Plan for
Additional Sampling and Analysis Activities

Halaco Superfund Site
Remedial Investigation

Oxnard, California

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Acronyms and Abbreviations

bgs	below ground surface
CUPA	Certified Unified Program Agency
DTSC	Department of Toxic Substances Control
EC	electrical conductivity
EPA	U.S. Environmental Protection Agency
ERGS	Environmental Radiological Ground Scanner
LAS	Lower Aquifer System
NCL	Nature Conservancy Land
NPL	National Priorities List
OID	Oxnard Industrial Drain
PAH	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
ppm	parts per million
PWA	Philip Williams & Associates
RWQCB	Regional Water Quality Control Board
STLC	Soluble Threshold Limit Concentrations
SVOC	semi-volatile organic compounds
TCLP	Toxicity Characteristic Leaching Procedure
TDS	total dissolved solids
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TTLC	Total Threshold Limit Concentrations
UAS	Upper Aquifer System
VOC	volatile organic compounds
WDA	Waste Disposal Area
WET	Waste Extraction Test

WMU	Waste Management Unit
XRF	X-ray fluorescence

1. Introduction

In September 2007, the U.S. Environmental Protection Agency (EPA) added the former Halaco Engineering Company facility and adjacent areas of contamination (the Site) to the Superfund National Priorities List (NPL). Shortly thereafter, EPA began a Remedial Investigation to determine the nature and extent of contamination at the Site, identify human health and ecological risks posed by the contamination, and identify areas needing remediation.

This plan summarizes historical information on environmental conditions at the Site and identifies “data gaps” that must be addressed before remediation can occur. As described in more detail in Section 5 of this plan, data gaps include:

- Has contaminated groundwater traveled offsite?
- Is deep groundwater contaminated?
- Are buried waste materials still reactive and capable of generating ammonia and other gases?
- Are buried wastes in contact with and contaminating groundwater?
- Are the wastes contaminated with dioxin or other organic contaminants?
- Is there residual contamination from the fuels and oils that Halaco stored and used onsite?
- How much Halaco waste material is there in the bottom sediments of the Oxnard Industrial Drain (OID) and Ormond Beach lagoon?
- Is there waste offsite beyond the known areas of contamination?

The plan proposes soil testing, water testing, and other sampling and analysis activities intended to fill the majority of the data gaps. This plan was developed after review and evaluation of more than 40 years of information on Halaco’s operations and environmental conditions at the Site, as summarized in Section 3.

While the Site was evaluated for placement on the NPL, two removal actions were completed to address immediate Site risks. The first removal action, completed by the property owners between August 2006 and February 2007, included the removal of drums and other hazardous substances from the Site, and the installation of fencing, silt curtain, and straw wattles around the waste pile. A second, EPA-funded removal action was completed in 2007 to stabilize and secure the Site and limit offsite migration of contaminated wastes. It included re-grading the waste pile to reduce the steepness of the slopes, placing matting on the slopes to reduce erosion, stabilizing the banks along the lower portion of the OID, removing an estimated 9,000 cubic yards of waste from the smelter area, removing an estimated 7,600 cubic yards of material from a wetland area adjacent to the Halaco property, and installing more than 6,000 feet of fencing around the perimeter of the waste management area. See the “Team 9” report (2008) for additional details. Figure 1 is an aerial photo of the Site after the second removal action was completed.

Since the Site was added to the NPL, EPA has conducted periodic groundwater and surface water level monitoring; worked with the property owners to repair and maintain erosion control measures; worked with the property owners, the Oxnard police, and the community to prevent unauthorized access to the Site; completed two technical reports on Site contamination (CH2M HILL 2008a and 2008b); and prepared this testing plan.

2. Background

2.1. Site Location and Operations

The Site is located in eastern Ventura County at 6200 Perkins Road in Oxnard, California (Figure 2). Halaco Engineering Company operated a secondary metal smelter at the Site from 1965 to 2004, recovering aluminum and magnesium for reuse. Halaco also reports that it recovered zinc until the 1970s. The Site includes an 11-acre parcel containing the former smelter and an adjacent 26-acre area where wastes were deposited and managed.

During its 40 years of operation, Halaco acquired scrap metal from more than 400 suppliers in a variety of forms and in varying levels of purity. Halaco processed dross, sludge, castings, sheets, pellets, granules, cans, car parts, and other scrap. Halaco reports that it processed one type of scrap, a low-level radioactive magnesium-thorium alloy, until about 1977. Other metals found in aluminum and magnesium alloys include copper, silver, zinc, lead, chromium, titanium, tin, manganese, and nickel.

The raw materials were received at the Perkins Road facility or at the railroad spur about one-half mile to the north, melted in Halaco's natural-gas-fired rotary furnaces, and then cast into various shapes and sizes (e.g., sows, pigs, ingots, anodes). Sodium chloride, potassium chloride, and magnesium chloride salts (known as "fluxes") were added to improve the recovery of aluminum and magnesium. The molten material in the furnace would stratify, and the recoverable metal was directly cast into large metal blocks or, at times, mixed with beryllium, manganese, and possibly other alloying agents to produce alloys meeting specifications. Some scrap raw materials were washed onsite to remove dirt and other impurities before they were placed in the furnace.

The residual material ("dross") from the furnaces was placed in large, rotating horizontal drums ("washers") located next to the OID and sprayed with water to break up the dross, dissolve the salts, and separate recoverable metals. Water was reportedly drawn from the OID and Halaco's settling ponds. A slurry of water, salt, metal particles, and other solids was discharged from the washers into a shaker where larger solids were recovered and then sold, disposed, or returned to the smelter area for use as feedstock. The remaining slurry was pumped to onsite settling ponds until about September 2002.

Halaco reports that all operations ceased in September 2004.

In support of its operations, Halaco stored and used large quantities of diesel fuel and oil in its vehicles and equipment, and used petroleum-based solvents for cleaning. Halaco also operated equipment to reduce air pollutants in exhaust gases generated during smelting. Halaco initially operated venturi-type scrubbers, which were replaced by baghouse filters in about 1988. Lime and ammonia were used to raise the pH, neutralize acidic gases, and remove particulate matter. The equipment generated solid and/or liquid waste.

Table 1 provides a list of materials known to have been present at the Site, in addition to the incoming scrap metals, finished products, and process wastes. The list was compiled primarily from inventories obtained from Halaco and the files of the City of Oxnard (City) Certified Unified Program Agency (CUPA) (Halaco, 1966-1995).

2.2. Waste Disposal

During its 40 years of operation, Halaco produced large quantities of solid and liquid waste. Most of the waste was process waste generated during the smelting process. Other waste was generated by the air pollution control equipment, and from used oil and spent solvent.

From 1965 to about 1970, Halaco discharged much or all of its process waste to a settling pond adjacent to the OID and used waste solids as fill in the smelter area. Historical documents indicate that Halaco considered discharging waste to the sewer in 1965, 1970, and 1979 but it is not known if discharges occurred.

After the Los Angeles Regional Water Quality Control Board (RWQCB) issued Waste Discharge Requirements in September 1970 (RWQCB, 1970), Halaco began pumping its wastewater across the OID into unlined earthen settling ponds in an area later named the Waste Management Unit (WMU). Beginning in or before 1980, Halaco began moving waste solids from the WMU to the area immediately to the north known as the Waste Disposal Area (WDA).

Discharge to the WMU ended in late 2002, when Halaco began using a filter press and began discharging wastewater to the City sewer in accordance with an industrial waste discharge permit. Discharges to the sewer ceased in or before June 2003, after the City expressed concern about ammonia in its collection system and exceeded performance goals for metals discharged from Oxnard’s wastewater treatment plant. Halaco reports that it recycled wastewater onsite after discharge to the sewer stopped. Records indicate that an estimated 6,700 tons (or more) of filter cake or other waste were shipped offsite for disposal. Filter cake left onsite when Halaco ceased operations was later moved to the WMU.

In 2007, EPA estimated that more than 700,000 cubic yards of waste solids remained onsite. The bulk of the solids are in the WMU, which covers about 15 acres and rises up to 40 feet above grade.

Used oil and spent solvent were reportedly disposed onsite before 2000. Oil and/or solvent wastes were reportedly used as “fuel” in the rotary furnaces, observed dripping on the ground during use in the process building, and mixed with air pollution control equipment waste and put in Halaco’s washers. Slurry from the washers was discharged to the onsite settling ponds, as described above.

Testing at the Site shows that elevated levels of a variety of metals are present in the waste, and that soils, sediments, and groundwater have been contaminated by Halaco’s wastes. Constituents found at elevated levels include aluminum, barium, beryllium, cadmium, chromium, copper, lead, magnesium, manganese, nickel, and zinc. Elevated levels of radioactive thorium (and decay products) are also present in some areas of the Site. In past sampling, elevated levels of ammonia and petroleum hydrocarbons have been detected at the Site. The ammonia is believed to be a byproduct of the smelting process, as described in Section 5.1. As explained below, elevated levels do not necessarily imply health risk.

2.3. Physical Setting

The Site is located near the Pacific Ocean in Oxnard, California. Immediately to the north and east of the Site is a wetland area owned by The Nature Conservancy. To the south of the Site are a wetland area, a lagoon, and the Pacific Ocean. To the north and west are the City's wastewater treatment plant and an industrial paper recycling plant. The predominant land uses near the Site are "Industry Coastal Dependent" and "Miscellaneous Open Space/Resource Protection." The Site is bisected by the OID, a surface water channel that drains upstream agricultural, commercial, and residential areas of the Oxnard Plain.

Most of Halaco's operations occurred in the 11-acre smelter area located to the west of the OID, which housed the rotary furnaces used for smelting and large cylindrical washers. The smelter area was also where raw and finished materials, equipment, fuel, oil, solvents, and other supplies were stored and used. To the east of the OID is the 26-acre waste management area that includes the WMU and WDA. The Site has been divided into the following study areas (Figure 2):

Study Area	Location
Smelter Area	Area west of the OID, where Halaco conducted most of its operations, and used some of its wastes as fill
Waste Management Unit (WMU)	Area east of the OID, where Halaco deposited most of its wastes
Waste Disposal Area (WDA)	Area east of the OID and north of the WMU, where Halaco wastes are also located
Oxnard Industrial Drain (OID)	Surface water channel bisecting the Site
Nature Conservancy Land (NCL-East and NCL-North)	Areas east and north of the Site, where some of Halaco's wastes are located
Wetlands Area	Area between the Site and the Pacific Ocean, fed by the OID and two other surface water channels (the J Street Drain and Hueneme Drain); this area includes the lagoon, beach, and ditch south of the WMU

Water levels in the OID, NCL, and wetlands area are above sea level most of the year because of a naturally occurring beach berm that limits the discharge of OID water to the ocean. The berm breaches occasionally (mostly during winter storm events), allowing the OID, NCL, and wetlands to temporarily drain to the ocean until water levels drop to near sea level or the berm is reestablished by natural processes.

Groundwater is present beneath the Site in three primary aquifer systems (from shallowest to deepest): the upper Semiperched Aquifer, the Upper Aquifer System (UAS), and the Lower Aquifer System (LAS). The Semiperched Aquifer extends to a depth of 50 to 100 feet below ground surface (bgs), generally has poor water quality, and is not used as a water supply.
The Semiperched Aquifer is underlain by an extensive clay deposit that separates it from the underlying UAS and LAS. The UAS and LAS yield significant amounts of water and contain good quality water across the Oxnard Plain, except in coastal areas (including the Site) where overpumping has historically reduced groundwater levels below sea level and allowed seawater intrusion. The water supply wells closest to the Site are two inactive City of Port Hueneme wells

approximately one-half mile to the northwest and an agricultural well used for irrigation approximately one-half mile to the east. Water quality testing of the agricultural well in March 2007 did not show any evidence of contamination from the Site.

Sources of more detailed information on surface water and groundwater flow at the Site include CH2M HILL (2008a). Sources of information on the topography, geology, hydrology, and marine processes near the Site include Philip Williams & Associates (PWA) (2007).

2.4. Ecological Setting

Habitat near the Site includes coastal salt marsh, coastal freshwater/brackish wetland, and the southern foredune. The wetlands are part of the larger Ormond Beach wetland area, which was once a vast region of tidal marshlands extending from Port Hueneme (to the northwest) to Point Mugu (to the southeast). The wetlands are home to several endangered or threatened species and the focus of federal and state restoration efforts.

An extensive beach-dune complex runs along the southern boundary of the Site. The wetlands adjacent to the Site are a remnant of the once-extensive salt marsh and brackish water lagoon and dune system. These lagoons were located inland from a narrow strip of low sand dunes and fed by surface water runoff from upland areas. Periodically, the sand dunes were breached by high streamflows or winter storm waves, allowing seawater to enter the lagoons.

More detailed information on ecological resources near the Site is available in CH2M HILL (2008b), WRA (2007), and other reports.

3. Information Sources

This section briefly describes sources of information on Halaco operations and environmental conditions at the Site. They include:

- Historical documents obtained from Federal, State, and local agencies with information about operations or environmental conditions at the Halaco Site (1965-2005)
- Responses to EPA Information Requests sent to Halaco personnel (2007)
- Historical aerial photographs (1929-1991)
- EPA Integrated Assessment (2006)
- EPA Radiation Screening (2006-07)
- EPA Smelter Sampling (2007)
- Ormond Beach Wetland Restoration Project (2006)

The types of information contained in these documents include descriptions of Halaco's smelting and waste disposal practices, Site chemical data (chemical concentrations in soil, sediment, groundwater, surface water, fish, and air), Site radiologic data (levels of radioactivity), and water level measurements.

Agency Documents

EPA has reviewed hundreds of historical documents related to environmental conditions at the Site. Documents have been obtained from the files of the RWQCB (Los Angeles), California Department of Toxic Substances Control (DTSC), California Department of Public Health Radiologic Health Branch, Oxnard CUPA, Ventura County Air Pollution Control District, and the Halaco bankruptcy trustee. Some of these documents are listed as references in Section 6.

