SUPPLEMENTAL GROUNDWATER SAMPLING AND ANALYSIS RESULTS

HALACO SUPERFUND SITE
REMEDIAL INVESTIGATION

OXNARD, CALIFORNIA

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Acronyms and Abbreviations

µg/L	microgram(s) per liter
bgs	below ground surface
AWPF	Advanced Water Purification Facility
Blaine Tech	Blaine Tech Services, Inc.
COC	chain of custody
CPT	cone penetrometer test
City	City of Oxnard
COC	chain of custody
DO	dissolved oxygen
EPA	U.S. Environmental Protection Agency
EC	electrical conductivity
Eh	oxidation reduction potential
FSP	Field Sampling Plan
Halaco	Halaco Engineering Co.
ID	inside diameter
MCL	Maximum Contaminant Level
mg/L	milligram(s) per liter
mL	milliliter(s)
National EWP	National Exploration, Wells & Pumps
NAVD 88	North American Vertical Datum of 1988
NCL	Nature Conservancy Land
NPL	National Priorities List
OID	Oxnard Industrial Drain
ORP	oxidation reduction potential
PVC	polyvinyl chloride
QAPP	Quality Assurance Project Plan
RI	Remedial Investigation

SOP	standard operating procedure
SAP	Sampling and Analysis Plan
Site	Halaco Engineering Co. Superfund Site
SVOC	semivolatile organic compound
T	temperature
TDS	total dissolved solids
TPH	total petroleum hydrocarbons
UWCD	United Water Conservation District
VOC	volatile organic compound
WDA	Waste Disposal Area
WMU	Waste Management Unit
WWTP	Wastewater Treatment Plant

SECTION 1

Introduction

This report provides the results of supplemental groundwater sampling and analysis for the Halaco Engineering Co. (Halaco) Superfund Site (Site) in Oxnard, California. See Figure 1 for the location. The work included installing additional groundwater monitoring wells and collecting and analyzing groundwater samples from new and existing monitoring wells in October 2013. The report includes a description of the well installation and testing activities, a brief narrative and tabular summary of results, and figures depicting selected results.

This testing is part of the remedial investigation (RI) being performed by the U.S. Environmental Protection Agency (EPA) for the Site. It supplements more extensive testing conducted in 2009 and 2010. The 2013 testing was completed in accordance with an EPA-approved Quality Assurance Project Plan (QAPP) (CH2M HILL, 2009a), Field Sampling Plan (FSP) (CH2M HILL, 2009b), and Addendum No. 2 to the QAPP and FSP (EPA – Region 9, 2012). The addendum is referred to as Sampling and Analysis Plan (SAP) Addendum No. 2.

1.1 Objectives

The objectives of the 2013 testing were as follows, as described in SAP Addendum No. 2:

1. Define the northern extent of groundwater contamination at the Site, to the north of the Halaco Properties (Smelter Parcel and Waste Management Area).
2. Evaluate the cause of the "groundwater sink" that appears to be responsible for the northward movement of contaminated groundwater across the Site and specifically to provide data to further test the hypothesis that contaminated groundwater is infiltrating into the Oxnard sewer trunk line (or permeable backfill) along McWane Boulevard and Perkins Road.
3. Evaluate whether total petroleum hydrocarbon quantified as diesel (TPH-diesel) detected in groundwater samples collected from the Oxnard aquifer, and at several wells in the Semiperched aquifer where other water quality results do not suggest Site impacts, is of natural origin.
4. Verify that the Site has not affected groundwater quality in the Oxnard aquifer.
5. Provide another snapshot of groundwater gradients and flow directions to supplement the five measurement events during the testing conducted in 2009 and 2010.

The data will be used to develop and evaluate remedial alternatives to address potential risks posed by the contaminated groundwater from Halaco's former operations.

1.2 Background

The Site is located in eastern Ventura County at and near 6200 Perkins Road in Oxnard, California. Halaco operated a secondary metal smelter at the Site from 1965 to 2004, recovering aluminum and magnesium for reuse. The Site background, including a description of Halaco's operations and waste disposal practices, and the physical and ecological settings is described in the QAPP. A brief summary is provided below.

The Site includes an 11-acre parcel containing the former smelter, a 26-acre Waste Management Area where wastes were deposited and managed, and adjacent areas affected by Halaco's wastes. The 26-acre area includes the Waste Management Unit (WMU), which contained Halaco's former waste settling ponds, and the Waste Disposal Area (WDA) to the north, which received waste from the WMU. The adjacent areas affected by Halaco's wastes include portions of the:

- Land owned by the Nature Conservancy east and north of the Waste Management Area, referred to as Nature Conservancy Land (NCL)-East and NCL-North
- Wetland and beach areas south of the former Smelter Parcel and WMU
- Oxnard Industrial Drain (OID), which bisects the Smelter Parcel and Waste Management Area, and an associated lagoon

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. Among the various scrap metal materials processed during the initial operating period, 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.

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 waste to a settling pond adjacent to the OID and used waste solids as fill in the smelter area. In about 1970, Halaco began pumping its wastewater across the OID into unlined earthen settling ponds in the area later named the WMU. Beginning in or before 1980, Halaco began moving waste solids from the WMU to the WDA.

Halaco reports that all operations ceased in September 2004. In 2007, EPA estimated that more than 700,000 cubic yards of waste solids remained onsite. Most of the solids are in the WMU, which covers about 15 acres and rises up to 35 feet above grade. Previous testing at the Site showed 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 included aluminum, barium, beryllium, cadmium, chromium, copper, lead, magnesium, manganese, nickel, and zinc. Elevated levels of radioactive thorium (and decay products) were also found in some areas. In past sampling, elevated levels of ammonia and petroleum hydrocarbons were also detected at the Site. The ammonia is believed to be a byproduct of the smelting process.

1.3 EPA Actions from 2006 through 2013

In 2006, EPA completed a testing effort at the site called the Integrated Assessment (Weston Solutions, Inc., 2007) to (1) determine the Site's eligibility for placement on the Superfund National Priorities List (NPL), and (2) evaluate the need for immediate actions to stabilize the Site. In September 2007, EPA added the former Halaco facility and adjacent areas of contamination to the NPL. Shortly thereafter, EPA began the RI 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.

In 2006 and 2007, two removal actions were completed to address immediate Site risks while EPA evaluated the Site for placement on the NPL. 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. 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.

In 2007, EPA completed additional site characterization activities. These include a radiation assessment of surface and subsurface conditions throughout the Smelter Parcel (Team 9, 2008).

In 2008, EPA completed a screening-level ecological and human health risk assessment to support RI activities for the Site (CH2M HILL, 2008a). This screening-level risk assessment identified major contaminants of potential concern and environmental exposure pathways for ecological and human receptors. This assessment used conservative estimates of exposure and potential ecological and human health effects to identify areas of the Site that may pose unacceptable risks to human health and/or the environment and that may warrant remediation.

Also in 2008, EPA completed a preliminary evaluation of the sources, nature, extent, and movement of contamination in surface water and groundwater at the Site (CH2M HILL, 2008b). This preliminary evaluation compiled and evaluated information on the sources, nature, and extent of surface water and groundwater contamination at the Site, and on the physical processes that affect the movement of the contamination.

In 2009, using the results of the Integrated Assessment, the radiation assessment, screening-level risk assessment, and preliminary groundwater evaluation, EPA identified data gaps and prepared a plan for additional sampling and analysis activities needed before remediation can occur (EPA Region 9, 2009). CH2M HILL then prepared the data quality objectives, QAPP, and FSP for an RI based on the testing plan.

In 2009 and 2010, EPA performed RI sampling and analysis activities for the Site in accordance with the QAPP and FSP. The results are presented in a series of five reports (CH2M HILL, 2011a, 2011b, 2011c, 2011d, and 2012).

In 2010, EPA demolished two abandoned industrial buildings at the Site. The two buildings were in poor condition and at risk of collapse.

In 2011, EPA identified the need to delineate the extent of soil and sediment contamination to the north and south of the Waste Management Area and evaluate the species of chromium present in the contaminated soils and sediments. EPA performed this work in accordance with Addendum No. 1 to the QAPP and FSP. The results are presented in a report prepared by CH2M HILL (2013).

In 2012, EPA identified the need to determine the northern extent of groundwater impacts from Halaco's former operations, verify the lack of impacts from these operations to the Oxnard aquifer, and confirm the presence (or absence) of TPH detected in select wells during the testing conducted in 2009 and 2010. EPA performed this work in accordance with Addendum No. 2 to the QAPP and FSP. The results are presented in this report.

SECTION 2

Initial Conceptual Site Model

This section summarizes what was known about the hydrogeology and the nature and extent of impacts on groundwater from Halaco's former operations, after collection and evaluation of the 2009-2010 RI data. Figure 2 shows the locations of the groundwater monitoring well network, which includes the wells sampled in 2009 and 2010 and the eight new wells installed as part of the 2013 testing described in this report.

The results of the surface water and groundwater testing performed in 2009 and 2010 are documented in the report, *Surface Water and Groundwater Sampling and Analysis Results* (2012 Surface Water and Groundwater Report; CH2M HILL, 2012). The evaluation of the data collected in 2009 and 2010 supplements earlier data collected by EPA from 2006 through 2008 for the Halaco site; older historical environmental data collected for the Halaco site prior to 2008; and other data collected as part of regional studies, including those to assess regional groundwater conditions and to support the ongoing Ormond Beach restoration efforts.

In addition, the results of fill, soil, sediment, and soil gas media testing performed for the Halaco properties and surrounding areas in 2009 and 2010 are documented in the following reports:

- *Solid Matrix Sampling and Analysis Results for the NCL-East and NCL-North Areas* (CH2M HILL, 2011a)
- *Solid Matrix Sampling and Analysis Results for the Wetlands and Beach Areas* (CH2M HILL, 2011b)
- *Solid Matrix Sampling and Analysis Results for the Oxnard Industrial Drain and Lagoon Areas* (CH2M HILL, 2011c)
- *Solid Matrix and Soil Gas Sampling and Analysis Results for the Smelter Parcel and Waste Management Areas* (CH2M HILL, 2011d)
- *"Step-Out" Solid Matrix Sampling and Analysis Results and Sediment Chromium Speciation* (CH2M HILL, 2013)

The 2012 Surface Water and Groundwater Report provides conclusions regarding surface water and groundwater flow, surface water and groundwater chemistry, and the extent of contamination in surface water and groundwater at the Site. It also summarizes information on the fill materials and aquifer units encountered during the investigation conducted in 2009 and 2010. A summary of the conclusions from the report is provided below.

2.1 Lithology and Aquifer Units

The lithology and aquifer units encountered during the 2009-2010 investigations are shown in two north-south cone penetrometer test (CPT) cross sections. The locations of the cross section are shown in Figure 3. The cross sections are provided in Figures 4a and 4b. Figure 4a is through the Smelter Parcel, and Figure 4b is through the Waste Management Area. These are the same CPT cross sections presented in the 2012 Surface Water and Groundwater Report, but are extended with additional CPT data obtained to the north during design of the City of Oxnard (City) Advanced Water Purification Facility (AWPF) (Figure 1). The units underlying the area consist of the following:

- **Fill materials,** including Halaco's process wastes and the remains of a former burn dump. These fill materials are described in detail in the Halaco Properties testing report (CH2M HILL, 2011d).
- **Semiperched aquifer,** including an upper finer-grained layer of clay and silt with sand and silt interbeds and a lower coarser-grained layer of sand and silty sand with clay and silt interbeds. The upper fine-grained layer is up to approximately 20 feet thick east of the WMU and thins to less than 10 feet west of the Smelter Parcel. The lower coarser-grained unit is approximately 70 to 80 feet thick.
- **Confining unit at the base of the Semiperched aquifer.** This confining unit is approximately 30 feet thick and consists of clay and silt that impede groundwater flow.
- **Oxnard aquifer.** The upper portion of the Oxnard aquifer consists of sand and gravelly sand with clay and silt interbeds.

The confining unit at the base of the Semiperched aquifer appears to be laterally continuous throughout the vicinity of the Halaco Properties, based on regional information, including the CPT data from the 2009-2010 investigations and the AWPF design activities.

2.2 Surface Water Flow

Surface water features at the Site include surface water channels that drain the Oxnard Plain (OID, J Street Drain, and Hueneme Drain) and standing surface water in the lagoon, NCL-East, and NCL-North areas next to the Halaco Properties. The OID, J Street Drain, and Hueneme Drain discharge into the lagoon. Flow between these features occurs as follows:

- **Lagoon and OID.** When the coastal sand berm that naturally forms on the beach parallel to the shoreline is intact, surface water elevations in the lagoon, OID (at the Site), ditch south of the WMU, and NCL-North pond are relatively high and stable. The beach berm typically breaches during the rainy season's first significant storm event when flows increase in the OID, J Street Drain, and Hueneme Drain. After the breach, the lagoon and OID levels drop and then fluctuate with the tide. The berm typically remains breached until after the winter rains end and flow in the drains decreases.
- **Ditch to South of WMU.** The ditch south of the WMU is open to the OID and lagoon and is full when the beach berm is intact. The ditch is empty when the beach berm is breached.

- **NCL-North Pond and Ditch.** The pond at NCL-North is hydraulically connected to the OID, although there appears to be a dike between the pond and the OID. The pond is full when the beach berm is intact and empty when the beach berm is breached. Water occurs in the ditch extending eastward from the pond along the north side of the extension of McWane Boulevard when the pond is full.
- **NCL-East.** Surface water levels in the NCL-East area are controlled by topography. Surface water accumulates from local precipitation and overflow from the lagoon and OID when levels are high during non-breach conditions. Ground surface topography in the NCL-East area is sloped from northeast to southwest. Water from the lagoon and OID can enter NCL-East through the ditch south of the WMU and the NCL-North pond area when the lagoon and OID levels are greater than the respective watershed divides that separate the NCL-East area from these two areas. Surface water in NCL-East dissipates through evaporation and percolation when the water level in the OID and lagoon is low, below the two topographic divides. The topographic watershed divides prevent water in NCL-East from draining back into the lagoon and OID.

2.3 Groundwater Flow

At the Site, shallow groundwater elevations and the movement of groundwater in the Semiperched aquifer are influenced by water elevations in the lagoon, OID, ditch south of the WMU, ponds in the NCL-North area, and NCL-East area east of the Waste Management Area. Groundwater elevations and groundwater movement in the deeper Oxnard aquifer are influenced by regional flow conditions across the Oxnard Plain. Flow between the Semiperched aquifer and the Oxnard aquifer is restricted by the low-permeability sediments (confining unit) separating the two aquifers.

2.3.1 Semiperched Aquifer

Groundwater elevations in the Semiperched aquifer drop during the rainy season when surface water elevations are seasonally low in response to the beach berm being breached. They rise when the beach berm is intact and surface water elevations are seasonally high. This results in higher groundwater elevations in the summer months and lower elevations in the winter months, corresponding to when the berm is breached.

The horizontal groundwater flow direction at the Site in the Semiperched aquifer is toward the north, from the lagoon toward McWane Boulevard. This occurs year-round. There is generally a downward hydraulic gradient from the water table to the deeper part of the Semiperched aquifer beneath the Halaco Properties.

The northward flow direction appears to be induced by a low groundwater elevation area north of the Halaco Properties. The downward gradient is caused by recharge of surface water from the OID, lagoon, and NCL-East at both seasonal high (berm is not breached) and seasonal low (beach berm is breached) surface water conditions.

A potential cause for the lower groundwater elevations to the north of the Halaco Properties (the “groundwater sink”) is the City’s sanitary wastewater collection system. The City’s sanitary wastewater collection system terminates in “northwest” and “southeast” trunk lines that feed into the “headworks” facility where wastewater enters the treatment plant.

The southeast trunk line is buried under McWane Boulevard along the north edge of the Halaco Properties. Seepage of groundwater into the southeast trunk line (or permeable backfill) could induce the low groundwater elevation area north of the Halaco Properties.

The headworks facility was reconstructed from approximately 2005 through 2007. Groundwater was pumped during construction to lower the water table. Groundwater elevation data collected during and after construction indicate that groundwater elevations were below sea level from 2005 through 2007 and remained low following the completion of construction dewatering. The low groundwater levels suggest that northward gradients may have existed during construction activities and that groundwater may be seeping into the northwest and southeast trunk lines.

2.3.2 Oxnard Aquifer and Confining Unit

At the Site, the horizontal groundwater flow direction in the Oxnard aquifer is toward the east and southeast as determined by the four deep monitoring wells screened in the upper part of this aquifer. This is consistent with the regional interpretation of the groundwater flow conditions by United Water Conservation District (UWCD).

Groundwater elevations in the four monitoring wells are similar to those measured in the nearby U.S. Geological Survey regional monitoring well (CM4-200). Seasonally, groundwater elevations rise in the winter and spring and decline in summer and fall as observed at CM4-200 since it was installed in the late 1980s.

The vertical groundwater gradient across the fine-grained confining unit that separates the Semiperched aquifer from the Oxnard aquifer was downward for two water level measurements and upward for three other measurements taken during 2009 and 2010.

The longer-term vertical groundwater gradient across the confining unit was downward prior to the 1990s, when the Oxnard aquifer was overdrafted and groundwater elevations in the Oxnard aquifer were below sea level. Since the early 1990s, on average, groundwater elevations in the Oxnard aquifer have been several feet above sea level, leading to a gradient that has mostly been upward from the Oxnard aquifer to the Semiperched aquifer. Brief periods of downward gradients occurred during this period of mostly upward gradients when groundwater elevations in the Oxnard aquifer temporarily declined.

The predominantly upward gradient since the early 1990s indicates that there has been little or no movement of shallow groundwater underlying the Site downward from the Semiperched aquifer, through the underlying aquitard, and into the Oxnard aquifer since that time. However, the vertical gradient was downward prior to the 1990s, indicating a potential for groundwater affected by Halaco's wastes from the Semiperched aquifer to have impacted the Oxnard aquifer.

2.4 Sources of Contamination

Wastes from Halaco's former operations appear to be the primary source of the groundwater contamination in the Semiperched aquifer at the Site, although the burn dump waste that underlies the Smelter Parcel may also affect groundwater quality. The chemistry of Halaco's waste solids and the burn dump waste is described in the Halaco Properties report (CH2M HILL, 2011d). Prior to 2002, when discharge to the settling ponds stopped, the height of Halaco's settling ponds caused large downward hydraulic gradients and deep penetration of Halaco's wastewater into the underlying Semiperched aquifer. Halaco's process wastewater had:

- A high pH and high levels of salts and residual metals
- Ammonia generated as a byproduct of the metal smelting operation
- Radionuclides from magnesium-thorium alloy scrap that Halaco reports it processed from 1965 to about 1977
- Organic constituents that may be the result of waste oil and solvent that was reportedly disposed of in Halaco's furnaces or rotary washers

2.5 Surface Water Chemistry

The general chemistry and metals testing results for the two surface water sampling events completed in 2009 and 2010 do not indicate impacts on water in the OID or lagoon. Ammonia and metals results indicated some limited impact on surface water in the WMU ditch.

2.6 Groundwater Chemistry

2.6.1 Semiperched Aquifer Groundwater

The general chemistry, radionuclides, and metals testing results indicate impacts from Halaco's wastes on groundwater in the Semiperched aquifer. Although less widespread, the volatile organic compound (VOC), semivolatile organic compound (SVOC), and TPH results also indicate impacts from Halaco's wastes and possibly from the former burn dump. The extent to which groundwater has been impacted by Halaco's operations was approximately bounded to the west and east following the 2009-2010 testing. The approximate western boundary is the western edge of the Smelter Parcel. The approximate eastern boundary is in the NCL-East area, although the boundary has not been precisely defined because of the limited number of monitoring wells in this area. The northern and southern boundaries of the affected area were not determined.

2.6.1.1 General Chemistry

Total dissolved solids (TDS) concentrations in the Halaco-affected groundwater exceed 50,000 milligrams per liter (mg/L). High concentrations occur throughout the Semiperched aquifer down to the top of the aquitard that separates the Semiperched aquifer from the deeper Oxnard aquifer.

The major ion chemistry and the ammonia concentrations in the affected groundwater closely resemble the levels measured in Halaco's process wastewater samples. The affected groundwater is unusually high in potassium, has a TDS/potassium ratio typically less than 30, and generally has more than 100 mg/L ammonia. Groundwater with the greatest impacts has TDS greater than 50,000 mg/L, a TDS/potassium ratio less than 10, and ammonia greater than 1,000 mg/L.

