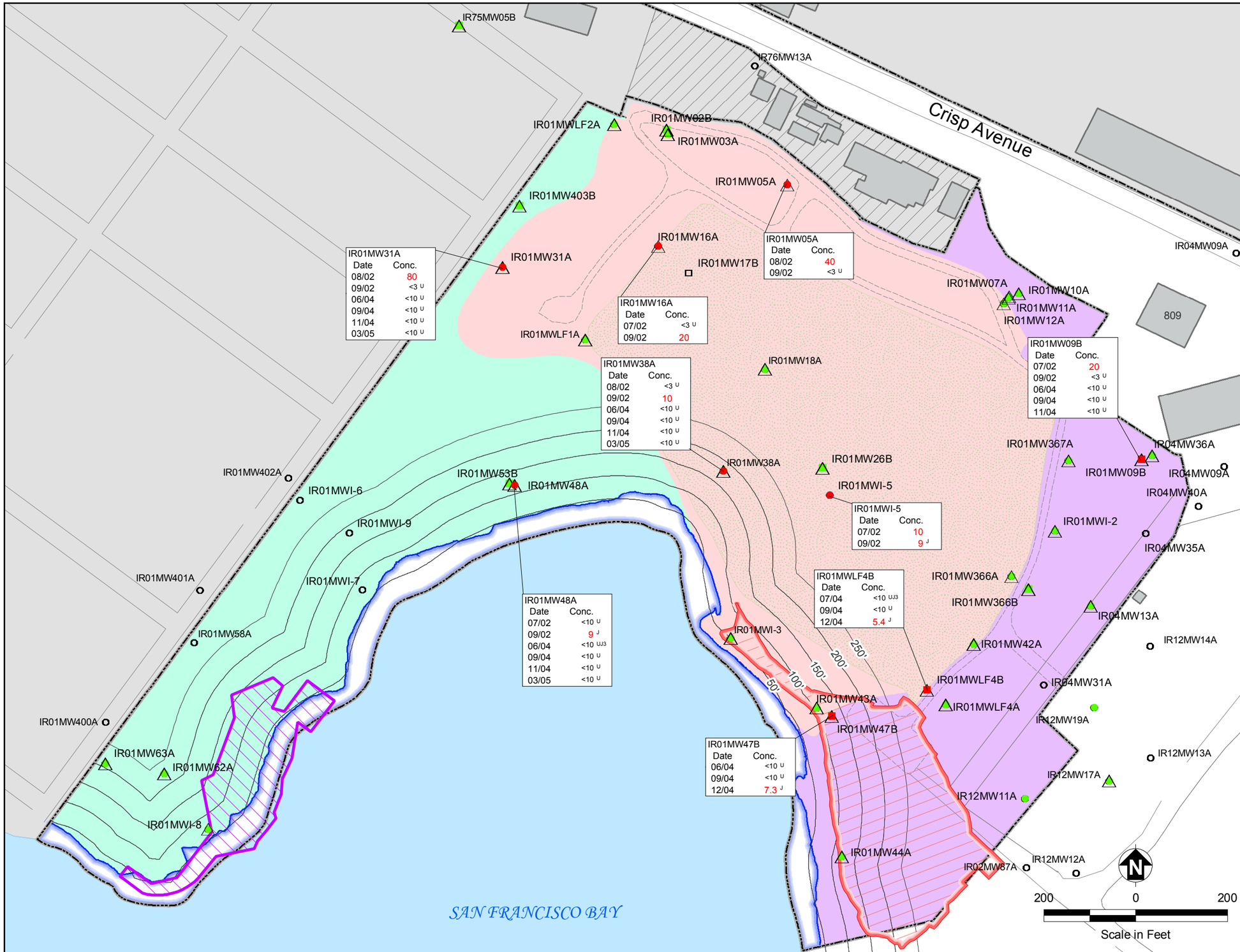
FIGURE M-2

EVALUATION OF UN-IONIZED AMMONIA IN GROUNDWATER

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Section 4\Water\Aquatic\Scenario5_Unionized Ammonia.mxd



Reporting Limit Exceeds Aquatic Criterion (for at least one sample)
A-aquifer Well
B-aquifer Well
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds Criterion
Road
Gravel Road
Metal Slag Area (final boundary)
PCB Hot Spot (final boundary)
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property
–50'– Distance from Shoreline (in feet)

Notes:

Results are shown for locations where data has exceeded the aquatic criterion.
Red text indicates results that exceed the aquatic criterion.
Where results are shown as non-detect (<), the reporting limit follows.

Conc. = concentration
µg/L = microgram per liter

J = estimated value
U = value was not detected above the reporting limit
Numbers associated with qualifiers are further defined in Appendix J.

Aquatic criterion for cyanide = 1 µg/L
Source: California Toxics Rule Criteria for Enclosed Bays and Estuaries (Chronic).

The laboratory reporting limits of current, routinely used, analytical methods are greater than the aquatic criterion.

IR01MWLF1A ← Well ID

Date	Conc
07/04	2.1
09/04	8.4
11/04	2.5
03/05	0.57

Sample Date (mm/yy) →
← Chemical Concentration (µg/L)

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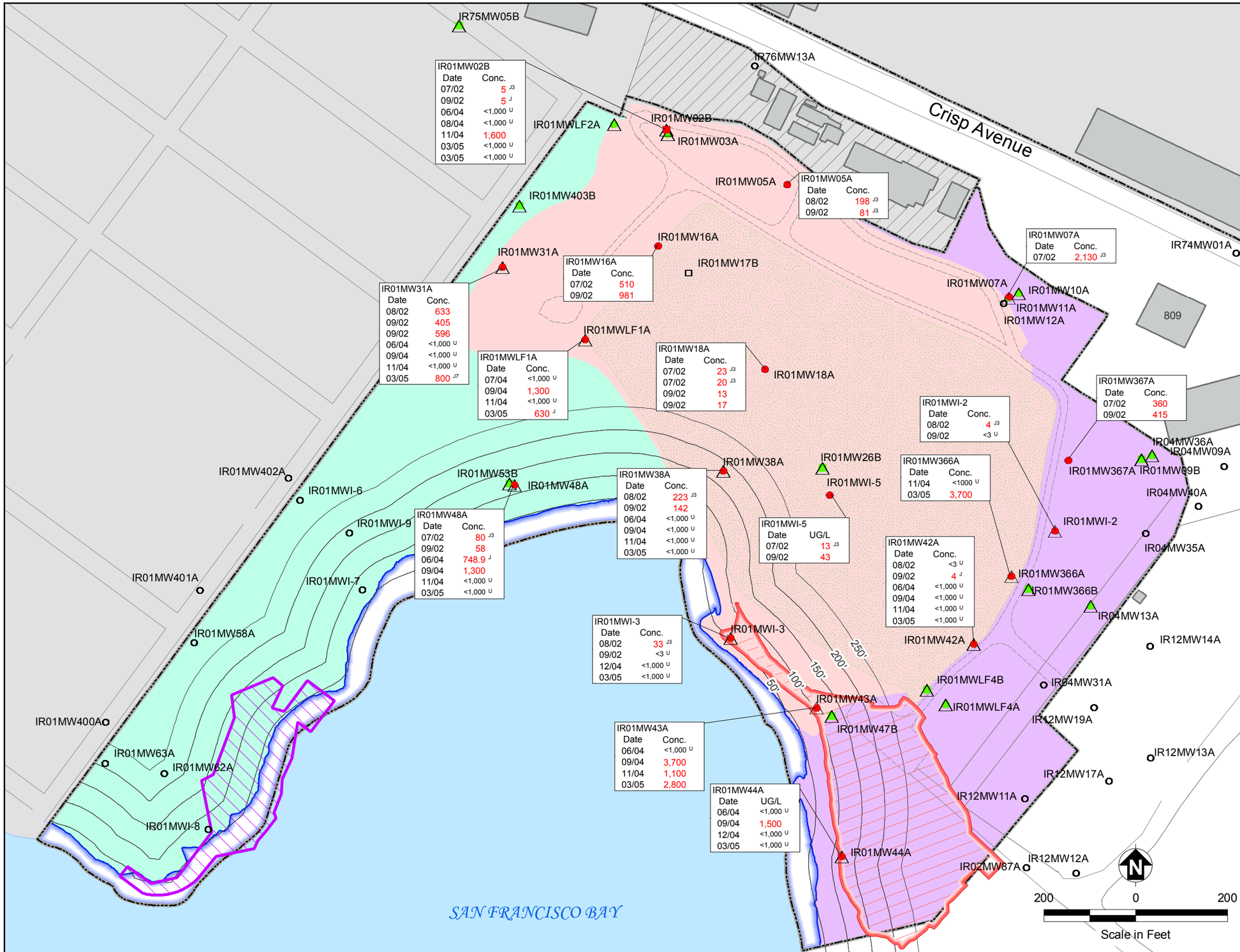
FIGURE M-3

EVALUATION OF CYANIDE IN GROUNDWATER

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Section 4\Water\Aquatic\Scenario5_Cyanide.mxd



Reporting Limit Exceeds Aquatic Criterion (for at least one sample)
A-aquifer Well
B-aquifer Well
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds Criterion
Road
Gravel Road
Metal Slag Area (final boundary)
PCB Hot Spot (final boundary)
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property
50' Distance from Shoreline (in feet)

Notes:

Results are shown for locations where data has exceeded the aquatic criterion.
Red text indicates results that exceed the aquatic criterion.
Where results are shown as non-detect (<), the reporting limit follows.

Conc. = concentration
µg/L = microgram per liter

J = estimated value
U = value was not detected above the reporting limit
Numbers associated with qualifiers are further defined in Appendix J.

Aquatic criterion for sulfide (as hydrogen sulfide) = 2.0 µg/L
Source: US EPA Quality Criteria for Water (Red Book).

The laboratory reporting limits of current, routinely used, analytical methods are greater than the aquatic criterion.

IR01MWLF1A — Well ID
Date Conc
07/04 2.1
09/04 8.4
11/04 2.5
03/05 0.57
Sample Date (mm/yy) — Chemical Concentration (µg/L)

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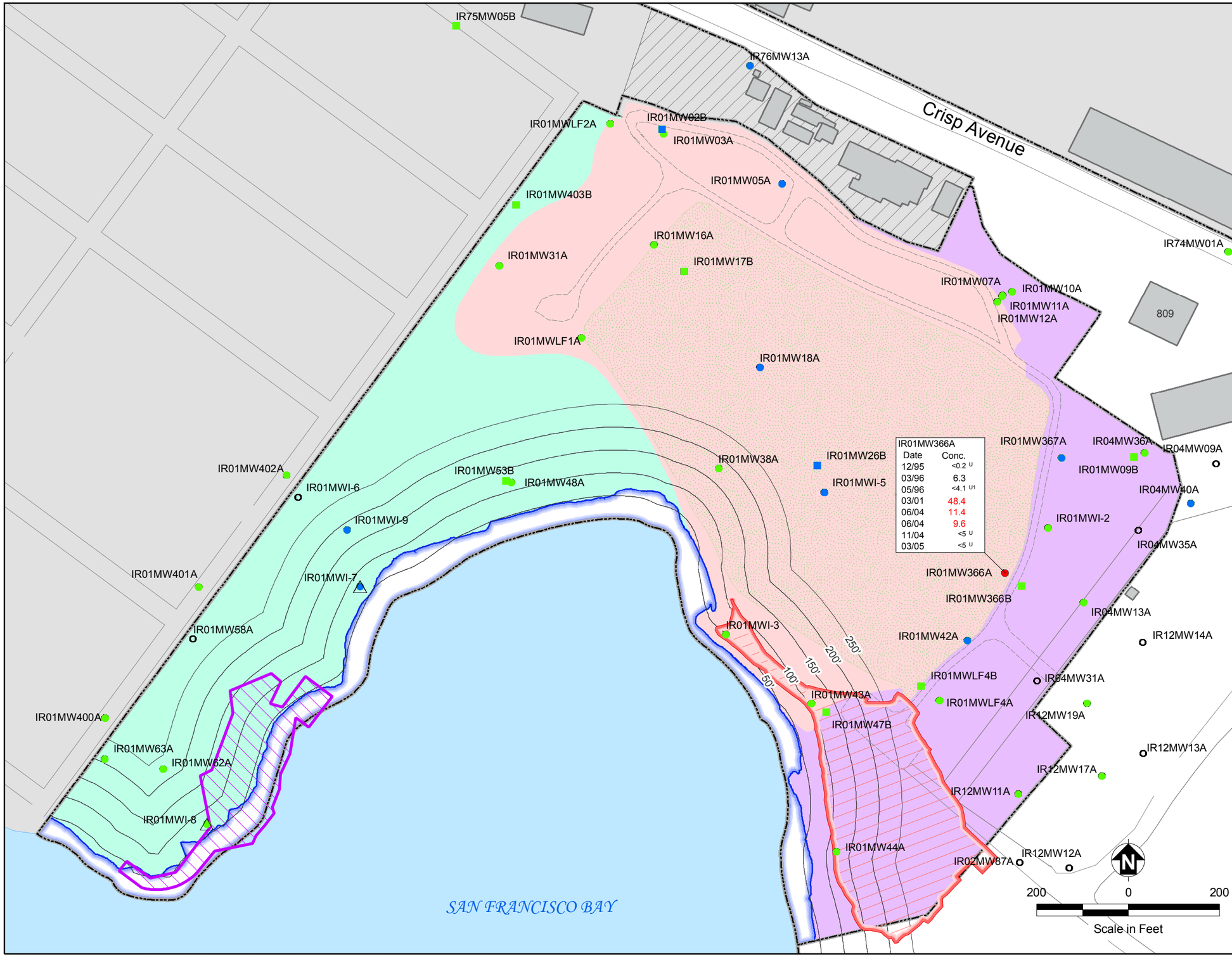
FIGURE M-4

EVALUATION OF SULFIDE IN GROUNDWATER

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Section 4\Water\Aquatic\Scenario5_Sulfide.mxd



IR01MW366A	
Date	Conc.
12/95	<0.2 U
03/96	6.3
05/96	<4.1 U1
03/01	48.4
06/04	11.4
06/04	9.6
11/04	<5 U
03/05	<5 U

△ Reporting Limit Exceeds Aquatic Criterion (for at least one sample)
○ A-aquifer Well
□ B-aquifer Well
○ / □ Not Analyzed for Analyte
● / ■ Analyte Not Detected
● / ■ Analyte Exceeds Reporting Limit
● / ■ Analyte Exceeds Criterion

Road
Gravel Road
Metal Slag Area (final boundary)
PCB Hot Spot (final boundary)
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property
50' Distance from Shoreline (in feet)

Notes:

Results are shown for locations where data has exceeded the Red text indicates results that exceed the aquatic criterion. Where results are shown as non-detect (<), the reporting limit follows.

Conc. = concentration
µg/L = microgram per liter

U = value was not detected above the reporting limit
Numbers associated with qualifiers are further defined in Appendix J.