Responses to EPA Information Requests

In July 2007, EPA sent requests for information to Clarence Haack, John Haack, Robert Haack, and John David Gable. The four individuals worked for the former Halaco Engineering Company and/or owned property where Halaco operated. The responses, submitted to EPA in October 2007, include limited information on Halaco's operations (Gable, 2007; Haack, 2007).

Historical Aerial Photographs

EPA has obtained and reviewed the following historical aerial photographs of the Site (Lockheed, 1982, 1991):

- 1929 (month and day unknown)
- October 10, 1945
- May 4, 1951
- October 2, 1959
- September 20, 1965
- October 11, 1969
- April 27, 1971
- March 26, 1972
- August 23, 1973
- March 4, 1974
- October 7, 1975
- May 16, 1978
- June 22, 1981
- January 10, 1991

The 1929 photograph shows little or no human impact at the Site. The 1945 through 1959 photographs show activity west of the OID that may be associated with the former City dump. The 1965 photograph shows industrial and waste disposal activity associated with Halaco's operations. The 1969 photograph shows fill material on the southeast corner of the smelter area pushing the OID further eastward toward its current alignment. The 1971 photograph shows the OID at its current alignment and the beginning of waste disposal on the east side in the WMU. The 1981 photo shows the early stages of waste disposal in the WDA. The 1991 photo shows waste disposal in both the WMU and WDA.

Halaco Integrated Assessment - Chemical and Radiologic Data

The largest source of environmental data at the Site is a 2006 EPA sampling and analysis effort known as the Integrated Assessment (Weston, 2007).

Samples were collected in June 2006 from the smelter area, WMU, WDA, wetland area, OID, beach sands, marine sediments, Nature Conservancy property, a residential area north of the Site, and agricultural areas north and east of the Site. Samples analyzed in an offsite laboratory included about 115 soil, sediment, and solid waste samples; 10 surface water samples; 14 groundwater samples; 35 air samples; and 9 composite fish samples. Soil and waste samples were collected to a depth of 8 feet in the smelter area, and a depth of 20 feet in the WMU. Samples were analyzed for up to 25 metals and, except for air and fish samples, five radionuclides (Ce-137, K-40, Th-228, Th-230, and Th-232). Approximately 337 soil, sediment, and waste samples were also analyzed for metals using X-ray fluorescence (XRF). XRF analysis is a relatively fast and inexpensive technique for determining the concentrations of metals in a sample, but is not able to measure the concentrations of metals with low atomic weights (e.g., beryllium, magnesium, and aluminum) and typically results in higher detection limits compared to the analytical methods used in an offsite fixed laboratory.

Samples collected in approximately 26 “background” locations believed to be unaffected by the Site were also analyzed.

Halaco Radiation Screening

Large parts of the Site have been screened for radioactivity with gamma radiation detectors.

In March 2006, the top and perimeter of the WMU were surveyed with hand-held sodium iodide detectors. Radiation levels were at or near background levels on top of the WMU, but above background in three areas around the perimeter of the WMU. The measured radiation spectrum was consistent with the presence of Th-232 and decay products in equilibrium. The largest of the three areas was at the southeast corner of the WMU, which was subsequently stabilized as part of EPA's 2007 action. Above-background radiation levels were also measured in portions of the smelter area.

In June 2006, EPA screened a large portion of the Site for radioactivity using a more sensitive, tractor-mounted gamma radiation detector known as the Environmental Radiological Ground Scanner (ERGS). The ERGS employs eight shielded sodium iodide detectors encased on five sides by lead shielding, and a global positioning system.

The ERGS was used to screen the northern portion of the smelter area, the WDA, the surface of most of the WMU, a portion of the NCL-East, a portion of the wetland area, and the beach. Areas with elevated gamma radiation (greater than two standard deviations above the median background level) were identified in the smelter area, wetland area, WDA, NCL-East, and on the beach. The waste materials in the wetland area were moved to the WMU in 2007, as described in Section 1. Follow-up testing indicated that the elevated levels on the beach were due to naturally occurring thorium-enriched "black sands." No significant anomalies were identified on the surface of the WMU. Most of the results are summarized in Appendix I of the Integrated Assessment (Weston, 2007).

In May and June 2007, additional screening for radioactivity was carried out with hand-held sodium iodide gamma radiation detectors on the eastern portion of the smelter property. The results indicated a large area with radiation levels above background, consistent with Halaco's use of waste material as fill between about 1965 and 1970.

Halaco Smelter Sampling - Chemical and Radiologic Data

In June 2007, EPA collected and analyzed samples in the southeast portion of the smelter area (Team 9, 2008). Thirty-seven waste and soil samples were analyzed for metals and radionuclides, and groundwater samples from nine boreholes were analyzed for radionuclides. All but two samples were collected onsite within or immediately adjacent to the smelter area. Two samples were identified as background.

Ormond Beach Wetland Restoration Project - Chemical Data

In 2006, approximately 30 soil and sediment samples and 10 surface water samples were collected as part of the Ormond Beach Wetland Restoration Project (AMEC, 2006). Approximately 16 soil and sediment and seven surface water samples were located near the Site. These samples were analyzed for general chemistry, metals, polychlorinated biphenyls (PCBs), organochlorine pesticides, and total petroleum hydrocarbons (TPH).

Eight soil samples were collected from the NCL and six soil samples from agricultural areas north and east of the Site. Two surface water samples were collected from the NCL, one sample from the OID upstream of the Site, two samples from the mouth of the OID and lagoon, and two samples from the J Street and Hueneme drains to the west and north of the Site. One wetland sediment sample and one soil sample were believed to represent background conditions.

4. Human Health and Ecological Risk Conceptual Site Models

Figures 3 and 4 present human health and ecological risk “conceptual models” for the Site. They depict the primary source of contamination at the Site (the smelter), possible “release mechanisms” (e.g., deposition of air emissions; discharge of wastewater or waste solids to the WMU, WDA, and smelter area; surface runoff; leaching to groundwater), the different “media” that may have been contaminated (e.g., soil, sediment, surface water, groundwater), and possible exposure routes (e.g., ingestion, inhalation, dermal contact, external radiation, plant uptake).

The conceptual models also list potential “receptors.” Potential human health receptors are residents and workers on or adjacent to the Site. Potential ecological receptors are terrestrial and aquatic plants, invertebrates, amphibians, fish, reptiles, birds, and mammals.

See CH2M HILL (2008b) for more detail.

5. Sampling and Analysis Recommendations

5.1. Analytes and Analytical Methods

This section provides a general discussion of the types of additional chemical and radiologic analyses planned at the Site. Section 5.2 discusses specific data needs in more than 16 areas at the Site.

Metals. The metals that Halaco primarily targeted for recovery (aluminum and magnesium) are major constituents of Halaco's wastes. Halaco's wastes also contain non-target metals that were present in the alloys that Halaco processed. Non-target metals include barium, beryllium, cadmium, chromium, copper, lead, manganese, nickel, and zinc.

Analysis of soil and water at the Site for metals has been the most common method of detecting the presence of Halaco waste. Additional metal analyses are planned for soil, sediment, and water at locations and depths not previously or adequately sampled. Analysis of air samples is also planned during windy winter conditions (previous sampling occurred during less windy summer months). Further analysis of tissue from fish and benthic invertebrates in the OID and lagoon for metals is also being considered to better estimate risks to piscivorous (e.g., least tern) and benthic invertebrate-eating (e.g., snowy plover) wildlife. Analysis of tissue from terrestrial plants and soil invertebrates in contaminated soils is also being considered to better estimate risks to terrestrial birds and mammals.

Radionuclides. Halaco reports that a specialized magnesium-thorium alloy was processed at the Site until about 1976, and above-background levels of thorium, a naturally occurring radioactive element, are present in some of Halaco's wastes. Additional analyses are planned in soil and sediment in locations and depths not previously or adequately sampled.

Radium and other "daughter products" produced by thorium's radioactive decay also have been measured at elevated levels, as expected. Three thorium isotopes and two radium isotopes are present in thorium-contaminated wastes. Future analyses will look for two of the five isotopes: Th-232 and Th-230. The radioactivity (i.e., "activity") of Ra-226, Ra-228, and Th-228 can be predicted from the activities of Th-232 and Th-230. Th-232, Th-228, and Ra-228 appear to be in "secular equilibrium" and past testing shows Ra-226 activities at a fixed fraction (one to three percent) of Th-230 in most samples. (An activity ratio of 2% would be expected after purified Th-230 had decayed for about 50 years.)

In two samples of Halaco's wastewater collected and analyzed in 2003, the radionuclide Cs-137 was detected. Sampling in 2006 in surface water and groundwater did not find elevated levels. Further analysis for Cs-137 is not planned.

Elevated levels of the radionuclide K-40 have been measured in surface water and groundwater at the Site. The elevated levels are expected (all potassium-containing materials have a fixed percentage of K-40) and are probably due in part to the potassium chloride salt used in the smelting process.

In locations where the concentrations of thorium may be elevated, measurements of the level of gamma radiation are also a useful screening tool for detecting the presence of Halaco waste. A radiation survey of the bottom sediments in the lagoon is being considered.

Chlorinated Pesticides and Polychlorinated Biphenyls (PCBs). DDT, DDT metabolites, and toxaphene have been detected in sediment and soil in the OID watershed upstream of the Site at concentrations greater than ecological effects thresholds. Dieldrin, chlordane, and PCBs were also analyzed for offsite, but not detected in any samples. Halaco is not known to have used pesticides onsite, but analysis of a limited number of additional samples from OID sediments and other onsite and offsite areas is planned to determine whether pesticides are present onsite and distinguish between Site-related (if any) and offsite sources. Samples from the smelter area overlying the footprint of the former Oxnard dump also may be analyzed for PCBs.

Dioxins and Furans. Polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans ("dioxin-like" compounds) have not been analyzed for onsite. Analysis for dioxin-like compounds is planned to evaluate residual levels in soil or sediment, if any, that may remain from Halaco's operations. A March 2005 draft EPA report documents the production of dioxin-like compounds by six secondary aluminum smelters tested in the early 1990s (EPA, 2005). Halaco used chloride salts that could have combined with organic impurities in the scrap to produce these compounds. Burning of wastes at the former Oxnard dump is also a potential source.

Other Organic Compounds. Some samples have been analyzed for organic constituents, including TPH, volatile organic compounds (VOCs), and oil and grease. Oil and grease were frequently detected in surface water and groundwater samples before 2005 at relatively low levels (less than 10 to 100 parts per million [ppm] prior to 2004 and less than 1 ppm in 2004); TPH was detected at low levels (less than 1 ppm in 2003 and none in 2004) in some groundwater samples; and VOCs were detected infrequently and at low levels in a small number of waste and groundwater samples. Based on sampling to date, these organic constituents are not expected to pose health risks at the Site. However, because large quantities of diesel fuel and solvents were used and stored at the Site, analysis of a limited number of samples for VOCs, semi-volatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), TPH, and/or other petroleum-associated analytes is planned in selected areas. Analysis of total organic carbon (TOC) is also being considered in onsite and offsite surface water and sediment to support evaluation of bioavailability (and potential toxicity) of any organic contaminants.

Ammonia and Other Gases. Historical documents report that Halaco's waste was reactive when first discharged, generating heat, ammonia, and other gases (California Department of Health Services, 1980; Amwest, 2000). Published reports confirm that aluminum smelter wastes may generate ammonia and other gases, including hydrogen, methane, acetylene, and carbon monoxide. There are multiple reports of strong ammonia odors at the Site originating from stockpiled materials at the Site, Halaco's wastewater, and seepage from the WMU. Historical testing has found elevated levels of ammonia in Halaco's wastewater and settling pond, and in groundwater at the Site. The main source of ammonia is believed to be the reaction of aluminum and magnesium with atmospheric nitrogen to produce metal nitrides, which react with water to form ammonia (EPA National Enforcement Investigations Center, 1981; Ventura County Air Pollution Control District, 1987).

It is not known whether the wastes present in the WMU, WDA, and southeast corner of the smelter will continue to generate measurable quantities of ammonia or other gases. Ammonia is toxic to fish, especially at high pH. Analysis of additional samples for total ammonia and other gases is planned. Because the formation of ammonia and other gases may be dependent on the moisture level, the moisture content of the samples may be adjusted before analysis.

Site-specific Sediment Bioassays. EPA's initial screening-level ecological risk assessment identified potential adverse effects on benthic invertebrates from metals in sediments in the OID and lagoon (CH2M HILL, 2008b). Site-specific sediment bioassays using appropriate test species are being considered to better evaluate risks to ecological receptors from contaminated OID and lagoon sediments. Contaminant levels in sediments used for the bioassays, if conducted, also will be measured to develop a Site-specific dose-response relationship.

Characteristics of Hazardous Waste. Halaco's wastes have been tested at various times using Federal and State tests that evaluate the reactivity and toxicity of a material to determine whether the material meets formal State or Federal definitions of hazardous waste. Tests have used one or more of the following procedures: (1) comparison of test results to EPA's Toxicity Characteristic Leaching Procedure (TCLP) concentration limits; (2) comparison of test results to California Total Threshold Limit Concentrations (TTLC); and (3) comparison of California's Waste Extraction Test (WET) results to California Soluble Threshold Limit Concentrations (STLC). More than 40 samples have been tested and compared to the TCLP criteria (see JMM, 1980; Weston, 2007), and more than 150 samples have been compared to the TTLC and STLC criteria.

In only one sample tested (from the WDA), the waste exceeded TCLP limits (for barium). But in a substantial fraction of samples, the waste exceeded California TTLC or STLC limits for one or more metals.