At the Smelter Parcel, the impacts (concentrations) are greatest near the water table in the southeastern area where Halaco's process waste is buried. Concentrations near the water table decrease toward the north in the direction of groundwater flow. Burn dump waste materials also may be affecting groundwater quality.

At the Waste Management Area, the impacts (concentrations) are greatest near the water table and the deeper portion of the Semiperched aquifer in the middle of the Waste Management Area. Impacts at the southern, eastern, and western perimeter of the WMU are generally much lower near the water table than in the interior but remain high in the deeper portion of the Semiperched aquifer. Shallow impacts at the perimeter were probably higher historically, but have decreased since Halaco stopped discharging to the settling ponds in 2002. The historically higher shallow concentrations at the perimeter may have moved inward and then northward in the direction of groundwater flow and become diluted with surface water recharge from surrounding surface water bodies (OID, lagoon, WMU ditch, and NCL-East).

2.6.1.2 Metals and Radionuclides

Metals concentrations and thorium and radium activities are elevated throughout the affected portion of the Semiperched aquifer. Metals that exceeded federal or state drinking water maximum contaminant levels (MCLs) for unfiltered (or "total metals") samples include aluminum, chromium, arsenic, barium, beryllium, cadmium, lead, and nickel. Metals that exceeded federal or state drinking water MCLs for field filtered (or "dissolved metals") samples include arsenic, barium, and cadmium. The elevated metals for the unfiltered samples may, in part, be due to the presence of turbidity in samples.

2.6.1.3 VOCs and SVOCs

VOCs and SVOCs were detected at low concentrations in some groundwater samples. All detections were below MCLs except for one detection of pentachlorophenol and one detection of benzo(a)pyrene, both near their quantitation limits.

2.6.1.4 TPH

TPH-gas and TPH-diesel were frequently detected in the affected portion of the Semiperched aquifer. Additionally, TPH-diesel was detected in a limited number of samples at or near the laboratory reporting limit at locations outside the area where groundwater is thought to be impacted by Halaco's operations based on general chemistry. TPH-oil was detected in two samples, one at an estimated concentration below the reporting limit.

2.6.2 Oxnard Aquifer

The general chemistry and radionuclide testing results indicated little or no impact from Halaco's operations on groundwater in the Oxnard aquifer. Metals concentrations appear to generally be at background levels, and VOCs and SVOCs were infrequently detected at low concentrations near the reporting limit. However, ammonia and TPH-diesel were detected at unexpectedly high levels in some samples.

2.6.2.1 General Chemistry

The TDS concentrations in samples from the four wells screened in the Oxnard aquifer were less than 2,000 mg/L, far below the TDS concentration in affected portions of the Semiperched aquifer, which exceeds 50,000 mg/L. Additionally, the major ion chemistry of groundwater from the four wells does not resemble the chemistry of Halaco's process wastewater samples. Ammonia was detected in the first of the two sampling events in two of the four wells screened in the Oxnard aquifer, at 120 and 5.8 mg/L.

2.6.2.2 Metals

Metals concentrations and thorium and radium activities were relatively low and appear to represent background conditions.

2.6.2.3 VOCs and SVOCs

A limited number of VOCs and SVOCs were detected at low concentrations in some groundwater samples, all below federal MCLs.

2.6.2.4 TPH

TPH-diesel was detected in all four samples at a maximum of 270 micrograms per liter (µg/L). TPH-gas and TPH-oil were not detected in any of the samples.

SECTION 3

Remedial Investigation Activities

This section describes the supplemental groundwater testing activities completed for the Site in 2013. The testing was completed to address the data gaps identified in SAP Addendum No. 2. To control measurement error, analytical measurements were undertaken as documented in the project QAPP, and samples were collected and shipped as documented in the project FSP and field standard operating procedures contained in the FSP. Figure 2 shows the groundwater monitoring well network, which includes the eight new wells installed in 2013.

3.1 Field Investigation Activities

3.1.1 Monitoring Well Installation and Surveying

Three new monitoring well clusters were installed at the following locations north of the Halaco Properties (objectives 1 and 2 of the 2013 testing, as described in Section 1.1).

- **Well Cluster 1, Oxnard Wastewater Treatment Plant:** Adjacent to Perkins Road between the Smelter Parcel and the City's sanitary sewer headworks facility
- **Well Cluster 2, New Indy Container Board Plant:** North of McWane Boulevard and the sewer line, east of the OID
- **Well Cluster 3, NCL-North:** North of McWane Boulevard and sewer line, west of the OID

The locations of the eight new wells and relative depths are as follows:

Area	Well Number	Relative Depth – Semiperched Aquifer	Approximate Distance from Sewer Line
Cluster 1– Oxnard Wastewater Treatment Plant	MW-28B	Shallow	100 feet
	MW-28C	Deep	100 feet
	MW-29B	Shallow	50 feet
Cluster 2 – New Indy Container Board Plant	MW-30B	Shallow	100 feet
	MW-30C	Deep	100 feet
	MW-31B	Shallow	50 feet
Cluster 3 – NCL–North	MW-32C	Deep	500 feet
	MW-33C	Deep	<10 feet

The locations were selected to satisfy the following criteria:

- Obtain data north of the northernmost groundwater wells or piezometers at the Site. Obtain data close enough to the Oxnard sewer line to detect the impact, if any, of the sewer line on groundwater levels and hydraulic gradients immediately west of the sewer line at Cluster 1 and immediately north of the sewer line at Clusters 2 and 3.
- Obtain data west of Perkins Road to evaluate the presence of Site-affected groundwater that may have been drawn northwestward from the Site toward the headworks facility by dewatering activities from 2005 to 2007.

The well clusters at the Wastewater Treatment Plant (WWTP) and container board plant each consist of two shallow wells screened to a maximum depth of approximately 25 to 27 feet below ground surface (bgs) and one deeper well screened to between 65 and 67 feet bgs. The third well cluster at NCL-North was originally planned to also consist of this set of wells. However, standing water in the pond and associated wetlands at NCL-North to the north of the Waste Management Area prevented access. Instead, two wells screened 64 and 65 feet bgs were installed, one immediately north (within 10 feet) of the Oxnard sewer line (near MW-4RA and MW-4RB) and the other approximately 500 feet north of the sewer line. The well next to the sewer line could be installed without entering the wetland area.

The new groundwater monitoring wells and piezometers were surveyed for horizontal coordinates and vertical elevations. Elevations were determined for the top of outer protective casing, top of inner well casing, and ground surface next to protective casing.

3.1.2 Surface Water and Groundwater Level Measurements

Surface and groundwater levels were measured on October 28, 2013. The beach berm was not breached. These measurements provide an additional snapshot of groundwater flow conditions to supplement the five measurement events in 2009 and 2010 and assess the horizontal groundwater gradients near the sewer line (objectives 2 and 5).

3.1.3 Groundwater Sampling

The eight new wells and nine existing wells were sampled on October 29 and 30, 2013 (objectives 1, 3, and 4). The existing wells selected for analysis are wells where TPH-diesel was detected in 2009 and 2010. One of the nine existing wells is known to be affected by Halaco's wastes (MW-12); four are screened in the Semiperched aquifer and believed to be unaffected or only slightly affected by Halaco's wastes (MW-21, -23C, -25C, and -27C), and four are screened in the Oxnard aquifer and believed to be unaffected by Halaco's wastes (MW-2D, -3D, -6D, and -19D). The groundwater samples were analyzed for general chemistry, metals (unfiltered and field filtered), TPH (diesel and oil), and field parameters (electrical conductivity [EC], pH, temperature (T), oxidation reduction potential (ORP, or Eh), dissolved oxygen [DO], and turbidity).

3.2 Field Procedures

CH2M HILL and subcontractors National Exploration, Wells & Pumps (National EWP) and Blaine Tech Services, Inc. (Blaine Tech) performed the field activities. CH2M HILL led the well installation and sample collection activities. CH2M HILL logged all samples, filled and labeled sample containers, completed chain-of-custody (COC) documentation, and shipped samples to the offsite analytical laboratories. National EWP installed the monitoring wells. Blaine Tech developed the monitoring wells and collected the groundwater samples. CH2M HILL called in the new well locations to DigAlert a minimum of 48 hours prior to installation to have subsurface utilities cleared. Additionally, CH2M HILL and subcontractor ULS Services Corporation cleared locations of potential subsurface utilities using surface geophysical methods for the new wells.

Monitoring wells were installed in accordance with a City Well Permit (No. 13-3772).

3.2.1 Monitoring Well Installation and Surveying

The monitoring wells were installed using hollow-stem auger drilling methods. Attachment A provides photographs of monitoring well installation and Attachment B provides boring and well construction logs.

Soil samples were collected at 5-foot intervals using a core barrel for visual lithologic logging. Monitoring wells were constructed inside the drill pipe after reaching total depth. Polyvinyl chloride (PVC), Schedule 40, 2-inch-ID casing and screen assembly was lowered into each borehole. The screens are 10 feet long with 0.020-inch slot size. Sand filter pack was then placed into the borehole across the well screen, followed by a layer of bentonite pellets. Cement-bentonite grout was then tremmied into the borehole to near ground surface as the drill pipe was retrieved.

Monitoring wells were completed with traffic rated vaults flush to the ground (WWTP and container board plant) or lockable above ground steel monuments (NCL-North). The aboveground protective steel monuments were set in a concrete pad sloped to drain away from the well. The monuments were constructed with 5-foot-long steel protective casing extending approximately 3 to 4 feet above ground.

The wells were initially developed by National EWP with the drill rig using a combination of surging and bailing throughout the well screen to settle the filter pack and remove fine-grained materials from the filter pack and aquifer. Additional well development, which included surging and bailing followed by pumping with a Grundfos submersible pump, was performed by Blaine Tech. Field parameters (EC, pH, T, DO, turbidity) were monitored during the additional well development.

The new wells were surveyed by FJS Land Consulting, a Professional Land Surveyor:

- Elevations were surveyed to an accuracy of 0.01 foot for (1) top of outer protective casing, (2) top of inner well casing, and (3) ground surface next to protective casing. All elevation survey locations are on the north side of the casings and marked. The vertical datum is the North American Vertical Datum of 1988 (NAVD 88).

- Horizontal coordinates were surveyed to an accuracy of 0.1 foot. The horizontal coordinate system is the California State Plane Coordinate System, Zone 5. The surveying was performed using survey-grade global positioning system equipment.

Attachment C provides the report from the well surveyor.

3.2.2 Surface Water and Groundwater Level Measurements

Surface water levels were measured to an accuracy of 0.01 foot from staff gauges at the following locations:

- OID, mounted on the footbridge at the end of Perkins Road
- NCL-East, located between MW-2RA and MW-1R
- NCL-North, located in the small pond to the north of the WDA

The OID staff gauge was previously in existence. EPA surveyed the elevation of the "8-foot" mark relative to NAVD 88 for the OID staff gage as part of EPA's water level study in 2007-2008. This gauge is marked to allow water level readings to an accuracy of 0.01 foot. An offset of 1.52 feet is added to the field reading to obtain the vertical elevation in NAVD 88.

EPA set the two NCL staff gauges in October 2007 as part of EPA's water level study. These two gauges are set to directly read surface water elevation relative to NAVD 88 to an accuracy of 0.01 foot.

Groundwater levels were measured from the top of the PVC casing for all monitoring wells and piezometers using a water level indicator graduated to an accuracy of 0.01 foot. Groundwater elevations were calculated by subtracting the depth-to-water reading from the surveyed elevation of the top of the casing. Elevations could not be measured for MW-16 because it was submerged by standing surface water at NCL-East, nor for MW-19 because it could not be found (apparently covered by process waste material from the waste pile).

3.2.3 Groundwater Sampling

Groundwater samples were collected in accordance with the Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures prepared by EPA (EPA, 1996). Groundwater from wells with 2-inch-diameter casings was purged and sampled with a Stainless Steel QED Sample Pro bladder pump. A new disposable polyethylene bladder and stainless steel grip plate was used at each well. New 0.17-inch-ID polyethylene tubing was used for air and water lines at each well.

Water quality field parameters (EC, pH, T, Eh, DO, turbidity) were measured during purging and at the time of sample collection using a YSI 556 Water Quality Meter with flow-through cell and a HACH 2100P Turbidimeter. Attachment D provides the water quality field parameters measured during well development and groundwater sampling.

Prior to sample collection the effluent tubing was disconnected from the flow-through cell. Sample containers were filled directly from the effluent water line. A new, disposable, 0.45-micron filter was attached in-line to the effluent water line to collect samples for dissolved metals analyses that required filtration. All samples were placed on ice in a cooler immediately after collection.

3.3 Sample Collection and Quality Control Samples

Groundwater samples for laboratory chemical analysis were placed in containers as detailed in Table 5-5 of the FSP. The following quality control samples were collected as specified in the QAPP and FSP:

- Field duplicates were collected at a frequency of 1 in every 10 samples.
- Field equipment blanks were collected at a frequency of once per day when non-dedicated sampling equipment was used.
- Extra volume for laboratory matrix spikes and matrix spike duplicates was collected at a frequency of 1 in every 20 collected samples.

The sample naming convention described in the FSP was used. This included a prefix to identify sample type (GW for groundwater), the surface water location ID or monitoring well number, and the month-year of sample collection.

Duplicate samples were identified by adding "100" to the sample location number. For example, GW-125C-1013 is the duplicate sample for GW-MW-25C-1013.

Samples that were field filtered were given a "Filtered" designation at the end of the sample ID. For example, the field filtered sample from MW-12 would be GW-MW-12-1109-Filtered.

3.4 Sample Custody and Tracking Procedures

COC procedures were followed in accordance with the FSP and QAPP. This included generating COC forms requesting analytical services from each of the analytical laboratories. EPA's Scribe program was used to generate sample labels, bottle tags, and COC forms; track samples from the field to the laboratory; and facilitate electronic capture of sample information into databases for the chemistry samples. Scribe is a software tool developed by EPA's Environmental Response Team to manage environmental data.

All samples for chemical analysis were placed on ice upon field collection and then shipped on ice to the analytical laboratory. All samples were shipped using Federal Express to facilitate tracking from the field to the laboratory.

3.5 Laboratory Analysis and Data Validation

The groundwater samples were analyzed by the EPA Region 9 Laboratory as follows:

- **Metals**:
  - Inductively coupled plasma atomic emission spectroscopy: aluminum (Al), barium (Ba), Beryllium (Be), Boron (B), calcium (Ca), copper (Cu), iron (Fe), magnesium (Mg), manganese (Mn), potassium (K), and sodium (Na).
  - Inductively coupled plasma mass spectrometer to generate lower detection limits: antimony (Sb), arsenic (As), cadmium (Cd), chromium (Cr), cobalt (Co), lead (Pb), molybdenum (Mo), nickel (Ni), selenium (Se), silver (Ag), thallium (Tl), vanadium (V), and zinc (Zn).
  - Cold vapor atomic absorption: Mercury (Hg)
- **General Chemistry:**
  - TDS by EPA 2450C
  - Alkalinity (hydroxide, carbonate, bicarbonate, total) by EPA SM2320
  - Anions by EPA 300
  - Ammonia by 350.1
  - Total Kjeldahl nitrogen by EPA 351.2
- **TPH:** Samples were analyzed for TPH quantified as diesel and oil. Analysis was performed with and without silica gel cleanup. The purpose of analyzing the samples with the two methods was to assess whether TPH-diesel detected in groundwater samples collected during 2009 and 2010, where other water quality results do not suggest Site impacts, may be of natural origin. The silica gel cleanup was performed to remove polar substances that may interfere with the TPH analysis. The silica gel cleanup was performed as follows: After extraction of the sample with dichloromethane, a 1 milliliter (mL) extract was placed on a column containing 1 gram of activated, solvent-cleaned silica gel. The sample was eluted with dichloromethane, concentrated to 1 mL, and analyzed by gas chromatography/flame ionization detector, as usual.

The EPA Region 9 Lab data went through internal review. The Region 9 Lab's internal data review process is equivalent to Tier 1A review under the Region 9 guidance.

The analytical results for the field equipment blanks did not indicate cross contamination when non-dedicated sampling equipment was used.

SECTION 4

Remedial Investigation Results

This section provides the results for the supplemental groundwater testing activities completed in 2013. The results are summarized in the following tables, figures, and attachments:

- Tables 1 and 2 provide the well construction and survey data for the new wells.
- Table 3 provides surface water and groundwater elevation data.
- Tables 4 though 6 provide the general chemistry, metals, and TPH analytical results.
- Figures 5a and 5b provide north-south hydrogeologic cross sections through the Smelter Parcel and Waste Management Area. These are the cross sections presented in the 2012 Surface Water and Groundwater Report, extended northward to show the area with the eight new wells and updated with the water level data measured on October 28, 2013.
- Figures 6 and 7 provide plan view groundwater elevation contour maps for the Semiperched aquifer and Oxnard aquifer for October 28, 2013.
- Figure 8 posts concentrations of several constituents next to Site monitoring wells and depicts the approximate extent of groundwater affected by Halaco's operations.
- Figure 9a and 9b provide TDS concentration contours on the north-south hydrogeologic cross sections. The data are from samples collected during November 2009 and June 2010 for the existing wells and October 2013 for the eight new wells.
- The following figures show surface water and groundwater chemistry data for samples collected in 2009 and 2010 for existing wells and 2013 for the eight new wells:
  - Figure 10 – Major ion chemistry
  - Figure 11 – TDS/K ratios versus TDS concentrations
  - Figure 12 – Trilinear diagram
- Attachment A provides photographs of well installation activities.
- Attachment B provides boring and construction logs for the new monitoring wells.
- Attachment C provides the land survey report for the new monitoring wells.
- Attachment D provides field parameters measured during well development and sampling.

4.1 Groundwater Flow

The surface water and groundwater elevation data for October 28, 2013, provide another snapshot of groundwater gradients and flow directions to supplement the five measurement events in 2009 and 2010 (objective 5). Additionally, these data provide information to assess the cause of the lower groundwater elevations north of the Halaco Properties (objective 2). Table 3 provides the water level elevation data.

The prior surface water and groundwater level measurements were taken on the following dates, as documented in the 2012 Surface Water and Groundwater Report:

- November 6, 2009 sampling event 1 (non-breach conditions)
- February 22, 2010 sampling event 2 (breach conditions)
- June 1, 2010 sampling event 3 (non-breach conditions)
- October 25, 2010 sampling event 4 (non-breach conditions)
- December 27, 2010 water level measurements (breach conditions)

The beach berm was not breached on October 28, 2013. The water level elevations and horizontal groundwater gradients are shown in the water level elevation contour maps in Figures 6 and 7 for the Semiperched aquifer and Oxnard aquifer. The water level elevations and vertical groundwater gradients are shown in the hydrogeologic cross sections in Figures 5a and 5b. The water level contour maps and hydrogeologic cross sections are updated from the 2012 Surface Water and Groundwater Report with the October 28, 2013 water level data.

4.1.1 Semiperched Aquifer

The surface water and groundwater elevations, gradients, and flow directions for October 28, 2013, are similar to the non-breach conditions on November 6, 2009; June 1, 2010; and October 25, 2010, for the Semiperched aquifer. The surface water and groundwater elevations are at a seasonal high because the beach berm is not breached and the lagoon is full, at an elevation of 8.02 feet. The surface water in NCL-East was measured at 7.80 feet where the extent of the water was nearly to the 8-foot ground surface elevation contour. Surface water from the OID and J Street Drain flows into the lagoon, which then flows eastward along the ditch south of the WMU into NCL-East and seeps through the beach berm toward the ocean. Groundwater from the J Street Drain, OID, lagoon, and NCL-East recharges shallow groundwater beneath and in the vicinity of the Halaco Properties.

The horizontal groundwater flow direction at the Halaco Properties in the Semiperched aquifer is toward the north, from the lagoon northward toward McWane Boulevard. There is generally a downward hydraulic gradient from the water table to the deeper part of the Semiperched aquifer. The northward flow direction is induced by the low groundwater elevation area to the north of the Halaco Properties. The downward gradient is caused by recharge of surface water from the OID, lagoon, and NCL-East.

The apparent cause for the lower groundwater elevations to the north of the Halaco Properties is the City's sanitary wastewater collection system. As described in Section 2, the City's sanitary wastewater collection system terminates in "northwest" and "southeast" trunk lines that feed into the headworks facility. The southeast trunk line is buried under McWane Boulevard along the north edge of the Halaco Properties as shown in plan view in

Figure 6 and the cross sections in Figures 5a and 5b. Seepage of groundwater into the southeast trunk line (or permeable backfill) appears to result in the low groundwater elevation area to the north of the Halaco Properties.