Aquatic criterion for cadmium = 8.8 µg/L
Source: National Recommended Water Quality Criteria (Chronic)

IR01MWLF1A	
Date	Conc
07/04	2.1
09/04	8.4
11/04	2.5
03/05	0.57

Well ID
Sample Date (mm/yy)
Chemical Concentration (µg/L)

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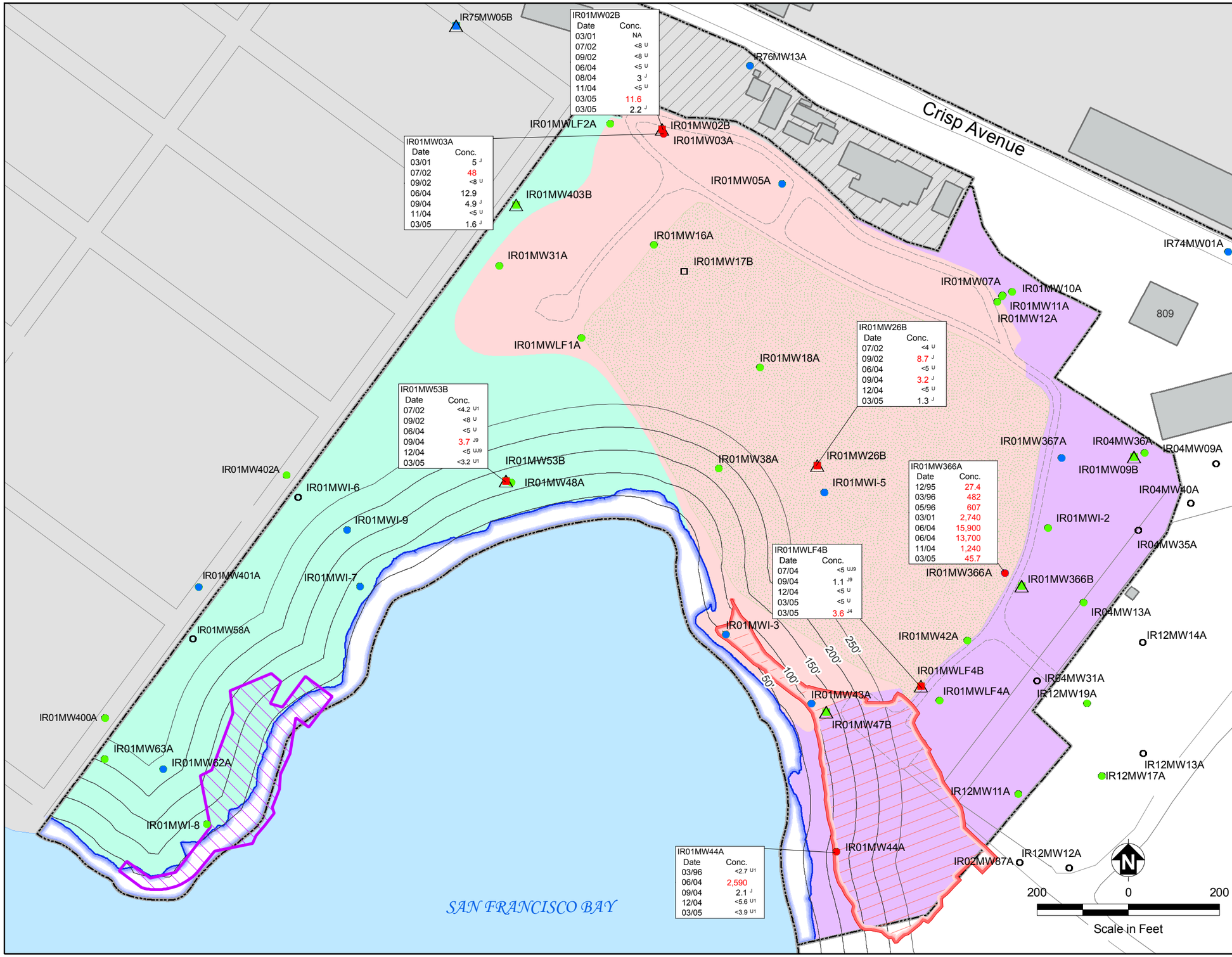
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE M-5

EVALUATION OF CADMIUM IN GROUNDWATER

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Section 4\Water\Aquatic\Scenario5_Cadmium.mxd



Reporting Limit Exceeds Aquatic Criterion (for at least one sample)
A-aquifer Well
B-aquifer Well
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds Criterion
Road
Gravel Road
Metal Slag Area (final boundary)
PCB Hot Spot (final boundary)
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property
–50'– Distance from Shoreline (in feet)

Notes:

Results are shown for locations where data has exceeded the aquatic criterion.
Red text indicates results that exceed the aquatic criterion.
Where results are shown as non-detect (<), the reporting limit follows.

Conc. = concentration
µg/L = microgram per liter

J = estimated value
U = value was not detected above the reporting limit
Numbers associated with qualifiers are further defined in Appendix J.

Aquatic criterion for copper in the A-aquifer = 28.0 µg/L
Source: Hunters Point Groundwater Ambient Level (HGAL)

Aquatic criterion for copper in the B-aquifer = 3.1 µg/L
Source: California Toxics Rule Criteria for Enclosed Bays and Estuaries (Chronic).

IR01MWLF1A ← Well ID

Date	Conc
07/04	2.1
09/04	8.4
11/04	2.5
03/05	0.57

Sample Date (mm/yy) → Date
Chemical Concentration (µg/L) ← Conc

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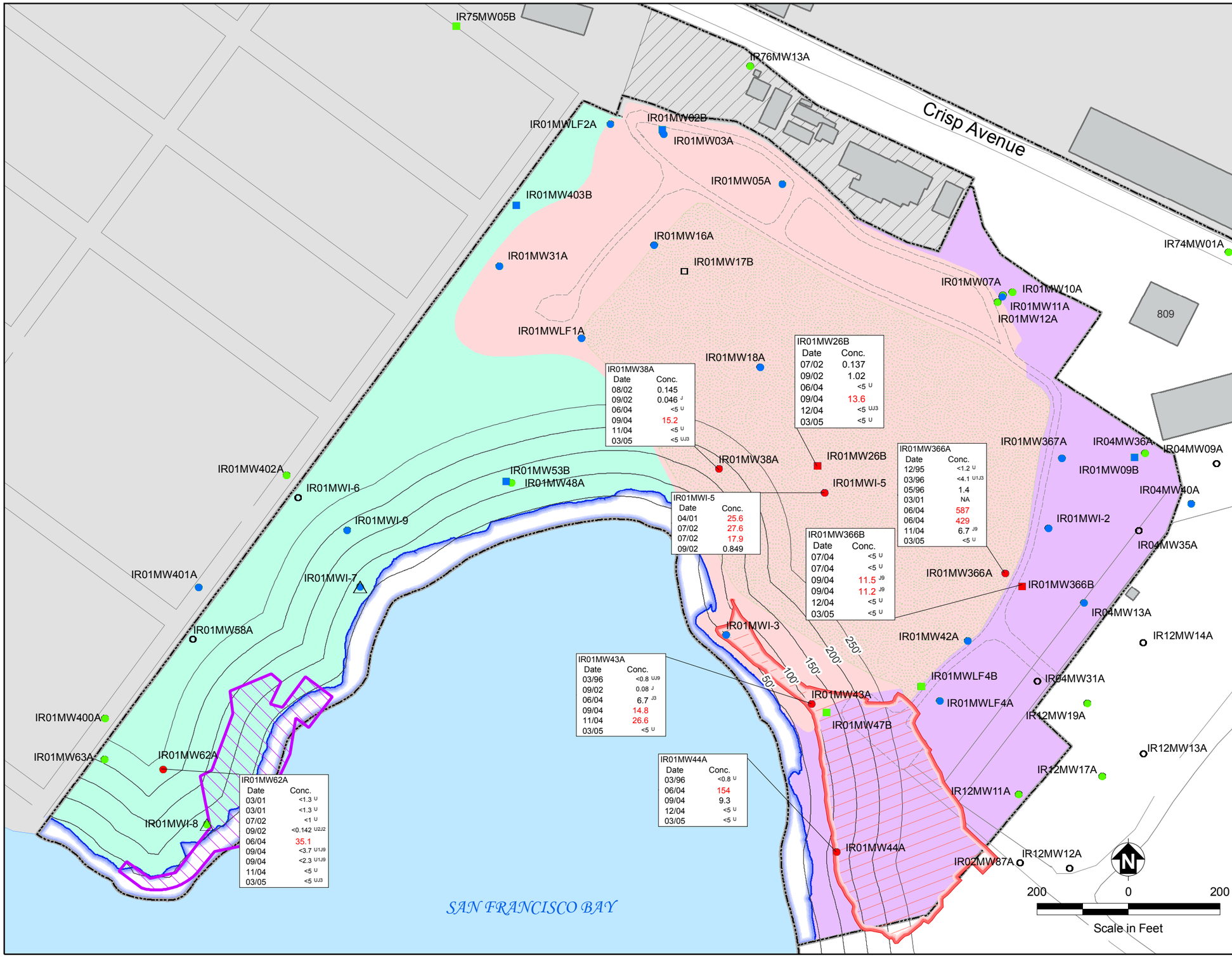
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE M-6

EVALUATION OF COPPER IN GROUNDWATER

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Section 4\Water\Aquatic\Scenario5_Copper.mxd



Reporting Limit Exceeds Aquatic Criterion (for at least one sample)
A-aquifer Well
B-aquifer Well
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds Criterion
Road
Gravel Road
Metal Slag Area (final boundary)
PCB Hot Spot (final boundary)
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property
50' Distance from Shoreline (in feet)

Notes:

Results are shown for locations where data has exceeded the aquatic criterion.
Red text indicates results that exceed the aquatic criterion.
Where results are shown as non-detect (<), the reporting limit follows.

Conc. = concentration
µg/L = microgram per liter

J = estimated value
U = value was not detected above the reporting limit
Numbers associated with qualifiers are further defined in Appendix J.

Aquatic criterion for lead in the A-aquifer = 14.4 µg/L
Source: Hunters Point Groundwater Ambient Level (HGAL)

Aquatic criterion for lead in the B-aquifer = 8.1 µg/L
Source: California Toxics Rule Criteria for Enclosed Bays and Estuaries (Chronic).

IR01MWLF1A ← Well ID

Date	Conc
07/04	2.1
09/04	8.4
11/04	2.5
03/05	0.57

Sample Date (mm/yy) →
← Chemical Concentration (µg/L)

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ERRG

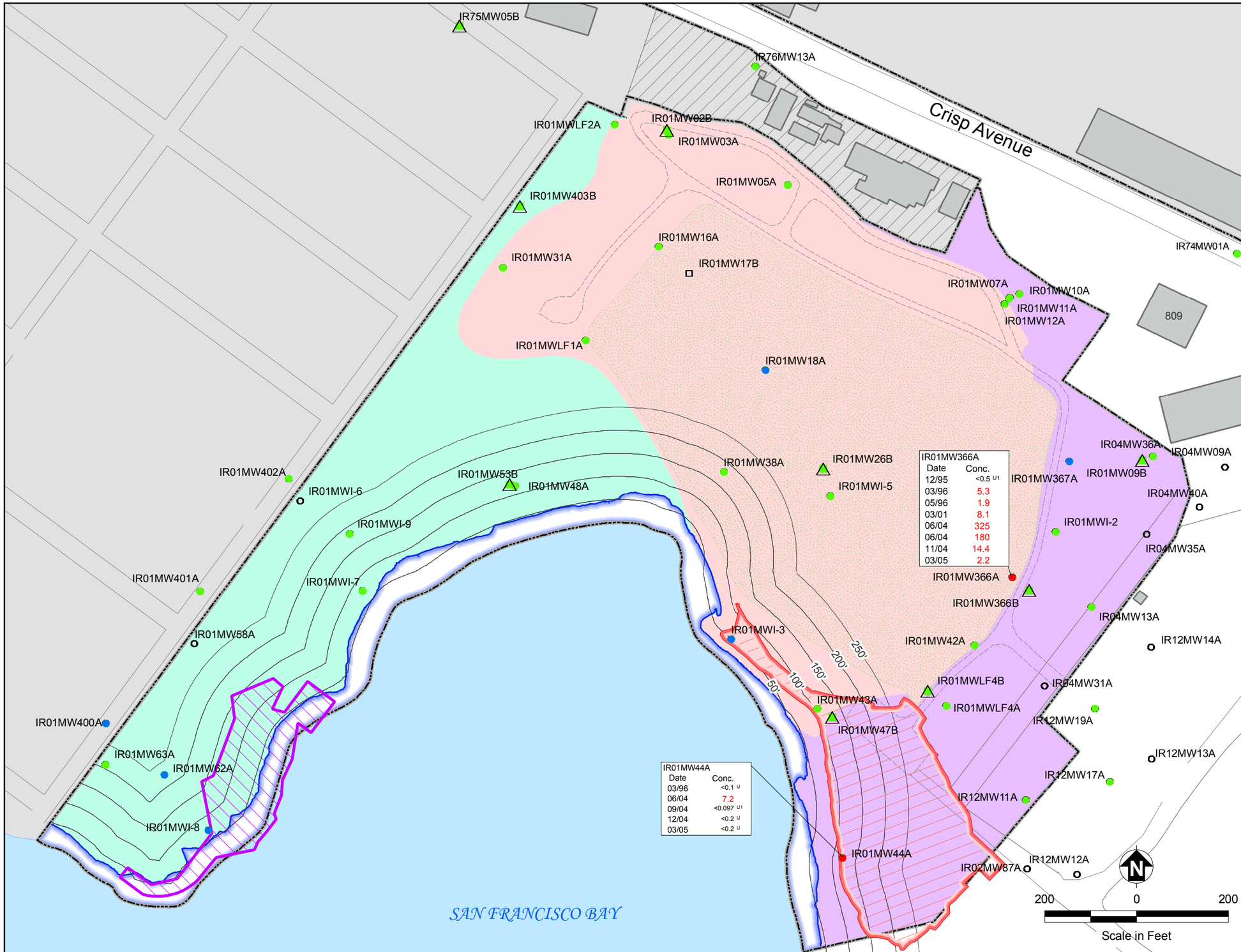
Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE M-7

EVALUATION OF LEAD IN GROUNDWATER

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Section 4\Water\Aquatic\Scenario5_Lead.mxd



IR01MW366A

Date	Conc.
12/95	<0.5 U1
03/96	5.3
05/96	1.9
03/01	8.1
06/04	325
06/04	180
11/04	14.4
03/05	2.2

IR01MW44A

Date	Conc.
03/96	<0.1 U
06/04	7.2
09/04	<0.097 U1
12/04	<0.2 U
03/05	<0.2 U

Reporting Limit Exceeds Aquatic Criterion (for at least one sample)
A-aquifer Well
B-aquifer Well
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds Criterion
Road
Gravel Road
Metal Slag Area (final boundary)
PCB Hot Spot (final boundary)
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property
50' Distance from Shoreline (in feet)

Notes:

Results are shown for locations where data has exceeded the aquatic criterion.
Red text indicates results that exceed the aquatic criterion.
Where results are shown as non-detect (<), the reporting limit follows.

Conc. = concentration
µg/L = microgram per liter

U = value was not detected above the reporting limit
Numbers associated with qualifiers are further defined in Appendix J.

Aquatic criterion for mercury in the A-aquifer = 0.60 µg/L
Source: Hunters Point Groundwater Ambient Level (HGAL)

Aquatic criterion for mercury in the B-aquifer = 0.025 µg/L
Source: San Francisco Bay Basin Plan, 4-Day Average Concentration (Chronic).

IR01MWLF1A ← Well ID

Date	Conc
07/04	2.1
09/04	8.4
11/04	2.5
03/05	0.57

Sample Date (mm/yy) → Date; Chemical Concentration (µg/L) ← Conc.

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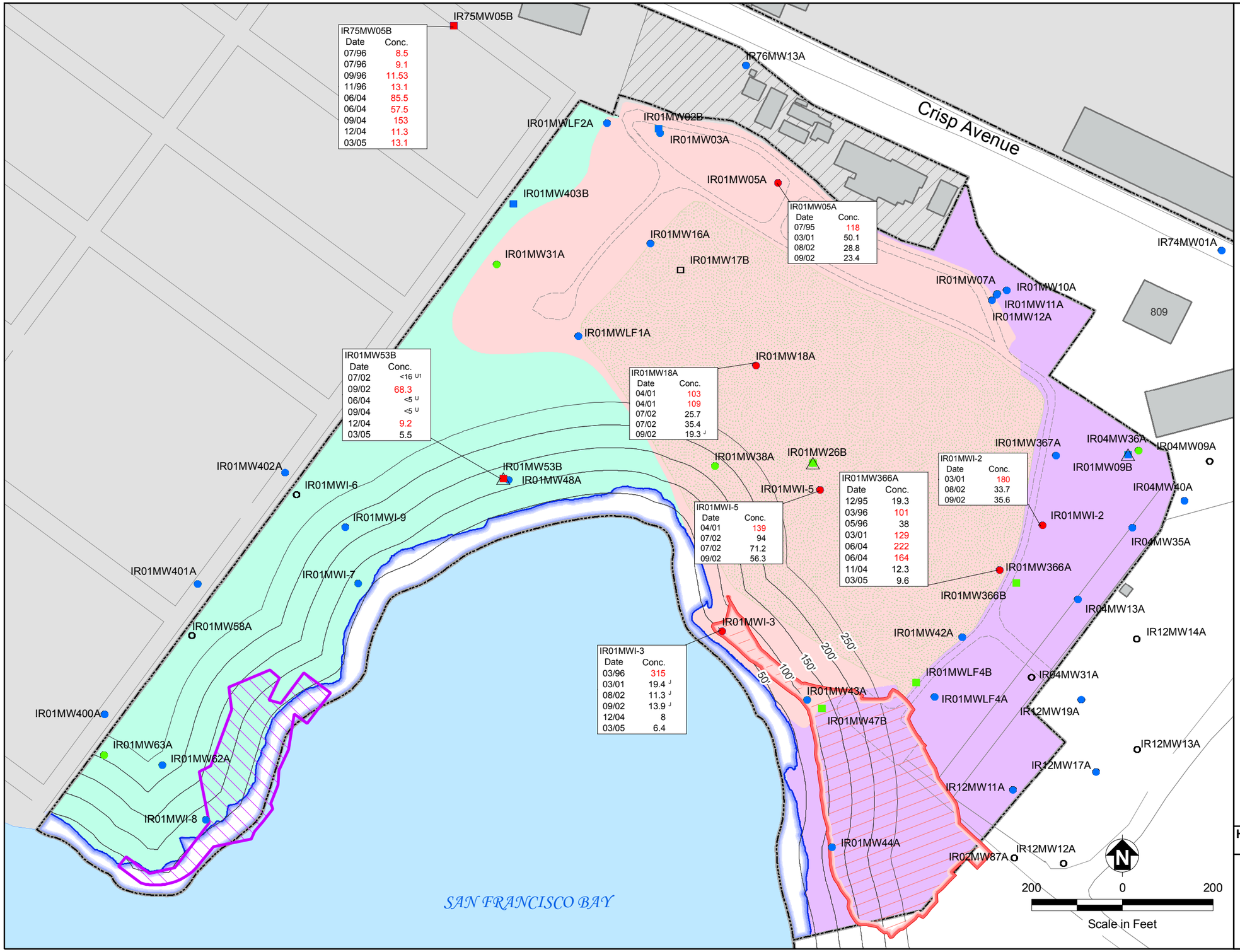
FIGURE M-8

EVALUATION OF MERCURY IN GROUNDWATER

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Section 4\Water\Aquatic\Scenario5_Mercury.mxd



Reporting Limit Exceeds Aquatic Criterion (for at least one sample)
A-aquifer Well
B-aquifer Well
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds Criterion
Road
Gravel Road
Metal Slag Area (final boundary)
PCB Hot Spot (final boundary)
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property
50' Distance from Shoreline (in feet)

Notes:

Results are shown for locations where data has exceeded the aquatic criterion.
Red text indicates results that exceed the aquatic criterion.
Where results are shown as non-detect (<), the reporting limit follows.