- In a 2002 study (Padre, 2002), 40 percent of the 20 samples tested exceeded STLC limits for copper and/or lead;
- In a 2003 study (Padre, 2003), 68 percent of the 54 samples tested exceeded STLC limits for copper and/or lead;
- In a 2006 study (Weston, 2007), 71 percent of the 35 samples tested exceeded STLC limits for beryllium, chromium, copper, and/or lead. Numerous samples also exceeded TTLC limits for one or more constituents.

Additional discussion of this topic is provided in Appendix J of the Integrated Assessment (Weston, 2007). Further statistical analysis of these results is under way to determine whether Halaco's wastes should be regulated as hazardous waste. Further tests of the waste's reactivity are also planned as described above in the discussion of ammonia and other gases.

General Chemistry and Other Tracers for Surface Water and Groundwater. General chemistry parameters and other tracers may be analyzed to help assess surface water and/or groundwater flow, and interactions between surface water and groundwater.

5.2. Specific Recommendations by Area

This section identifies portions of the Site where additional sample collection and analysis is planned. Table 2 summarizes the approximate number, locations, or frequencies of samples analyzed in past sampling in each area, the approximate number of additional samples planned, and the types of analyses planned. Figure 5 depicts the areas recommended for additional sampling.

5.2.1. Waste, Soil, and Sediment Testing

Soils, sediments, and wastes at much of the Site have been tested for metals contamination. Figures 6a, 6b, and 6c are “bubble plots” depicting the levels of one of the metals (lead) found in waste, soil, and sediment samples collected at the Site between 2006 and 2007. The figures show a clear “footprint” of contamination. Separate figures are provided for surface contamination (less than 5 feet deep) and subsurface contamination (5 feet and deeper). The sampling results shown in the figures are based on XRF analysis.

Some areas of the Site have not been adequately tested, some areas have not been tested at adequate depths, and some areas tested for metals have not been tested for other potential contaminants. The following sections provide an area-by-area summary of planned sampling.

To support plans for additional testing, the following sections compare past sampling results to one or more of the following screening levels: human health screening levels for contaminated soils, ecological screening levels for contaminated soils or sediments, and “background levels” (i.e., contaminant concentrations in locations believed to be unaffected by Halaco’s activities). The screening levels, particularly for ecological risk, make use of conservative measures of exposure and effects. If concentrations are below screening levels, no health risk is expected. If concentrations are above screening levels, further evaluation is usually necessary to determine whether the levels of soil, sediment, or water contamination pose a health risk. The comparisons are based on offsite lab results (rather than XRF results) unless noted otherwise.

For additional discussion of XRF and lab results, see CH2M HILL (2009). For more information on the sources of and limitations in the human health and ecological screening levels see CH2M HILL (2008b). For a tabular summary of sampling results and more than 70 box plots comparing the sampling results in each area to background and screening levels, see CH2M HILL (2008b). One of the box plots, for copper in soil and sediment, is included as Figure 7.

Smelter Area Soils – North Area: The North Area was used for material and equipment storage, and for temporary impoundment of surface water runoff pumped from the smelter area (URS, 2004). One-quarter of the 12 soil samples (at nine locations) in this area exceeded the human health risk screening level for lead in soils in industrial areas (800 milligrams per kilogram). Almost one-half of the sampling locations exceeded (the lower) screening levels for residential land use (150 milligrams per kilogram). Locations exceeding the arsenic screening level are not counted because samples from background locations also exceeded the screening level. Some sampling locations also had elevated levels of thorium and/or radium. **A limited number of additional samples are planned to determine whether the extent and levels of contamination in the North Area pose a health risk that warrants cleanup.**

Smelter Area Soils – Parking Area: The Parking Area was used primarily for vehicle parking. In the one soil sample collected in this area, the concentration of lead exceeded background levels but did not exceed human health risk screening levels for industrial or residential land use. Radionuclides in the sample were at background levels. **A limited number of additional samples are planned to determine whether the levels of contamination in the Parking Area pose a health risk that warrants cleanup.**

Smelter Area Soils – Process Building Area: The Process Building Area was the location of most of Halaco's operations, including the rotary furnaces used for smelting, storage of raw materials and wastes, equipment storage and maintenance, and fuel and oil storage in above-ground and underground tanks. One soil sampled collected from this area and analyzed at an offsite laboratory exceeded the industrial use screening level for lead. One other sampling location analyzed by XRF also exceeded the industrial use screening level for lead. Four other locations exceeded a residential use screening level. The one sample analyzed for thorium did not exceed background levels. **Additional testing is planned to evaluate the area for metals, radionuclides, and other potential contaminants (VOCs, SVOCs, TPH, PCBs, dioxins, and furans), and to determine the vertical extent of contamination. Current and former tank locations will be targeted (Figure 8).**

A limited number of soil gas samples also may be analyzed for methane and other landfill gases to determine whether wastes remaining from the former Oxnard dump are generating landfill gas. Sampling also may be conducted to determine the nature and extent of wastes remaining from the former Oxnard dump, and the extent to which the wastes are in contact with groundwater. Limited measurements may also be made to evaluate physical properties of the subsurface (e.g., compaction or consolidation) in areas where the presence of subsurface Halaco or Oxnard dump wastes might result in settlement.

Smelter Area Soils – Southeast Area: The Southeast Area was a disposal location for Halaco's waste solids from approximately 1965 to 1970. The wastes were discharged to a settling pond adjacent to the OID, and waste solids were used as fill in the southeastern portion of the smelter area. The waste depth varies, reaching about 12 feet at the southern end of this area. Historical aerial photos suggest that a portion of the OID channel formerly passed though this area.

About one-third of the approximately 16 soil sampling locations in this area analyzed at an offsite lab exceeded screening levels for industrial land use (not counting arsenic). Similar results were found in another six locations analyzed by XRF. Samples from most locations tested at the offsite lab had elevated radionuclides. **Additional investigation is planned to determine the depth of waste material, the extent to which there is contact between the waste and surface water in the OID, and the extent to which there is contact between Halaco's waste (and wastes remaining from the former Oxnard dump) and groundwater. A limited number of**

additional samples are also planned to evaluate the area for analytes other than metals and radionuclides (VOCs, SVOCs, TPH, PCBs, dioxins, and furans).

A limited number of solid or soil gas samples may be collected and analyzed for ammonia and other gases that may be produced by reactivity of the waste materials.

Waste Management Unit: The WMU was the disposal location for most or all of Halaco's wastes from about 1970 to 2002. In addition to process wastes from the smelting operation, the WMU received wastes from the air pollution control equipment, and may have been a disposal location for waste oil (DTSC, 2000). In more than one-half of the approximately 36 locations tested in 2006 at an offsite lab in this area, one or more metals were elevated above screening levels for industrial land use (not counting arsenic). Samples were collected from depths of 5 to 20 feet, and most of the exceedances were for aluminum and/or chromium. Similar results were found in another 132 samples analyzed by XRF. Two locations tested in 2006 had elevated radionuclides at depths of 15 feet or greater. Similar results were found in a 2002 study, with elevated levels of thorium in samples at depths of 25 feet or greater. The deeper wastes are most likely the oldest wastes, produced in the 1960s or 1970s when Halaco reports processing radioactive thorium-containing alloys. VOCs were also analyzed for in approximately 10 samples from the WMU in 2006, but infrequently detected and at concentrations below risk screening levels.

Additional investigation is planned to determine the depth of the waste material, the extent to which there is contact between the waste and surface water in the OID, and the extent to which there is contact between the waste and groundwater. The investigation likely will include retrieval of core samples until native material is reached. Additional samples are planned for analysis of metals and radionuclides to determine the levels of contamination in the bottom 20 feet of the WMU. A portion of the samples also will be analyzed for other organics not previously analyzed for.

When Halaco was operating, ammonia was measured in liquids seeping from the WMU at concentrations up to approximately 1,000 ppm. **Solid or soil gas samples also may be collected and analyzed for ammonia and other gases to determine the current and future reactivity of the waste materials.**

Investigations are under way to determine whether the waste materials in the WMU and WDA could be processed and used as industrial feedstocks. **If potentially feasible alternatives are identified, additional testing may be completed to evaluate the cost and feasibility of reusing the wastes.**

Halaco asserted that the WMU lies on top of a low-permeability "clay layer" that prevents downward movement of water through the wastes but evidence for such a barrier is weak. **At least four borings are planned through or adjacent to the WMU to evaluate the permeability of the soils underlying the WMU.** Measurements of hydraulic and geotechnical properties of the waste (e.g., permeability, shear strength, consolidation) also may be made to better estimate the downward movement of precipitation through the WMU, estimate the likelihood of future settlement of the waste materials, and evaluate remedial options. The current cover over the WMU is not designed to limit infiltration.

Waste Disposal Area: The WDA is the final disposal location for some of Halaco's wastes, which were initially discharged to the WMU and then moved to the WDA. Wastes were placed in the WDA beginning in or before 1980. Sampling to date in the WDA has mostly characterized metals and radionuclides in surface samples. In a few cases, samples were collected from the subsurface to a maximum depth of 8 feet. More than one-half of the five locations previously sampled in this area for laboratory analysis exceeded screening levels for industrial land use (for aluminum, beryllium, or chromium). Similar results were found in another 22 samples analyzed by XRF. The levels of radionuclides were also elevated in two of the five sampling locations. **Additional investigation is planned to determine the depth of waste material and determine whether the levels of contamination vary with depth.**

Nature Conservancy Land Soils and Sediments – East: A portion of the NCL-East adjacent to the WMU has been contaminated by erosion of waste material from the WMU, and possibly by seepage during the period that Halaco used the WMU as a settling pond for its wastewater. Sampling in the NCL-East has confirmed the presence of Halaco's waste adjacent to the waste pile at concentrations exceeding ecological screening levels (Figure 6b). **Additional investigations, including visual observation and the collection and analysis of soil and sediment samples, are planned to determine the vertical and horizontal extent of contamination.**

Nature Conservancy Land Soils and Sediments – North: Samples have been collected at four locations in the NCL-North area. Analysis of these samples has not detected contamination from Halaco's operations. **A limited number of additional samples are planned to confirm that this area is not contaminated.**

Oxnard Industrial Drain and Lagoon Sediments: Halaco discharged waste to the OID from about 1965 to 1970. Some of the discharged wastes and wastes eroded from the Site since 1970 have moved into the downstream lagoon. Six of the seven sediment samples collected from the OID adjacent to the waste management area and analyzed in an offsite laboratory exceeded background levels and ecological screening levels for metals. Several metals were found at elevated concentrations, including aluminum, barium, beryllium, cadmium, chromium, copper, lead, magnesium, nickel, and zinc. **Additional samples are planned to evaluate the area for analytes other than metals and radionuclides (VOCs, SVOCs, and pesticides) and to determine the horizontal and vertical extent of sediment contamination. Sediment toxicity tests are also being considered.**

J Street and Hueneme Drain Sediments: Sediments in the J Street and Hueneme drains have not been tested for Site-related contamination. These areas appear to be upstream of the Site and are not expected to be affected by Halaco's wastes. **A limited number of samples are planned to confirm that the J Street and Hueneme drains are not affected by Halaco's wastes and help distinguish between Site-related and other sources of contamination observed in the lagoon and adjacent areas.**

Loading Dock Soils: Halaco used a railroad loading dock approximately one-half mile north of the smelter parcel to receive and ship materials. The area has not been sampled. **Limited sampling is planned, recognizing that others used the same loading dock and it**

may be difficult to determine the source of elevated levels of metals or other constituents, if detected.

McWane Boulevard Soils – North of the WDA and NCL East: There are reports that Halaco waste material is present along an unpaved extension of McWane Blvd north of the WDA and NCL East. A visual inspection of the area on June 21, 2008, identified scattered pieces of waste on the surface. **Inspection of the subsurface is planned, along with a limited number of samples, to determine whether significant contamination is present.**

Wetland Area Soils – South and west of Smelter Area: In March 2007, EPA removed approximately 7,600 cubic yards of Halaco waste mixed with soil and sand from a wetlands area south and west of the smelter area. The area was re-vegetated after removal. A visual inspection of the area on June 21, 2008, and limited sampling outside of the removal area has identified small, isolated pieces of waste in the area. **A limited number of additional samples are planned to confirm that significant contamination is not present in this area.**

Wetland Area Sediments – Ditch South of WMU: In five of six samples collected in the ditch sediments south of the WMU and analyzed in an offsite lab, one or more metals were detected above screening levels for industrial land use (not counting arsenic). The levels of radionuclides were also elevated in one sample. **Additional investigation is planned to determine the depth of waste material and the lateral and vertical extent of contamination in this area.**

Beach Dunes and Sediments: The beach dunes and sediments located between the lagoon and ocean prevent surface water and sediment in the OID and lagoon from discharging to the ocean for much of the year. Periodically, the dunes are breached and potentially contaminated surface water and sediment discharge to the ocean. None of the results for the six samples collected in from the beach dunes and analyzed at an offsite laboratory exceed human health screening levels for metals (not counting arsenic), but four of the six samples exceeded ecological risk screening levels for cadmium and/or mercury and appeared to exceed background levels. One sample may have elevated levels of thorium. **Additional sampling is planned to determine whether the elevated levels in beach sands are Site-related and determine whether the levels pose any health risk. Historical channels from the OID through the beach dunes will be targeted during sampling.**

Marine Sediments: Analysis of marine sediment samples collected from 25 locations offshore of Halaco for metals did not detect contamination attributable to Halaco's operations. (No clear difference was observed between upgradient and downgradient concentrations.) Six of the samples were analyzed in an offsite lab; 19 were analyzed by XRF. **No additional sampling of marine sediments is planned.**

Offsite Residential Soils: Twelve samples were collected in a residential area north of the Site and analyzed for metals. Two samples were analyzed for metals and radionuclides in an offsite lab; ten were analyzed for metals using XRF. Analysis of these samples has not detected contamination from Halaco's operations. **No additional sampling in offsite residential areas is planned.**

Offsite Agricultural Soils: Twelve samples were collected in agricultural areas north and east of the WMU. Two samples were analyzed for metals and radionuclides in an offsite lab; ten were analyzed for metals using XRF. Analysis of these samples has not detected contamination from Halaco's operations. **No additional sampling is planned.**

5.2.2. Groundwater

Past Groundwater Sampling and Analysis

The earliest known groundwater testing at the Site occurred in 1970. Currently, 18 groundwater monitoring wells are intact and usable. All 18 are screened in the upper 20 to 30 feet of the semiperched groundwater aquifer underlying the Site. There are no wells onsite in the deeper portion of the semiperched zone (which is estimated to extend to a depth of 50 to 100 feet bgs) or in the underlying Oxnard aquifer. Figure 9 shows well locations.