The groundwater elevations and gradients for October 28, 2013, at the newly installed monitoring wells to the north of the Halaco Properties are consistent with seepage of groundwater into the southeast trunk line (or permeable backfill) that would induce the low groundwater elevation area to the north.

- The two shallow wells at the WWTP (MW-28B and MW-29B) have a water level elevation difference of 0.20 foot, with the well closer to the trunk line having a lower elevation (MW-29B). This indicates recharge from the west (J Street Drain) and eastward flow toward the trunk line.
- The two shallow wells at the container board plant (MW-30B and MW-31B) have a water level elevation difference of 1.28 feet, with the well closer to the trunk line having a lower elevation (MW-31B). This indicates recharge from the north and southward flow toward the trunk line.
- The two deeper wells at NCL-North (MW-32C and MW-33C) have a water level elevation difference of 1.85 feet with the well closer to the trunk line having a lower elevation (MW-33C). This indicates recharge from the north and southward flow toward the trunk line. Additional recharge occurs from the overlying pond and wetland area between the screens for these two wells.

Although a supplemental set of surface water and groundwater elevation data were not measured while the beach berm was breached, when elevations are at a seasonal low, it is anticipated that the inward horizontal gradients toward the trunk line would still occur. This is because the groundwater elevations of the existing wells closest to the trunk line at the Smelter Parcel (MW-15, piezometer clusters PZ-1 and PZ-2) are near zero elevation regardless of the breached condition of the berm, as determined from the five measurement events in 2009 and 2010. The groundwater elevations in the piezometer clusters near the trunk line at the Waste Management Area (PZ-3 and PZ-4) are higher than those at the Smelter Parcel, likely due to recharge from the neighboring pond and wetlands area at NCL-North.

4.1.2 Oxnard Aquifer

The groundwater gradients and flow directions for October 28, 2013 are similar to the five measurement events in 2009 and 2010 for the Oxnard aquifer. The horizontal groundwater flow direction is toward the east and southeast as determined by the four deep monitoring wells screened in the upper part of this aquifer. This is consistent with the regional interpretation of the groundwater flow conditions by UWCD.

The vertical groundwater gradient across the fine-grained confining unit that separates the Semiperched aquifer from the Oxnard aquifer was downward for October 28, 2013. The elevations for the four “D” wells ranged from -1.59 to -1.97 feet with an average difference of 8.66 feet between the companion “C” wells (Well Clusters MW-2, MW-3, MW-6, and MW-19). This gradient direction is temporary and not consistent with the longer-term trend in vertical gradients across the confining unit since the early 1990s. Groundwater elevations in the Oxnard aquifer have, on average, been several feet above sea level since the early 1990s, leading to a gradient that has mostly been upward from the Oxnard aquifer to the Semiperched aquifer. Brief periods of downward gradients occurred during this period of mostly upward gradients when groundwater elevations in the Oxnard aquifer temporarily declined. Groundwater elevations in the Upper Aquifer System generally decline in summer and fall, when there is heavier agricultural irrigation pumping, and rise in the winter and spring, when less pumping occurs.

4.2 Northern Extent of Groundwater Contamination

The analytical results for the groundwater samples collected from the eight new wells on October 29 and 30, 2013, define the northern extent of groundwater impacted by Halaco's former operations at the Site (objective 1). Tables 4, 5, and 6 provide analytical results for general chemistry, metals, and TPH. The approximate extent of impacted groundwater is shown in Figure 8, which is updated from the 2012 Surface Water and Groundwater Report with the analytical data for the samples collected for the eight new wells and nine existing wells.

As described in the 2012 Surface Water and Groundwater Report and summarized in Section 2, key characteristics used to delineate the extent of groundwater impacted by Halaco's former operations are high TDS concentrations, a low TDS/potassium ratio, and elevated metals and ammonia concentrations above background. These parameters were selected to help distinguish groundwater affected by Halaco's wastes from groundwater affected by seawater or historical agricultural practices. The extent of Halaco-impacted groundwater in Figure 8 is interpreted based on a combination of the following:

- High TDS concentrations (> 20,000 mg/L)
- General chemistry results indicating little or no contribution from seawater
- High potassium concentrations and low TDS/potassium ratio (< 30)
- Relatively low sulfate and bicarbonate (alkalinity) and high chloride concentrations
- Elevated ammonia concentrations (> 10 mg/L)
- Lack of metals above background or exceeding MCLs

The TDS concentrations are illustrated in Figures 9a and 9b, which are the north-south hydrogeologic cross sections in Figures 5a and 5b. The major ion chemistry is illustrated in Figure 10 and the TDS/potassium ratios are illustrated in Figure 11. Figures 9a, 9b, 10, and 11 are updated from the 2012 Surface Water and Groundwater Report with the groundwater analytical results for the new wells and existing wells sampled on October 29 and 30, 2013. For the historical data collected during 2009 and 2010, these figures present the data collected in the fall during non-breach conditions for consistency with the data collected in 2013.

Additionally, the general chemistry is illustrated in Figure 12, which is a new trilinear diagram not presented in the 2012 report. The diagram shows surface water and groundwater not affected by Halaco's former operations in blue, a sample of Halaco's process wastewater in red (larger red square), groundwater that is affected by Halaco's former operations in red (smaller red symbols), and seawater in green (larger green diamond). The diagram shows that water affected by Halaco's process wastewater is lower in sulfate and bicarbonate (alkalinity) and higher in chloride. The diagram combines sodium and potassium, so it is not as useful as the TDS/potassium ratios shown in Figure 11 to distinguish groundwater that is affected by the process wastewater.

The northern extent of impacts is interpreted to be along the City's sanitary wastewater collection system buried under McWane Boulevard along the north edge of the Halaco Properties. This is consistent with the northward groundwater flow direction beneath the Halaco Properties and seepage of groundwater into the southeast trunk line.

- The shallow wells at the WWTP (MW-28B, MW-29B) and container board plant (MW-30B, MW-31B) had a relatively low TDS (between 6,900 and 8,700 mg/L), high TDS/potassium ratio (61 to 87), low ammonia (<3 mg/L), and no metals that exceeded MCLs. These results indicate little or no impact from Halaco's wastes and are consistent with groundwater recharged from the west at the WWTP and from the north at the container board plant. The general chemistry of these shallow wells is similar to that of the J Street Drain and OID, suggesting that recharge is from neighboring surface water features and not from the Halaco Properties.
- The deeper wells at the WWTP (MW-28C) and container board plant (MW-30C) had a relatively high TDS (between 29,000 and 41,000 mg/L, respectively), high TDS/potassium ratio (104 to 117), low ammonia (<6 mg/L), and no metals that exceeded MCLs. This is consistent with little or no impact from Halaco's wastes. The high TDS is potentially due to seawater intrusion based on the similarity in chemistry between the groundwater and seawater samples.
- The deeper well at NCL-North immediately north of the sewer trunk line (MW-33C) had high TDS (62,000 mg/L), low TDS/potassium ratio (9), and high ammonia (370 mg/L). This is consistent with significant impacts from Halaco's former operations, indicating a continuous plume of impacted groundwater from beneath the former settling ponds at the WMU northward to the sewer trunk line. The general chemistry between the original process water and groundwater from MW-33C is similar. Although the well is impacted from Halaco's process water, there are no metals that exceed MCLs, indicating limited mobility of metals.
- The northern extent of groundwater impacted at NCL-North is bounded by the well located approximately 500 feet north of the sewer line (MW-32C). This well had a relatively low TDS (6,100 mg/L), high TDS/potassium ratio (76), low ammonia (< 3 mg/L), and no metals that exceeded MCLs. This is consistent with little or no impact from Halaco's wastes and groundwater recharged from the north at NCL-North and from surface water from the OID and overlying wetlands area. The general chemistry for this deeper well is similar to the general chemistry for the OID.

Although the groundwater impacted at NCL-North extends to the north of the well immediately north of the sewer line, the actual northward extent is interpreted to be limited because the groundwater flow direction now appears to be southward across NCL-North toward the sewer line. The impacted groundwater north of the sewer line appears to be a remnant of when Halaco operated the process wastewater settling ponds at the WMU. As explained in the 2012 Surface Water and Groundwater Report, Halaco discharged hundreds of millions of gallons of wastewater to the WMU from about 1970 to 2002. Percolation to the subsurface from the settling ponds at the WMU would have caused water table mounding in the elevated waste pile materials, up to more than 20 feet above the regional water table. The increased head from this mounding would have resulted in radial flow away from the pond areas, both laterally outward and vertically downward in the

Semiperched aquifer. These historical conditions would have resulted in a northward groundwater gradient toward NCL-North, and groundwater impacted by the process wastewater would have migrated to this area when the settling ponds were operational. The gradient is now southward beneath NCL-North, causing remnants of impacted groundwater at NCL-North to flow southward toward the sewer line.

4.3 Presence of TPH-Diesel

The analytical results for the groundwater samples collected from the eight new wells and nine existing wells on October 29 and 30, 2013 indicate that the TPH-diesel detected in groundwater samples collected during the 2009-2010 sampling from the Oxnard aquifer, and at several wells in the Semiperched aquifer, where other water quality results do not suggest Site impacts, may be of natural origin (objective 3). Table 6 provides the TPH-gas, TPH-diesel, and TPH-oil results for select samples collected during the 2009-2010 sampling (analyzed without silica gel cleanup) and the TPH-diesel and TPH-oil results for the 2013 samples (analyzed without and with silica gel cleanup). With the exception of MW-12 and MW-25C, the wells resampled in 2013 for TPH do not appear to be affected by Halaco's wastes. MW-12 was selected for sampling because it is in the Smelter Parcel and is highly contaminated. MW-25C is near the eastern edge of Halaco-affected groundwater.

The results for the 2013 samples analyzed using modified TPH-diesel and TPH-oil with silica gel cleanup were below the detection limits for all the samples collected for both the Semiperched and Oxnard aquifers. For the standard method without silica gel cleanup, TPH-oil was not detected in any samples, but TPH-diesel was detected in MW-12 at 1 mg/L and at several wells below the quantitation limit (MW-21, MW-23C, MW-29B, MW-30C, MW-33C, and MW-2D). The lack of the detection of TPH-diesel analyzed using silica gel cleanup where TPH-diesel was detected using the standard analytical method suggests the TPH-diesel detected in groundwater samples collected during the 2009-2010 sampling may be of natural origin.

4.4 Potential Impact on Oxnard Aquifer

The analytical results for the groundwater samples collected on October 29 and 30, 2013 from the four wells screened in the Oxnard aquifer, indicate that the Site has not affected groundwater quality in the Oxnard aquifer (objective 4). The lack of impacts on the Oxnard aquifer is indicated by the following:

- Low TDS concentrations (< 2,000 mg/L)
- Low potassium concentrations and high TDS/potassium ratios (> 181)
- Low sulfate, bicarbonate (alkalinity), and chloride
- Low ammonia concentrations (< 1 mg/L)
- Lack of metals above background or MCLs

SECTION 5

Conclusions

This section provides conclusions regarding the supplemental groundwater sampling and analysis conducted at the Site in 2013. The testing included the installation of eight new groundwater monitoring wells in the Semiperched aquifer north of McWane Boulevard; measuring surface water and groundwater levels at the new and existing monitoring wells; collection of groundwater samples from the eight new wells and nine existing monitoring wells; and analysis of the samples for general chemistry, metals (total and dissolved), and TPH-diesel (with and without silica gel cleanup).

These data, and findings from previous studies, indicate the following conclusions relative to the objectives for the supplemental testing conducted in 2013.

5.1 Groundwater Flow

The surface water and groundwater elevation data for October 28, 2013, provide another snapshot of groundwater gradients and flow directions to supplement the five measurement events in 2009 and 2010. Additionally, these data provide information to assess whether the lower groundwater elevations to the north of the Halaco Properties are the result of groundwater infiltration into the City's sanitary wastewater collection system.

The groundwater gradients and flow directions interpreted from the October 28, 2013 water level measurements are consistent with the gradients and flow directions interpreted from the five measurement events in 2009-2010. For the Semiperched aquifer, groundwater flows northward across the Halaco Properties, from the lagoon (due to recharge from the lagoon and other surface water bodies) toward McWane Boulevard to the north. For the Oxnard aquifer, groundwater flows east and southeast, from the UWCD recharge basins in the Oxnard plain forebay area located about 10 miles north of the Site toward the ocean. The 2012 Surface Water and Groundwater Report provides a detailed analysis of these groundwater flow conditions.

The lower groundwater elevations to the north of the Halaco Properties appear to be the result of groundwater infiltration into the City's sanitary wastewater collection system (sewer line) that is buried beneath McWane Boulevard and runs along the northern edge of the Halaco Properties. This is demonstrated by the northward groundwater gradients and direction of flow across the Halaco Properties towards the sewer line and the reverse (north to south) gradients and direction of flow from areas north of McWane Boulevard southward toward the sewer line. Infiltration may occur into the sewer line itself or into granular backfill surrounding the sewer line.

5.2 Northern Extent of Groundwater Contamination

The analytical results for the groundwater samples collected from the eight new wells on October 29 and 30, 2013, help to evaluate the northern extent of groundwater impacted by Halaco's former operations at the Site. The northern extent of impacts is interpreted to be along the City's sanitary wastewater collection system buried under McWane Boulevard along the north edge of the Halaco Properties. This is consistent with the northward groundwater flow direction beneath the Halaco Properties and seepage of groundwater into the sewer line (or permeable backfill).

For the Smelter Parcel, the three new groundwater monitoring wells constructed immediately north of the sewer line at the container board plant and three wells constructed immediately west of the sewer line at the WWTP indicated little or no impact from Halaco's former operations. The two deeper Semiperched aquifer wells at the WWTP and container board plant did contain elevated TDS concentrations that appear to be consistent with seawater intrusion based on general chemistry. The four shallow Semiperched aquifer wells at the WWTP and container board plant did not contain elevated TDS concentrations indicative of seawater.

For the Waste Management Area, the two new deeper Semiperched aquifer groundwater monitoring wells constructed immediately north of the sewer line and 500 feet north of the sewer line bound the extent of impacts from Halaco's former operations. The well immediately north of the sewer line is heavily impacted, while the well 500 feet to the north does not show any impacts. The actual northern extent of Halaco's impacts at NCL-North between wells MW-32C and MW-33C is uncertain. The actual northward extent is interpreted to be closer to MW-33C (Figure 8) because the current groundwater flow direction appears to be southward across NCL-North toward the sewer line as a result of seepage into the sewer line (or backfill).

The interpreted northern extent of Halaco impacts presented in this section is based on available data from the current monitoring well network. However, because historical groundwater flow directions were probably to the north when Halaco's settling ponds were in use, the northern extent of contamination could be further to the north than shown in Figure 8, closer to MW-32. It is also possible that isolated pockets of contamination are present to the north of the contour shown in Figure 8 that have not been identified by the current monitoring well network.

5.3 Presence of TPH-Diesel

The analytical results for the groundwater samples collected from the eight new wells and nine additional existing wells on October 29 and 30, 2013, indicate that the TPH-diesel detected in groundwater samples collected during the 2009-2010 sampling from the Oxnard aquifer, and at several wells in the Semiperched aquifer, where other water quality results do not suggest Site impacts, may be of natural origin.

The results for the 2013 samples analyzed using modified TPH-diesel and TPH-oil with silica gel cleanup were below the detection limits for all the samples collected for both the Semiperched and Oxnard aquifers. For the standard method without silica gel cleanup, TPH-oil was not detected in any samples, and TPH-diesel was detected only in a subset of the wells sampled at a low, estimated concentration below the quantitation limit and at one well (MW-12), at 1 mg/L.

5.4 Potential Impact on Oxnard Aquifer

The analytical results for the groundwater samples collected from the four wells screened in the Oxnard aquifer on October 29 and 30, 2013, indicate that the Site has not affected groundwater quality in the Oxnard aquifer. The lack of impacts on the Oxnard aquifer is indicated by low TDS concentrations, low potassium concentrations and high TDS/potassium ratio, anion chemistry (relatively high sulfate and bicarbonate (alkalinity) and relatively low chloride), low ammonia concentrations, and lack of metals above background or MCLs.

SECTION 6

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Tables

TABLE 1

Construction of New Groundwater Monitoring Wells and Piezometers

Halaco Site Remedial Investigation, Oxnard, California

Location	Well	Aquifer	Relative Depth	Surface Completion (A/F)	Drilling Method	Date Installed	Survey Information: Outer TOC Elevation (feet, 1988 NAVD)	Inner TOC Elevation (feet, 1988 NAVD)	Ground Surface Elevation (feet, 1988 NAVD)	Stickup (feet ags)	Well Construction: Total Diameter (feet bgs)	Total Depth (feet bgs)	Top of Screen (feet bgs)	Bottom of Screen (feet bgs)	Screen Length (feet)	Well Screen Elevation: Calculated Top of Screen Elevation (feet, 1988 NAVD)	Calculated Bottom of Screen Elevation (feet, 1988 NAVD)
Oxnard Wastewater Plant	MW-28B	Semiperched	Shallow	F	HSA	10/1/13	9.77	9.56	9.8	-0.22	2	25.3	15	25	10	-5.23	-15.23
	MW-28C	Semiperched	Medium	F	HSA	9/30/13	9.77	9.48	9.8	-0.29	2	67.3	57	67	10	-47.23	-57.23
	MW-29B	Semiperched	Shallow	F	HSA	10/1/13	9.57	9.27	9.6	-0.30	2	25.3	15	25	10	-5.43	-15.43
New Indy Container Board Plant	MW-30B	Semiperched	Shallow	F	HSA	10/3/13	10.24	9.94	10.2	-0.30	2	27.3	17	27	10	-6.76	-16.76
	MW-30C	Semiperched	Medium	F	HSA	10/2/13	10.33	9.94	10.3	-0.39	2	69.3	59	69	10	-48.67	-58.67
	MW-31B	Semiperched	Shallow	F	HSA	10/3/13	11.33	10.98	11.3	-0.35	2	27.3	17	27	10	-5.67	-15.67
The Nature Conservancy	MW-32C	Semiperched	Medium	A	HSA	10/4/13	12.27	12.07	8.2	3.90	2	65.3	55	65	10	-46.83	-56.83
	MW-33C	Semiperched	Medium	A	HSA	10/4/13	12.76	12.49	9.8	2.73	2	64.3	54	64	10	-44.24	-54.24

Notes:

A = above ground (monument)
F = flush with ground (vault)
ags = above ground surface
bgs = below ground surface
HSA = hollow stem auger
TOC = top of casing

TABLE 2

Groundwater Monitoring Well Survey Data

Halaco Site Remedial Investigation, Oxnard, California

Location	Well	Date Installed	Well Diameter (inches)	Vertical Elevations*					Horizontal Coordiantes			
				Surface Completion (A/F)	Outer TOC Elevation (feet, 1988 NAVD)	Inner TOC Elevation (feet, 1988 NAVD)	Ground Surface Elevation (feet, 1988 NAVD)	Stickup (feet ags)	North Latitude**	West Longitude**	(Y) Northing***	(X) Easting***
Oxnard Wastewater Plant	MW-28B	10/1/13	2	A	9.77	9.56	9.8	-0.22	34.082749	-119.110383	1875794.695	6203286.755
	MW-28C	9/30/13	2	A	9.77	9.48	9.8	-0.29	34.082749	-119.110379	1875794.666	6203290.652
	MW-29B	10/1/13	2	A	9.57	9.27	9.6	-0.30	34.082752	-119.110331	1875797.408	6203330.654
New Indy Container Board Plant	MW-30B	10/3/13	2	A	10.24	9.94	10.2	-0.30	34.082564	-119.105702	1875601.079	6203857.635
	MW-30C	10/2/13	2	A	10.33	9.94	10.3	-0.39	34.082559	-119.105701	1875596.177	6203858.113
	MW-31B	10/3/13	2	A	11.33	10.98	11.3	-0.35	34.082513	-119.105704	1875550.146	6203855.01
The Nature Conservancy	MW-32C	10/4/13	2	F	12.27	12.07	8.2	3.90	34.082956	-119.104820	1875988.598	6204603.384
	MW-33C	10/4/13	2	F	12.76	12.49	9.8	2.73	34.082405	-119.104886	1875432.479	6204541.342

Notes:

n/a = not available
ags = above ground surface
TOC = top of casing

A = stickup well completion (above ground monument)
F = flush mount well completion (below ground vault)

* MSL elevation, survey feet (NAVD 1988)
** degrees, minutes, seconds (NAD 1983) (CORPSCON6)
*** CA State Plane Coordinates System Zone 5, Survey feet