Conc. = concentration
µg/L = microgram per liter

J = estimated value
U = value was not detected above the reporting limit
Numbers associated with qualifiers are further defined in Appendix J.

Aquatic criterion for nickel in the A-aquifer = 96.5 µg/L
Source: Hunters Point Groundwater Ambient Level (HGAL)

Aquatic criterion for nickel in the B-aquifer = 8.2 µg/L
Source: California Toxics Rule Criteria for Enclosed Bays and Estuaries (Chronic).

IR01MWLF1A (Well ID)

Date	Conc
07/04	2.1
09/04	8.4
11/04	2.5
03/05	0.57

Sample Date (mm/yy) — Chemical Concentration (µg/L)

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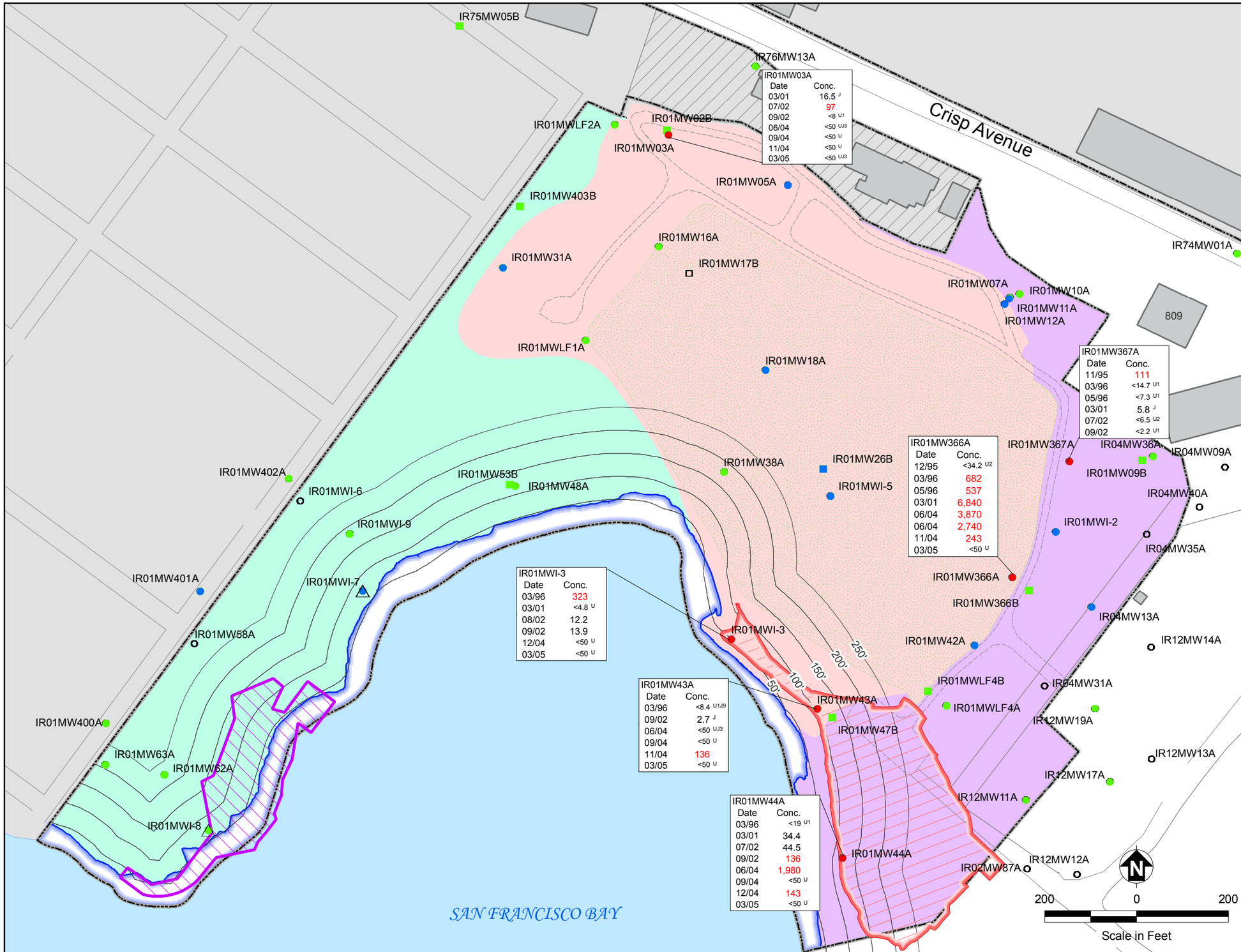
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE M-9

EVALUATION OF NICKEL IN GROUNDWATER

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Section 4\Water\Aquatic\Scenario5_Nickel.mxd



Reporting Limit Exceeds Aquatic Criterion (for at least one sample)
A-aquifer Well
B-aquifer Well
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds Criterion
Road
Gravel Road
Metal Slag Area (final boundary)
PCB Hot Spot (final boundary)
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property
50' Distance from Shoreline (in feet)

Notes:

Results are shown for locations where data has exceeded the aquatic criterion.
Red text indicates results that exceed the aquatic criterion.
Where results are shown as non-detect (<), the reporting limit follows.

Conc. = concentration
µg/L = microgram per liter

J = estimated value
U = value was not detected above the reporting limit
Numbers associated with qualifiers are further defined in Appendix J.

Aquatic criterion for zinc = 81 µg/L
Source: California Toxics Rule Criteria for Enclosed Bays and Estuaries (Chronic).

IR01MWLF1A ← Well ID

Date	Conc
07/04	2.1
09/04	8.4
11/04	2.5
03/05	0.57

Sample Date (mm/yy) → Chemical Concentration (µg/L) ←

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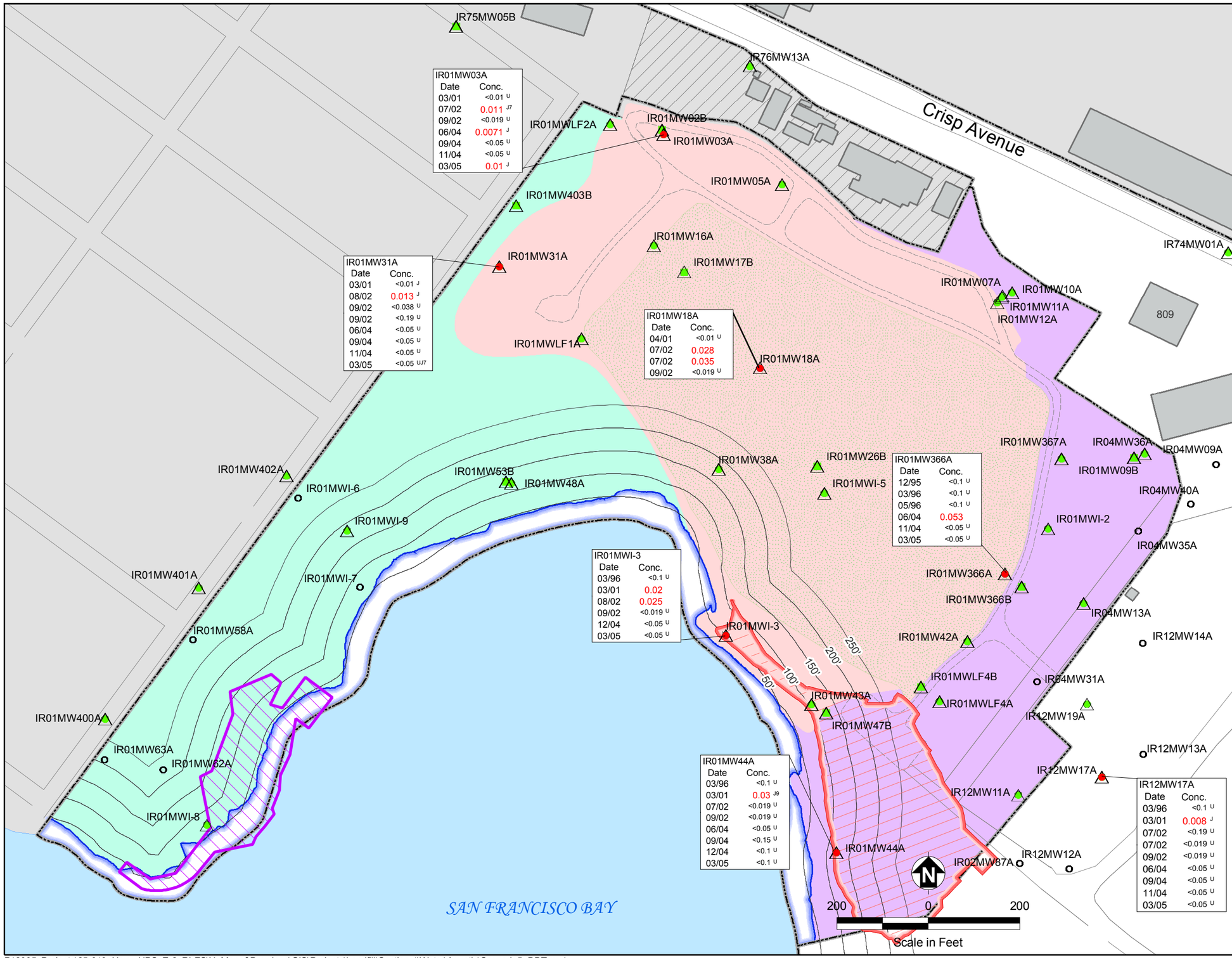
FIGURE M-10

EVALUATION OF ZINC IN GROUNDWATER

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Section 4\Water\Aquatic\Scenario5_Zinc.mxd



Reporting Limit Exceeds Aquatic Criterion (for at least one sample)
A-aquifer Well
B-aquifer Well
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds Criterion
Road
Gravel Road
Metal Slag Area (final boundary)
PCB Hot Spot (final boundary)
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property
50' Distance from Shoreline (in feet)

Notes:

Results are shown for locations where data has exceeded the aquatic criterion.
Red text indicates results that exceed the aquatic criterion.
Where results are shown as non-detect (<), the reporting limit follows.

Conc. = concentration
µg/L = microgram per liter
DDT = dichlorodiphenyltrichloroethane

J = estimated value
U = value was not detected above the reporting limit
Numbers associated with qualifiers are further defined in Appendix J.

Aquatic criterion for 4,4'-DDT = 0.001 µg/L
Source: California Toxics Rule Criteria for Enclosed Bays and Estuaries (Chronic).

The laboratory reporting limits of curent, routinely used, analytical methods are greater than the aquatic criterion.

IR01MWLF1A ← Well ID
Date Conc
07/04 2.1
09/04 8.4
11/04 2.5
03/05 0.57

Sample Date (mm/yy) →
← Chemical Concentration (µg/L)

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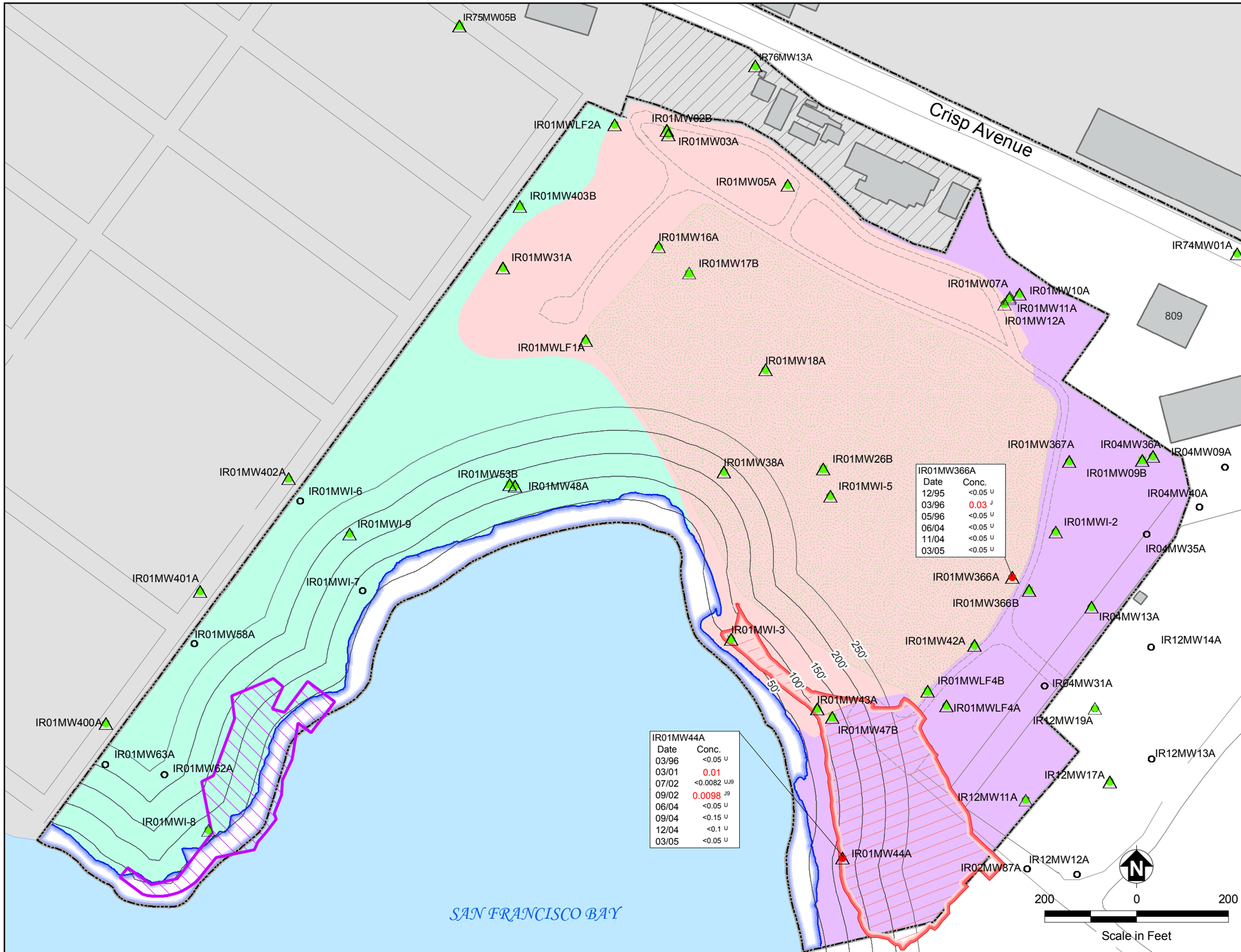
FIGURE M-11

EVALUATION OF 4,4-DDT IN GROUNDWATER

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Section 4\Water\Aquatic\Scenario5_DDT.mxd



Reporting Limit Exceeds Aquatic Criterion (for at least one sample)
A-aquifer Well
B-aquifer Well
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds Criterion
Road
Gravel Road
Metal Slag Area (final boundary)
PCB Hot Spot (final boundary)
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property
−50'− Distance from Shoreline (in feet)

Notes:

Results are shown for locations where data has exceeded the aquatic criterion.
Red text indicates results that exceed the aquatic criterion.
Where results are shown as non-detect (<), the reporting limit follows.