Fourteen of the 18 monitoring wells were sampled for water quality once in 2006. Nine wells were sampled quarterly in 2003 and 2004. An earlier network of three to four wells was sampled twice per year from 1981 through 2003, when they were destroyed. Analytical parameters varied, but included electrical conductivity (EC), pH, oil and grease, magnesium, and selected metals (aluminum, copper, zinc) from 1981 to 2002 and additional parameters between 2003 and 2004. The expanded list of parameters included additional metals, ammonia, total dissolved solids (TDS), thorium, radium, and VOCs.

Monitoring data show that Halaco's wastes have contaminated shallow groundwater at the Site, at least to the depth of the current groundwater monitoring wells. The wells are screened to a depth of approximately -10 feet elevation in the smelter area and -20 feet elevation in the waste management area. Monitoring data have shown elevated levels of several parameters associated with Halaco's wastes in selected wells, including TDS, EC, pH, magnesium and other metals, ammonia, and oil and grease. Monitoring data also show relatively low levels of sulfate in wells near waste disposal areas, consistent with the composition of Halaco's wastewater.

The horizontal extent of contamination and the vertical extent of contamination below the existing well network are not known. When Halaco discharged wastewater to the WMU from about 1970 to 2002, water table "mounding" under the WMU would have resulted in groundwater flowing radially outward from the historical wastewater disposal areas and vertically downward within the Semiperched Aquifer. Until the early 1990s, there were also downward hydraulic gradients between the Semiperched and underlying Oxnard aquifer because of overpumping in the Oxnard aquifer, which lowered groundwater elevations below sea level. It is unknown whether contaminated groundwater in the semiperched zone has moved downward through the underlying aquitard.

Impacts on groundwater continue even though wastewater discharge and mounding no longer occur and local groundwater flow directions changed after wastewater discharges ended in 2002. Currently, groundwater in the semiperched zone under the Site moves away from recharge areas (lagoon, OID, NCL-East) and generally inland. Figure 9 shows groundwater levels for December 12, 2007. The extraction or removal of groundwater north of the Site also may contribute to northerly gradients across the Site.

See CH2M HILL (2008a) for a more detailed discussion of aquifer structure, groundwater elevations and flow, the nature and extent of groundwater contamination at the Site, and summaries of sampling results.

Plans for Additional Groundwater Sampling

At least two phases of groundwater investigation are planned. Phase 1 plans are:

- Periodic water level monitoring and water quality sampling and analysis at existing monitoring wells.
- Installation and sampling of four well-pairs (eight wells) around the perimeter of the Site. Each pair is likely to include one well screened above the aquitard separating the semiperched zone from the Oxnard aquifer and one well below the aquitard. Total well depth will be approximately 200 feet. Drilling methods will be considered that allow the recovery of continuous cores from each boring to allow detailed characterization of the lithology of the semiperched zone, underlying aquitard, and upper reaches of the Oxnard aquifer. These wells will provide data to determine whether contamination is present in the deeper part of the Semiperched Aquifer and the Oxnard aquifer.
- Additional investigation to identify the cause of the depressed water levels seen in a groundwater monitoring well at the northwest corner of the Site and northerly groundwater flow gradient. The investigation may include an evaluation of the integrity of sewer lines north of the Site into which groundwater may be infiltrating and/or the installation and sampling of temporary wells or piezometers.
- Additional investigation to determine whether the former Oxnard dump is contributing to groundwater contamination.

After the phase 1 investigation is completed, additional investigation is likely to be needed to determine the horizontal and vertical extent of groundwater contamination, including the impacts, if any, of tanks, the OID settling pond, and other “point” or “limited area” sources of contamination at the Site.

5.2.3. Surface Water

Past Surface Water Sampling and Analysis

Routine surface water sampling at the Site began in 1981 and continued until 2004. Monitoring frequencies varied, but typically were every two months. Analytical parameters also varied, but at a minimum included EC, pH, oil and grease, magnesium, and selected metals (aluminum, copper, zinc). Samples collected between 2002 and 2004 were also analyzed for additional metals, total dissolved solids, sulfate, chloride, hardness, ammonia, nitrate, nitrite, gross alpha, gross beta, thorium isotopes (Th-228, Th-230, Th-232), radium (Ra-226, Ra-228), VOCs, and TPH. Sampling locations varied, but typically included Halaco’s wastewater discharge, the OID north and south of the waste management area, the lagoon (starting in 2002), the ditch south of the WMU (starting in 2001), and the “surf line” (starting in 2002). Several one-time sampling events were also completed, in some cases with an expanded list of sampling locations and/or analytes. Figure 10 shows surface water sampling locations.

There is evidence that Halaco’s wastes affected surface water quality, particularly during the period that Halaco discharged wastewater to the WMU (approximately 1970 to 2002). However, Halaco’s impact on surface water is often difficult to distinguish from two other sources for many of the chemical constituents in Halaco’s waste: runoff from the 5,935-acre watershed that drains into the OID (PWA, 2007) and seawater that seasonally moves into the lagoon and OID. The latter process occurs when the naturally occurring sand berm separating the OID and lagoon from the ocean breaches, and seawater moves inland during high tides.

In the OID and lagoon, contamination of surface water probably resulted from direct discharge of waste materials into the OID from 1965 to 1970, erosion and suspension of contaminated bank sediments, stormwater runoff, and groundwater to surface water discharge (because of mounding of groundwater under the WMU). The strongest evidence of an impact from Halaco’s wastes is seen in sampling results for ammonia and oil and grease between 1980 and 2002. Sampling results also showed, at times, elevated levels of metals, anions, TDS, and EC, but the increases were inconsistent. Since wastewater discharges ended in about 2002 (lowering groundwater levels) and EPA stabilized the waste pile in 2007 (limiting runoff and erosion), impacts on surface water are probably limited to major storm events when discharge velocities in the OID are high and stormwater runoff overwhelms erosion control measures. Discharge of contaminated groundwater to surface water is also possible, particularly when surface water levels drop after the naturally occurring sand berm is breached. As discussed above, OID sediments (as distinguished from water in the OID) are also contaminated, exceeding risk screening levels for metals and radionuclides.

Surface waters (and sediment) in the small ditch immediately to the south of the WMU, and in standing waters in the NCL-East, also have been affected by Halaco’s wastes. Elevated levels of metals, ammonia, and major ions (especially potassium) associated with Halaco’s wastewater were measured in liquids observed to seep from the WMU (in 1999), in ponded water in the NCL-East (in 1980 and 1991), and in the ditch to the south of the WMU (in 2003 and 2004). As with the OID and lagoon, current impacts on surface water are probably limited to major storm events, when stormwater runoff overwhelms erosion control measures.

See CH2M HILL (2008a) for a more detailed discussion of surface water flow at the Site, groundwater and surface water interactions, the impact of Halaco’s operations on surface water quality at the Site, and summaries of sampling results.

Plans for Additional Surface Water Sampling

Because Halaco’s impacts are more clearly seen in sediments than in the overlying water, particularly since Halaco’s wastewater discharge ended in 2002, limited or no additional surface water sampling is planned in the OID and lagoon. Limited sampling is planned for the NCL-East to determine the impact of possibly contaminated surface water conveyed by the ditch south of the WMU into NCL-East during high water levels in the OID.

If additional surface water sampling occurs, it will be targeted at locations and times of the year when impacts to surface water are most likely. In the OID, that is likely to be when flows are highest and most likely to erode and suspend contaminated bottom or bank sediments. Impacts are also possible during low flow, low water level conditions when discharge of contaminated groundwater to surface water is possible. As described above, low water levels occur when the berm separating the lagoon from the ocean is breached and seawater moves into the lagoon.

If surface water is sampled at the Site, both filtered and unfiltered samples will be collected. The results of filtered samples would be used for comparisons to EPA Ambient Water Quality Criteria. Analytes would include those associated with Halaco's operations, chemicals that may originate upstream, and tracers to help distinguish between Site-related and upstream sources. Additional measurements may be made at locations not affected by the Site, including the OID upstream of the Site and the J Street and Hueneme Drains.

Surface water elevation and flow measurements will be made as needed to estimate or interpret discharge and flow direction. Samples also may be collected to confirm that the NCL-North is not affected by the Site, and of runoff or seepage from the WMU if observed during the rainy season.

5.2.4. Air

Past Air Sampling and Analysis

In June 2006, temporary air filters were placed at six locations around the Site over an eight-day period, and particulate matter (i.e., dust) collected on the filters was sent to an offsite laboratory for analysis. Figure 11 shows the six sampling locations and depicts the concentrations of metals in the samples from the six locations. A tabular summary of results is available in Weston 2007. Several analytes (Be, Cd, Cu, Pb, Mg, Mn, Mo, Ni) were higher in concentration at downwind locations (AIR-2, AIR-3, AIR-6) compared to upwind locations (AIR-1). The samples were collected during a period of moderate winds out of the west that are typical of the summer months when the sampling occurred.

These samples were collected before EPA completed its stabilization effort in 2007, which included the consolidation and removal of loose waste solids from the smelter area and placement of approximately 141,000 square yards of fiber matting over the WMU and WDA to reduce wind- and water-borne movement of waste materials.

Figure 12 depicts monthly wind roses for Oxnard Airport data measured in 2004 and 2005. The wind roses show moderate winds consistently from the west during the non-winter months from mid-March through early October. During winter, winds are typically from the west or northeast, with higher peak wind speeds than in the non-winter months.

Plans for Additional Air Sampling

Additional monitoring is planned during periods of high winds to determine whether windblown material is moving offsite. Three sampling locations are planned: one location far enough upwind to avoid the effects of the smelter area and waste pile, and two locations downwind of the most erosion-prone areas of the Site where maximum ground-level particulate concentrations are expected.

5.2.5. Fish and Other Biota

Past Fish Sampling and Analysis

More than 93 fish were collected in 2006 from the lower reach of the OID or in the adjacent lagoon at the mouth of the OID. The fish were composited into nine samples, which were analyzed for metals, gross alpha radiation, and gross gamma radiation. Six of nine fish samples consisted of water column species; three consisted of benthic species. The levels of gross alpha and gamma radiation were below detection limits. Some metals were detected above screening levels, but it is unclear whether the levels are Site related.

No site-specific chemical concentration data in tissues of other types of biota are available for the Site.

Plans for Additional Sampling of Fish (and other biota)

Collection and analysis of additional fish is being considered in the OID and lagoon, and in upstream areas, to determine whether the metal concentrations in fish tissue reflect any contribution from the Site. Further analysis of tissue from fish and benthic invertebrates in the OID and lagoon is also being considered to better estimate risks to piscivorous (e.g., least tern) and benthic invertebrate-eating (e.g., snowy plover) wildlife. Analysis of tissue from terrestrial resident plants and soil invertebrates in contaminated soils is also being considered to better estimate risks to terrestrial birds and mammals. The collection and analysis of benthic invertebrates, soil invertebrates, and terrestrial plants, if they occur, will be co-located with sediment and soil samples collected from locations expected to represent low to high sediment or soil concentrations.

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Tables

TABLE 1

Materials Reportedly Stored or Used at the Halaco Facility

Halaco Site Remedial Investigation

Material	Comment
1,1,1-trichloroethane	Stored in maintenance shop
Acetylene	Stored in maintenance shop
Aluminum dross, cans, scrap	One of the two primary materials processed by Halaco
Ammonia gas	Used for air pollution control
Ammonium phosphate	Stored in maintenance shop
Barium chloride	
Beryllium	Used as alloying agent
Boric acid	
Calcium hypochlorite	
Calcium hydroxide	
Cerium	
Flourospar	Calcium fluoride
Lead soaps	
Lime	Used for air pollution control
Magnesium scrap, sludge, dross	One of the two primary materials processed by Halaco
Magnesium chloride	Used in large quantities as "flux"
Manganese hardener	
Manganese chloride	Manganese added as alloying agent
Mischmetal	Mixture or alloy of rare earth elements
Mobilfluid 423	
Mobiltac E	65% asphalt, 15% TCE, 15% other petroleum compounds
Petroleum compounds	Including gasoline, diesel fuel, motor oil, lithium grease, other grease, mineral oil, "heavy paraffinic distillate," naptha, "petroleum asphalts"
Pink flux	
Potassium chloride	Used in large quantities as "flux"; also listed as potash
Reynolds Al Mn hardener	
Silicon metal	
Sodium chloride	Used in large quantities as "flux"
Sodium hydroxide	
Sulfuric acid	
Sulfur	
Sulfur dioxide	Used as cover gas during production of magnesium ingots
Trichloroethylene	Chlorinated solvent
Zinc	Material processed by Halaco
Zirconium hardener	

TABLE 2
Summary of Past Sampling and Preliminary Estimates of Planned Sampling
Halaco Site Remedial Investigation