TABLE 3

Groundwater and Surface Water Elevations

Halaco Site Remedial Investigation, Oxnard, California

Location	Well	Hydrogeologic Zone: "A" Water Table	"B" Shallow Sands	"C" Medium Sands	"D" Oxnard Aquifer	Well Construction: Surface Completion (A/F)	Outer TOC Elevation (feet, 1988 NAVD)	Inner TOC Elevation (feet, 1988 NAVD)	Ground Surface Elevation (feet, 1988 NAVD)	Stickup (feet ags)	Well Diameter (inches)	Groundwater Elevations (October 28, 2013): Measured Total Well Depth (feet BTOC)	Measured Depth to Water (feet BTOC)	Calculated Depth to Water (feet bgs)	Calculated Water Level Elevation (feet, 1988 NAVD)
Monitoring Wells															
1	MW-1R		X			A	10.93	10.46	8.16	2.30	2	20.05	2.94	0.64	7.52
2	MW-2RA	X				A	10.56	10.01	7.91	2.10	2	12.03	2.48	0.38	7.53
	MW-2RB		X			A	10.64	9.81	7.91	1.90	2	29.96	3.62	1.72	6.19
	MW-2C			X		A	30.03	29.63	27.57	2.07	2	87.90	22.85	20.78	6.78
	MW-2D				X	A	30.23	29.67	27.46	2.21	2	155.20	31.64	29.43	-1.97
3	MW-3RA	X				A	10.95	9.93	8.22	1.71	2	10.09	1.68	-0.03	8.25
	MW-3RB		X			A	10.84	10.00	8.09	1.91	2	22.23	2.29	0.38	7.71
	MW-3C			X		A	27.42	27.10	24.77	2.33	2	86.11	19.60	17.27	7.50
	MW-3D				X	A	27.69	27.35	25.13	2.23	2	154.40	29.29	27.06	-1.94
4	MW-4RA	X				A	11.76	10.51	9.56	0.95	2	20.12	2.96	2.01	7.55
	MW-4RB		X			A	11.29	11.29	9.52	1.77	2	31.38	5.84	4.07	5.45
5	MW-5	X				A	20.43	20.20	18.76	1.44	2	22.27	11.95	10.51	8.25
6	MW-6	X				A	16.32	16.14	14.87	1.27	2	19.51	9.05	7.78	7.09
	MW-6C			X		A	21.85	21.17	19.70	1.46	2	84.00	13.71	12.25	7.46
	MW-6D				X	A	22.02	21.71	19.92	1.79	2	153.90	23.30	21.51	-1.59
11	MW-11	X				F	13.82	13.57	13.69	-0.12	1	7.46	6.17	6.29	7.40
12	MW-12	X				A	16.33	14.81	14.15	0.66	1	12.52	7.82	7.16	6.99
	MW-12C			X		A	17.60	17.29	14.86	2.43	2	71.78	11.00	8.57	6.29
13	MW-13	X				F	10.06	9.85	9.86	-0.01	1	10.21	2.71	2.72	7.14
	MW-13C			X		F	9.72	9.37	9.79	-0.42	2	66.67	6.91	7.33	2.46
14	MW-14	X				F	8.17	7.91	7.86	0.05	1	11.92	0.96	0.91	6.95
15	MW-15	X				F	8.42	8.25	8.39	-0.14	1	15.11	8.05	8.19	0.20
17	MW-17	X				A	47.00	45.82	42.49	3.33	1	46.10	39.42	36.09	6.40
18	MW-18	X				A	45.87	45.83	41.81	4.02	1	48.56	40.41	36.39	5.42
19	MW-19	X				F	17.73	17.37	17.64	-0.27	1	n/m	n/m	n/a	n/a
	MW-19C			X		A	20.46	19.85	17.99	1.86	2	74.20	14.29	12.43	5.56
	MW-19D				X	A	20.43	19.86	18.00	1.86	2	145.08	21.71	19.85	-1.85
20	MW-20		X			F	13.37	12.99	13.37	-0.38	2	30.46	7.21	7.59	5.78
21	MW-21		X			F	9.10	8.60	9.10	-0.50	2	25.17	2.09	2.59	6.51
	MW-21C			X		F	9.03	8.65	9.10	-0.44	2	65.00	2.79	3.23	5.86
22	MW-22		X			F	8.55	8.18	8.44	-0.26	2	24.47	2.99	3.25	5.19
23	MW-23B		X			A	11.99	11.91	9.39	2.53	2	32.34	6.24	3.71	5.67
	MW-23C			X		A	11.81	11.48	9.02	2.46	2	66.90	6.21	3.75	5.27
24	MW-24		X			A	17.68	16.87	14.74	2.12	2	34.84	11.84	9.72	5.03
	MW-24C			X		A	18.12	17.92	14.95	2.97	2	67.38	13.39	10.42	4.53
25	MW-25B		X			A	12.31	12.06	9.56	2.50	2	32.54	6.76	4.26	5.30
	MW-25C			X		A	12.42	12.21	9.60	2.62	2	64.35	7.07	4.45	5.14
27	MW-27B		X			A	11.70	11.54	8.90	2.64	2	32.06	6.51	3.87	5.03
	MW-27C			X		A	11.73	11.44	8.86	2.58	2	66.39	5.14	2.57	6.30
28	MW-28B		X			F	9.77	9.56	9.77	-0.22	2	25.03	6.70	6.92	2.86
	MW-28C			X		F	9.77	9.48	9.77	-0.29	2	66.36	6.99	7.28	2.49
29	MW-29B		X			F	9.57	9.27	9.57	-0.30	2	24.98	6.61	6.91	2.66
30	MW-30B		X			F	10.24	9.94	10.24	-0.30	2	26.79	9.17	9.47	0.77
	MW-30C			X		F	10.33	9.94	10.33	-0.39	2	66.96	7.65	8.04	2.29
31	MW-31B		X			F	11.33	10.98	11.33	-0.35	2	26.53	11.49	11.84	-0.51
32	MW-32C			X		A	12.27	12.07	8.17	4.10	2	67.67	5.83	1.73	6.24
33	MW-33C			X		A	12.76	12.49	9.76	3.00	2	62.37	8.10	5.10	4.39
Piezometers															
1	PZ-1A	X				F	8.67	8.55	8.66	-0.11	0.75	10.14	9.05	9.16	-0.50
	PZ-1B	X				F	8.65	8.34	8.64	-0.29	0.75	19.79	8.81	9.10	-0.47
	PZ-1C		X			F	8.65	8.39	8.64	-0.25	0.75	32.31	8.17	8.42	0.22
2	PZ-2A	X				F	9.31	9.13	9.30	-0.17	0.75	10.11	10.04	10.21	-0.91
	PZ-2B	X				F	9.35	9.19	9.34	-0.16	0.75	19.82	10.79	10.95	-1.60
	PZ-2C		X			F	9.22	9.00	9.21	-0.22	0.75	32.46	10.84	11.06	-1.84
3	PZ-3A	X				A	17.12	17.00	15.24	1.76	0.75	18.59	14.08	12.32	2.92
	PZ-3B	X				A	17.31	17.08	15.22	1.86	0.75	28.85	13.92	12.06	3.16
	PZ-3C		X			A	17.29	17.11	15.28	1.83	0.75	40.47	9.54	7.71	7.57
4	PZ-4A	X				A	15.41	15.07	13.36	1.71	0.75	15.28	10.13	8.42	4.94
	PZ-4B	X				A	15.38	15.07	13.25	1.82	0.75	25.00	9.83	8.01	5.24
	PZ-4C		X			A	15.18	15.02	13.12	1.90	0.75	37.68	10.08	8.18	4.94
Surface Water															
1	OID					SG	n/a	n/a	4.28	9.52	n/a	n/a	n/a	n/a	8.02
	NCL-E					SG	n/a	n/a	6.02	10.43	n/a	n/a	n/a	n/a	7.80
	NCL-N					SG	n/a	n/a	6.61	10.40	n/a	n/a	n/a	n/a	dry

Notes:

n/m = not measured
n/a = not applicable
TOC = top of casing
ags = above ground surfa
bgs = below ground surfa
BTOC = below top of casing
A = stickup well completion (above ground monument)
F = flush mount well completion (below ground vault)
SG = staff gauge

TABLE 4

General Chemistry Analytical Results, Groundwater

Halaco Site Remedial Investigation, Oxnard, California

					Alkalinity				Anions				Nitrogen Species				Cations (total)						
Location	Sample	Date	Time	Total Dissolved Solids	Total Alkalinity	Hydroxide Alkalinity	Bicarbonate Alkalinity	Carbonate Alkalinity	Chloride	Sulfate	Bromide	Fluoride	Ammonia as N	Nitrate as N	Nitrite as N	Nitrogen, Total Kjeldahl	Calcium	Magnesium	Potassium	Sodium	Hardness, as $CaCO_3$ (total)	Hardness, as $CaCO_3$ (dissolved)	TDS/ Potassium Ratio
				Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q
Semiperched Aquifer Wells	GW-MW-12-1013	10/30/13	14:05	80,000	520	230	10 U	290	42,000	1.5 J	73	3.50	260	1 U	100 U	510	4,100	2,000	13,000	8,000	19,000	18,000	6
	GW-MW-21-1013	10/30/13	12:45	8,600	290	10 U	290	10 U	4,200	1,500	17	0.60	0.46	0.1 U	10 U	1.1	280	280	96	2,400	1,900	1,900	90
	GW-MW-23C-1013	10/29/13	13:38	15,000	270	10 U	270	10 U	8,800	1,800	33	0.39	2.2 J	0.1 U	50 U	3.4 J	230	470	190	5,700	2,500	3,300	79
	GW-MW-25C-1013	10/30/13	8:50	20,000	290	10 U	290	10 U	11,000	3,000	44	0.10 U	8	0.1 U	50 U	7.9	750	1,000	78	5,300	6,200	6,400	256
	GW-MW-125C-1013	10/30/13	8:55	20,000	290	10 U	290	10 U	11,000	2,900	44	0.10 U	8.1	0.1 U	50 U	8.4	770	1,100	80	5,400	6,300	6,200	250
	GW-MW-27C-1013	10/30/13	12:37	2,600	230	10 U	230	10 U	840	730	2.9	0.39	0.58	0.1 U	50 U	1	330	110	24	310	1,300	1,400	108
Oxnard Wastewater Plant	GW-MW-28B-1013	10/29/13	11:01	8,700	300	10 U	300	10 U	3,800	1,900	16	0.58	1.6	0.1 U	10 U	2.9	220	300	100	2,500	1,800	2,000	87
	GW-MW-28C-1013	10/29/13	9:36	29,000	340	10 U	340	10 U	15,000	4,200	54	0.10 J	4.2	0.1 U	100 U, J	5.4 J	450	1,300	280	8,400	6,400	6,100	104
	GW-MW-29B-1013	10/29/13	12:20	8,200	320	10 U	320	10 U	3,300	1,900	14	0.72	1.4	0.1 U	10 U	2.3	240	300	95	2,300	1,800	2,000	86
New Indy Container Board Plant	GW-MW-30B-1013	10/29/13	9:25	6,900	490	10 U	490	10 U	2,800	1,500	12	0.89	2.1	0.1 U	10 U	3.3	320	250	110	1,800	1,800	2,000	63
	GW-MW-30C-1013	10/29/13	10:30	41,000	450	10 U	450	10 U	17,000	6,700	68	0.10 U	5.3	0.1 U	100 U	6.8	420	1,500	350	11,000	7,300	6,800	117
	GW-MW-130C-1013	10/29/13	10:35	38,000	420	10 U	420	10 U	17,000	6,400	68	0.10 U	5.2	0.1 U	50 U	7	400	1,400	360	11,000	6,700	7,000	106
	GW-MW-31B-1013	10/29/13	11:40	7,300	510	10 U	510	10 U	3,100	1,400	13	0.82	1.5	0.1 U	10 U	2.6	270	260	120	1,900	1,700	2,000	61
The Nature Conservancy	GW-MW-32C-1013	10/29/13	13:15	6,100	480	10 U	480	10 U	2,500	1,300	12	0.27	2.2	0.1 U	10 U	3.7	330	310	80	1,500	2,100	2,000	76
	GW-MW-33C-1013	10/30/13	10:00	62,000	170	10 U	170	10 U	35,000	1,800	110	0.10 U	370	1 U	100 U	720	460	240	7,700	14,000	2,200	2,600	8
Oxnard Aquifer Wells	GW-MW-2D-1013	10/30/13	11:31	890	210	10 U	210	10 U	89	360	0.41	0.66	0.45	0.1 U	1 U	0.65	120	36	4.8	99	460	490	185
	GW-MW-3D-1013	10/30/13	10:10	940	220	10 U	220	10 U	110	360	0.52	0.64	0.44 J	0.1 U	1 U	0.53	130	37	5.2	100	470	700	181
	GW-MW-6D-1013	10/30/13	11:15	1,300	200	10 U	200	10 U	370	370	1.4	0.51	0.49	0.1 U	1 U	0.82	200	57	6.6	130	730	1,100	197
	GW-MW-19D-1013	10/30/13	8:51	1,100	210	10 U	210	10 U	200	360	0.82	0.60	0.42	0.1 U	1 U	0.81	160	44	5.3	110	570	580	208

Note:

Units are in milligrams per liter (mg/L).

Data Qualifiers (Q):

J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

TABLE 5
Metals Analytical Results, Groundwater
Halaco Site Remedial Investigation, Oxnard, California

Location	Sample	Date	Time	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
				Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q
Total Metals																												
Semiperched Aquifer Wells	GW-MW-12-1013	10/30/13	14:05	68 J	12 U	12 J	1,800,000	0.5 U	1,000	10 U	4,100,000	10 U	7.1	13	2,000 U	25 U	2,000,000	190	0.03 U	18	10 U	13,000,000	20 U	6.2 U	8,000,000	25 U	100 U	12
	GW-MW-21-1013	10/30/13	12:45	110	12 U	12 U	72	0.5 U	1,600	10 U	280,000	10 U	6.2 U	10 U	6,600	25 U	280,000	530	0.03 U	22	10 U	96,000	20 U	6.2 U	2,400,000	25 U	100 U	120 U
	GW-MW-23C-1013	10/29/13	13:38	100 U	12 U	6.4 J	41	0.5 U	2,600	10 U	230,000	10 U	6.2 U	10 U	6,900	25 U	470,000	520 J	0.03 U	21	10 U,J	190,000	20 U	6.2 U	5,700,000	25 U	100 U	120 U
	GW-MW-25C-1013	10/30/13	8:50	100 U	12 U	12 U	51	0.5 U	1,800	10 U	750,000	10 U	6.2 U	10 U	16,000	25 U	1,000,000	2,900	0.03 U	11 J	10 U	78,000	20 U	6.2 U	5,300,000	25 U	100 U	120 U
	GW-MW-125C-1013	10/30/13	8:55	100 U	12 U	12 U	61	0.5 U	1,900	10 U	770,000	10 U	6.2 U	10 U	16,000	25 U	1,100,000	3,100	0.03 U	9.5 J	10 U	80,000	20 U	6.2 U	5,400,000	25 U	100 U	120 U
	GW-MW-27C-1013	10/30/13	12:37	53 J	1.2 U	6.9	45	0.5 U	790	1 U	330,000	10 U	0.93	10 U	3,900	2.5 U	110,000	760	0.03 U	14	10 U	24,000	20 U	0.62 U	310,000	2.5 U	10 U	19
Oxnard Wastewater Plant	GW-MW-28B-1013	10/29/13	11:01	470	12 U	12 U	44	0.5 U	2,400	10 U	220,000	10 U	6.2 U	10 U	7,200	25 U	300,000	970	0.03 U	31	10 U	100,000	20 U	6.2 U	2,500,000	25 U	100 U	120 U
	GW-MW-28C-1013	10/29/13	9:36	300	12 U	12 U	41	0.5 U	3,700	10 U	450,000	10 U,J	6.2 U	10 U	13,000	25 U	1,300,000	1,200	0.03 U	19	10 U,J	280,000	20 U	6.2 U	8,400,000	25 U	100 U	120 U
	GW-MW-29B-1013	10/29/13	12:20	240	12 U	12 U	42	0.5 U	2,700	10 U	240,000	10 U	6.2 U	10 U	11,000	25 U	300,000	1,600	0.03 U	33	10 U	95,000	20 U	6.2 U	2,300,000	25 U	100 U	120 U
New Indy Container Board Plant	GW-MW-30B-1013	10/29/13	9:25	200	12 U	12 U	49	0.5 U	1,600	10 U	320,000	10 U	6.2 U	10 U	12,000	25 U	250,000	1,300	0.03 U	26	10 U	110,000	20 U	6.2 U	1,800,000	25 U	100 U	120 U
	GW-MW-30C-1013	10/29/13	10:30	320	12 U	12 U	20	0.5 U	6,700	10 U	420,000	10 U	6.2 U	10 U	13,000	25 U	1,500,000	580	0.03 U	47	10 U	350,000	20 U	6.2 U	11,000,000	25 U	100 U	120 U
	GW-MW-130C-1013	10/29/13	10:35	250	12 U	12 U	19	0.5 U	5,600	10 U	400,000	10 U	6.2 U	10 U	12,000	25 U	1,400,000	540	0.03 U	52	10 U	360,000	20 U	6.2 U	11,000,000	25 U	100 U	120 U
	GW-MW-31B-1013	10/29/13	11:40	55 J	12 U	12 U	40	0.5 U	1,800	10 U	270,000	10 U	6.2 U	10 U	9,600	25 U	260,000	1,200	0.03 U	30	10 U	120,000	20 U	6.2 U	1,900,000	25 U	100 U	120 U
The Nature Conservancy	GW-MW-32C-1013	10/29/13	13:15	130	12 U	12 U	49	0.5 U	2,000	10 U	330,000	10 U	6.2 U	10 U	3,900	25 U	310,000	470	0.03 U	23	10 U	80,000	20 U	6.2 U	1,500,000	25 U	100 U	120 U
	GW-MW-33C-1013	10/30/13	10:00	150	12 U	12 U	110	0.5 U	1,400	10 U	460,000	10 U	6.2 U	10 U	25,000	25 U	240,000	1,200	0.016 J,C1	14	10 U	7,700,000	20 U	6.2 U	14,000,000	25 U	100 U	120 U
Oxnard Aquifer Wells	GW-MW-2D-1013	10/30/13	11:31	110	1.2 U	2.6	43	0.5 U	710	1 U	120,000	10 U	0.45 J	10 U	240	2.5 U	36,000	340	0.03 U	22	10 U	4,800	20 U	0.62 U	99,000	2.5 U	10 U	7.9 J
	GW-MW-3D-1013	10/30/13	10:10	120	1.2 U	1.8	49	0.5 U	690	1 U	130,000	10 U	0.35 J	10 U	990	2.5 U	37,000	290	0.03 U	19	10 U	5,200	20 U	0.62 U	100,000	2.5 U	10 U	7.5 J
	GW-MW-6D-1013	10/30/13	11:15	100 U	1.2 U	2.1	56	0.5 U	690	1 U	200,000	10 U	0.39 J	10 U	1,900	2.5 U	57,000	390	0.03 U	15	10 U	6,600	20 U	0.62 U	130,000	3.3	10 U	12 U
	GW-MW-19D-1013	10/30/13	8:51	320	1.2 U	1.9	52	0.5 U	700	1 U	160,000	10 U	0.73	10 U	1,200	0.8 J	44,000	310	0.03 U	18	10 U	5,300	20 U	0.62 U	110,000	1 U	10 U	7.4
Dissolved Metals (field filtered)																												
Semiperched Aquifer Wells	GW-MW-12-1013 Filtered	10/30/13	14:05	100 U	25 U	12 J	1,500,000	0.5 U	1,100	20 U	3,900,000	10 U	8.3	14	100 U	10 U	1,900,000	180	0.03 U	23	10 U	13,000,000	20 U	12 U	7,500,000	10 U	100 U	11
	GW-MW-21-1013 Filtered	10/30/13	12:45	100 U	12 U	12 U	42	0.5 U	1,700	10 U	290,000	10 U	6.2 U	10 U	5,100	25 U	290,000	520	0.03 U	25	10 U	93,000	20 U	6.2 U	2,300,000	25 U	100 U	120 U
	GW-MW-23C-1013 Filtered	10/29/13	13:38	100 U	12 U	12 U	39	0.5 U	2,900	10 U	290,000	10 U	6.2 U	10 U	6,800	25 U	620,000	520	0.03 U	23	10 U	170,000	20 U	6.2 U	5,500,000	25 U	100 U	120 U
	GW-MW-25C-1013 Filtered	10/30/13	8:50	100 U	12 U	12 U	53	0.5 U	2,000	10 U	780,000	10 U,J	6.2 U	10 U	13,000	25 U	1,100,000	3,000	0.03 U	11 J	10 U,J	80,000	20 U	6.2 U	5,400,000	25 U	100 U	120 U
	GW-MW-125C-1013 Filtered	10/30/13	8:55	100 U	12 U	12 U	57	0.5 U	1,900	10 U	750,000	10 U	6.2 U	10 U	12,000	25 U	1,000,000	3,000	0.03 U	10 J	10 U	81,000	20 U	6.2 U	5,300,000	25 U	100 U	120 U
	GW-MW-27C-1013 Filtered	10/30/13	12:37	100 U	1.2 U	4.7	46	0.5 U	890	1 U	350,000	10 U	0.79	10 U	3,000	2.5 U	120,000	810	0.03 U	13	10 U	23,000	20 U	0.62 U	310,000	2.5 U	10 U	11 J
Oxnard Wastewater Plant	GW-MW-28B-1013 Filtered	10/29/13	11:01	100 U	12 U	12 U	40	0.5 U	2,600	10 U	260,000	10 U	6.2 U	10 U	5,900	25 U	340,000	990	0.03 U	36	10 U	88,000	20 U	6.2 U	2,300,000	25 U	100 U	120 U
	GW-MW-28C-1013 Filtered	10/29/13	9:36	100 U	12 U	12 U	40	0.5 U	4,200	10 U	420,000	10 U,J	6.2 U	10 U	11,000	25 U	1,200,000	1,200	0.03 U	24	10 U,J	240,000	20 U	6.2 U	8,100,000	25 U	100 U	120 U
	GW-MW-29B-1013 Filtered	10/29/13	12:20	100 U	12 U	12 U	38	0.5 U	2,900	10 U	270,000	10 U	6.2 U	10 U	10,000	25 U	330,000	1,700	0.03 U	38	10 U	83,000	20 U	6.2 U	2,200,000	25 U	100 U	120 U
New Indy Container Board Plant	GW-MW-30B-1013 Filtered	10/29/13	9:25	100 U	12 U	12 U	47	0.5 U	1,700	10 U	360,000	10 U	6.2 U	10 U	10,000	25 U	280,000	1,300	0.03 U	29	10 U	91,000	20 U	6.2 U	1,600,000	25 U	100 U	120 U
	GW-MW-30C-1013 Filtered	10/29/13	10:30	100 U	12 U	12 U	18	0.5 U	6,400	10 U	390,000	10 U	6.2 U	10 U	11,000	25 U	1,400,000	600	0.03 U	45	10 U	330,000	20 U	6.2 U	11,000,000	25 U	100 U	120 U
	GW-MW-130C-1013 Filtered	10/29/13	10:35	100 U	12 U	12 U	17	0.5 U	6,300	10 U	410,000	10 U	6.2 U	10 U	11,000	25 U	1,500,000	550	0.03 U	44	10 U	340,000	20 U	6.2 U	10,000,000	25 U	100 U	120 U
	GW-MW-31B-1013 Filtered	10/29/13	11:40	100 U	12 U	12 U	39	0.5 U	1,800	10 U	310,000	10 U	6.2 U	10 U	9,300	25 U	300,000	1,300	0.03 U	29	10 U	120,000	20 U	6.2 U	1,900,000	25 U	100 U	120 U
The Nature Conservancy	GW-MW-32C-1013 Filtered	10/29/13	13:15	100 U	12 U	12 U	48	0.5 U	2,000	10 U	320,000	10 U	6.2 U	10 U	3,600	25 U	280,000	520	0.03 U	24	10 U	81,000	20 U	6.2 U	1,500,000	25 U	100 U	120 U
	GW-MW-33C-1013 Filtered	10/30/13	10:00	100 U	12 U	12 U	130	0.5 U	1,500	10 U	540,000	10 U	6.2 U	10 U	22,000	25 U	290,000	1,500	0.03 U	15	10 U	7,100,000	20 U	6.2 U	14,000,000	25 U	100 U	120 U
Oxnard Aquifer Wells	GW-MW-2D-1013 Filtered	10/30/13	11:31	100 U	1.2 U	2.3	41	0.5 U	790	1 U	130,000	10 U	0.41 J	10 U	180	1 U	38,000	360	0.03 U	23	10 U	4,800	20 U	0.62 U	99,000	1 U	10 U	7.1
	GW-MW-3D-1013 Filtered	10/30/13	10:10	100 U	1.2 U	1.5	50	0.5 U	710	1 U	190,000	10 U	0.62 U	10 U	950	1 U	55,000	420	0.03 U	17	10 U	5,000	20 U	0.62 U	100,000	1 U	10 U	3.6 J
	GW-MW-6D-1013 Filtered	10/30/13	11:15	100 U	1.2 U	1.6	75	0.5 U	710	1 U	290,000	10 U	0.41 J	10 U	1,900	1 U	83,000	560	0.03 U	17	10 U	6,300	20 U	0.62 U	140,000	1 U	10 U	7.1
	GW-MW-19D-1013 Filtered	10/30/13	8:51	100 U	1.2 U	1.5	43	0.5 U	750	1 U	160,000	10 U	0.33 J	10 U	850	2.5 U	45,000	310	0.03 U	16	10 U	5,500	20 U	0.62 U	110,000	2.5 U	10 U	6.3 J