Conc. = concentration
µg/L = microgram per liter
J = estimated value
U = value was not detected above the reporting limit
Numbers associated with qualifiers are further defined in Appendix J.

Aquatic criterion for alpha-chlordane = 0.004 µg/L
Source: California Toxics Rule Criteria for Enclosed Bays and Estuaries (Chronic).

The reporting limits of current, routinely used, analytical methods are greater than the aquatic criterion.

IR01MWLF1A
Date Conc
07/04 2.1
09/04 8.4
11/04 2.5
03/05 0.57

Well ID
Sample Date (mm/yy)
Chemical Concentration (µg/L)

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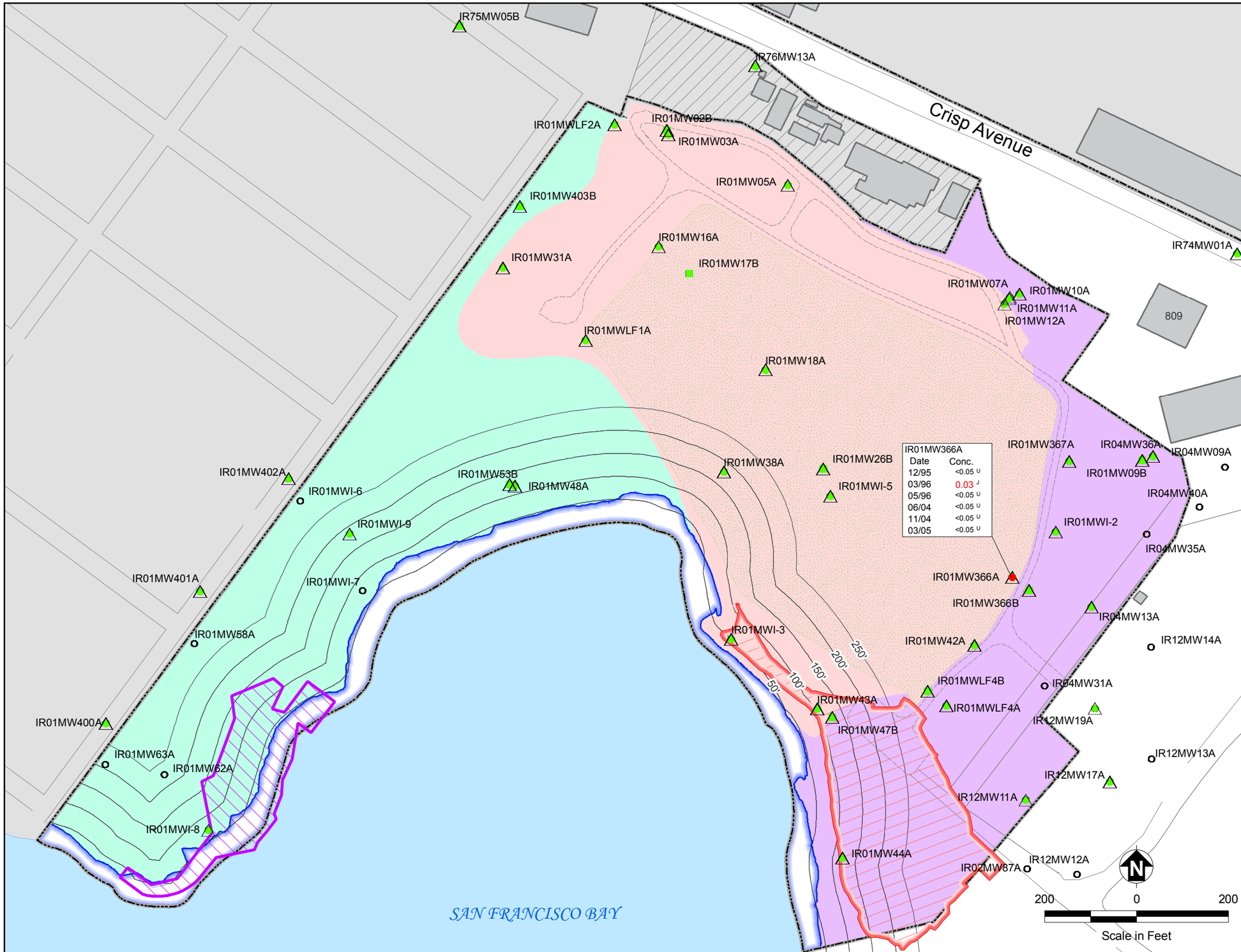
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE M-12

EVALUATION OF ALPHA-CHLORDANE IN GROUNDWATER

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Section 4\Water\Aquatic\Scenario5_Alpha-Chlordane.mxd



IR01MW366A	
Date	Conc.
12/95	<0.05 U
03/96	0.03 J
05/96	<0.05 U
06/04	<0.05 U
11/04	<0.05 U
03/05	<0.05 U

Reporting Limit Exceeds Aquatic Criterion (for at least one sample)
A-aquifer Well
B-aquifer Well
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds Criterion
Road
Gravel Road
Metal Slag Area (final boundary)
PCB Hot Spot (final boundary)
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property
50' Distance from Shoreline (in feet)

Notes:

Results are shown for locations where data has exceeded the aquatic criterion.
Red text indicates results that exceed the aquatic criterion.
Where results are shown as non-detect (<), the reporting limit follows.

Conc. = concentration
µg/L = microgram per liter

J = estimated value
U = value was not detected above the reporting limit
Numbers associated with qualifiers are further defined in Appendix J.

Aquatic criterion for endosulfan I = 0.0087 µg/L
Source: California Toxics Rule Criteria for Enclosed Bays and Estuaries (Chronic).

The laboratory reporting limits of current, routinely used, analytical methods are greater than the aquatic criterion.

IR01MWLF1A	
Date	Conc
07/04	2.1
09/04	8.4
11/04	2.5
03/05	0.57

Well ID
Sample Date (mm/yy)
Chemical Concentration (µg/L)

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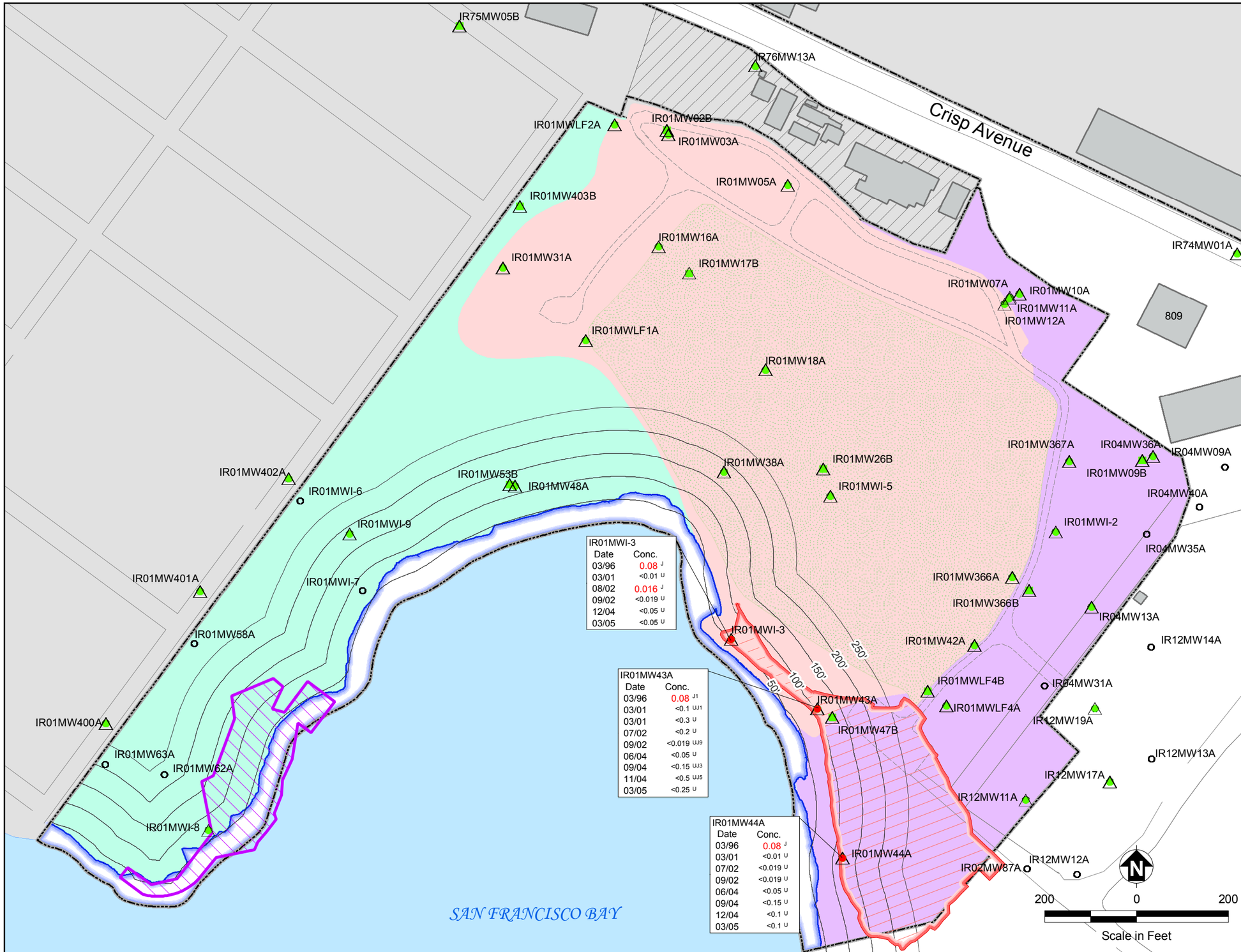
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE M-13

EVALUATION OF ENDOSULFAN I IN GROUNDWATER

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Section 4\Water\Aquatic\Scenario5_EndosulfanI.mxd



Reporting Limit Exceeds Aquatic Criterion (for at least one sample)
A-aquifer Well
B-aquifer Well
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds Criterion
Road
Gravel Road
Metal Slag Area (final boundary)
PCB Hot Spot (final boundary)
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property
50' Distance from Shoreline (in feet)

Notes:

Results are shown for locations where data has exceeded the aquatic criterion.
Red text indicates results that exceed the aquatic criterion.
Where results are shown as non-detect (<), the reporting limit follows.

Conc. = concentration
µg/L = microgram per liter

J = estimated value
U = value was not detected above the reporting limit
Numbers associated with qualifiers are further defined in Appendix J.

Aquatic criterion for endosulfan II = 0.0087 µg/L
Source: California Toxics Rule Criteria for Enclosed Bays and Estuaries (Chronic).

The laboratory reporting limits of current, routinely used, analytical methods are greater than the aquatic criterion.

IR01MWLF1A (Well ID)

Date	Conc
07/04	2.1
09/04	8.4
11/04	2.5
03/05	0.57

Sample Date (mm/yy) — Chemical Concentration (µg/L)

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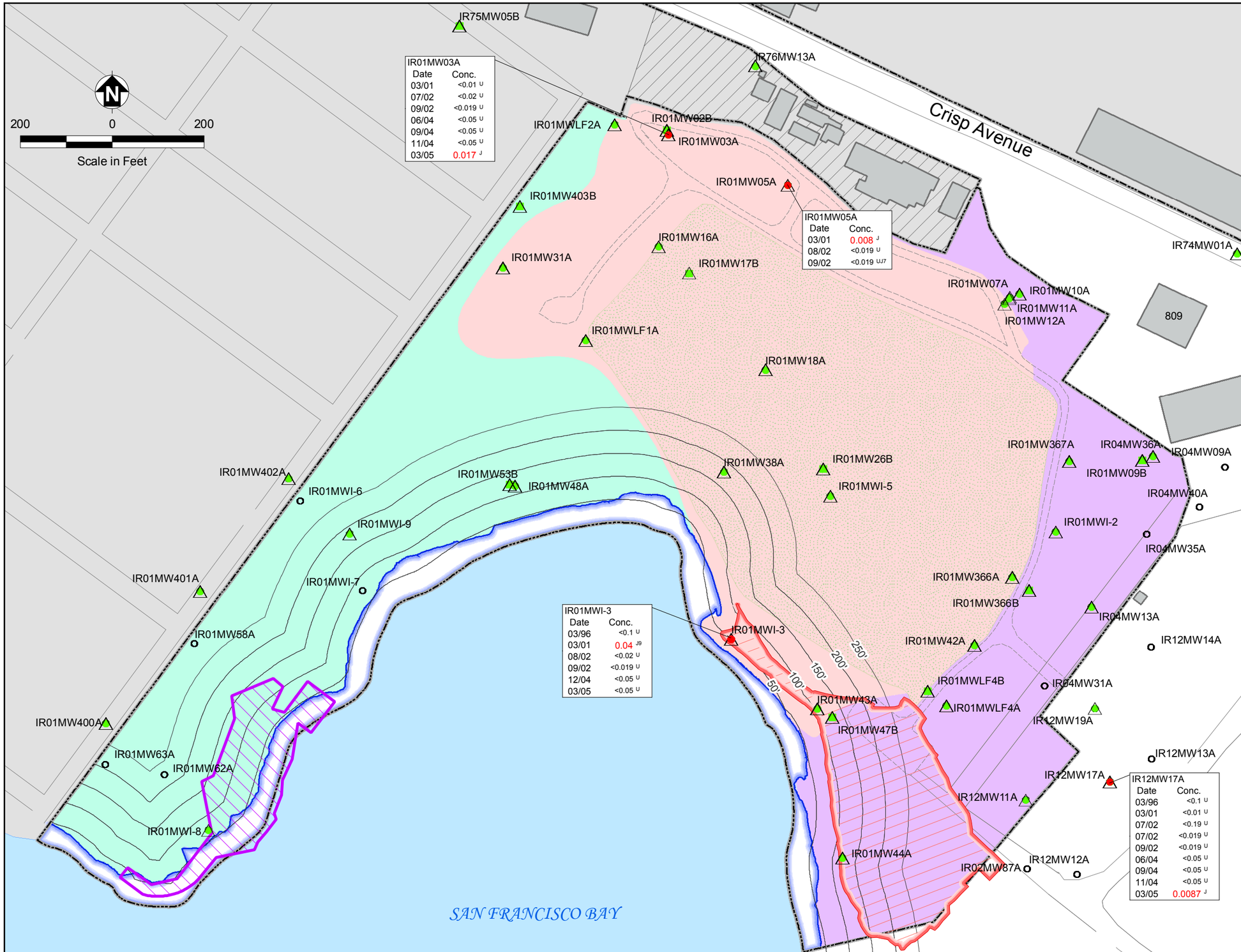
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE M-14

EVALUATION OF ENDOSULFAN II IN GROUNDWATER

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Section 4\Water\Aquatic\Scenario5_EndosulfanII.mxd



△ Reporting Limit Exceeds Aquatic Criterion (for at least one sample)
○ A-aquifer Well
□ B-aquifer Well
○ / □ Not Analyzed for Analyte
● / ■ Analyte Not Detected
● / ■ Analyte Exceeds Reporting Limit
● / ■ Analyte Exceeds Criterion
Road
Gravel Road
Metal Slag Area (final boundary)
PCB Hot Spot (final boundary)
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property
50' Distance from Shoreline (in feet)

Notes:

Results are shown for locations where data has exceeded the aquatic criterion.
Red text indicates results that exceed the aquatic criterion.
Where results are shown as non-detect (<), the reporting limit follows.

Conc. = concentration
µg/L = microgram per liter

J = estimated value
U = value was not detected above the reporting limit
Numbers associated with qualifiers are further defined in Appendix J.

Aquatic criterion for lead in the B-aquifer = 0.0023 µg/L
Source: California Toxics Rule Criteria for Enclosed Bays and Estuaries (Chronic).

The laboratory reporting limits of current, routinely used, analytical mehtods are greater than the aquatic criterion.