Matrix	Area	Past Sampling (number of locations): EPA Halaco Site Investigations (2006/2007)			Ormond Beach Regional Investigation (2006)		Halaco Site Routine Surface Water and Groundwater Monitoring (1981-2003)		Halaco Site Routine Surface Water and Groundwater Monitoring (2002-2004)		Planned Sampling - Preliminary Estimates			Analyte frequency								
		Metals (lab)	Metals (XRF)	Other Analytes	Metals (lab)	Other Analytes	Metals (lab)	Other Analytes	Metals (lab)	Other Analytes	No. of Locations	Depths per Location	Tentative Depths (ft. bgs)	Metals (%)	Radionuclides (%)	VOCs (%)	SVOCs, TPH (%)	PCBs and dioxins (%)	Pesticides (%)	Ammonia (%)	General Chem. /Tracers (%)	Bioassays (%)
Solid Matrix	Smelter area soils - north area	9	17	r,v	-	-	-	-	-	-	**5-10**	**2**	0, 5	100	100	25	25	-	10	-	-	
	Smelter area soils - parking area	1	-	-	-	-	-	-	-	-	**4-8**	**2**	0, 5	100	100	25	25	-	10	-	-	
	Smelter area soils - process building area	1	6	r,v	-	-	-	-	-	-	**10-20**	**2**	0, 5, 10	100	100	50	50	25	10	-	-	
	Smelter area soils - southeast area	16	8	r	-	-	-	-	-	-	**10-20**	**4**	0, 5, 10, 15	100	100	50	50	25	10	50	-	-
	Waste Management Unit (WMU)	34	33	r	-	-	-	-	-	-	**10-20**	**2**	30, 40	100	100	50	50	25	10	100	-	-
	Waste Disposal Area (WDA)	5	18	r	-	-	-	-	-	-	**5-10**	**2**	5, 15	100	100		-	-	10	100	-	-
	NCL soils and sediments - east	8	40	r	4	t,p	-	-	-	-	**10-25**	**4**	0, 5	100	100		-	-	25	-	-	-
	NCL soils and sediments - north	-	-	-	4	t,p	-	-	-	-	**5-15**	**2**	0, 5	100	100		-	-	-	-	-	-
	Oxnard Industrial Drain (OID) and lagoon sediments	16	12	r	-	-	-	-	-	-	**5-15**	**1 - 3**	0, 2, 5	100	100	50	50	50	50	-	-	20
	J Street and Hueneme Drain sediments	-	-	-	-	-	-	-	-	-	**2-5**	**2**	0	100	100	100	100	100	100	-	-	-
	Loading dock soils	-	-	-	-	-	-	-	-	-	**4-8**	**1**	0, 2	100	100		-	-	-	-	-	-
	McWane Blvd soils, north of WDA and NCL East	-	-	-	-	-	-	-	-	-	**5-10**	**2**	0, 2	100	100		-	-	-	-	-	-
	Wetland area soils - south and west of smelter area	12	12	r	2	t,p	-	-	-	-	**10-15**	**2**	0, 5	100	100		-	-	-	-	-	-
	Wetland area sediments - ditch south of WMU	6	23	r	-	-	-	-	-	-	**5-10**	**2**	0, 5	100	100		-	-	-	-	-	-
	Beach dunes and sediments	12	33	r	-	-	-	-	-	-	**10-20**	**2**	0, 5	100	100		-	-	-	-	-	-
	Marine sediments	12	27	r	-	-	-	-	-	-	**0**	**N/A**	N/A	-	-		-	-	-	-	-	-
	Offsite residential soils	2	10	r	-	-	-	-	-	-	**TBD**	**TBD**	N/A	100	100	-	-	-	-	-	-	-
	Offsite agricultural soils	2	10	r	6	t,p	-	-	-	-	**0**	**N/A**	N/A	-	-		-	-	-	-	-	-
Surface Water	Oxnard Industrial Drain (OID) and lagoon	8	-	r,v	3	a,g,t,p	2, bimonthly	e,ph,o	3, bimonthly	a,v,o,t,r,g	**TBD**	**TBD**	N/A	TBD	TBD	-	-	-	-	TBD	TBD	-
	Ditch south of WMU	2	-	r,v	-		-	-	3, bimonthly	a,v,o,t,r,g	**TBD**	**TBD**	N/A	TBD	TBD	-	-	-	-	TBD	TBD	-
	Ocean surf line	-	-	-	-		-	-	1, bimonthly	a,v,o,t,r,g	**TBD**	**TBD**	N/A	TBD	TBD	-	-	-	-	TBD	TBD	-
	NCL - East	-	-	-	-	-	-	-	-	-	**TBD**	**TBD**	N/A	TBD	TBD	-	-	-	-	TBD	TBD	-
	NCL - North	-	-	-	-	-	-	-	-	-	**TBD**	**TBD**	N/A	TBD	TBD	-	-	-	-	TBD	TBD	-
	J Street and Hueneme Drains	-	-	-	2	a,g,t,p	-	-	-	-	**TBD**	**TBD**	N/A	TBD	TBD	-	-	-	-	TBD	TBD	-
Ground-water	Semi-perched Aquifer - shallow wells (existing)	14	-	r,v	-	-	4, semiannual	e,ph,o	11, quarterly	a,v,o,t,r,g	**TBD**	**TBD**	10 to 50	100	100	25	25	-	25	100	100	-
	Semi-perched Aquifer - deep wells (new)	-	-	-	-	-	-	-	-	-	**4**	**TBD**	50 to 100	100	100	25	25	-	25	100	100	-
	Upper Aquifer System - Oxnard Aquifer (new)	-	-	-	-	-	-	-	-	-	**4**	**TBD**	100 to 200	100	100	25	25		25	100	100	-
Air	Upwind, onsite, downwind	6	-	-	-	-	-	-	-	-	**3-5**	**5-10**	N/A	100	100	-	-	-	-	-	-	-
Soil Gas	Smelter area	-	-	-	-	-	-	-	-	-	**5-10**	**1-2**	TBD	-	-	100	-	-	-	100	-	-
	WMU and WDA	-	-	-	-	-	-	-	-	-	**5-15**	**1-3**	TBD	-	-	100	-	-	-	100	-	-
Biota	Plants - TBD	-	-	-	-	-	-	-	-	-	**TBD**	**TBD**	N/A	100	-	-	-	-	-	-	-	-
	Invertebrates - TBD	-	-	-	-	-	-	-	-	-	**TBD**	**TBD**	N/A	100	-	-	-	-	-	-	-	-
	Fish - OID/lagoon	9	-	r	-	-	-	-	-	-	**TBD**	**TBD**	N/A	100	-	-	-	-	-	-	-	-

Notes:

TBD = to be determined
N/A = not applicable
"Analyte frequency" is the percentage of samples in specified area to be analyzed for each parameter or set of parameters
EPA solid waste samples from Weston (2007) and Team 9 (2008)
EPA surface water, groundwater, and air samples from Weston (2007)
Ormond Beach regional investigation samples from AMEC (2006)

Other Analytes:

v = volatile organic compounds (VOCs)
o = oil and grease (O&G)
t = total petroleum hydrocarbons (TPH)
p = pesticides and PCBs
a = ammonia and other nitrogen species
r = radionuclides (may include isotopes and gross alpha/beta)
e = electrical conductivity
g = general chemistry (may include pH, EC, T, TDS, and major ions)

Figures

Aerial image © Google Earth, 2007. Annotation by CH2M HILL, 2008.

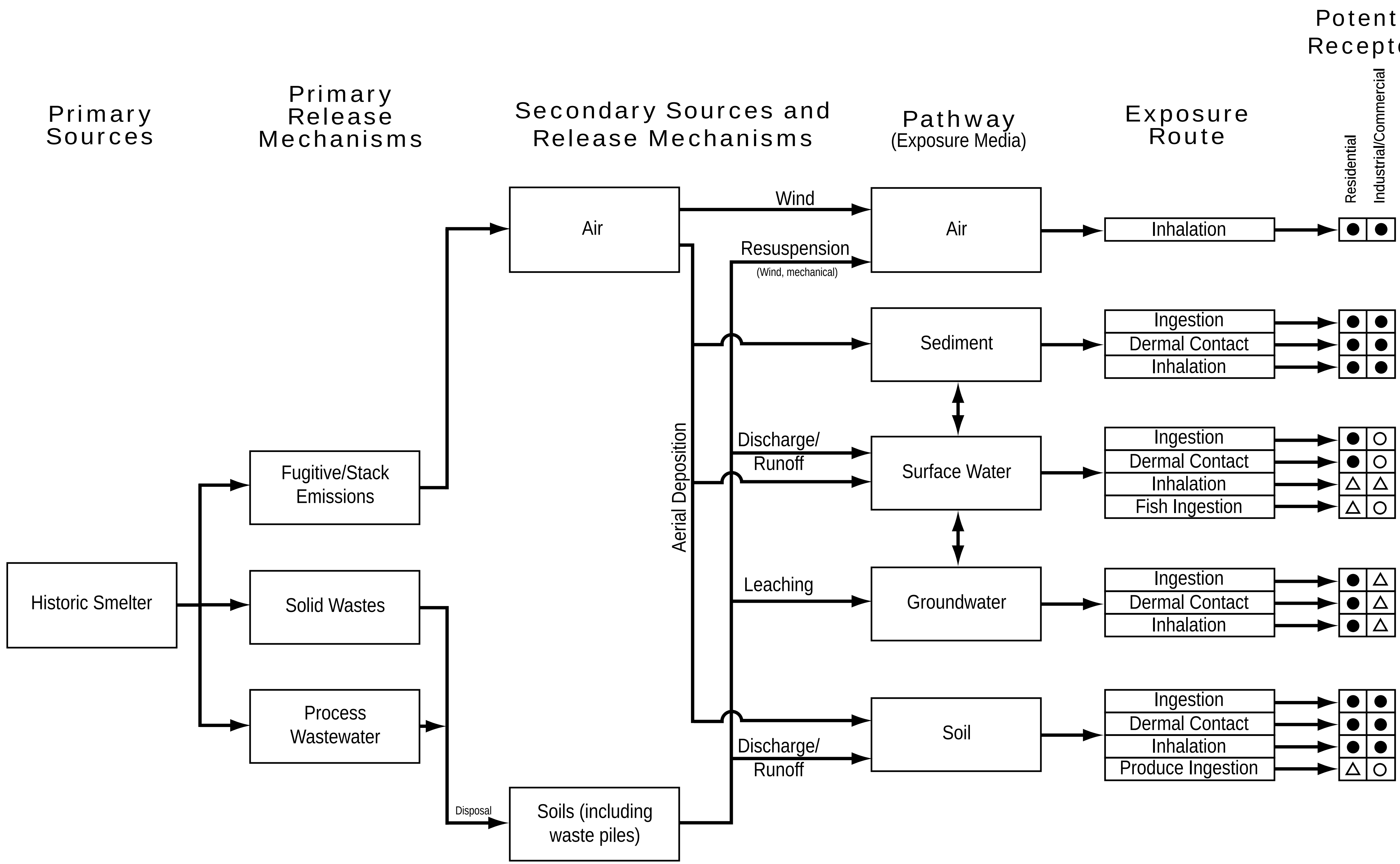
FIGURE 1
Halaco Site
Halaco Site, Oxnard, California

FIGURE 2
Site Location and Areas
Halaco Site, Oxnard, California

Source: Figure 2-1, Integrated Assessment Report (Weston, 2007)

CH2MHILL

ES122007006SAC Figure_2.ai 01.21.09 tdaus



LEGEND:

● = Potentially complete exposure pathway

○ = Incomplete exposure pathway

N = Pathway not applicable

△ = Possibly complete exposure pathway, but likely not significant

FIGURE 3
Conceptual Site Model Diagram
Screening-level Human Health Risk Assessment
Halaco Site, Oxnard, California

ES122007006SAC Figure_3.ai 01.22.09 tdaus

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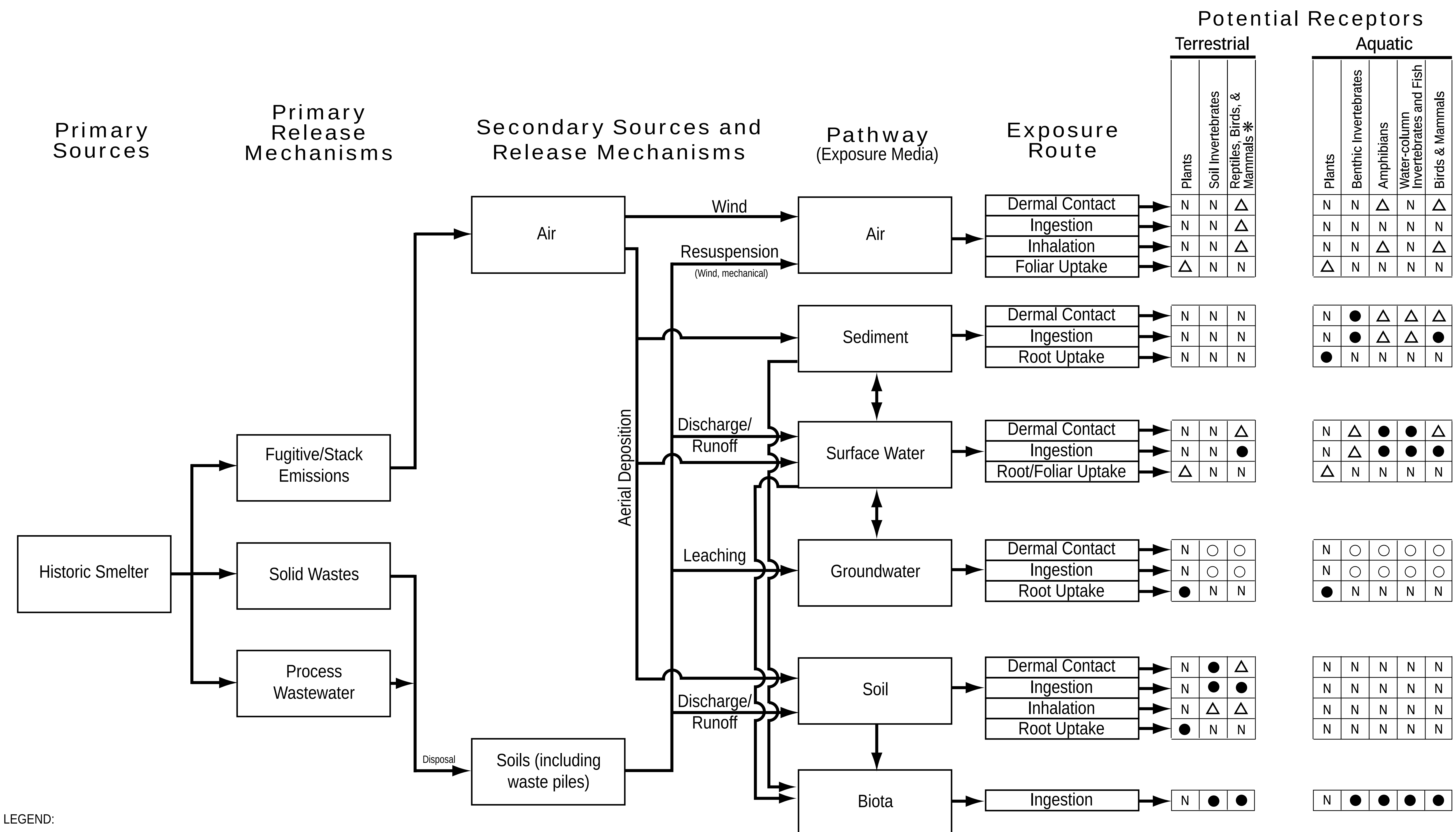

LEGEND:

● = Potentially complete exposure pathway

○ = Incomplete exposure pathway

N = Pathway not applicable

△ = Possibly complete exposure pathway, but likely not significant or insufficient data for analysis in a Screening Level Ecological Risk Assessment

* Data required to evaluate exposure and effects to reptiles are lacking; therefore reptiles were not evaluated. Instead, analyses for birds were assumed to be representative of reptiles.