Note:

Units are in micrograms per liter (µg/L).

Data Qualifiers (Q):

J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit listed in the table.

TABLE 6
TPH Analytical Results, Groundwater
Halaco Site Remedial Investigation, Oxnard, California

	2009-2010 Analytical Results									2013 Analytical Results											
				No Silica Gel Cleanup									No Silica Gel Cleanup				With Silica Gel Cleanup				
				TPH as Gasoline		TPH as Diesel		TPH as Motor Oil					TPH as Diesel		TPH as Oil		TPH as Diesel		TPH as Oil	
Location	Sample	Date	Time	Result	Q	Result	Q	Result	Q	Sample	Date	Time	Result	Q	Result	Q	Result	Q	Result	Q
Semiperched Aquifer Wells	GW-MW-12-1109	11/20/09	9:55	93		1,000		890	U	GW-MW-12-1013	10/30/13	14:05	1,000		950	U	240	U	950	U
	GW-MW-21-1109	11/19/09	12:15	50	U	170	J	940	U	GW-MW-21-1013	10/30/13	12:45	170	J	950	U	240	U	950	U
	GW-MW-23C-0610	6/3/10	13:30	50	U	3,100		6,200		GW-MW-23C-1013	10/29/13	13:38	150	J	1,000	U	250	U	1,000	U
	GW-MW-25C-0610	6/2/10	12:45	33		240	U	950	U	GW-MW-25C-1013	10/30/13	8:50	250	U	1,000	U	250	U	1,000	U
										GW-MW-125C-1013	10/30/13	8:55	240	U	950	U	240	U	950	U
	GW-MW-27C-0610	6/2/10	10:10	50	U	260		1,000	U	GW-MW-27C-1013	10/30/13	12:37	250	U	1,000	U	250	U	1,000	U
Oxnard Wastewater Plant										GW-MW-28B-1013	10/29/13	11:01	250	U	1,000	U	250	U	1,000	U
										GW-MW-28C-1013	10/29/13	9:36	250	U	1,000	U	250	U	1,000	U
										GW-MW-29B-1013	10/29/13	12:20	120	U	1,000	U	250	U	1,000	U
New Indy Container Board Plant										GW-MW-30B-1013	10/29/13	9:25	240	U	950	U	240	U	950	U
										GW-MW-30C-1013	10/29/13	10:30	140	J	950	U	240	U	950	U
										GW-MW-130C-1013	10/29/13	10:35	230	U	930	U	230	U	930	U
										GW-MW-31B-1013	10/29/13	11:40	240	U	950	U	240	U	950	U
The Nature Conservancy										GW-MW-32C-1013	10/29/13	13:15	250	U	1,000	U	250	U	1,000	U
										GW-MW-33C-1013	10/30/13	10:00	180	J	940	U	230	U	940	U
Oxnard Aquifer	GW-MW-2D-1109	11/17/09	12:10	50	U	140	J	950	U	GW-MW-2D-1013	10/30/13	11:31	240	J	1,000	U	250	U	1,000	U
	GW-MW-3D-1109	11/18/09	7:10	50	U	260		950	U	GW-MW-3D-1013	10/30/13	10:10	250	U	1,000	U	250	U	1,000	U
	GW-MW-6D-1109	11/18/09	9:55	50	U	180	J	950	U	GW-MW-6D-1013	10/30/13	11:15	250	U	1,000	U	250	U	1,000	U
	GW-MW-19D-1109	11/17/09	10:15	50	U	270		950	U	GW-MW-19D-1013	10/30/13	8:51	250	U	1,000	U	250	U	1,000	U

Note:

Units are in micrograms per liter (µg/L)

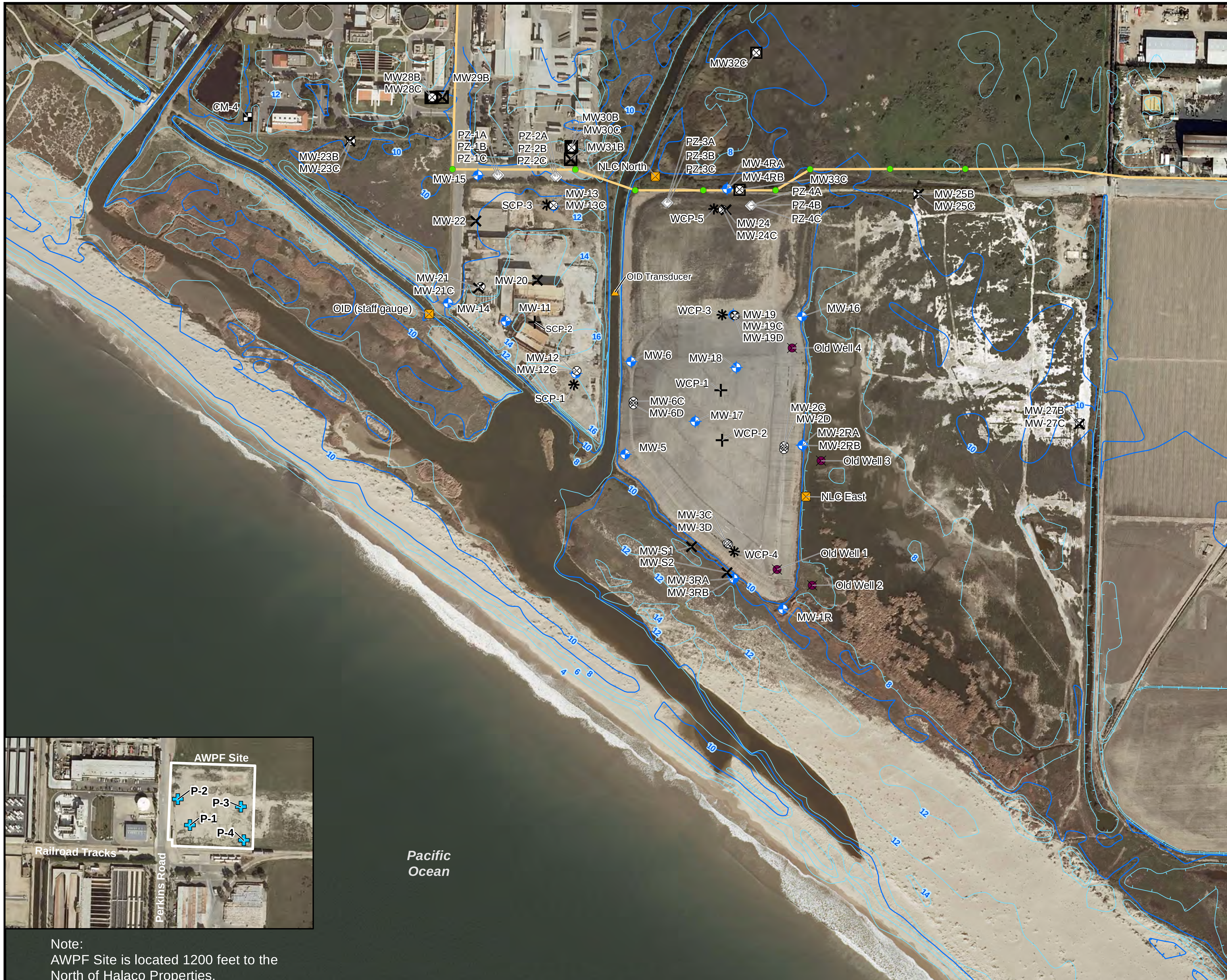
Data Qualifiers (Q):

J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

Figures

Aerial image © Google Earth, 2014. Annotation by CH2M HILL, 2014.

FIGURE 1
Halaco Superfund Site Areas
Halaco Site Remedial Investigation



LEGEND

Groundwater Monitoring Locations

- New Shallow Well (2013)
- New Deeper Well (2013)
- Shallow Well (2003, 2006)
- Shallow Well (2009, 2010)
- Deeper Well (2009, 2010)
- Shallow CPT Boring
- Deep CPT Boring
- Piezometer Cluster (2009, 2010)
- Former Monitoring Well (Destroyed)
- Surface Water Gauging Station
- Former Surface Water Pressure Transducer
- AWPF Piezometers
- USGS Regional Monitoring Well

Sewer Line

- Oxnard Sewer Trunk Line
- Manhole

Ground Elevation Contours, ft msl (AMEC, 2006)

- 2 ft Contour
- 10 ft Contour

Aerial Photo Date: 2009

N

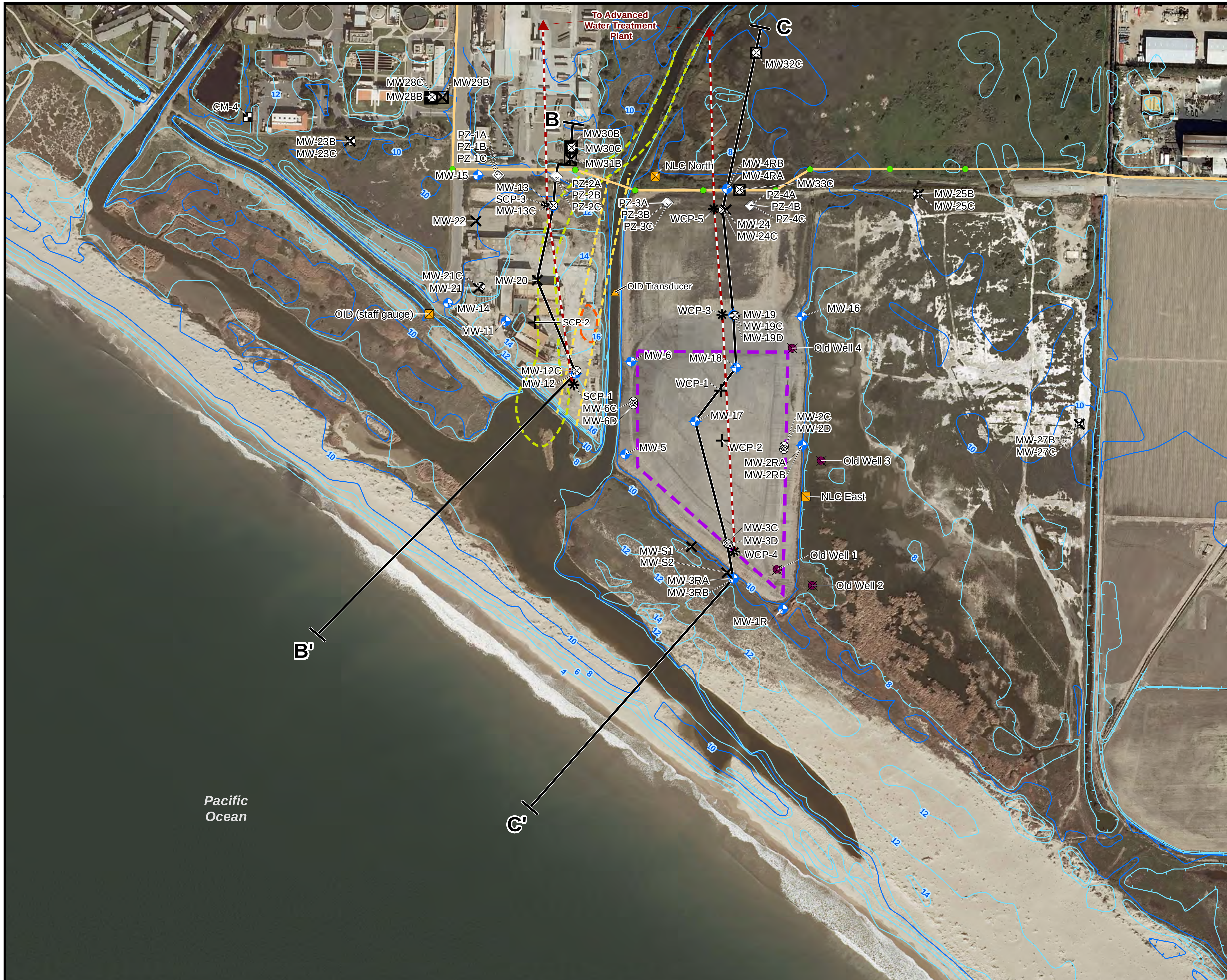
0 200 400

Feet

1 inch = 400 feet

FIGURE 2
Groundwater Monitoring Well Locations

HALACO SITE REMEDIAL INVESTIGATION
OXNARD, CALIFORNIA



LEGEND

- CPT Transect Line
- Hydrogeologic Transect Line

Groundwater Monitoring Locations

- New Shallow Well (2013)
- New Deeper Well (2013)
- Shallow Well (2003, 2006)
- Shallow Well (2009, 2010)
- Deeper Well (2009, 2010)
- Shallow CPT Boring
- Deep CPT Boring
- Piezometer Cluster (2009, 2010)
- Former Monitoring Well (Destroyed)
- Surface Water Gauging Station
- Former Surface Water Pressure Transducer
- USGS Regional Monitoring Well
- Approximate Extent of Former Process Waste Settling Pond

Historical OID Alignment

- 1929 OID
- 1959 OID
- 1969 Pond

Sewer Line

- Oxnard Sewer Trunk Line
- Manhole

Ground Elevation Contours, ft msl (AMEC, 2006)

- 2 ft Contour
- 10 ft Contour

Aerial Photo Date: 2009

N

0 200 400
Feet
1 inch = 400 feet

FIGURE 3
Cross Section Location Map
HALACO SITE REMEDIAL INVESTIGATION
OXNARD, CALIFORNIA