IR01MWLF1A ← Well ID

Date	Conc
07/04	2.1
09/04	8.4
11/04	2.5
03/05	0.57

Sample Date (mm/yy) → Date
Chemical Concentration (µg/L) ← Conc

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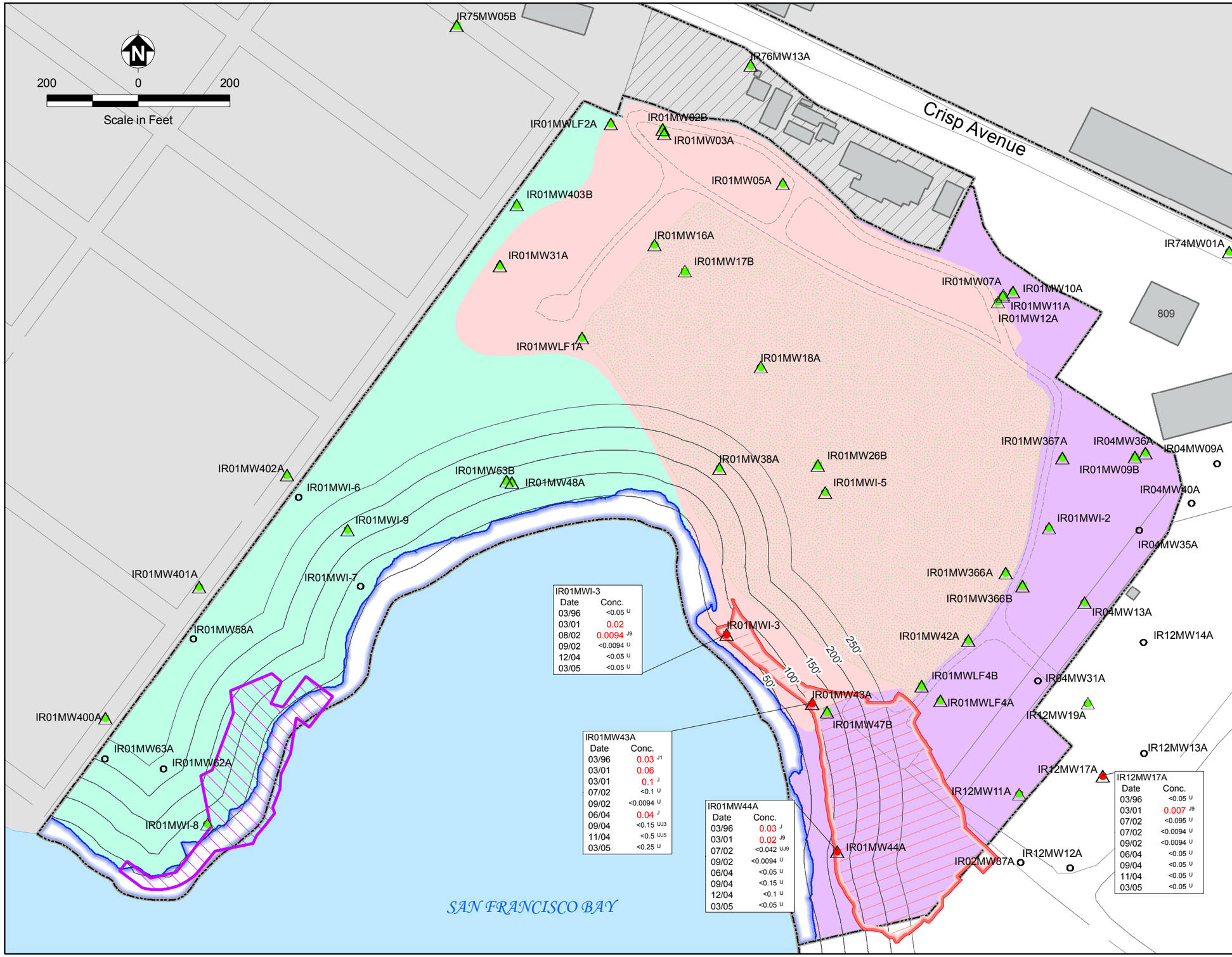
Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE M-15

EVALUATION OF ENDRIN IN GROUNDWATER

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Section 4\Water\Aquatic\Scenario5_Endrin.mxd



IR01MWI-3	
Date	Conc.
03/96	<0.05 U
03/01	0.02
08/02	0.0094 J9
09/02	<0.0094 U
12/04	<0.05 U
03/05	<0.05 U

IR01MW43A	
Date	Conc.
03/96	0.03 J1
03/01	0.06
03/01	0.1 J
07/02	<0.1 U
09/02	<0.0094 U
06/04	0.04 J
09/04	<0.15 UJ3
11/04	<0.5 UJ5
03/05	<0.25 U

IR01MW44A	
Date	Conc.
03/96	0.03 J
03/01	0.02 J9
07/02	<0.042 UJ9
09/02	<0.0094 U
06/04	<0.05 U
09/04	<0.15 U
12/04	<0.1 U
03/05	<0.05 U

IR12MW17A	
Date	Conc.
03/96	<0.05 U
03/01	0.007 J9
07/02	<0.095 U
07/02	<0.0094 U
09/02	<0.0094 U
06/04	<0.05 U
09/04	<0.05 U
11/04	<0.05 U
03/05	<0.05 U

- Reporting Limit Exceeds Aquatic Criterion (for at least one sample)
- A-aquifer Well
- B-aquifer Well
- Not Analyzed for Analyte
- Analyte Not Detected
- Analyte Exceeds Reporting Limit
- Analyte Exceeds Criterion
- Road
- Gravel Road
- Metal Slag Area (final boundary)
- PCB Hot Spot (final boundary)
- Limit of Landfill Cap
- Parcel Boundary
- Building
- UCSF Compound
- Landfill Area
- Adjacent Area
- Panhandle Area
- Shoreline Area
- San Francisco Bay
- Non-Navy Property
- 50' Distance from Shoreline (in feet)

Notes:

Results are shown for locations where data has exceeded the aquatic criterion.
Red text indicates results that exceed the aquatic criterion.
Where results are shown as non-detect (<), the reporting limit follows.

Conc. = concentration
µg/L = microgram per liter

J = estimated value
U = value was not detected above the reporting limit
Numbers associated with qualifiers are further defined in Appendix J.

Aquatic criterion for gamma-chlordane = 0.004 µg/L
Source: California Toxics Rule Criteria for Enclosed Bays and Estuaries (Chronic).

The laboratory reporting limits current, routinely used, analytical methods are greater than the aquatic criterion.

IR01MWLF1A	
Date	Conc
07/04	2.1
09/04	8.4
11/04	2.5
03/05	0.57

Well ID

Sample Date (mm/yy)

Chemical Concentration (µg/L)

ERRG ENGINEERING/REMEDIATION RESOURCES GROUP, INC.

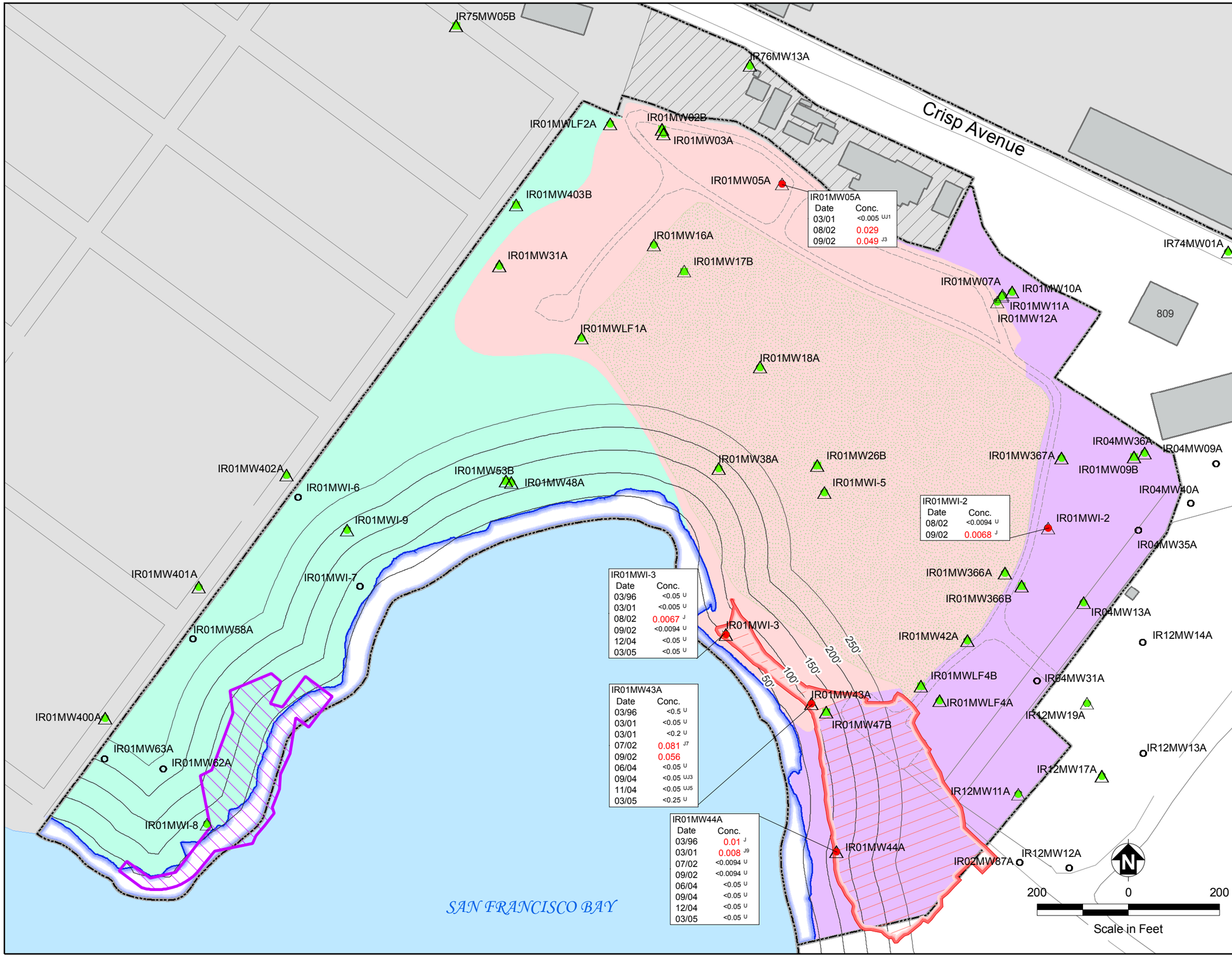
Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE M-16

EVALUATION OF GAMMA-CHLORDANE IN GROUNDWATER

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Section 4\Water\Aquatic\Scenario5_Gamma Chlordane.mxd



Reporting Limit Exceeds Aquatic Criterion (for at least one sample)
A-aquifer Well
B-aquifer Well
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds Criterion
Road
Gravel Road
Metal Slag Area (final boundary)
PCB Hot Spot (final boundary)
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property
50' Distance from Shoreline (in feet)

Notes:

Results are shown for locations where data has exceeded the aquatic criterion.
Red text indicates results that exceed the aquatic criterion.
Where results are shown as non-detect (<), the reporting limit follows.

Conc. = concentration
µg/L = microgram per liter

J = estimated value
U = value was not detected above the reporting limit
Numbers associated with qualifiers are further defined in Appendix J.

Aquatic criterion for heptachlor = 0.0036 µg/L
Source: California Toxics Rule Criteria for Enclosed Bays and Estuaries (Chronic).

The laboratory reporting limits of current, routinely used, analytical methods are greater than the aquatic criterion.

IR01MWLF1A ← Well ID

Date	Conc
07/04	2.1
09/04	8.4
11/04	2.5
03/05	0.57

Sample Date (mm/yy) → Date
Chemical Concentration (µg/L) ← Conc

ERRG ENGINEERING/REMEDIATION RESOURCES GROUP, INC.

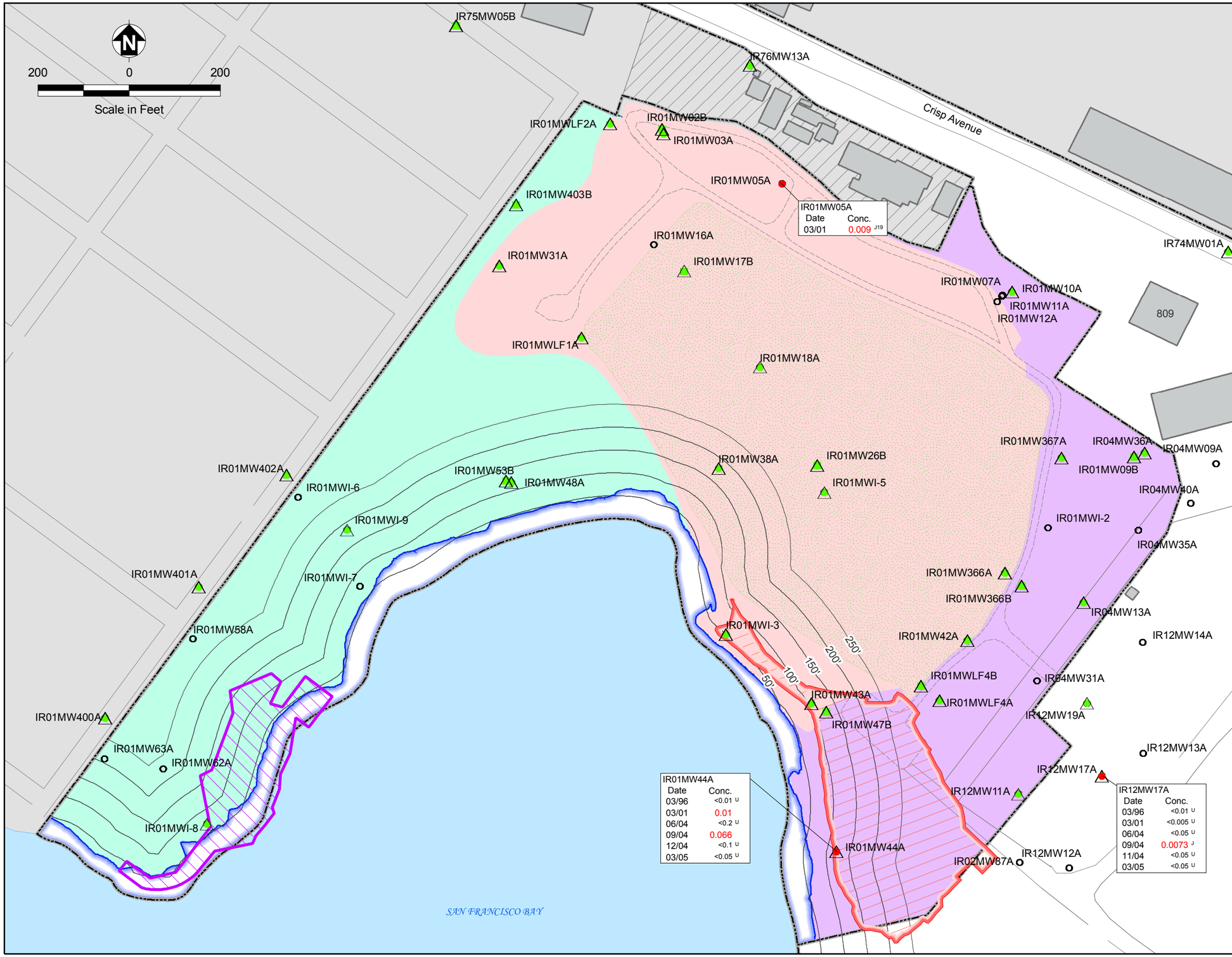
Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE M-17

EVALUATION OF HEPTACHLOR IN GROUNDWATER

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Section 4\Water\Aquatic\Scenario5_Heptachlor.mxd



Reporting Limit Exceeds Aquatic Criterion (for at least one sample)
A-aquifer Well
B-aquifer Well
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds Criterion
Road
Gravel Road
Metal Slag Area (final boundary)
PCB Hot Spot (final boundary)
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property
50' Distance from Shoreline (in feet)

Notes:

Results are shown for locations where data has exceeded the aquatic criterion.
Red text indicates results that exceed the aquatic criterion.
Where results are shown as non-detect (<), the reporting limit follows.

Conc. = concentration
µg/L = microgram per liter

J = estimated value
U = value was not detected above the reporting limit
Numbers associated with qualifiers are further defined in Appendix J.

Aquatic criterion for heptachlor epoxide = 0.0036 µg/L
Source: California Toxics Rule Criteria for Enclosed Bays and Estuaries (Chronic).

The laboratory reporting limits of current, routinely used, analytical methods are greater than the aquatic criterion.