FIGURE 4
Conceptual Site Model Diagram
Screening-level Ecological Risk Assessment
Halaco Site, Oxnard, California

ES122007006SAC Figure_4.ai 01.21.09 tdaus

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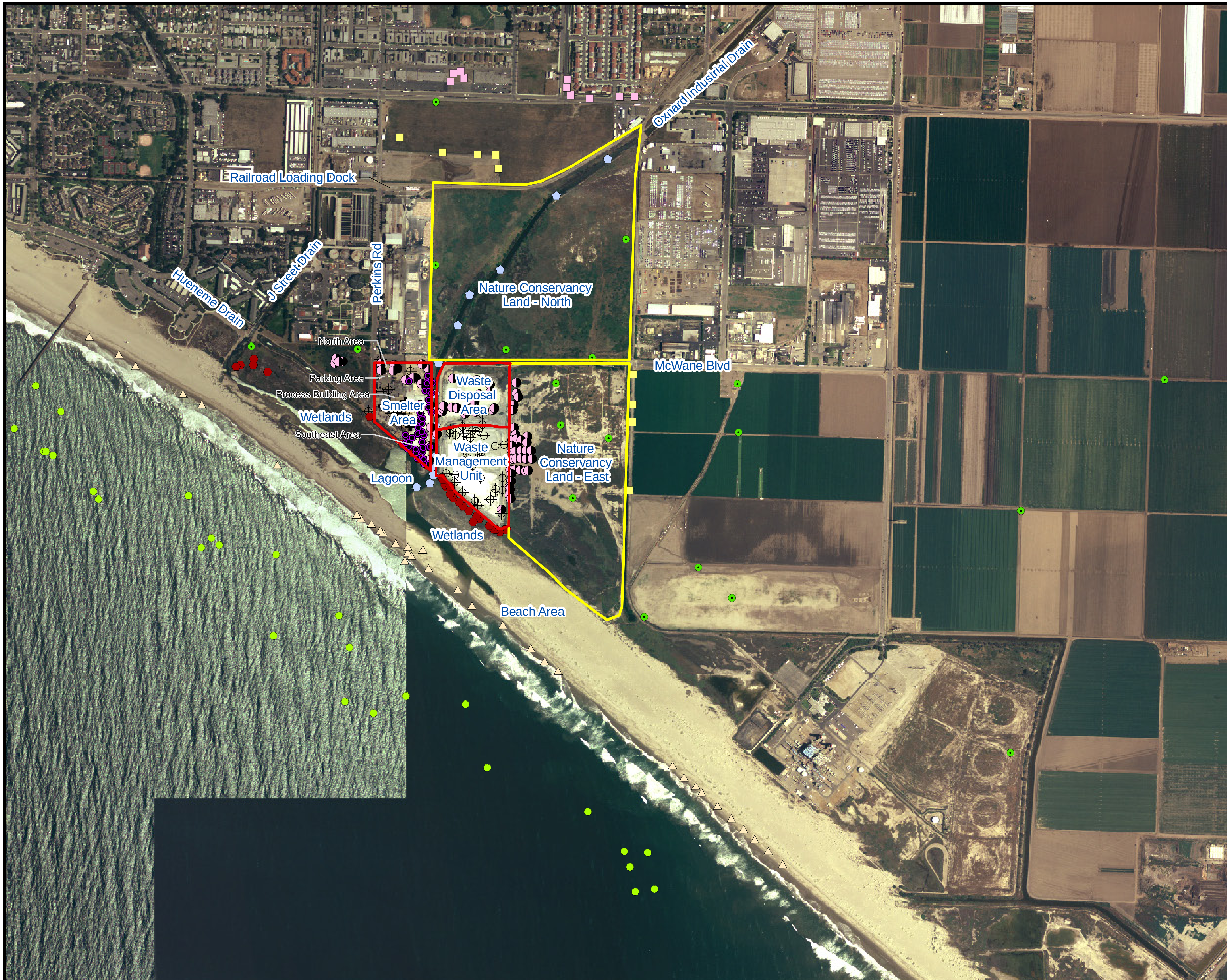

LEGEND

Integrated Assessment Report Investigation (Weston, 2007)

- Surface Sediment Sample (SDF)
- Residential Soil Sample (SSR)
- Agricultural Soil Sample (SSA)
- Soil Sample (SSN)
- Soil Boring (SSN)
- Soil Boring (SW)
- Wetlands Sediment Sample (SWL)
- Beach Sediment Sample (SDB)
- Marine Sediment Sample (SDM)
- Waste Samples from Smelter Area (SWF)

Southeast Smelter Investigation (Team 9, 2008)

- SE Smelter Soil or Sediment Samples

Ormand Beach Wetlands Restoration Investigation (AMEC, 2006)

- AMEC Soil or Sediment Samples

N

800 400 0 800
Feet

FIGURE 5
Areas Recommended for Additional Sampling

HALACO SITE
OXNARD, CALIFORNIA

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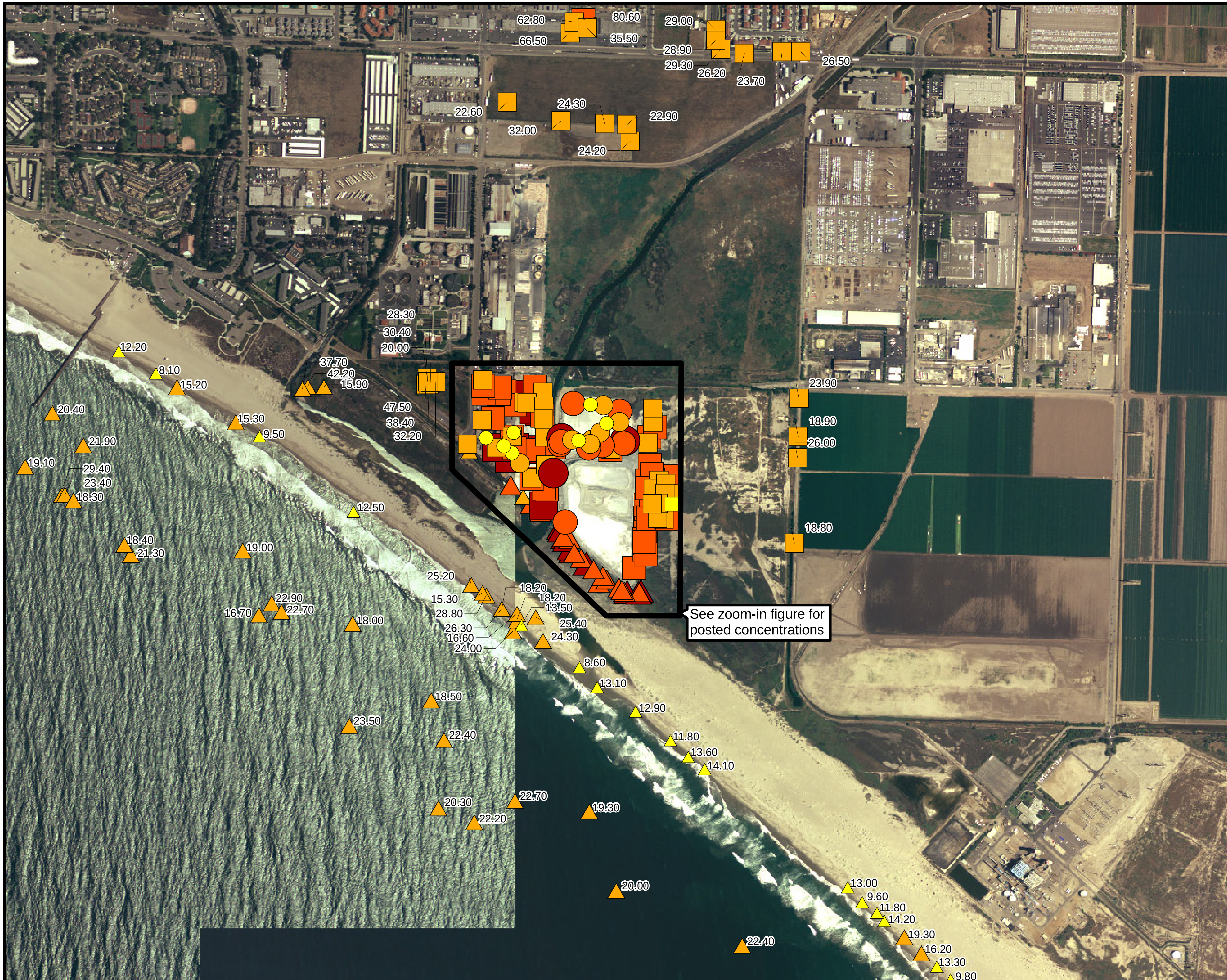

LEGEND
Lead Results in mg/kg

Waste Samples
- < 15
- 15 - 70
- 70 - 250
- > 250

Soil Samples
- < 15
- 15 - 70
- 70 - 250
- > 250

Sediment Samples
- < 15
- 15 - 70
- 70 - 250
- > 250

164.00 (Lead Result; mg/kg)

Notes:
1. Data obtained from field X-ray fluorescence (XRF) analysis.
2. Shallow soil data from zero to less than 5-feet below ground surface.

N

800 400 0 800 Feet

FIGURE 6a
Bubble Plots Depicting Shallow Soil and Sediment Contamination, Zoom-out

HALACO SITE
OXNARD, CALIFORNIA

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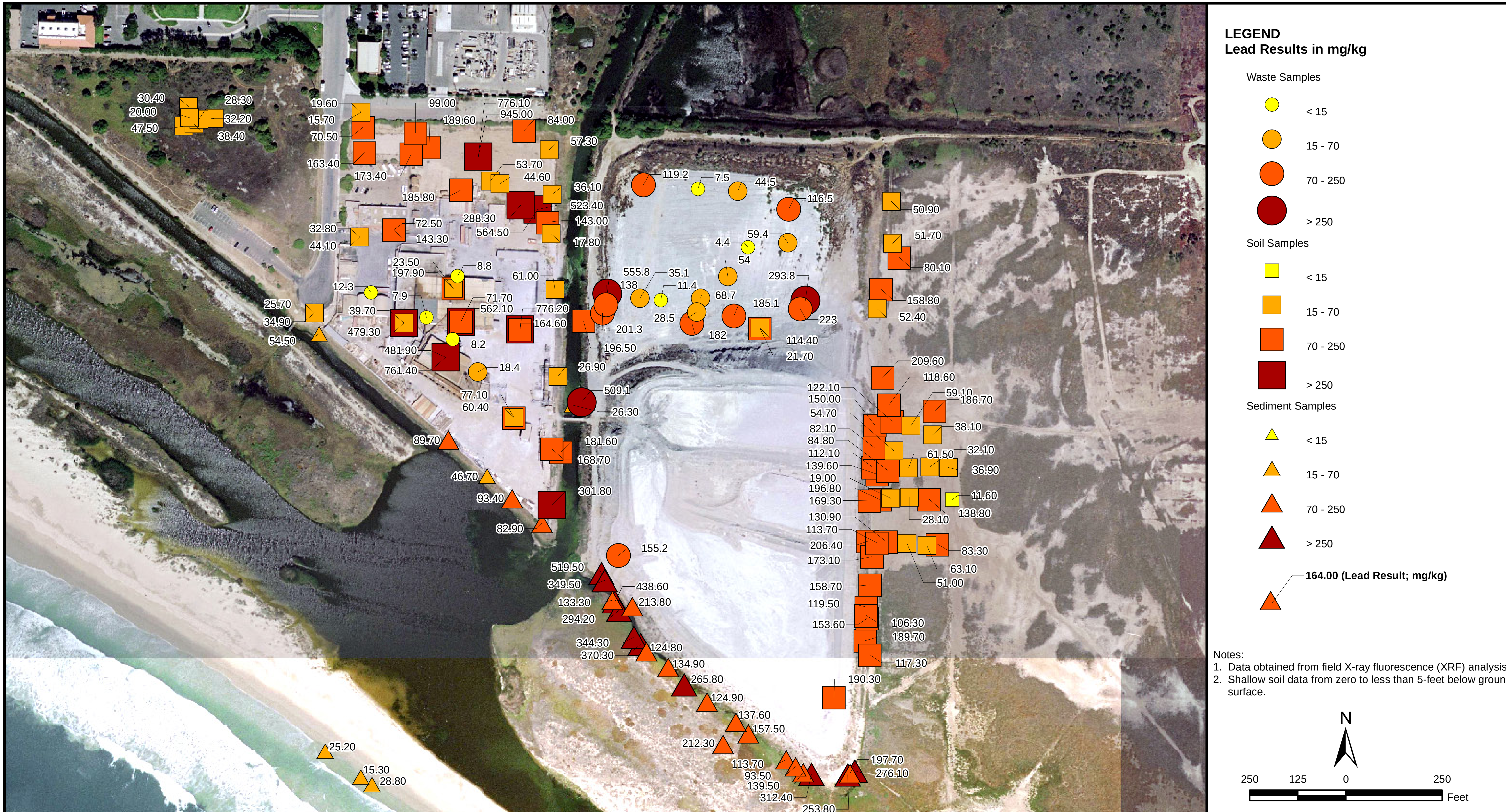
BAO \\ZINFANDEL\PROJ\USENVIRONMENTALPROTE\358156HALACO\GIS\MAPFILES\2009\SHALLOW_SOIL_ZOOMOUT.MXD 1/21/2009 13:22:33