R:\HALACO\MAPFILES\GW\REMEDIAL_INVESTIGATION_2014\FIGURE3_CROSS_SECTION_LOCATIONS.MXD SGONZALES 5/28/2014 1:19:18 PM

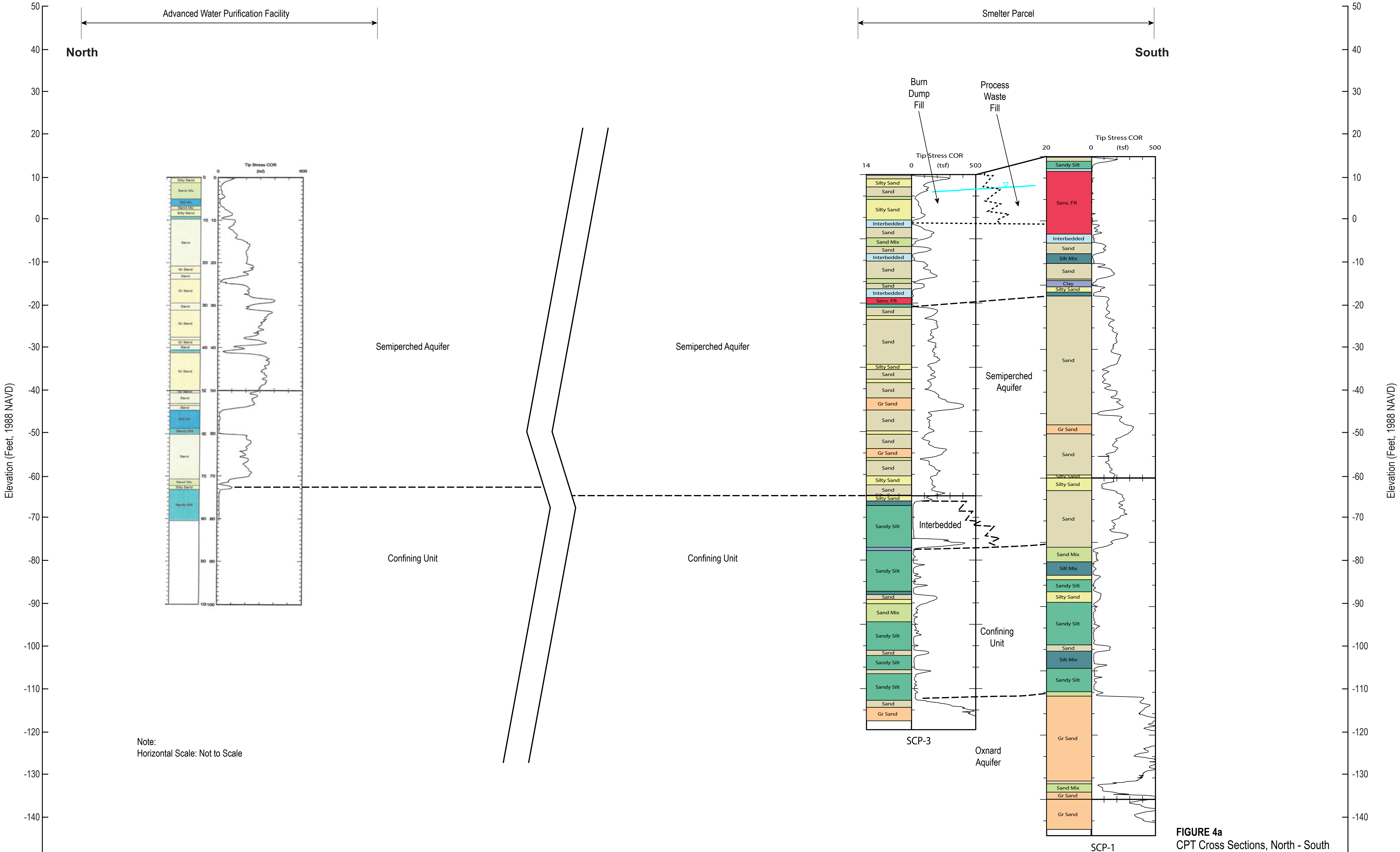


FIGURE 4a
CPT Cross Sections, North - South
Halaco Site Remedial Investigation

CH2MHILL

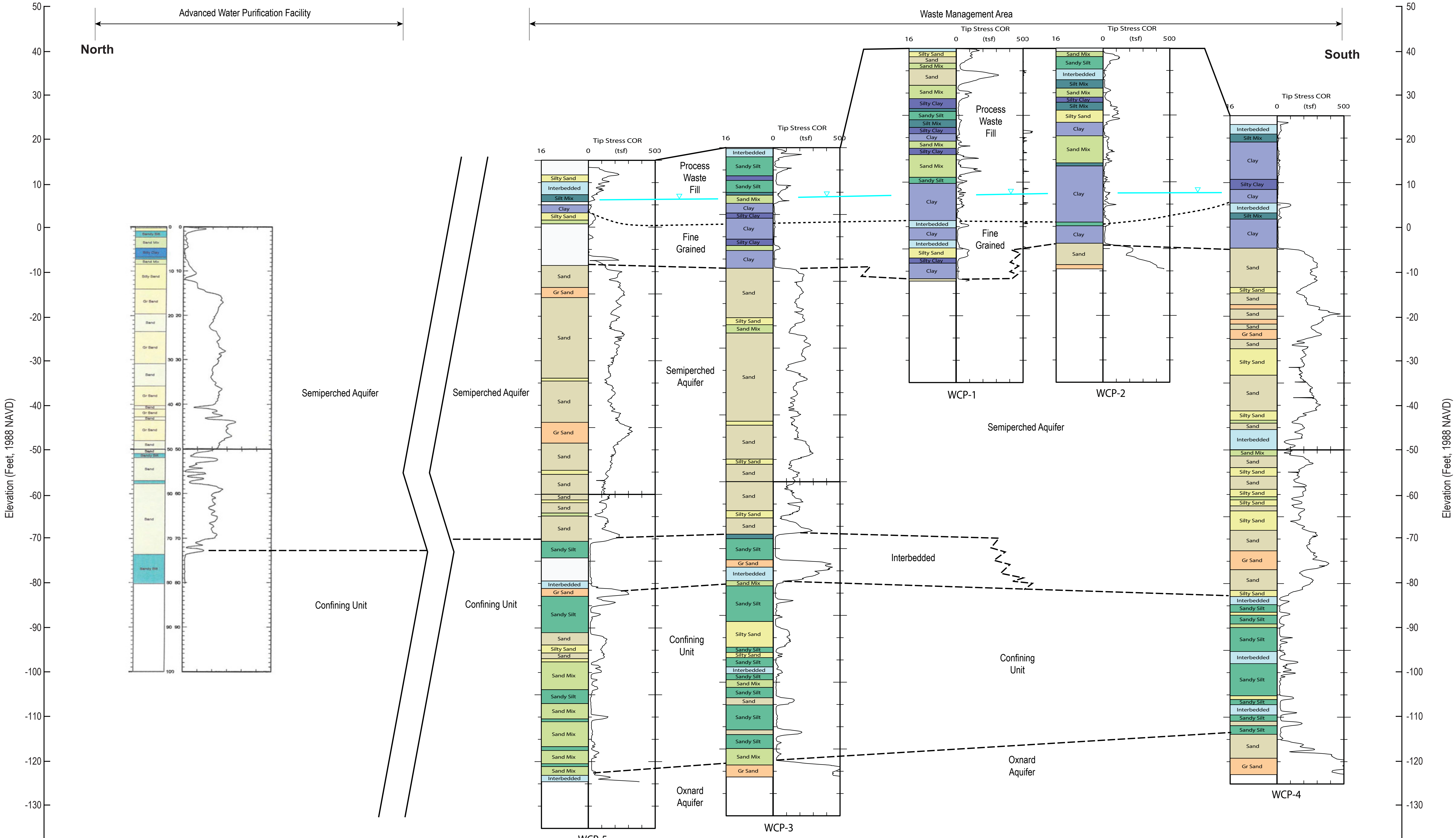
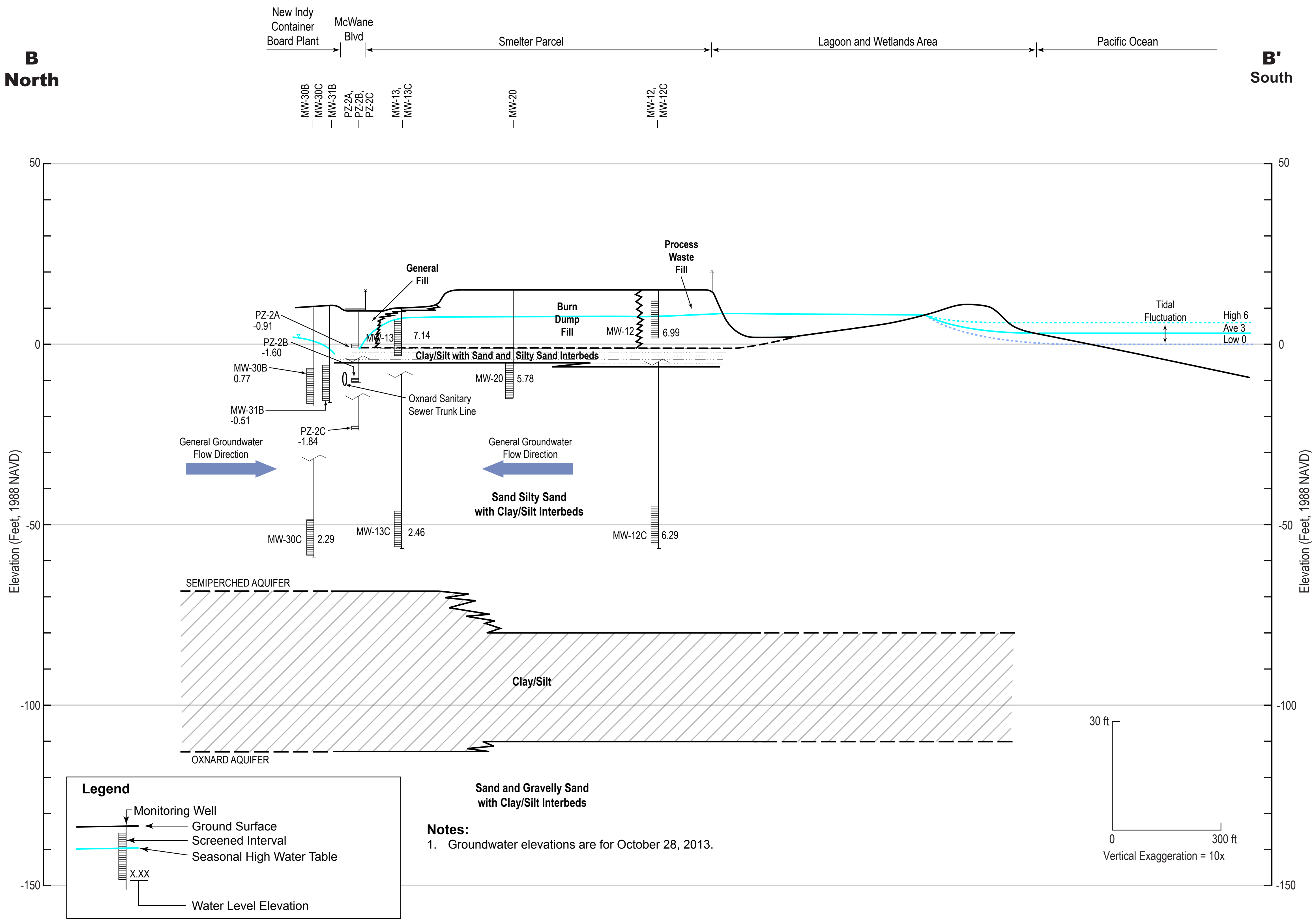


FIGURE 4b
CPT Cross Sections, North - South
Halaco Site Remedial Investigation

CH2MHILL



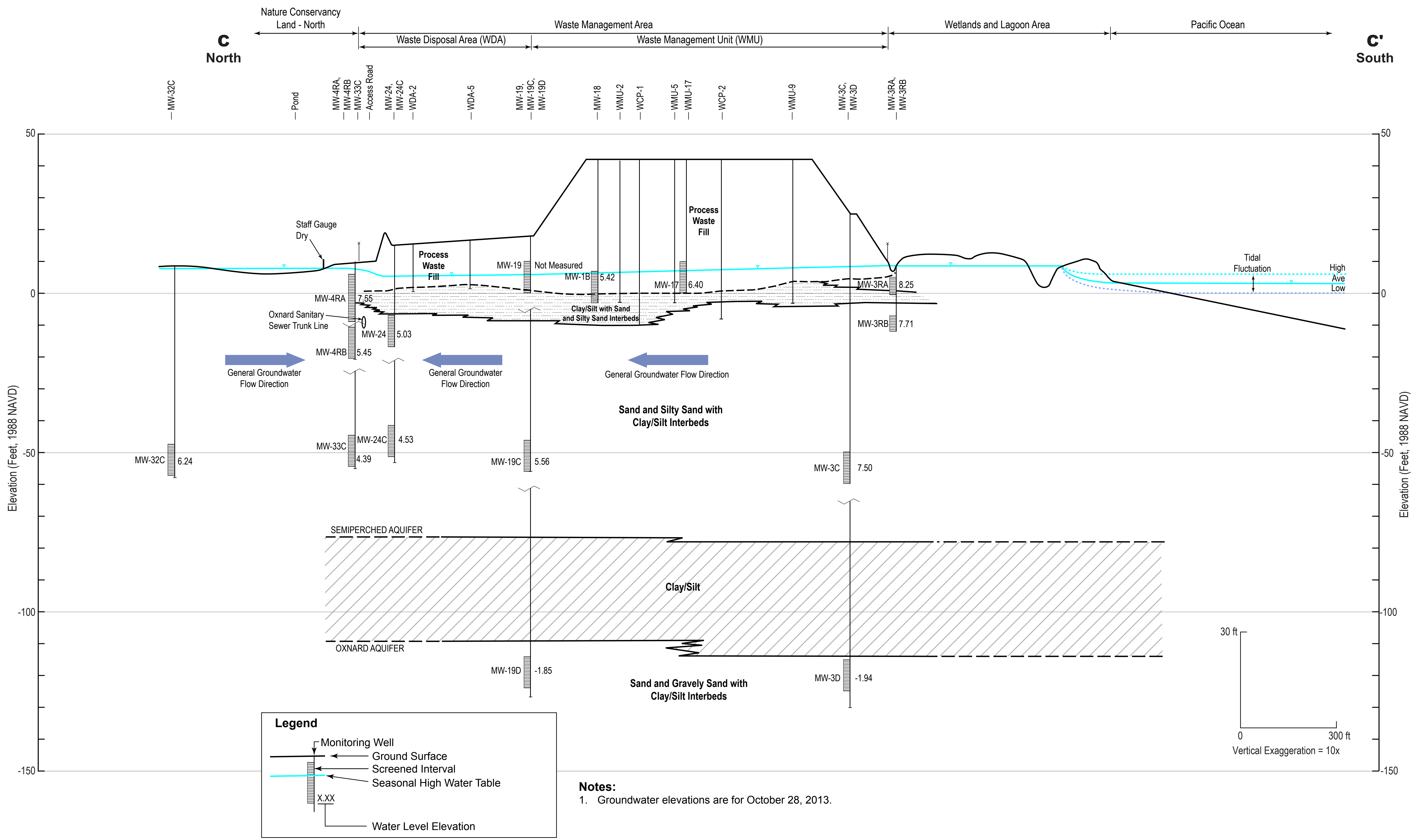
Notes:

1. Groundwater elevations are for October 28, 2013.

WBG110210203057SCO385135.DE.01 Halaco_cross-section BB'_rev3.ai 5/14

FIGURE 5a
Hydrogeologic Cross Section B-B'
Halaco Site Remedial Investigation

CH2MHILL



Notes:
1. Groundwater elevations are for October 28, 2013.

FIGURE 5b
Hydrogeologic Cross Section C-C'
Halaco Site Remedial Investigation

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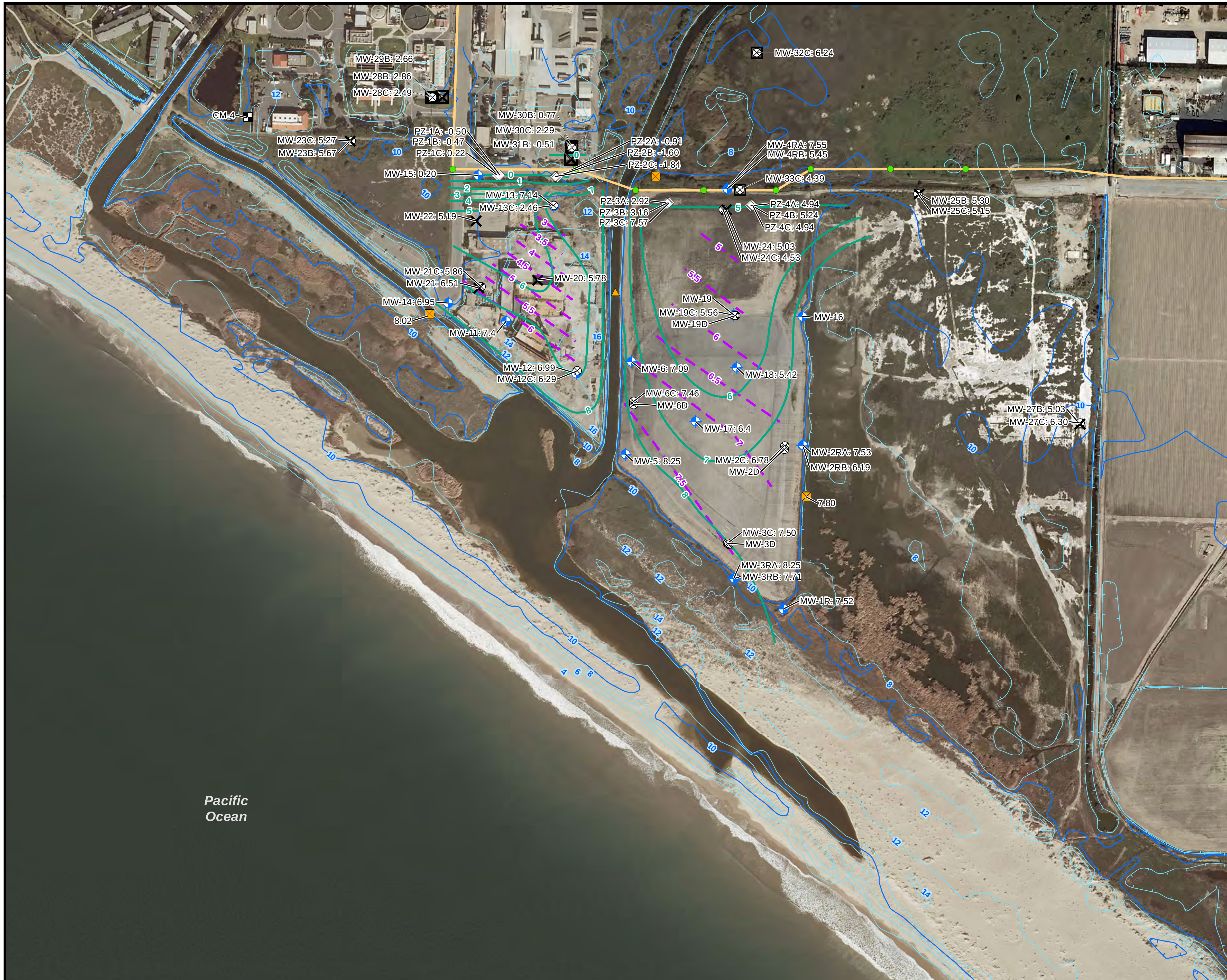
CH2MHILL



LEGEND

Groundwater Monitoring Locations

- New Shallow Well (2013)
- New Deeper Well (2013)
- Shallow Well (2003, 2006)
- Shallow Well (2009, 2010)
- Deeper Well (2009, 2010)
- Piezometer Cluster (2009, 2010)
- Surface Water Gauging Station
- Former Surface Water Pressure Transducer
- USGS Regional Monitoring Well

Sewer Line

- Oxnard Sewer Trunk Line
- Manhole

Ground Elevation Contours, ft (AMEC, 2006)