IR01MWLF1A ← Well ID

Date	Conc
07/04	2.1
09/04	8.4
11/04	2.5
03/05	0.57

Sample Date (mm/yy) → Date
Chemical Concentration (µg/L) ← Conc

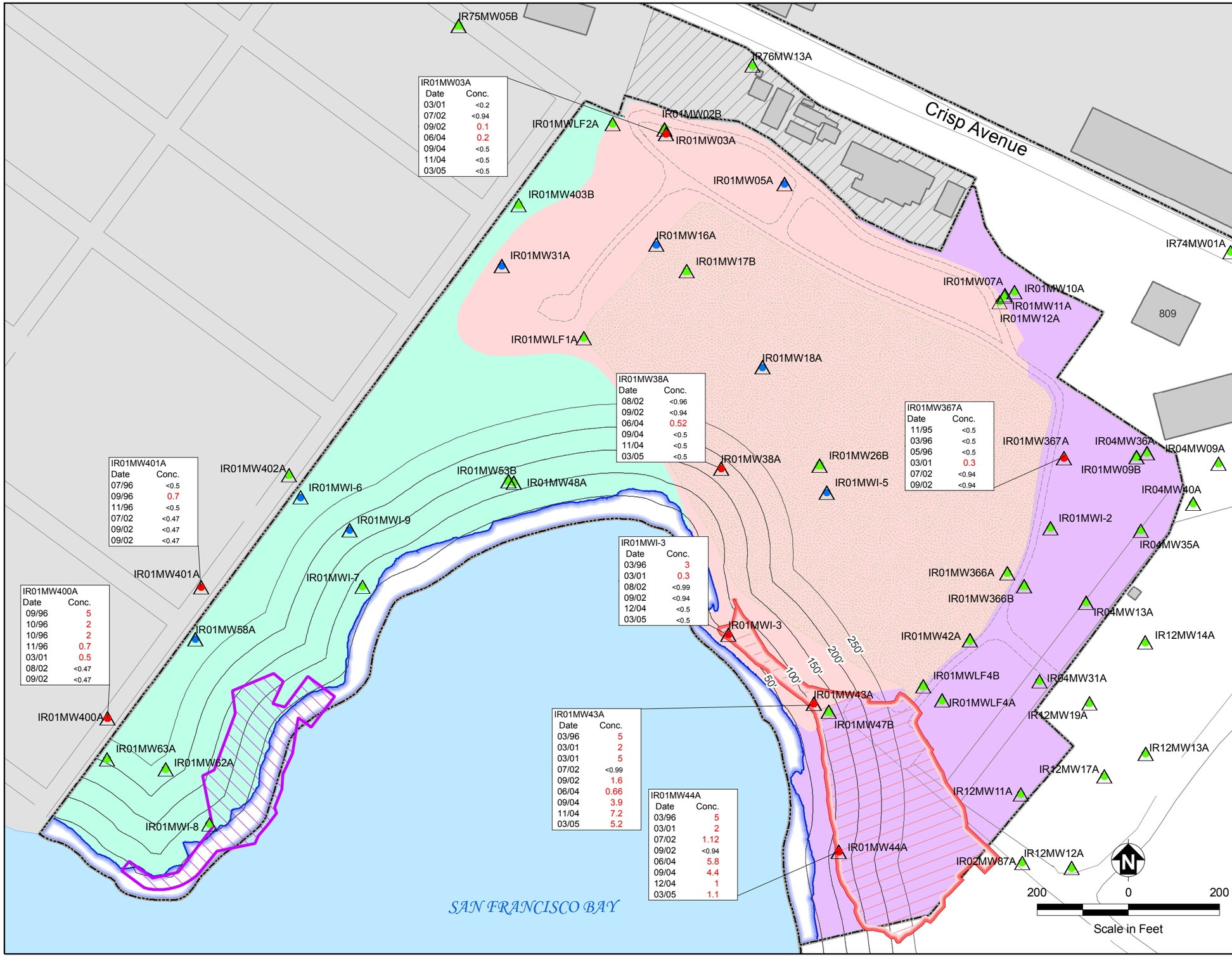
ERRG ENGINEERING/REMEDIATION RESOURCES GROUP, INC.

Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE M-18
EVALUATION OF HEPTACHLOR EPOXIDE IN GROUNDWATER

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Section 4\Water\Aquatic\Scenario5_Heptachlor Epoxide.mxd



Reporting Limit Exceeds Aquatic Criterion (for at least one sample)
A-aquifer Well
B-aquifer Well
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds Criterion
Road
Gravel Road
Metal Slag Area (final boundary)
PCB Hot Spot (final boundary)
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property
– 50' – Distance from Shoreline (in feet)

Notes:

Results are shown for locations where data has exceeded the aquatic criterion.
Red text indicates results that exceed the aquatic criterion.
Where results are shown as non-detect (<), the reporting limit follows.

Conc. = concentration
µg/L = microgram per liter
PCBs = polychlorinated biphenyls

J = estimated value
U = value was not detected above the reporting limit
Numbers associated with qualifiers are further defined in Appendix J.

Aquatic criterion for total PCBs = 0.03 µg/L
Source: California Toxics Rule Criteria for Enclosed Bays and Estuaries (Chronic).

The laboratory reporting limits for current, routinely used, analytical methods are greater than the aquatic criterion.

IR01MWLF1A ← Well ID

Date	Conc
07/04	2.1
09/04	8.4
11/04	2.5
03/05	0.57

Sample Date (mm/yy) → Chemical Concentration (µg/L)

ERRG ENGINEERING/REMEDIATION RESOURCES GROUP, INC.

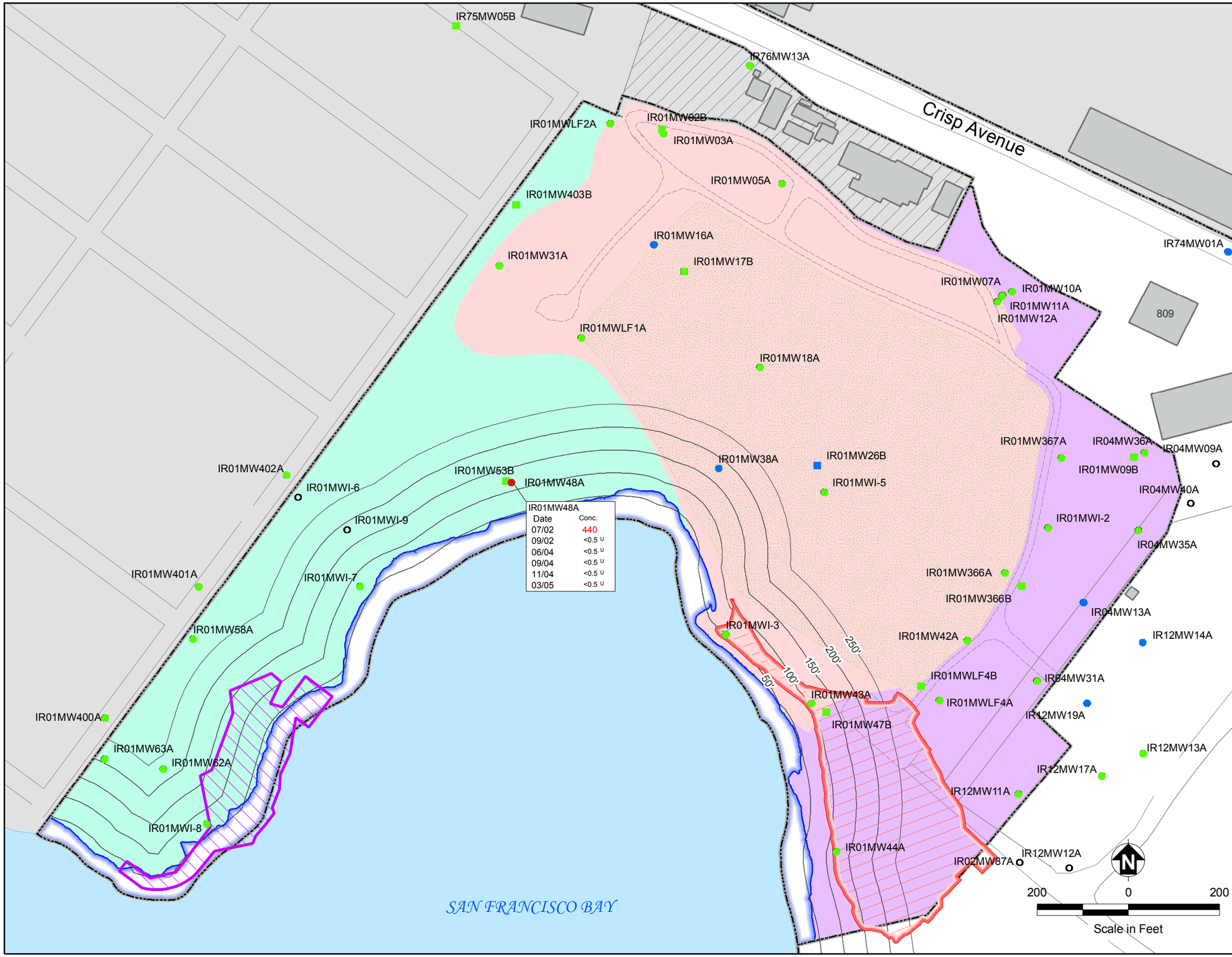
Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE M-19

EVALUATION OF TOTAL PCBS IN GROUNDWATER

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Section 4\Water\Aquatic\Scenario5_PCBs.mxd



Reporting Limit Exceeds Aquatic Criterion (for at least one sample)
A-aquifer Well
B-aquifer Well
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds Criterion
Road
Gravel Road
Metal Slag Area (final boundary)
PCB Hot Spot (final boundary)
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property
50' Distance from Shoreline (in feet)

Notes:

Results are shown for locations where data has exceeded the aquatic criterion.
Where results are shown as non-detect (<), the reporting limit follows.

Conc. = concentration
µg/L = microgram per liter

U = value was not detected above the reporting limit
Numbers associated with qualifiers are further defined in Appendix J.

Aquatic criterion for trichloroethene = 400 µg/L
Source: National Ambient Water Quality Criteria (AWQC) for Protection of Saltwater Aquatic Life, Lowest Observed Effect Level (20 % of Acute Concentration).

IR01MWLF1A ← Well ID

Date	Conc
07/04	2.1
09/04	8.4
11/04	2.5
03/05	0.57

Sample Date (mm/yy) → Date; Chemical Concentration (µg/L) → Conc

ENGINEERING/REMEDIATION RESOURCES GROUP, INC.
ERRG

Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California

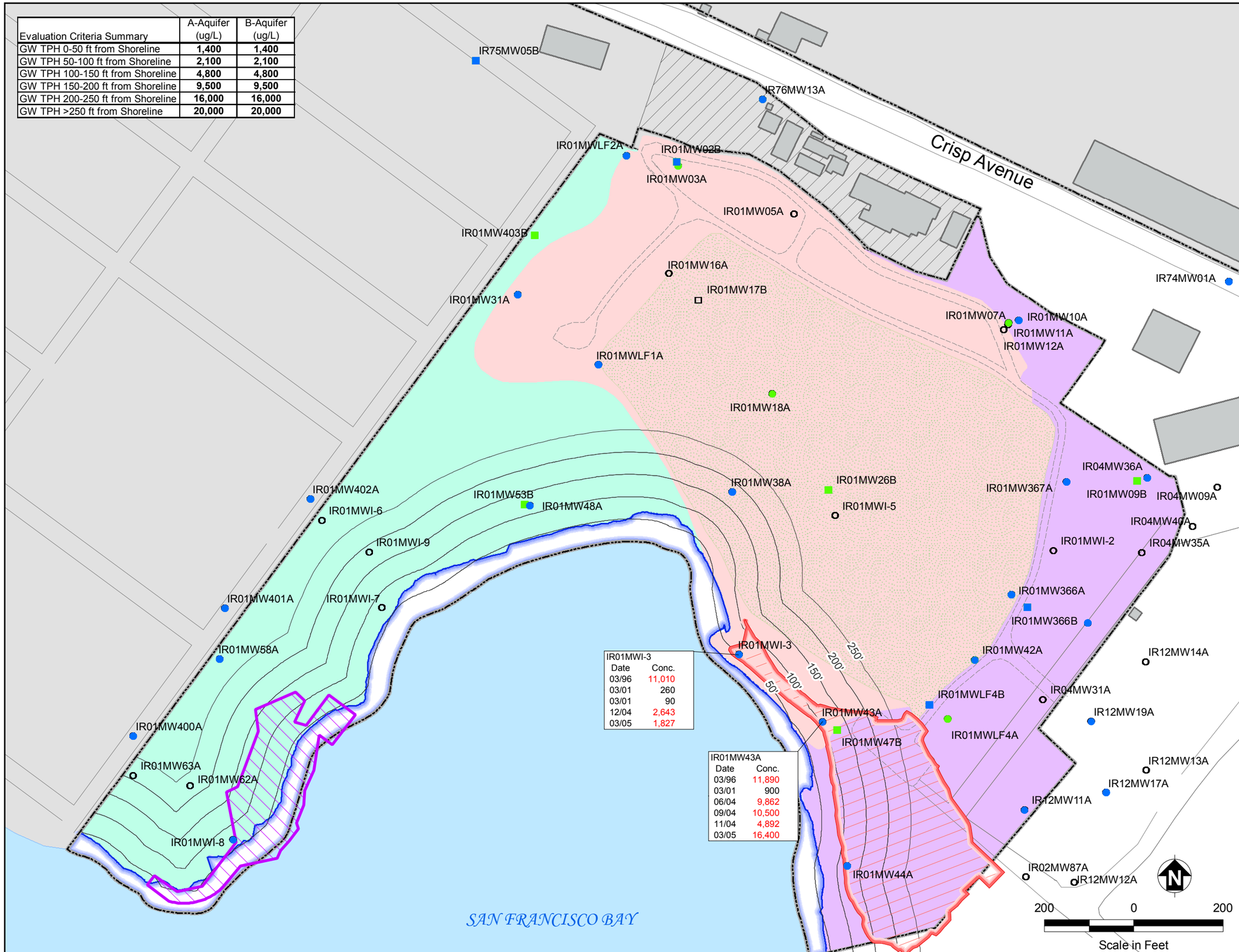
FIGURE M-20

EVALUATION OF TRICHLOROETHENE IN GROUNDWATER

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Section 4\Water\Aquatic\Scenario5_Trichloroethene.mxd

Evaluation Criteria Summary	A-Aquifer (ug/L)	B-Aquifer (ug/L)
GW TPH 0-50 ft from Shoreline	**1,400**	**1,400**
GW TPH 50-100 ft from Shoreline	**2,100**	**2,100**
GW TPH 100-150 ft from Shoreline	**4,800**	**4,800**
GW TPH 150-200 ft from Shoreline	**9,500**	**9,500**
GW TPH 200-250 ft from Shoreline	**16,000**	**16,000**
GW TPH >250 ft from Shoreline	**20,000**	**20,000**



- A-aquifer Well
- B-aquifer Well
- Not Analyzed for Analyte
- Analyte Not Detected
- Analyte Exceeds Reporting Limit
- Analyte Exceeds Criterion
- Road
- Gravel Road
- Metal Slag Area (final boundary)
- PCB Hot Spot (final boundary)
- Limit of Landfill Cap
- Parcel Boundary
- Building
- UCSF Compound
- Landfill Area
- Adjacent Area
- Panhandle Area
- Shoreline Area
- San Francisco Bay
- Non-Navy Property
- 50' Distance from Shoreline (in feet)

Notes:

Results are shown for locations where data has exceeded the aquatic criterion.
Red text indicates results that exceed the aquatic criterion.
Where results are shown as non-detect (<), the reporting limit follows.

Conc. = concentration
ft = feet
µg/L = microgram per liter
TPH = total petroleum hydrocarbons

J = estimated value
U = value was not detected above the reporting limit
Numbers associated with qualifiers are further defined in Appendix J.

Aquatic criterion varies based on distance from shoreline (see table in upper left corner of figure).
Source: Draft Petroleum Hydrocarbon Corrective Action Plan (Revision 1), Parcels C, D, and E, Tetra Tech EMI 2002.

IR01MWLF1A (Well ID)

Date	Conc
07/04	2.1
09/04	8.4
11/04	2.5
03/05	0.57

Sample Date (mm/yy) — Chemical Concentration (µg/L)

ERRG ENGINEERING/REMEDIATION RESOURCES GROUP, INC.

Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE M-21

EVALUATION OF TOTAL TPH IN GROUNDWATER

Remedial Investigation/Feasibility Study for Parcel E-2

2005-12-16 P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Section 4\Water\SumTPH-Wells.mxd

Tables

TABLE M-1: SURFACE WATER SCREENING CRITERIA

Remedial Investigation/Feasibility Study for Parcel E-2, Hunters Point Shipyard, San Francisco, California

Analyte Monitored Under Hunters Point Shipyard Groundwater Program	San Francisco Bay Basin Plan[a] (µg/L)		California Toxics Rule Criteria for Enclosed Bays and Estuaries[e] (µg/L)									National Recommended Water Quality Criteria[k] (µg/L) Saltwater Aquatic Life					National Ambient Water Quality Criteria (AWQC) for Protection of Saltwater Aquatic Life[i] (µg/L) Lowest Observed Effect Level (LOEL)							Other Criteria (footnotes indicate source) (µg/L)		Surface Water Criteria Selected for Aquatic Evaluation (µg/L)
			Chronic[g]		Acute[g]			Instantaneous Maximum				Chronic[g]		Acute[g]			Chronic[h]		Acute[i]			Other[j]				
	Concentration	Footnotes	Concentration	Footnotes	Concentration	20% of Concentration[f]	Footnotes	Concentration	10% of Concentration[f]	Footnotes	Concentration	Footnotes	Concentration	20% of Concentration[f]	Footnotes	Concentration	Footnotes	Concentration	20% of Concentration[f]	Footnotes	Concentration	Footnotes	Other	Footnotes	
1,1,1-Trichloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		--	31,200	6,240	--	--	--	--	--	6,240
1,1,2,2-Tetrachloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9,020	1,804	--	--	--	--	--	1804
1,1-Dichloroethene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	224,000	44800	(27)	--	--	--	--	44,800
1,2,4,5-Tetrachlorobenzene	--	--	--	--	--	--	--	--	--	--						--	--	250	50	(22)	50	(22.23)	--	--	50
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	129	(22)	160	--	(22)	--	--	--	--	129
1,2-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	129	(22)	1,970	--	(24)	--	--	--	--	129
1,2-Dichloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	113,000	22,600	--	--	--	--	--	22,600
1,2-Dichloroethene (total)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	224,000	44,800	(27)	--	--	--	--	44,800
1,2-Dichloropropane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3,040	(28)	10,300	--	(28)			--	--	3,040
1,3-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	129	(22)	1,970	--	(24)			--	--	129
1,3-Dichloropropene (total)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	790	158	(29)	--	--	--	--	158
1,4-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	129	(22)	1,970	--	(24)	--	--	--	--	129
2,4-Dinitrophenol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	230	46	(88)	150	(38,88)	--	--	46
2,4-Dinitrotoluene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	590	118	(53)	370	(53, 82)	--	--	118
2,6-Dinitrotoluene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	590	118	(53)	370	(53, 82)	--	--	118
2-Chloronaphthalene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.5	1.5	(48)	--	--	--	--	1.5
2-Nitrophenol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4,850	970	(88)	--	--	--	--	970
4,4'-DDD	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.6	0.72	--	--	--	--	--	0.72
4,4'-DDE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14	2.8	--	--	--	--	--	2.8
4,4'-DDT	--	--	0.001	(114)	0.13	--	--	--	--	--	0.001	G,aa,ii	0.13	--	G,ii	--	--	--	--	--	--	--	--	--	0.001
4,6-Dinitro-2-methylpheno	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4,850	970	(88)	--	--	--	--	970
4-Amino-2,6-dinitrotoluene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	590	118	--	370	(82)	--	--	118
4-Nitrophenol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4,850	970	(88)	--	--	--	--	970
Acenaphthene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	710	--	970	--	--	500	(38)	--	--	710
Acenaphthylene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	(52)	--	--	--	--	60
Aldrin	--	--	--	--	--	--	--	1.3	--	II	--	--	1.3	0.26	G	--	--	--	--	--	--	--	--	--	0.26
Alpha-chlordane	--	--	0.004	(114)	--	--	--	0.09	--	--	0.004	G,aa,o	0.09	--	G,o	--	--	--	--	--	--	--	--	--	0.004
Ammonia (un-ionized)	25	s	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	35	u	400	t	25
Anthracene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	(52)	--	--	--	--	60
Aroclor 1016	--	--	0.03	(114, 116) rr	--	--	--	--	--	--	0.03	N,aa	--	--	--	--	--	10	--	--	--	--	--	--	0.03
Aroclor 1221	--	--	0.03	(114, 116) rr	--	--	--	--	--	--	0.03	N,aa	--	--	--	--	--	10	--	--	--	--	--	--	0.03
Aroclor 1232	--	--	0.03	(114, 116) rr	--	--	--	--	--	--	0.03	N,aa	--	--	--	--	--	10	--	--	--	--	--	--	0.03
Aroclor 1242	--	--	0.03	(114, 116) rr	--	--	--	--	--	--	0.03	N,aa	--	--	--	--	--	10	--	--	--	--	--	--	0.03
Aroclor 1248	--	--	0.03	(114, 116) rr	--	--	--	--	--	--	0.03	N,aa	--	--	--	--	--	10	--	--	--	--	--	--	0.03
Aroclor 1254	--	--	0.03	(114, 116) rr	--	--	--	--	--	--	0.03	N,aa	--	--	--	--	--	10	--	--	--	--	--	--	0.03
Aroclor 1260	--	--	0.03	(114, 116) rr	--	--	--	--	--	--	0.03	N,aa	--	--	--	--	--	10	--	--	--	--	--	--	0.03
Arsenic	36	b	36	oo	69	--	mm, oo	--	--	--	36	A,D,bb	69	--	A,D,bb	--	--	2,319	--	(95)	13	(6)	--	--	36
Atrazine	--	--	--	--	--	--	--	--	--	--	11	r,(68)	310	--	r,(68)	--	--	--	--	--	--	--	--	--	11
Benzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5,100	--	--	700	--	--	--	700
Benzo(a)anthracene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	(52)	--	--	--	--	60
Benzo(a)pyrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	(52)	--	--	--	--	60
Benzo(b)fluoranthene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	(52)	--	--	--	--	60
Benzo(g,h,i)perylene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	(52)	--	--	--	--	60
Benzo(k)fluoranthene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	(52)	--	--	--	--	60
Bromochloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6,400	(20)	12,000	--	(20)	11,500	(20, 83)	--	--	6,400
Bromodichloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6,400	(20)	12,000	--	(20)	11,500	(20, 83)	--	--	6,400
Bromoform	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6,400	(20)	12,000	--	(20)	11,500	(20, 83)	--	--	6,400
Bromomethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6,400	(20)	12,000	--	(20)	11,500	(20, 83)	--	--	6,400
Butylbenzylphthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2,944	588.8	(45)	3.4	(38, 45)	--	--	588.8
Cadmium	9.3	b	9.3	(1, 142)	42	--	(1, 142)	--	--	--	8.8	D,bb,gg	40	--	D,bb,gg	--	--	--	--	--	--	--	--	--	8.8
Carbon tetrachloride	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6,400	(20)	50,000	--	--	11,500	(20, 82)	--	--	6,400
Chlordane			0.004	(114)	--	--	--	0.09	0.009	--	0.004	G,aa	0.09	0.009	G	--	--	--	--	--	--	--	--	--	0.004
Chlorobenzene	--	--	--	--	--		--				--	--	--	--	--	129	(22)	160	--	(22)	--	--	--	--	129
Chloroform	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6,400	(20)	12,000	--	(20)	11,500	(20, 82)	--	--	6,400
Chloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6,400	(20)	12,000	--	(20)	11,500	(20, 82)	--	--	6,400
Chromium VI	50 (VI)	b,o	50 (VI)	o	1100 (VI)	--	--	--	--	--	50 (VI)	D,bb,o	1100 (VI)	--	D,bb,o	--	--	--	--	--	--	--	--	--	50
Chrysene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	(52)	--	--	--	--	60
Cis-1,2-dichloroethene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	224,000	44,800	(27)	--	--	--	--	44,800
Copper	3.1	e	3.1	oo	4.8	--	oo	--	--	--	3.1	D,cc,ff	4.8	--	D,cc,ff	--	--	--	--	--	--	--	--	--	3.1
Cyanide	1	e	1	pp	1	--	pp	--	--	--	1	Q,bb	1	--	Q,bb	--	--	--	--	--	--	--	--	--	1
Dibenz(a,h)anthracene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	(52)	--	--	--	--	60
Dibromochloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6,400	(20)	12,000	--	(20)	11,500	(20, 83)	--	--	6,400
Dieldrin	--	--	0.0019	(114), II	--	--	--	0.71	--	II	0.0019	G,aa	0.71	0.142	G	--	--	--	--	--	--	--	--	--	0.142
Diethylphthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2,944	588.8	(45)	3.4	(38, 45)	--	--	588.8
Dimethylphthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2,944	--	(45)	3.4	(38, 45)	--	--	3.4
Di-n-butylphthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2,944	588.8	(45)	3.4	(38, 45)	--	--	588.8
Di-n-octylphthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2,944	588.8	(45)	3.4	(38, 45)	--	--	588.8
Endosulfan I	--	--	0.0087	(114, 115), II	--	--	--	0.034	--	(115), II	0.0087	G,Y,o	0.034	--	G,Y,o	--	--	--	--	--	--	--	--	--	0.0087
Endosulfan II	--	--	0.0087	(114, 115), II	--	--	--	0.034	--	(115), II	0.0087	G,Y,o	0.034	--	G,Y,o	--	--	--	--	--	--	--	--	--	0.0087
Endrin	--	--	0.0023	(114), II	--	--	--	0.037	--	II	0.0023	G,aa	0.037	--	G	--	--	--	--	--	--	--	--	--	0.0023
Ethylbenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	430	86	--	--	--	--	--	86
Fluoranthene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16	--	40	--	--	--	--	--	--	16

TABLE M-1: SURFACE WATER SCREENING CRITERIA

Remedial Investigation/Feasibility Study for Parcel E-2, Hunters Point Shipyard, San Francisco, California

Analyte Monitored Under Hunters Point Shipyard Groundwater Program	San Francisco Bay Basin Plan[a] (µg/L)		California Toxics Rule Criteria for Enclosed Bays and Estuaries[e] (µg/L)									National Recommended Water Quality Criteria[k] (µg/L) Saltwater Aquatic Life					National Ambient Water Quality Criteria (AWQC) for Protection of Saltwater Aquatic Life[i] (µg/L) Lowest Observed Effect Level (LOEL)							Other Criteria (footnotes indicate source) (µg/L)		Surface Water Criteria Selected for Aquatic Evaluation (µg/L)
			Chronic[g]		Acute[g]			Instantaneous Maximum				Chronic[g]		Acute[g]			Chronic[h]		Acute[i]			Other[j]				
	Concentration	Footnotes	Concentration	Footnotes	Concentration	20% of Concentration[f]	Footnotes	Concentration	10% of Concentration[f]	Footnotes	Concentration	Footnotes	Concentration	20% of Concentration[f]	Footnotes	Concentration	Footnotes	Concentration	20% of Concentration[f]	Footnotes	Concentration	Footnotes	Other	Footnotes	
Fluorene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	(52)	--	--	--	--	60
Gamma-BHC (lindane)	--	--	--	--	--	--	--	0.16	--	II	--	--	0.16	0.032	G	--	--	--	--	--	--	--	--	--	0.032
Gamma-chlordane	--	--	0.004	(114)	--	--	--	0.09	--	--	0.004	G,aa,o	0.09	--	G,o	--	--	--	--	--	--	--	--	--	0.004
Heptachlor	--	--	0.0036	(114)	II	--	--	0.053	--	II	0.0036	G,aa	0.053	--	G	--	--	--	--	--	--	--	--	--	0.0036
Heptachlor epoxide	--	--	0.0036	(114)	II		--	0.053	--	II	0.0036	G,V,aa	0.053	--	G,V	--	--	--	--	--	--	--	--	--	0.0036
Hexachlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	129	(22)	160	--	(22)	--	--	--	--	129
Hexachlorobutadiene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	32	6.4	--	--	--	--	--	6.4
Hexachlorocyclopentadiene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.0	1.4	--	--	--	--	--	1.4
Hexachloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	940	188	--	--	--	--	--	188
Indeno(1,2,3-cd)pyrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	(52)	--	--	--	--	60
Isophorone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12,900	2,580	--	--	--	--	--	2,580
Lead	8.1	b	8.1	(1, 142), m	210	--	(1, 142), m	--	--	--	8.1	D,bb	210	--	D,bb	--	--	--	--	--	--	--	--	--	8.1
Mercury	0.025	b	--	--	--	--	--	--	--	--	0.94	D,ee,hh	1.8	--	D,ee,hh	--	--	--	--	--	--	--	--	--	0.025
Methoxychlor	--	--	--	--	--	--	--	--	--	--	0.03	F	--	--	--	--	--	--	--	--	--	--	0.003	(51),f	0.003
Methyl-tert-butyl-ether	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8,000	p	8,000
Methylene chloride	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6,400	(20)	12,000	--	(20)	11,500	(20, 82)	--	--	6,400
Mirex	--	--	--	--	--	--	--	--	--	--	0.001	F	--	--	--	--	--	--	--	--	--	--	--	--	0.001
Naphthalene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2,350	470	--	--	--	--	--	470
Nickel	8.2	b	8.2	(2, 142), oo	74	--	(1, 142), oo	--	--	--	8.2	D,bb	74	--	D,bb	--	--	--	--	--	--	--	--	--	8.2
Nitrobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6,680	1,336	--	--	--	--	--	1,336
N-Nitroso-di-n-propylamine	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3,300,000	660,000	(56)	--	--	--	--	660,000
N-nitrosodiphenylamine	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3,300,000	660,000	(56)	--	--	--	--	660,000
Pentachlorophenol	--	--	7.9	--	13	--	--	--	--	--	7.9	bb	13	--	bb	--	--	--	--	--	--	--	--	--	7.9
Phenanthrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	(52)	--	--	--	--	60
Phenol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5,800	1,160	--	--	--	--	--	1,160
Pyrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	(52)	--	--	--	--	60
Selenium	--	--	71	(1, 142)	290	--	(1, 142)	--	--	--	71	D,bb,dd	290	--	D,bb,dd	--	--	--	--	--	--	--	--	--	71
Silver	1.9	c	--	--	1.9	0.38	(1, 142)	--	--	--	--	--	1.9	0.38	D,G	--	--	--	--	--	--	--	--	--	0.38
Sulfide-Hydrogen sulfide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	(51)	2
Tetrachloroethene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	450	--	10,200	--	--	--	--	--	--	450
Thallium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2,130	426	--	--	--	--	--	426
Toluene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5,000	--	6,300	--	--	--	--	--	--	5,000
Toxaphene	--	--	0.0002	--	0.21	--	--	--	--	--	0.0002	aa	0.21	--	--	--	--	--	--	--	--	--	--	--	0.0002
TPH-Diesel	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,400 - 20,000	q,v	1,400 - 20,000
TPH-Gasoline	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,400 - 20,000	q,v	1,400 - 20,000
TPH-Motor Oil	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,400 - 20,000	q,v	1,400 - 20,000
trans-1,2-Dichloroethene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	224,000	44,800	(27)	--	--	--	--	44,800
Trichloroethene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2,000	400	--	--	--	--	--	400
Zinc	81	b	81	oo	90	--	oo	--	--	--	81	D,bb	90	--	D,bb	--	--	--	--	--	--	--	--	--	81

TABLE M-1: SURFACE WATER SCREENING CRITERIA

Remedial Investigation/Feasibility Study for Parcel E-2, Hunters Point Shipyard, San Francisco, California

Notes:	Values shaded are those criterion made more suitably protective by means of standard convention of lowering acute values by 80 percent to make them more appropriate for use under chronic exposure scenarios.
	Footnotes and references are detailed below.
--	No criterion available
µg/L	Microgram per liter
CFR	Code of Federal Regulations
BHC	Hexachlorocyclohexane
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethene
DDT	Dichlorodiphenyltrichloroethane
EPA	U.S. Environmental Protection Agency
Fed Reg	Federal Register
RWQCB	Regional Water Quality Control Board, San Francisco Bay
TPH	Total petroleum hydrocarbons
TtEMI	Tetra Tech EM, Inc.