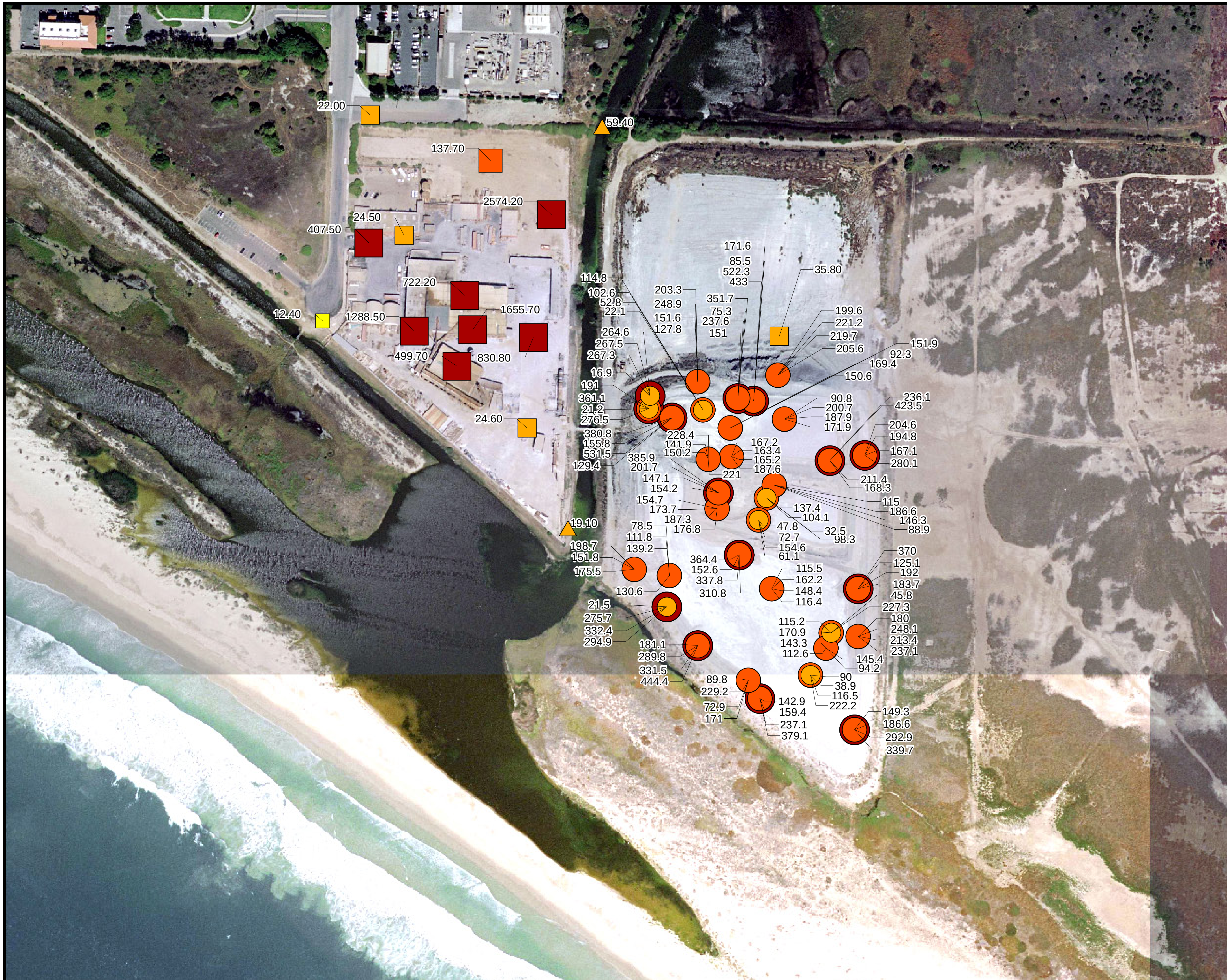
Notes:
1. Data obtained from field X-ray fluorescence (XRF) analysis.
2. Shallow soil data from zero to less than 5-feet below ground surface.

FIGURE 6b
Bubble Plots Depicting Shallow Soil and Sediment Contamination, Zoom-in

HALACO SITE
OXNARD, CALIFORNIA

CH2MHILL

BAO \\ZINFANDEL\PROJ\USENVIRONMENTALPROTE\358156HALACO\GIS\MAPFILES\2009\SHALLOW_SOIL_ZOOMIN.MXD 1/21/2009 13:21:27



LEGEND
Lead Results in mg/kg

Waste Samples
- < 15
- 15 - 70
- 70 - 250
- > 250

Soil Samples
- < 15
- 15 - 70
- 70 - 250
- > 250

Sediment Samples
- < 15
- 15 - 70
- 70 - 250
- > 250

164.00 (Lead Result; mg/kg)

Notes:
1. Data obtained from field X-ray fluorescence (XRF) analysis.
2. Deep soil data from greater than 5-feet below ground surface.

N

250 125 0 250 Feet

FIGURE 6c
Bubble Plots Depicting Deep Soil and Sediment Contamination, Zoom-in

HALACO SITE
OXNARD, CALIFORNIA

CH2MHILL

BAO \\ZINFANDEL\PROJ\USENVIRONMENTALPROTE\358156HALACO\GIS\MAPFILES\2009\DEEP_SOIL_ZOOMIN.MXD 1/21/2009 13:25:39

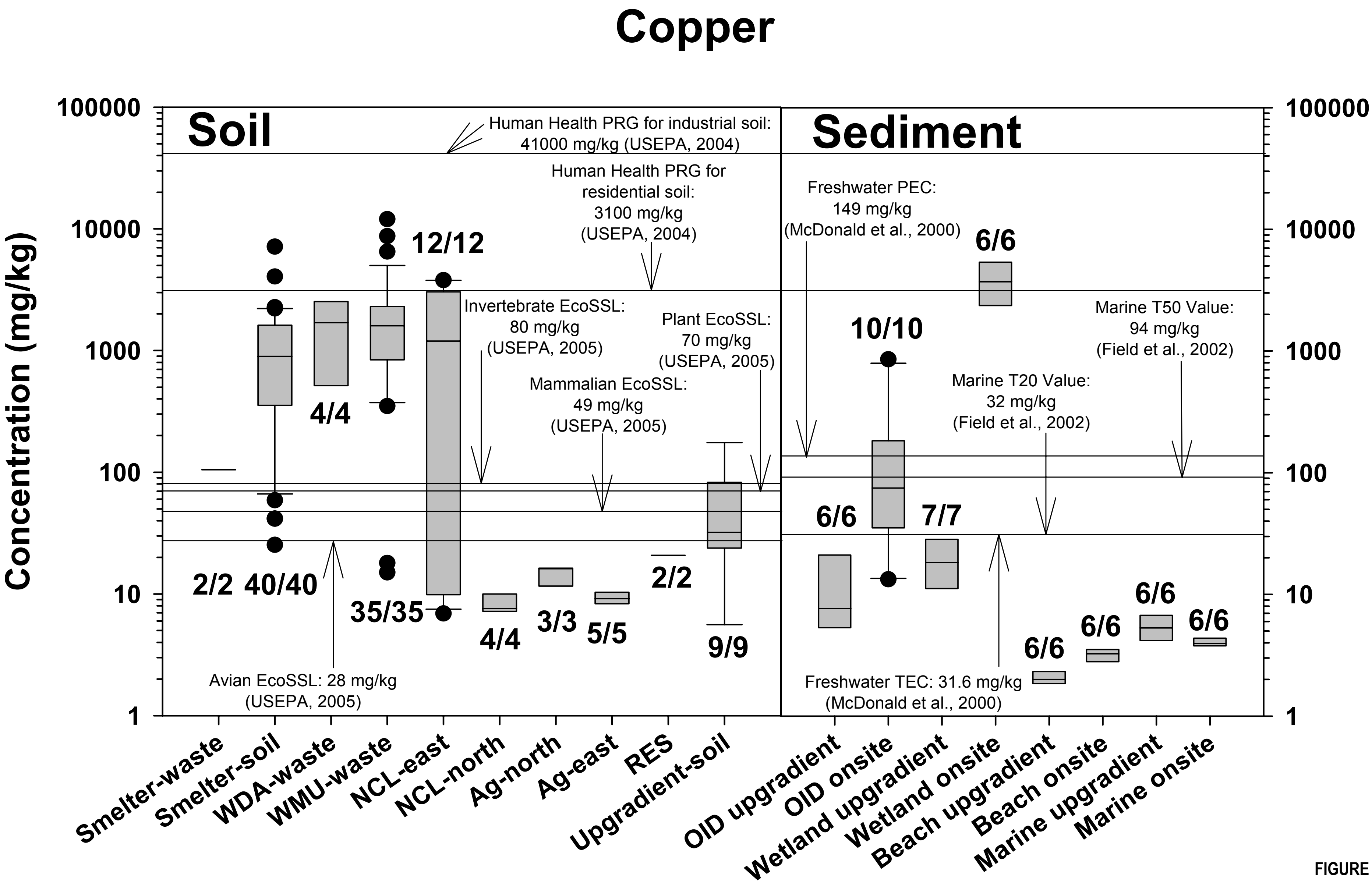
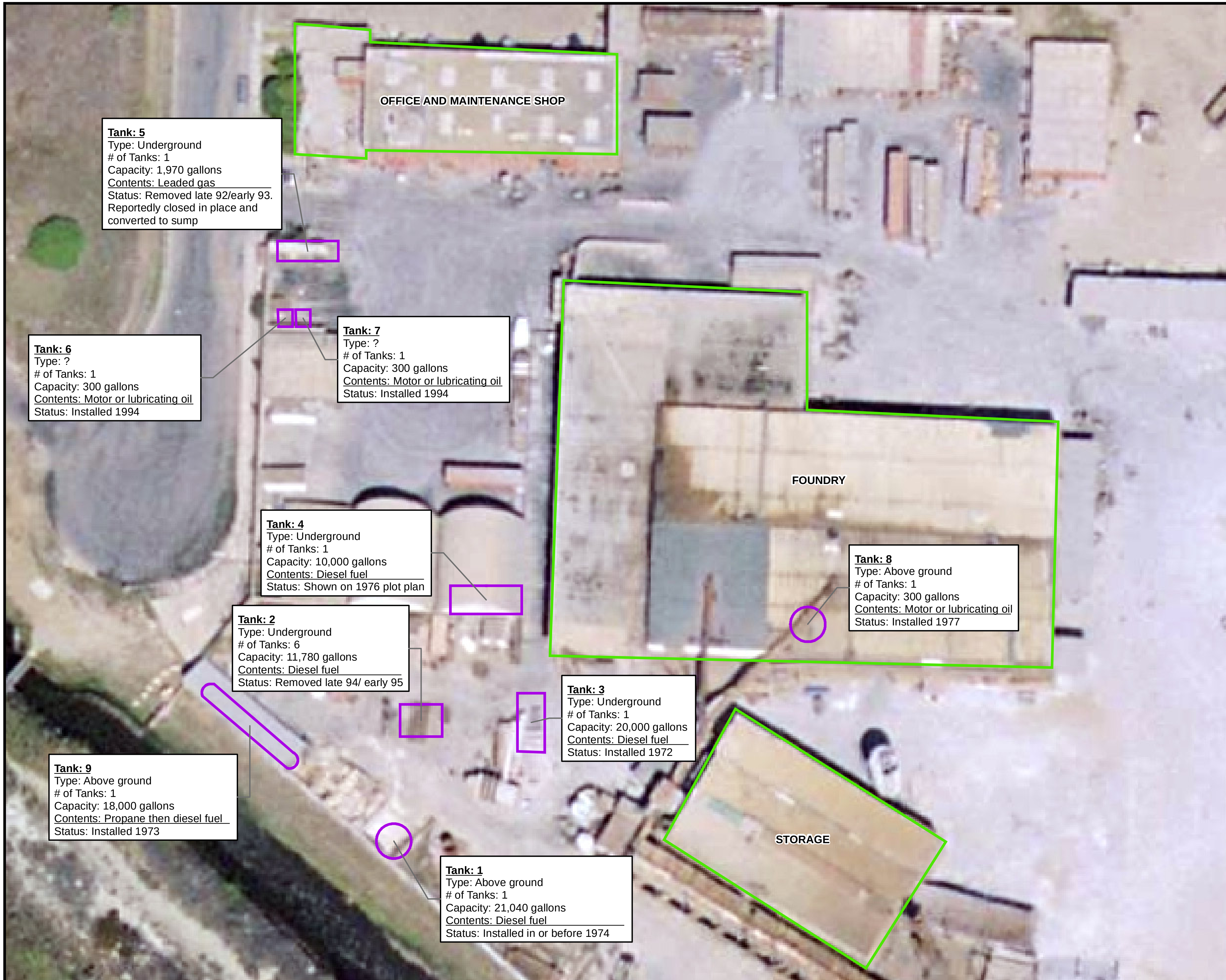


FIGURE 7
Box Plot for Copper in Soil and Sediment
Halaco Site, Oxnard, California

Note: 1. 2/2 = Number of samples/number of detections.
2. See CH2M HILL (2008b) for references within the box plot.