- 2 ft Contour
- 10 ft Contour

Groundwater Elevation Contours

- Shallow "A" and "B" Wells 1 ft Contour
- Deeper "C" Wells 0.5 ft Contour

Groundwater Elevation, ft

MW-21: 6.38

Surface Water Elevation, ft

NCL East: 7.80

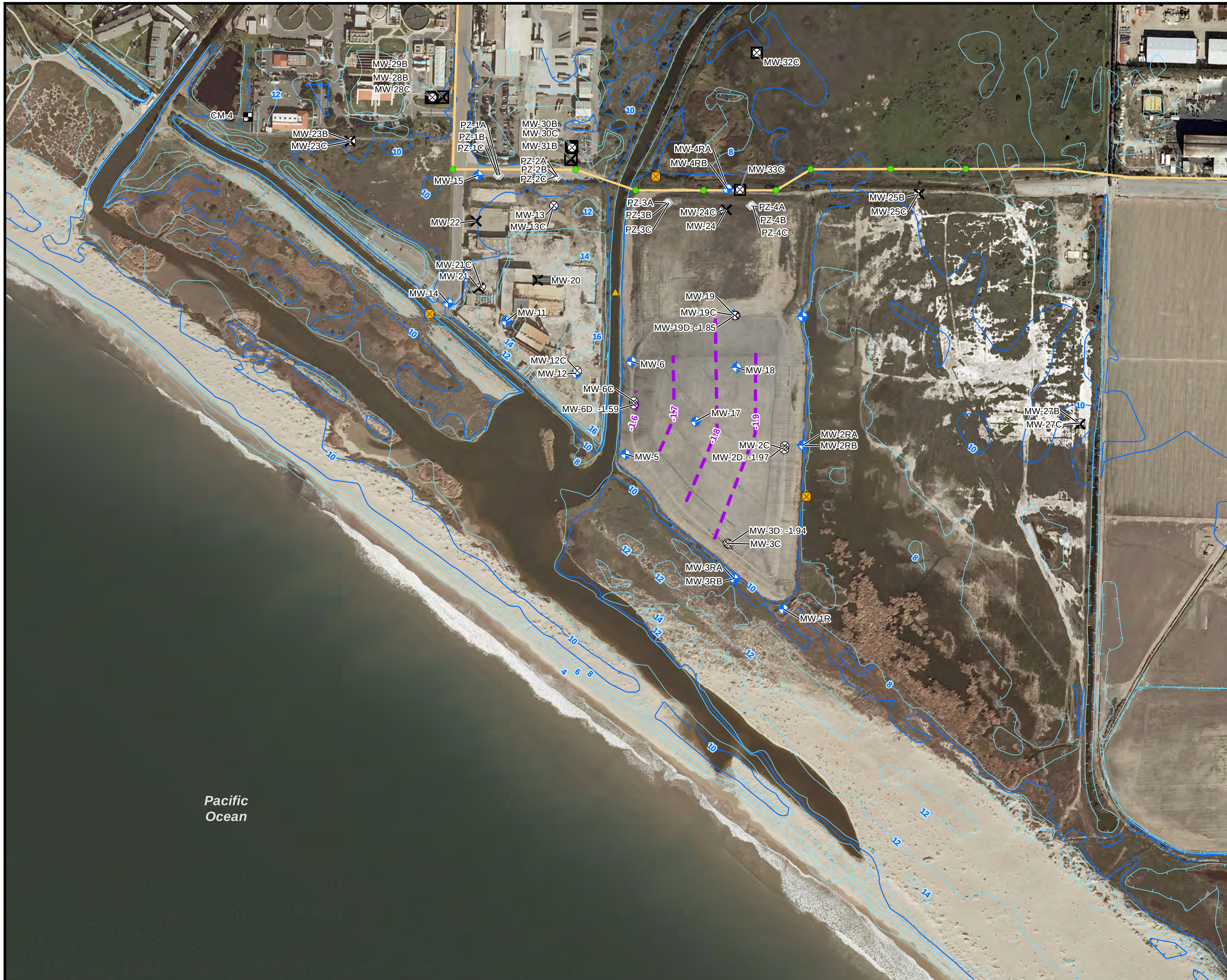
Note:
Elevation Datum is NAVD 1988
Aerial Photo Date: 2009

N

0 200 400
Feet
1 inch = 400 feet

FIGURE 6
Groundwater Elevation Contour Map
Semiperched Aquifer - 10/28/2013
HALACO SITE REMEDIAL INVESTIGATION
OXNARD, CALIFORNIA

R:\HALACO\MAPFILES\GW\REMEDIAL_INVESTIGATION_2014\FIGURE6_GWCONTOURS_SEMIPERCHED.MXD SGONZALES 5/27/2014 3:29:03 PM



LEGEND

Groundwater Monitoring Locations

- New Shallow Well (2013)
- New Deeper Well (2013)
- Shallow Well (2003, 2006)
- Shallow Well (2009, 2010)
- Deeper Well (2009, 2010)
- Piezometer Cluster (2009, 2010)
- Surface Water Gauging Station
- Former Surface Water Pressure Transducer
- USGS Regional Monitoring Well

Sewer Line

- Oxnard Sewer Trunk Line
- Manhole

Ground Elevation Contours, ft (AMEC, 2006)

- 2 ft Contour
- 10 ft Contour

Groundwater Elevation Contours

- 0.1 ft Contours

Groundwater Elevation, ft

- MW-3D: 1.94

Note:
Elevation Datum is NAVD 1988

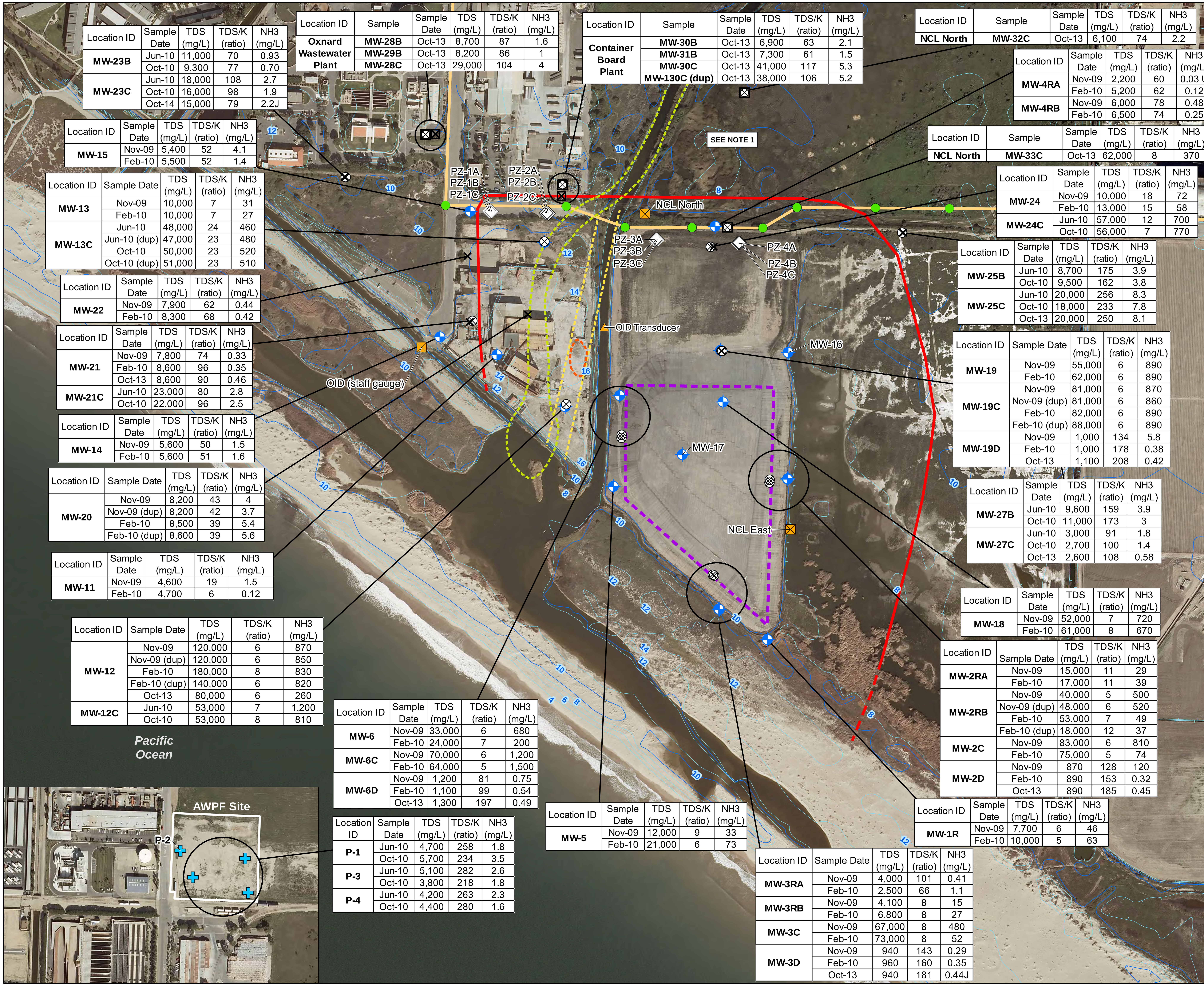
Aerial Photo Date: 2009

N

0 200 400
Feet
1 inch = 400 feet

FIGURE 7
Groundwater Elevation Contour Map
Oxnard Aquifer - 10/28/2013
HALACO SITE REMEDIAL INVESTIGATION
OXNARD, CALIFORNIA

R:\HALACO\MAPFILES\GW\REMEDIAL_INVESTIGATION_2014\FIGURE7_GWCONTOURS_OXNARD.MXD SGONZALES 5/27/2014 3:33:04 PM



Location ID	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
MW-23B	Jun-10	11,000	70	0.93
	Oct-10	9,300	77	0.70
MW-23C	Jun-10	18,000	108	2.7
	Oct-10	16,000	98	1.9
	Oct-14	15,000	79	2.2J

Location ID	Sample	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
Oxnard Wastewater Plant	MW-28B	Oct-13	8,700	87	1.6
	MW-29B	Oct-13	8,200	86	1
	MW-28C	Oct-13	29,000	104	4

Location ID	Sample	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
Container Board Plant	MW-30B	Oct-13	6,900	63	2.1
	MW-31B	Oct-13	7,300	61	1.5
	MW-30C	Oct-13	41,000	117	5.3
	MW-130C (dup)	Oct-13	38,000	106	5.2

Location ID	Sample	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
NCL North	MW-32C	Oct-13	6,100	74	2.2

Location ID	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
MW-4RA	Nov-09	2,200	60	0.03 U
	Feb-10	5,200	62	0.12
MW-4RB	Nov-09	6,000	78	0.48
	Feb-10	6,500	74	0.25

Location ID	Sample	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
NCL North	MW-33C	Oct-13	62,000	8	370

Location ID	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
MW-15	Nov-09	5,400	52	4.1
	Feb-10	5,500	52	1.4

Location ID	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
MW-24	Nov-09	10,000	18	72
	Feb-10	13,000	15	58
MW-24C	Jun-10	57,000	12	700
	Oct-10	56,000	7	770

Location ID	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
MW-13	Nov-09	10,000	7	31
	Feb-10	10,000	7	27
MW-13C	Jun-10	48,000	24	460
	Jun-10 (dup)	47,000	23	480
	Oct-10	50,000	23	520
	Oct-10 (dup)	51,000	23	510

Location ID	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
MW-25B	Jun-10	8,700	175	3.9
	Oct-10	9,500	162	3.8
MW-25C	Jun-10	20,000	256	8.3
	Oct-10	18,000	233	7.8
	Oct-13	20,000	250	8.1

Location ID	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
MW-22	Nov-09	7,900	62	0.44
	Feb-10	8,300	68	0.42

Location ID	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
MW-21	Nov-09	7,800	74	0.33
	Feb-10	8,600	96	0.35
	Oct-13	8,600	90	0.46
MW-21C	Jun-10	23,000	80	2.8
	Oct-10	22,000	96	2.5

Location ID	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
MW-19	Nov-09	55,000	6	890
	Feb-10	62,000	6	890
MW-19C	Nov-09	81,000	6	870
	Nov-09 (dup)	81,000	6	860
	Feb-10	82,000	6	890
	Feb-10 (dup)	88,000	6	890
MW-19D	Nov-09	1,000	134	5.8
	Feb-10	1,000	178	0.38
	Oct-13	1,100	208	0.42

Location ID	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
MW-14	Nov-09	5,600	50	1.5
	Feb-10	5,600	51	1.6

Location ID	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
MW-20	Nov-09	8,200	43	4
	Nov-09 (dup)	8,200	42	3.7
	Feb-10	8,500	39	5.4
	Feb-10 (dup)	8,600	39	5.6

Location ID	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
MW-27B	Jun-10	9,600	159	3.9
	Oct-10	11,000	173	3
MW-27C	Jun-10	3,000	91	1.8
	Oct-10	2,700	100	1.4
	Oct-13	2,600	108	0.58

Location ID	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
MW-11	Nov-09	4,600	19	1.5
	Feb-10	4,700	6	0.12

Location ID	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
MW-18	Nov-09	52,000	7	720
	Feb-10	61,000	8	670

Location ID	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
MW-12	Nov-09	120,000	6	870
	Nov-09 (dup)	120,000	6	850
	Feb-10	180,000	8	830
	Feb-10 (dup)	140,000	6	820
	Oct-13	80,000	6	260
MW-12C	Jun-10	53,000	7	1,200
	Oct-10	53,000	8	810

Location ID	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
MW-2RA	Nov-09	15,000	11	29
	Feb-10	17,000	11	39
MW-2RB	Nov-09	40,000	5	500
	Nov-09 (dup)	48,000	6	520
	Feb-10	53,000	7	49
	Feb-10 (dup)	18,000	12	37
MW-2C	Nov-09	83,000	6	810
	Feb-10	75,000	5	74
MW-2D	Nov-09	870	128	120
	Feb-10	890	153	0.32
	Oct-13	890	185	0.45

Location ID	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
MW-6	Nov-09	33,000	6	680
	Feb-10	24,000	7	200
MW-6C	Nov-09	70,000	6	1,200
	Feb-10	64,000	5	1,500
MW-6D	Nov-09	1,200	81	0.75
	Feb-10	1,100	99	0.54
	Oct-13	1,300	197	0.49

Location ID	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
MW-5	Nov-09	12,000	9	33
	Feb-10	21,000	6	73

Location ID	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
MW-1R	Nov-09	7,700	6	46
	Feb-10	10,000	5	63

Location ID	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
P-1	Jun-10	4,700	258	1.8
	Oct-10	5,700	234	3.5
P-3	Jun-10	5,100	282	2.6
	Oct-10	3,800	218	1.8
P-4	Jun-10	4,200	263	2.3
	Oct-10	4,400	280	1.6

Location ID	Sample Date	TDS (mg/L)	TDS/K (ratio)	NH3 (mg/L)
MW-3RA	Nov-09	4,000	101	0.41
	Feb-10	2,500	66	1.1
MW-3RB	Nov-09	4,100	8	15
	Feb-10	6,800	8	27
MW-3C	Nov-09	67,000	8	480
	Feb-10	73,000	8	52
MW-3D	Nov-09	940	143	0.29
	Feb-10	960	160	0.35
	Oct-13	940	181	0.44J

LEGEND

Groundwater Monitoring Locations
- New Shallow Well (2013)
- New Deeper Well (2013)
- Shallow Well (2003, 2006)
- Shallow Well (2009, 2010)
- Deeper Well (2009, 2010)
- Piezometer Cluster (2009, 2010)
- Surface Water Gauging Station
- Former Surface Water Pressure Transducer
- AWPF Piezometers
- USGS Regional Monitoring Well

Sewer Line
- Oxnard Sewer Trunk Line
- Manhole

Ground Elevation Contours, ft (AMEC, 2006)
- 2 ft Contour
- 10 ft Contour

Historical OID Alignment
- 1929 OID
- 1959 OID
- 1969 Pond

Approximate Extent of Impacted Groundwater and Former Ponds
- Approximate Extent of Groundwater Impacted by Halaco's Operations
- Approximate Extent of Former Process Waste Settling Pond

Note:
Elevation Datum is NAVD 1988

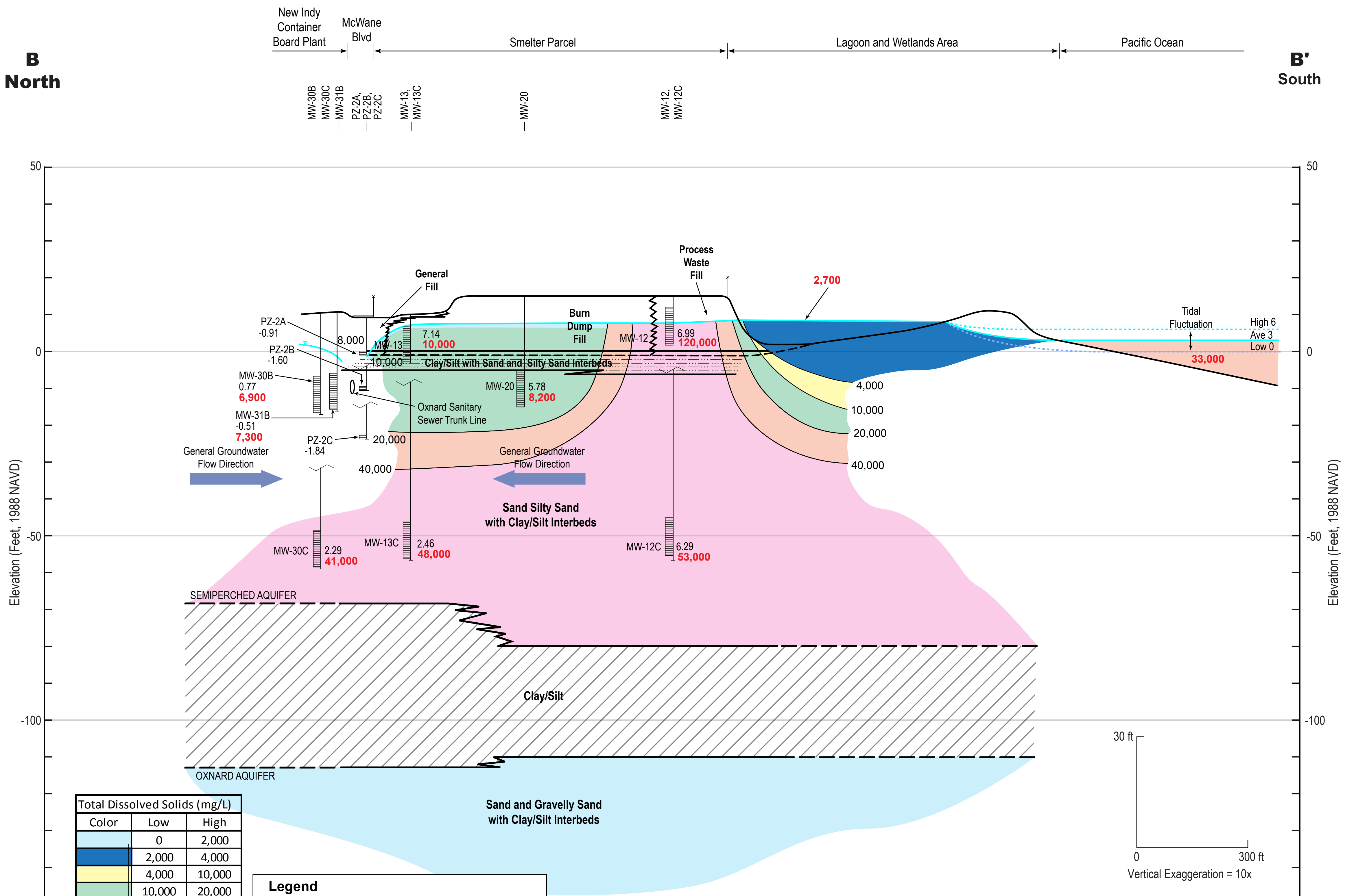
Aerial Photo Date: 2009

1. The northern extent of Halaco's impacts in the NCL North area is uncertain and the actual northern extent could be closer to MW-32C.

N

0 200 400
Feet
1 inch = 200 feet

FIGURE 8
Approximate Extent of Groundwater Impacted by Halaco's Operations
HALACO SITE REMEDIAL INVESTIGATION
OXNARD, CALIFORNIA



Total Dissolved Solids (mg/L)		
Color	Low	High
	0	2,000
	2,000	4,000
	4,000	10,000
	10,000	20,000
	20,000	40,000
	40,000	>40,000

11,000 **Total dissolved solids concentrations (mg/L)**

Legend

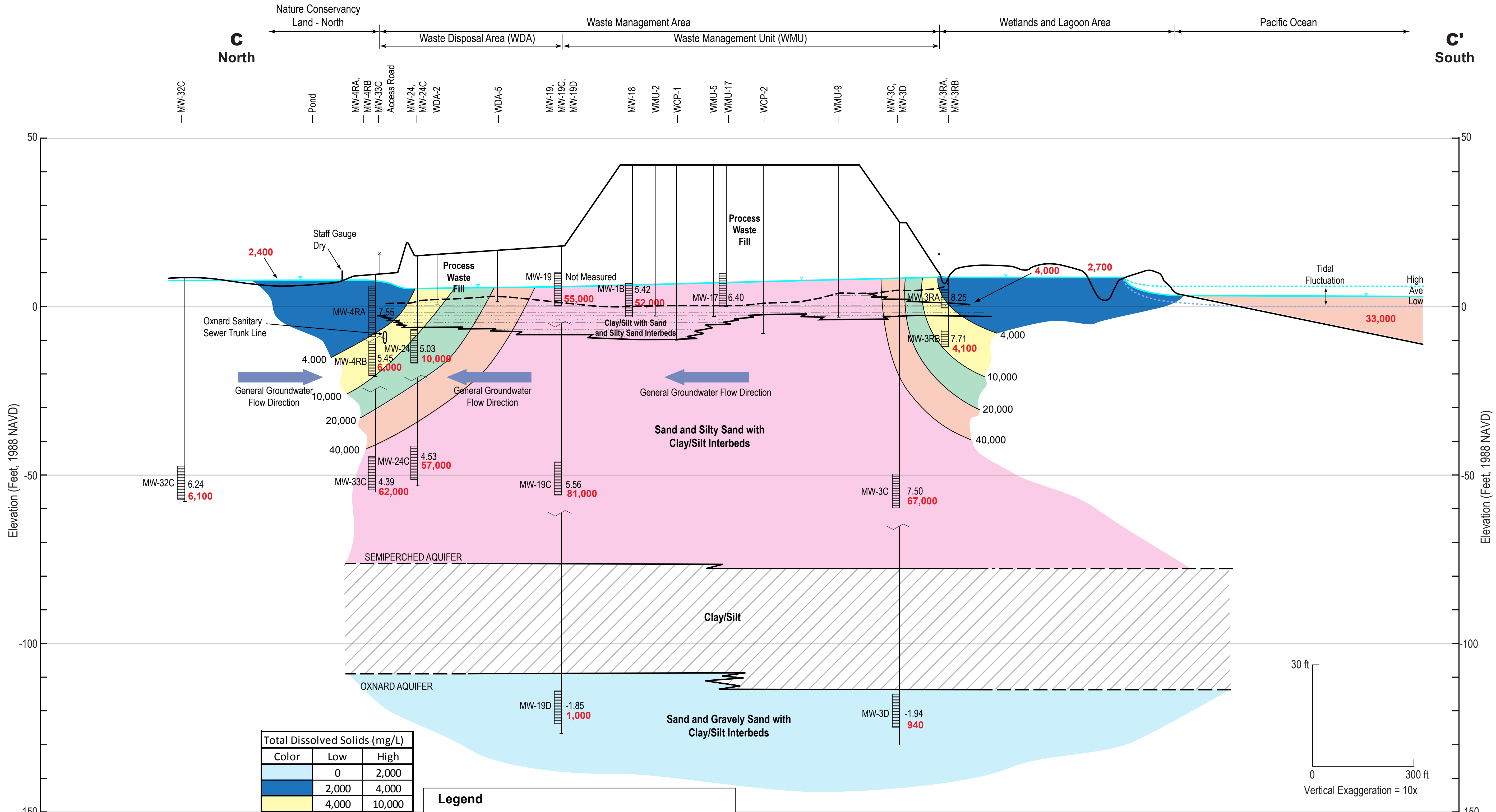
Monitoring Well
Ground Surface
Screened Interval
Seasonal High Water Table
X.XX
Water Level Elevation

Notes:

1. See Hydrogeologic Cross Section B-B' for notes on surface water and groundwater elevations.
2. TDS concentrations for existing wells and surface water were collected either during November 2009 or June 2010.
3. TDS concentrations for new wells MW-32C and MW-33C were collected October 2013.