Footnotes:

a California Environmental Protection Agency, Regional Water Quality Control Board, San Francisco Bay Area Region (RWQCB). 2006. "San Francisco Bay Basin Plan Water Quality Control Plan." December 22. Table 3-3 Marine Water Quality Objectives for Toxic Pollutants for Surface Waters.

b From RWQCB "Basin Plan" 4-Day Average (Chronic)

c From RWQCB "Basin Plan" 24-Hour and 1-Hour Average (Acute)

d From RWQCB "Basin Plan" Instantaneous Maximum

e From "Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California" (CTR) (EPA 2000) and "Water Quality Control Plan, San Francisco Bay Basin Region" (RWQCB 2006). The most appropriate criteria were used.

f Criterion made more suitably protective by means of standard convention of lowering acute values by 80 percent and instantaneous values by 90 percent to make them more appropriate for use under chronic exposure scenarios.

g An acute criterion (EPA identified as Criteria Maximum Concentration [CMC]) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect. The chronic concentration (EPA identified as Criterion Continuous Concentration [CCC]) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect. The CMC and CCC are just two of the six parts of an aquatic life criterion; the other four parts are the acute averaging period, chronic averaging period, acute frequency of allowed exceedence, and chronic frequency of allowed exceedence. Because 304(a) aquatic life criteria are national guidance, they are intended to be protective of the vast majority of the aquatic communities in the United States.

h EPA National "AWQC Lowest Observed Effect Level (Chronic)" (RWQCB 2003)

i EPA National "AWQC Lowest Observed Effect Level (Acute)" (RWQCB 2003)

j EPA National "AWQC Lowest Observed Effect Level (Other)" (RWQCB 2003)

k From "National Recommended Water Quality Criteria" (EPA 2006), unless otherwise noted.

l From "Final Technical Memorandum Estimation of Ambient Concentrations of Metals in Groundwater" (TtEMI 2001)

m In instances where criteria from "Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California" (EPA 2000) refer to the "Water Quality Control Plan, San Francisco Bay Basin Region" (RWQCB 2006), RWQCB 2006 criteria were used.

o Detailed application of this toxicity criterion may require the review and/or summation of analyte isomer, congener, or speciation results, as applicable. Please see applicable regulatory agency source document for additional detail.

p RWQCB 1998

q TtEMI 1999

r RWQCB 2003

s From RWQCB "Basin Plan" Annual Median

t From RWQCB "Basin Plan" Maximum, Lower Bay

u EPA National "AWQC for Saltwater Aquatic Life Protection, Recommended Criteria, Continuous Concentration (4-Day Average)" (RWQCB 2003)

v Total TPH aquatic criteria assigned as a function of distance from shoreline; the source of these criteria is the 2004 "Draft Addendum to the Final Petroleum Hydrocarbon Corrective Action Plan, Parcel B, Hunters Point Shipyard, San Francisco, California" (TtEMI. 2004)

The following lettered footnotes are derived from EPA "National Recommended Water Quality Criteria" (EPA 2006), Table 1 - Priority Toxic Pollutants (unless otherwise noted):

A This recommended water quality criterion was derived from data for arsenic (III), but is applied here to total arsenic, which might imply that arsenic (III) and arsenic (V) are equally toxic to aquatic life and that their toxicities are additive. In the arsenic criteria document (EPA 440/5-84-033, January 1985), Species Mean Acute Values are given for both arsenic (III) and arsenic (V) for five species and the ratios of the SMAVs for each species range from 0.6 to 1.7. Chronic values are available for both arsenic (III) and arsenic (V) for one species; for the fathead minnow, the chronic value for arsenic (V) is 0.29 times the chronic value for arsenic (III). No data are known to be available concerning whether the toxicities of the forms of arsenic to aquatic organisms are additive.

D Freshwater and saltwater criteria for metals are expressed in terms of the dissolved metal in the water column. The recommended water quality criteria value was calculated by using the previous 304(a) aquatic life criteria expressed in terms of total recoverable metal, and multiplying it by a conversion factor (CF). The term "Conversion Factor" (CF) represents the recommended conversion factor for converting a metal criterion expressed as the total recoverable fraction in the water column to a criterion expressed as the dissolved fraction in the water column. (Conversion Factors for saltwater CCCs are not currently available. Conversion factors derived for saltwater CMCs have been used for both saltwater CMCs and CCCs). See "Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria,@ October 1, 1993, by Martha G. Prothro, Acting Assistant Administrator for Water, available from the Water Resource center, USEPA, 401 M St., SW, mail code RC4100, Washington, DC 20460; and 40CFR'131.36(b)(1). Conversion Factors applied in the table can be found in Appendix A to the Preamble- Conversion Factors for Dissolved Metals.

F The deviation of this value is presented in the Red Book (EPA 440/9-76-023, July 1976); footnote from Table 2 - Non-Priority Toxic Pollutants

G This Criterion is based on 304(a) aquatic life criterion issued in 1980, and was issued in one of the following documents: Aldrin/Dieldrin (EPA 440/5-80- 019), Chlordane (EPA 440/5-80-027), DDT (EPA 440/5-80-038), Endosulfan (EPA 440/5-80-046), Endrin (EPA 440/5-80-047), Heptachlor (EPA 440/5-80-052), Hexachlorocyclohexane (EPA 440/5-80-054), Silver (EPA 440/5-80-071). The Minimum Data Requirements and derivation procedures were different in the 1980 Guidelines than in the 1985 Guidelines. For example, a CMC derived using the 1980 Guidelines was derived to be used as an instantaneous maximum. If assessment is to be done using an averaging period, the values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines.

N This criterion applies to total polychlorinated biphenyls (e.g. the sum of all congener or all isomer or homolog or Aroclor analyses.)

Q This recommended water quality criterion is expressed as mg free cyanide (as CN)/L.

V This value was derived from data for heptachlor, and the criteria document provides insufficient data to estimate the relative toxicities of heptachlor and heptachlor epoxide.

Y This value was derived from data for endosulfan and is most appropriately applied to the sum of alpha-endosulfan and beta-endosulfan.

aa This criterion is based on a 304(a) aquatic life criterion issued in 1980 or 1986, and was issued in one of the following documents: Aldrin/Dieldrin (EPA 440/5-80-019), Chlordane (EPA 440/5-80-027), DDT (EPA 440/5-80-038), Endrin (EPA 440/5-80-047), Heptachlor (EPA 440/5-80-052), Polychlorinated biphenyls (EPA 440/5-80-068), Toxaphene (EPA 440/5-86-006). This CCC is currently based on the Final Residue Value (FRV) procedure. Since the publication of the Great Lakes Aquatic Life Criteria Guidelines in 1995 (60FR15393-15399, March 23, 1995), the Agency no longer uses the Final Residue Value procedure for deriving CCCs for new or revised 304(a) aquatic life criteria. Therefore, the Agency anticipates that future revisions of this CCC will not be based on the FRV procedure.

bb This water quality criterion is based on a 304(a) aquatic life criterion that was derived using the 1985 Guidelines (Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses, PB85-227049, January 1985) and was issued in one of the following criteria documents: Arsenic (EPA 440/5-84-033), Cadmium (EPA-822-R-01-001), Chromium (EPA 440/5-84-029), Copper (EPA 440/5-84-031), Cyanide (EPA 440/5- 84-028), Lead (EPA 440/5-84-027), Nickel (EPA 440/5-86-004), Pentachlorophenol (EPA 440/5-86-009), Toxaphene, (EPA 440/5-86-006), Zinc (EPA 440/5-87- 003).

Footnotes (Continued):

cc When the concentration of dissolved organic carbon is elevated, copper is substantially less toxic, and use of Water-Effect Ratios might be appropriate.

dd The selenium criteria document (EPA 440/5-87-006, September 1987) provides that if selenium is as toxic to saltwater fishes in the field as it is to freshwater fishes in the field, the status of the fish community should be monitored whenever the concentration of selenium exceeds 5.0 Fg/L in salt water because the saltwater CCC does not take into account uptake via the food chain.

ee This recommended water quality criterion was derived on page 43 of the mercury criteria document (EPA 440/5-84-026, January 1985). The saltwater CCC of 0.025 ug/L given on page 23 of the criteria document is based on the Final Residue Value procedure in the 1985 Guidelines. Since the publication of the Great Lakes Aquatic Life Criteria Guidelines in 1995 (60FR15393-15399, March 23, 1995), the Agency no longer uses the Final Residue Value procedure for deriving CCCs for new or revised 304(a) aquatic life criteria.

ff This recommended water quality criterion was derived in Ambient Water Quality Criteria Saltwater Copper Addendum (draft, April 14, 1995) and was promulgated in the Interim final National Toxics Rule (60 FR 22228-222237, May 4, 1995).

gg EPA is actively working on this criterion, and so this recommended water quality criterion may change substantially in the near future.

hh This recommended water quality criterion was derived from data for inorganic mercury (II), but is applied here to total mercury. If a substantial portion of the mercury in the water column is methylmercury, this criterion will probably be under protective. In addition, even though inorganic mercury is converted to methylmercury and methylmercury bioaccumulates to a great extent, this criterion does not account for uptake via the food chain because sufficient data were not available when the criterion was derived.

ii This criterion applies to DDT and its metabolites (that is, the total concentration of DDT and its metabolites should not exceed this value.)

The following lettered footnotes are derived from EPA "Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California" (EPA 2000).

ll This criterion is based on 304(a) aquatic life criterion issued in 1980, and was issued in one of the following documents: Aldrin/Dieldrin (EPA 440/5–80–019), Chlordane (EPA 440/5–80–027), DDT (EPA 440/5–80–038), Endosulfan (EPA 440/5–80–046), Endrin (EPA 440/5–80–047), Heptachlor (440/5–80–052), Hexachlorocyclohexane (EPA 440/5–80–054), Silver (EPA 440/5–80–071). The Minimum Data Requirements and derivation procedures were different in the 1980 Guidelines than in the 1985 Guidelines. For example, a ''CMC'' derived using the 1980 Guidelines was derived to be used as an instantaneous maximum. If assessment is to be done using an averaging period, the values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines (originally footnote g in the CTR).

mm Criteria for these metals are expressed as a function of the water-effect ratio (WER) (originally footnote i in the CTR).

nn No criterion for protection of human health from consumption of aquatic organisms (excluding water) was presented in the 1980 criteria document or in the 1986 Quality Criteria for Water. Nevertheless, sufficient information was presented in the 1980 document to allow a calculation of a criterion, even though the results of such a calculation were not shown in the document (originally footnote j in the CTR).

oo These freshwater and saltwater criteria for metals are expressed in terms of the dissolved fraction of the metal in the water column. Criterion values were calculated by using EPA's Clean Water Act 304(a) guidance values (described in the total recoverable fraction) and then applying the conversion factors in § 131.36(b)(1) and (2) (originally footnote m in the CTR).

pp These criteria were promulgated for specific waters in California in the National Toxics Rule (''NTR''), at § 131.36. The specific waters to which the NTR criteria apply include: Waters of the State defined as bays or estuaries and waters of the State defined as inland, i.e., all surface waters of the State not ocean waters. These waters specifically include the San Francisco Bay upstream to and including Suisun Bay and the Sacramento-San Joaquin Delta. This section does not apply instead of the NTR for this criterion (originally footnote o in the CTR).

rr PCBs are a class of chemicals that include Aroclors 1242,1254,1221,1232,1248,1260, and 1016. The aquatic life criteria apply to the sum of this set of seven Aroclors (originally footnote u in the CTR).

The following numbered footnotes are derived from "A Compilation of Water Quality Goals" (RWQCB 2003). These footnotes directly correlate with the source document.

1 Expressed as dissolved
2 Expressed as total recoverable
6 Pentavalent arsenic [As(V)] effects on plants.
20 For halomethanes
22 For chlorinated benzenes
23 Toxicity to a fish species exposed for 7.5 days
24 For dichlorobenzenes
27 For dichloroethylenes
28 For dichloropropanes
29 For dichloropropenes
38 Toxicity to algae occurs
45 For sum of phthalate esters
48 For chlorinated naphthalenes
51 From U.S. Environmental Protection Agency, *Quality Criteria for Water* (1976) "The Red Book," and also appears in current list of recommended criteria.
52 For polynuclear aromatic hydrocarbons
53 For dinitrotoluenes
56 For nitrosamines
68 Draft / tentative / provisional; applies only to second value if two separate values are listed; applies to range if a range of values is listed.
82 A decrease in the number of algal cells occurs.
83 Adverse effects on a fish species exposed for 168 days.
88 For nitrophenols
95 For the pentavalent form
114 Developed as 24-hour average using 1980 EPA guidelines, but applied as 4-day average in the National Toxics Rule.
115 Criterion most appropriately applied to the sum of alpha-endosulfan and beta-endosulfan.
116 Applies separately to Aroclors 1242, 1254, 1221, 1232, 1248, 1260, and 1016; based on carcinogenicity at 1-in-a-million risk level.
142 Criteria do not apply to waters subject to water quality objectives in Tables III-2A and III-2B of the San Francisco Bay Regional Water Quality Control Board's 1986 Basin Plan.
143 These criteria were promulgated for specific California waters in the National Toxics Rule.

References:

Gilbert, R.O. 1987 *Statistical Methods for Environmental Pollution Monitoring* . Van Nostrand Reinhold, New York.
Regional Water Quality Control Board (RWQCB). 1998. "Recommended Interim Water Quality Objectives (or Aquatic Life Criteria) for Methyl Tertiary-Butyl Ether (MTBE)." San Francisco Bay Region. October 1.
RWQCB. 2003. "A Compilation of Water Quality Goals." Prepared by Jon B. Marshack, Central Valley Region. August.
RWQCB. 2006. "San Francisco Bay Basin Plan." San Francisco Bay Region. December 22.
TtEMI 1999. "Draft Remedial Investigation Report, Site 12 Operable Unit, Naval Station Treasure Island, San Francisco, California." June 1.
TtEMI 2001. "Final Technical Memorandum Estimation of Ambient Concentrations of Metals in Groundwater, Naval Station Treasure Island, San Francisco, California." March 30.
TtEMI 2004. "Draft Addendum to the Final Petroleum Hydrocarbon Corrective Action Plan, Parcel B, Hunters Point Shipyard, San Francisco, California." April 15.
U.S. Environmental Protection Agency (EPA). 2000. "Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California." 40 CFR Part 131, RIN 2040-AC44. May 18.
EPA. 2006. "National Recommended Water Quality Criteria."

Table M-2 Hunters Point Groundwater Ambient Levels
Hunters Point Shipyard Parcel E-2 Remedial Investigation/Feasibility Study

Analyte	HGAL[1] (µg/L)
ALUMINUM	NA
ANTIMONY	43.3
ARSENIC	27.3
BARIUM	504
BERYLLIUM	1.40
CADMIUM	5.08
CALCIUM	NA
CHROMIUM	15.7
CHROMIUM VI	NA
COBALT	20.8
COPPER	28.0
IRON	2,380
LEAD	14.4
MAGNESIUM	1.44E+06
MANGANESE	8,140
MERCURY	0.60
MOLYBDENUM	61.9
NICKEL	96.5
POTASSIUM	448,000
SELENIUM	14.5
SILVER	7.43
SODIUM	9.242E+06
THALLIUM	13.0
VANADIUM	26.6
ZINC	75.7

Notes:

[1] Source: PRC Environmental Management, Inc. 1996. "Estimation of Hunters Point Shipyard Groundwater Ambient Levels Technical Memorandum." September 16.

µg/L - micrograms per liter

HGAL - Hunters Point groundwater ambient level

Table M-3 Groundwater COPCs for Aquatic Receptors
Hunters Point Shipyard Parcel E-2, Remedial Investigation/Feasibility Study

Chemical Group	Chemical of Potential Concern	Tidally Influenced Wells Recommended for Further Monitoring and Evaluation[a]	Surface Water Criteria Selected for Aquatic Evaluation (µg/L)[b]
Anions	Un-ionized Ammonia	IR01MW48A, IR01MWI-3, IR01MW43A	25
	Sulfide	IR01MW48A, IR01MWI-3, IR01MW43A, IR01MW44A	2
Metals	Copper	IR01MW44A	28.0 [c]
	Lead	IR01MW43A, IR01MW44A	14.4 [c]
	Mercury	IR01MW44A	0.60 [c]
	Zinc	IR01MW43A, IR01MW44A	81
Pesticides/PCBs	4,4-DDT	IR01MWI-3, IR01MW44A	0.001
	Endosulfan II	IR01MWI-3	0.0087
	Gamma-chlordane	IR01MWI-3, IR01MW43A	0.004
	Heptachlor	IR01MWI-3	0.0036
	Heptachlor epoxide	IR01MW44A	0.0036
	PCBs (Total)	IR01MWI-3, IR01MW43A, IR01MW44A	0.03
Petroleum Hydrocarbons	TPH (Total)	IR01MWI-3, IR01MW43A	1,400 - 20,000[d]

Notes:

µg/L = micrograms per liter

DDT = dichlorodiphenyltrichloroethane

COPC = Chemical of potential concern

HGAL = Hunters Point Groundwater Ambient Level

PCB = polychlorinated biphenyls

TPH = Total Petroleum Hydrocarbons

References:

(a) Tidally influenced wells are defined where the maximum tidal fluctuation exceeds 0.10 foot in the A aquifer based on data collected during the Phase III groundwater data gaps investigation (TtEMI, 2004b). Tidally influenced wells at Parcel E-2 consist of IR01MWI-8, IR01MW62A, IR01MW63A, IR01MWI-7, IR01MWI-9, IR01MW48A, IR01MWI-3, IR01MW43A, and IR01MW44A.

(b) References for the aquatic evaluation criteria shown below are included in Table M-1

(c) Value shown has been HGAL adjusted and is applicable to the A-aquifer

(d) Range of values shown; total TPH aquatic criteria assigned as a function of distance from shoreline; the source of these criteria is the 2004 "Draft Addendum to the Final Petroleum Hydrocarbon Corrective Action Plan, Parcel B, Hunters Point Shipyard, San Francisco, California." (TtEMI, 2004a)