LEGEND

- Oil / Fuel Tanks
- Buildings

1. Basemap aerial photo date: 2005.
2. Approximate Tank locations based on review of historical photos & site plan figures obtained from Oxnard CUPA.

N

50 25 0 50 Feet

FIGURE 8
Approximate Locations of Former and Current Oil/Fuel Tanks (1965-2004)

HALACO SITE
OXNARD, CALIFORNIA

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LEGEND

Groundwater Monitoring Well

Surface Water Gauging Station

Surface Water Pressure Transducer

Ground Elevation Contours (AMEC, 2006)

2-foot Contours

10-foot Contours

Groundwater Elevation Contours, Shallow Wells

1-foot Contours

Groundwater Elevation Contours, Deeper Wells

1-foot Contours

Aerial Source: YCE Incorporated April 12, 2007.
Datum: ft MSL NAVD 1988.
Groundwater Elevations: December 12, 2007

Figure 9
Groundwater Levels and Monitoring Well Locations

HALACO SITE
OXNARD, CALIFORNIA

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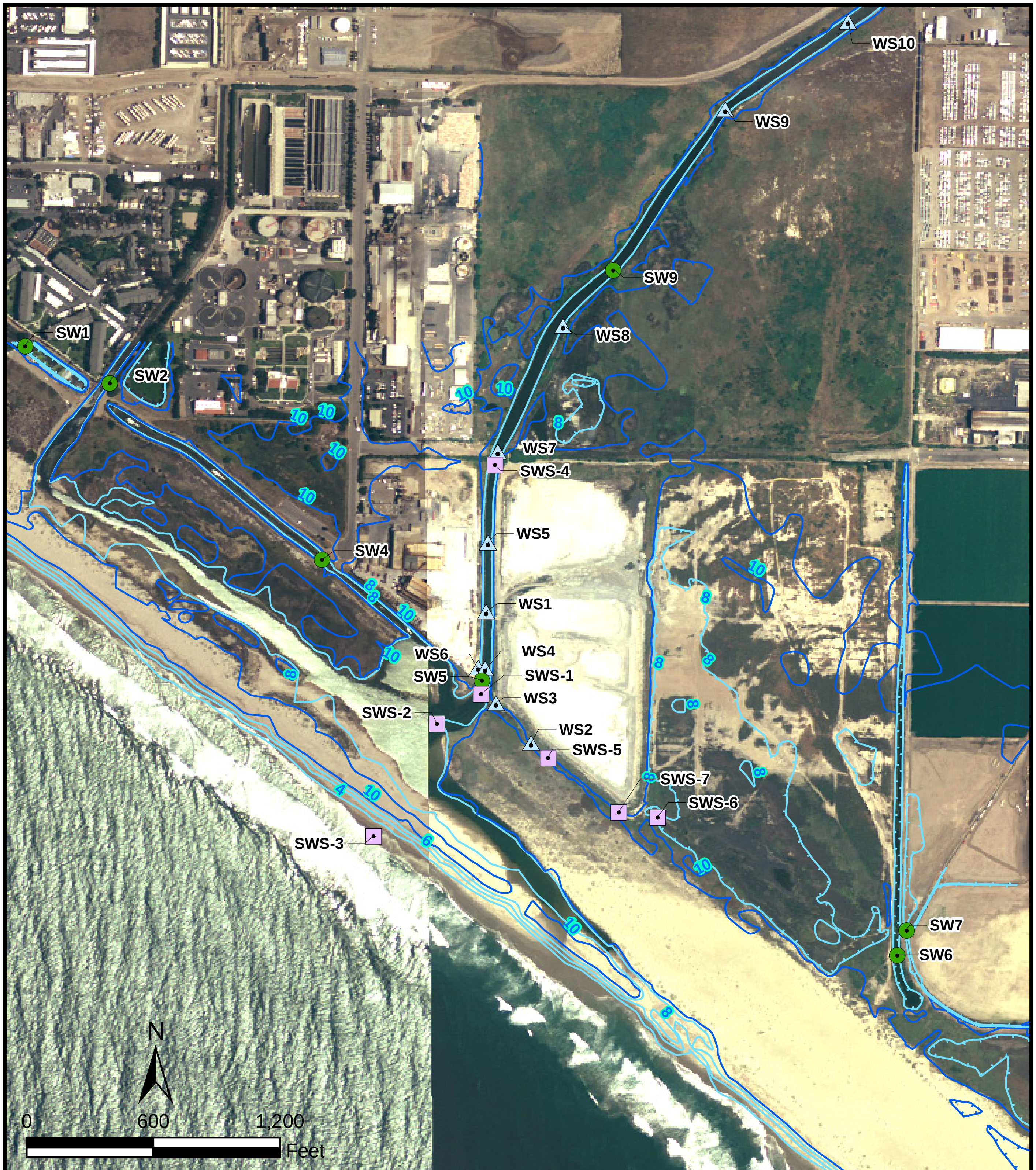

LEGEND

SW	●	Ormond Beach Regional Investigation (AMEC 2006)
SWS	▪	Halaco Routine Monitoring
WS	△	Site Integrated Assessment (Weston 2007)

Ground Elevation Contours (AMEC, 2006)

2-foot Contours

10-foot Contours

Note: Sample locations area approximate.

Figure 10
Surface Water Sampling Locations

HALACO SITE
OXNARD, CALIFORNIA

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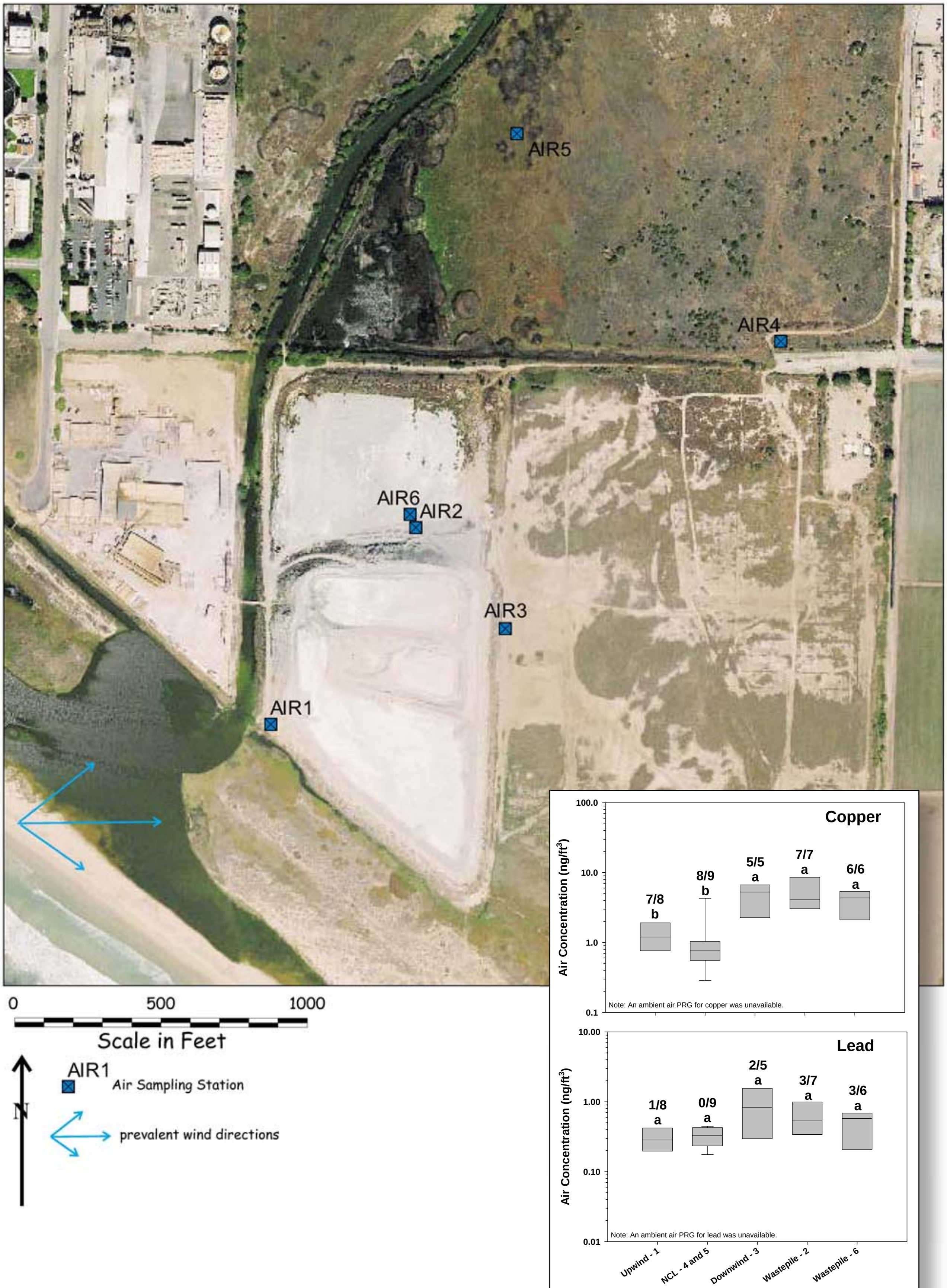

FIGURE 11
Metals Concentrations in Air Samples, June 2006
Halaco Site, Oxnard, California

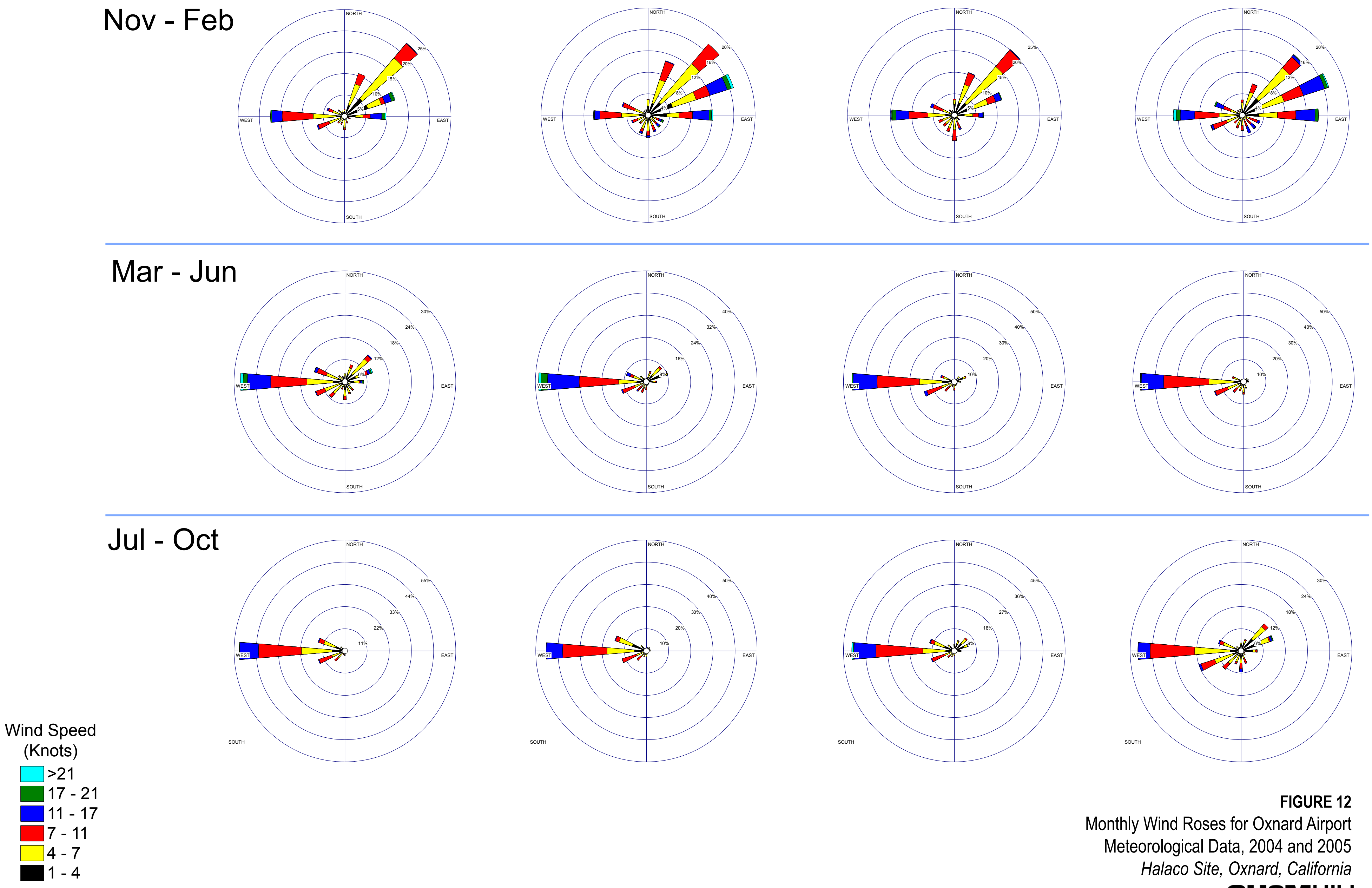

FIGURE 12
Monthly Wind Roses for Oxnard Airport
Meteorological Data, 2004 and 2005
Halaco Site, Oxnard, California

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