WBG110210203057SCO385135.DE.01 Halaco_cross-section BB'_v3.ai 5/14

FIGURE 9a
Hydrogeologic Cross Section B-B' with TDS
Halaco Site Remedial Investigation
CH2MHILL



Total Dissolved Solids (mg/L)		
Color	Low	High
light blue	0	2,000
dark blue	2,000	4,000
yellow	4,000	10,000
green	10,000	20,000
peach	20,000	40,000
pink	40,000	>40,000

11,000 **Total dissolved solids concentrations (mg/L)**

Legend

- Monitoring Well
- Ground Surface
- Screened Interval
- Seasonal High Water Table
- X.XX Water Level Elevation

Notes:

1. See Hydrogeologic Cross Section C-C' for notes on surface water and groundwater elevations.
2. TDS concentrations for existing wells and surface water were collected either during November 2009 or June 2010.
3. TDS concentrations for new wells MW-30B, MW-30C, and MW-31B were collected October 2013.

FIGURE 9b
Hydrogeologic Cross Section C-C' with TDS
Halaco Site Remedial Investigation
Oxnard, California

CH2MHILL

WBG110210203057SCO385135.DE.01 Halaco_cross-section CC'_v3.ai 5/14

Figure 10
Major Ion Chemistry

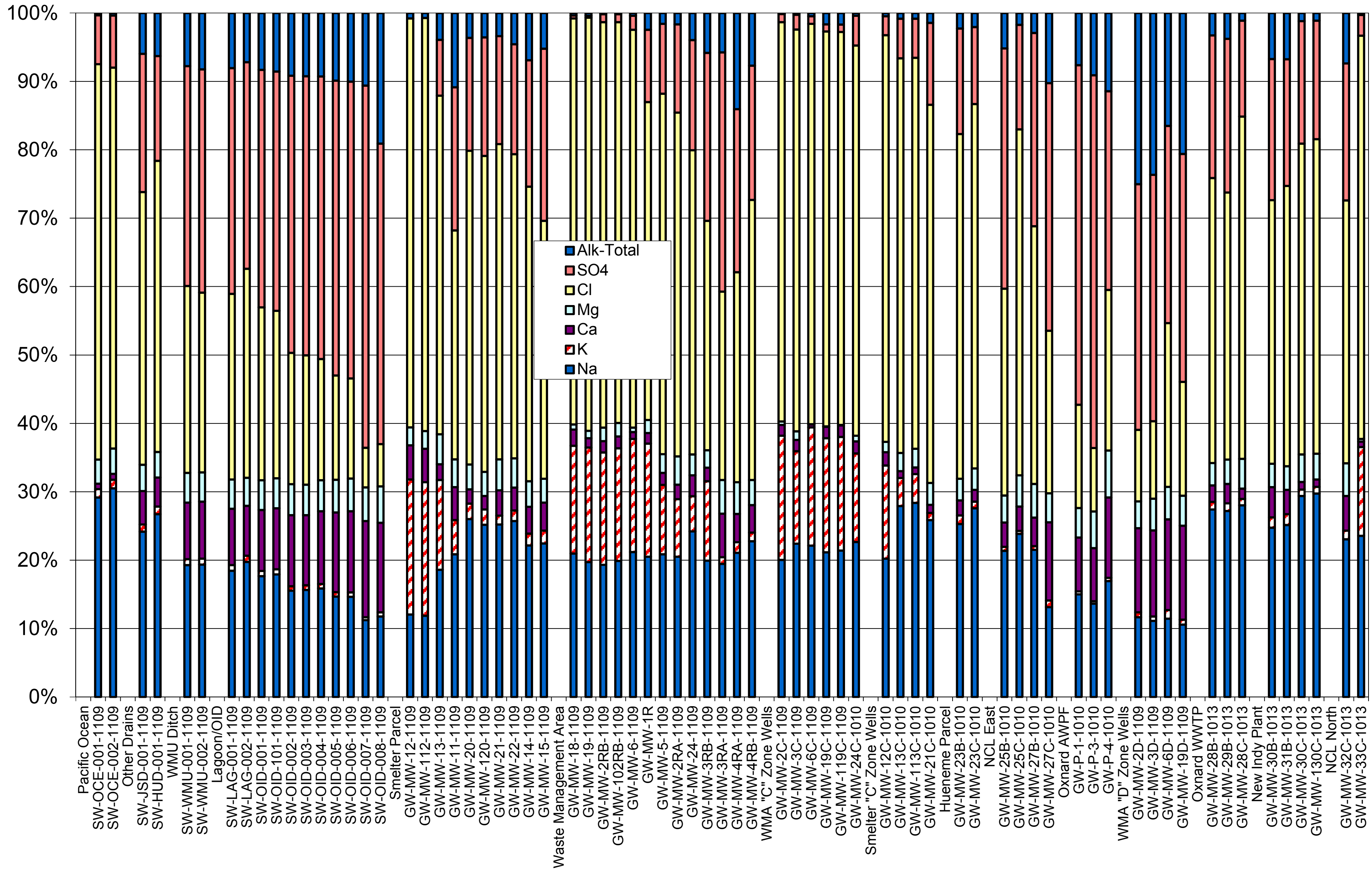


Figure 11
TDS/K Ratios

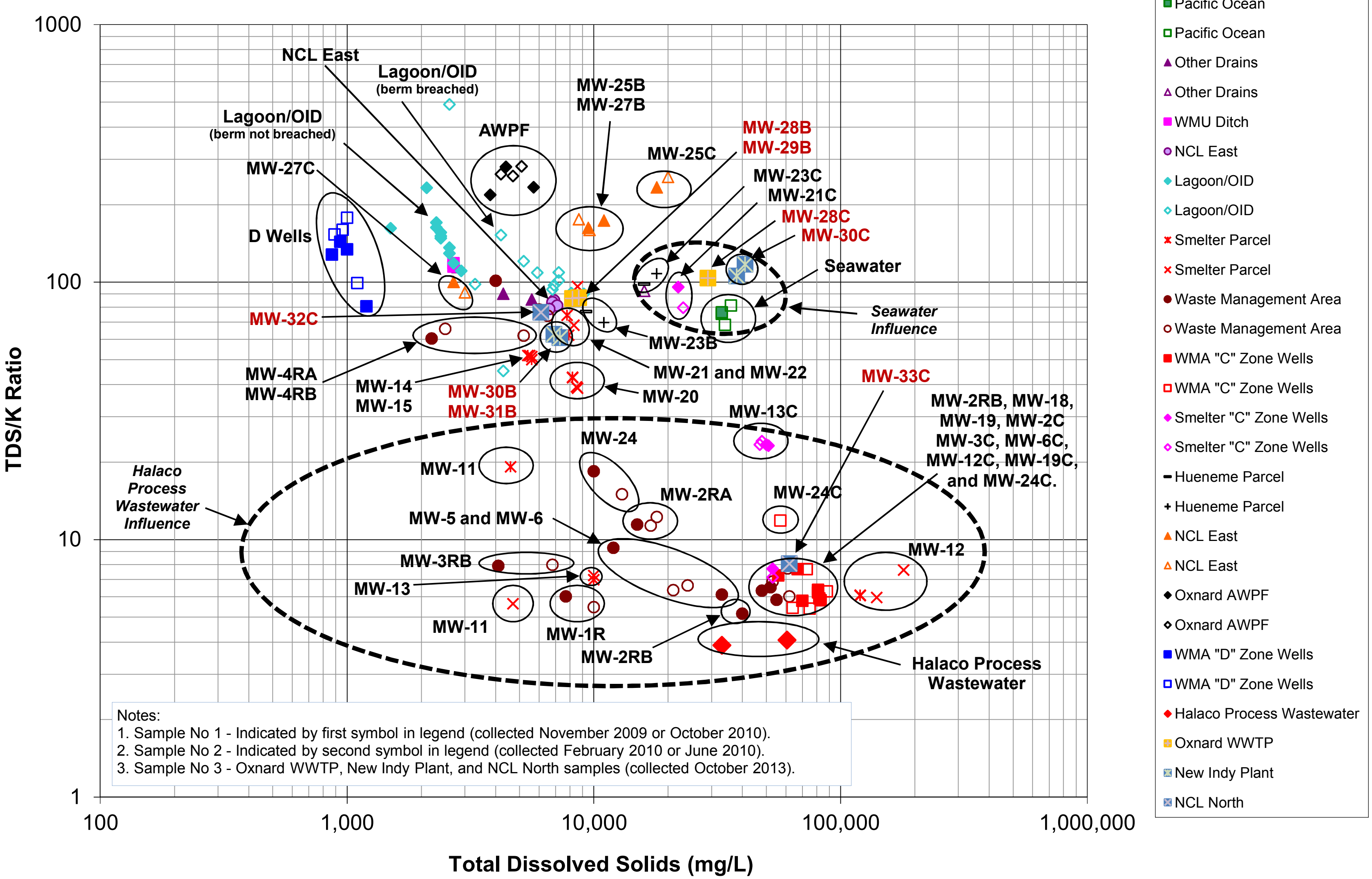


Figure 12
Trilinear Diagram

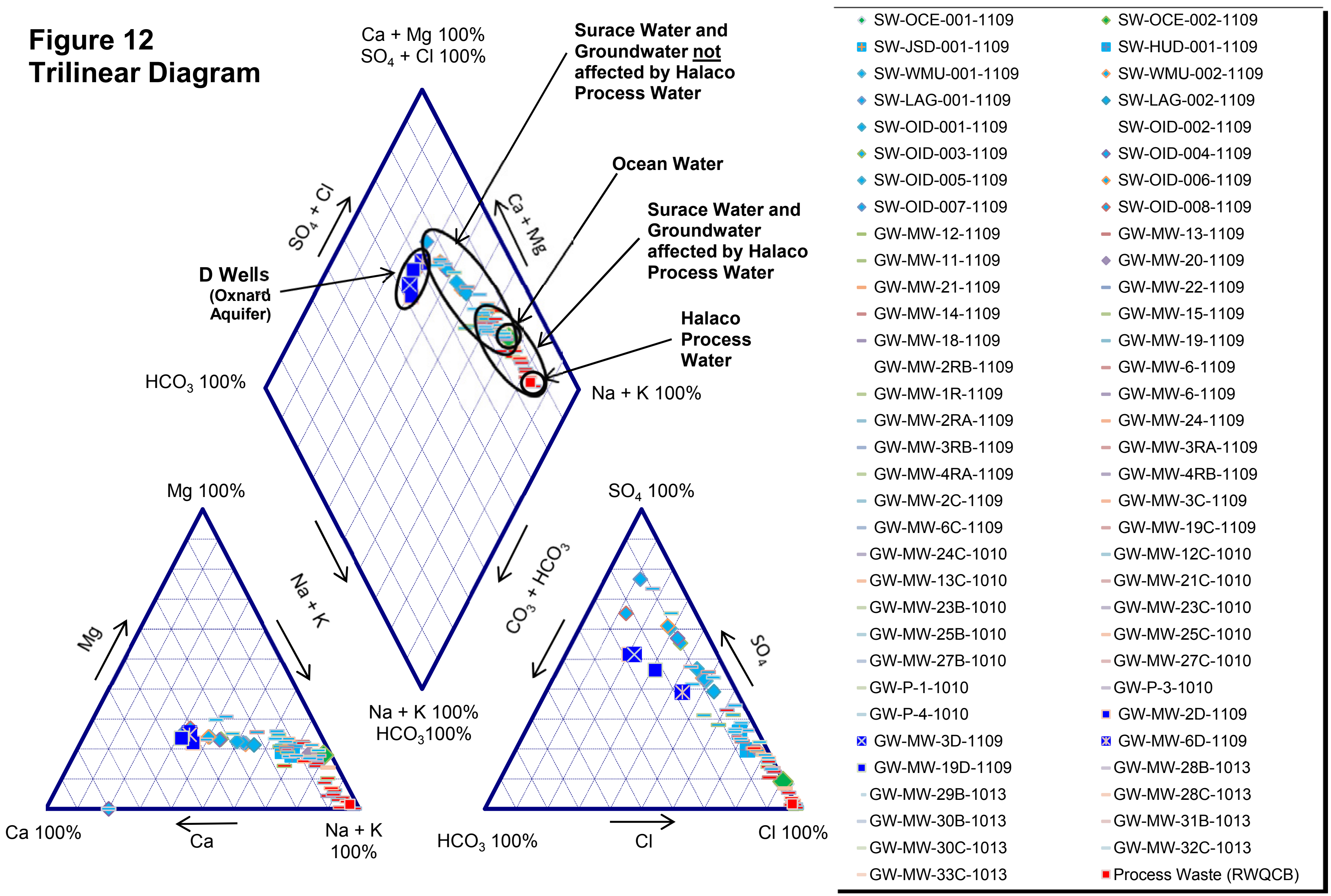


FIGURE_12_Trilinear_Diagram.xls

Attachment A
Photographs of Monitoring Well Installation Activities

PHOTO 1
Hollow Stem Auger Drilling, MW-32C, The Nature Conservancy Land – North

PHOTO 2
Well Completion, MW-32C, The Nature Conservancy Land – North

PHOTO 3
Well Completions, MW-28B and MW-28C, Oxnard WWTP

PHOTO 4
Well Completion, MW-31B, New Indy Container Board Plant

Attachment B
Monitoring Well Boring Logs and Construction Diagrams

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PROJECT NUMBER: 460434.FI.01 **BORING NUMBER:** MW-28C
Sheet: 1 of 1

SOIL BORING LOG

PROJECT: Halaco Superfund **LOCATION:** Water Treatment Plant - South East
ELEVATION: **DRILLING CONTRACTOR:** National EWP
DRILLING METHOD AND EQUIPMENT: CME-LAR
WATER LEVELS: **START:** 9/30/13 **LOGGER:** C. Kamali

DEPTH BELOW (Feet)	SAMPLE TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	GRAPHIC LOG	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Ground Surface	
0					Hand augered to 6' bgs to clear subsurface utilities	
5					Silt (ML), grayish brown (10YR 5/2) moist, 95% fines, 5% fine sand, tr. mica, low plasticity.	0.0 ppm
10	10' SPT 11.5'	1.0	4, 7, 8		Poorly Graded Sand (SP) medium dense, olive gray (5Y 4/2), wet, 95% fine sand, 5% fines, tr. mica,	0.0 ppm
15	SPT	1.4	9, 18, 20		Poorly Graded Sand (SP), olive gray (5Y 4/2), wet, dense, 70% fine sand, 30% med. sand, tr. coarse sand. tr. mica.	0.0 PPM
20	SPT	1.5	10, 14, 19		Poorly Graded Sand (SP), olive gray (5Y 4/2) wet, dense, 90% med. sand, 10% fine sand, tr. coarse sand, tr. mica	0.0 PPM
25						

reference template: Ch2m_GeotechBoring_KMEP

CH2MHILL

PROJECT NUMBER: **BORING NUMBER:** MW-28C
Sheet: 1 of 1

SOIL BORING LOG

PROJECT: **LOCATION:**
ELEVATION: **DRILLING CONTRACTOR:**
DRILLING METHOD AND EQUIPMENT:
WATER LEVELS: **START:** **LOGGER:**

DEPTH BELOW (Feet)	SAMPLE TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	GRAPHIC LOG	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
25 / 0					Ground Surface	
	SPT	1.5	12,16,19		Well Graded Sand (SW), olive gray (5Y 4/2), wet, dense, 60% med. sand, 20% coarse sand, 10% fine sand, 10% coarse gravel, subangular, tr. seashell	0.0 ppm
30 / 5	SPT	1.5	14,20,31		Well Graded Sand (SW), olive gray (5Y 4/2), wet, v. dense, 60% med. sand, 25% coarse sand, 15% fine sand,	0.0 ppm
35 / 10	SPT	1.5	19,25,31		Poorly Graded Sand (SP), olive gray (5Y 4/2), wet, v. dense, 95% fine sand, 5% fines, tr. mica (biotite).	0.0 ppm
40 / 15	SPT	1.5	19,21,30		Poorly Graded Sand (SP) 70% fine sand, 30% med. sand, tr. mica	0.0 ppm
45 / 20		1.5	21,27,41		Poorly Graded Sand (SP) olive gray (5Y 4/2) wet, v. dense, 95% fine sand, 5% fines, tr gravel, rounded, tr. mica.	0.0 ppm
50 / 25						

reference template: Ch2m_GeotechBoring_KMEP

CH2MHILL

PROJECT NUMBER: **BORING NUMBER:** MW-28C
Sheet: 1 of 1

SOIL BORING LOG

PROJECT: **LOCATION:**
ELEVATION: **DRILLING CONTRACTOR:**
DRILLING METHOD AND EQUIPMENT:
WATER LEVELS: **START:** **LOGGER:**

DEPTH BELOW (Feet)	SAMPLE TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	GRAPHIC LOG	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Ground Surface	
50	SPT	1.5	13, 24, 45		Poorly Graded Sand (SP), olive gray (5Y 4/2), wet, v. dense, 60% fine sand, w/ lenses of med and coarse sand at 50.5' (40%), tr. seashells.	0.0 ppm
55		1.5	17, 19, 36		Poorly Graded Sand (SP) olive (5Y 4/3), wet, v. dense, 90% fine sand, 5% med. sand, 5% fines, tr. seashells.	0.0 ppm
60 (~~10~~)		1.5	8, 10, 15		Poorly Graded Sand w/ Silt (SP-SM) olive (5Y 4/3), wet, m. dense, 90% fine sand, 10% fines, tr fine mica	0.0 ppm
65 (~~15~~)		1.5	11, 16, 24		Same as above,	0.0 ppm
70 (~~20~~)		1.5			Poorly Graded Sand (SP) olive (5Y 4/3), wet, dense, 95% fine sand, 5% fines, tr. fine mica TD = 70'	0.0 ppm
75 (~~25~~)						

reference template: Ch2m_GeotechBoring_KMEP

CH2MHILL

PROJECT NUMBER: 460434.FI.01	BORING NUMBER: MW-28B
	Sheet: 1 of 1

SOIL BORING LOG

PROJECT: Halaco Superfund Site **LOCATION:** Water Treatment plant, SE
ELEVATION: **DRILLING CONTRACTOR:** National EWP
DRILLING METHOD AND EQUIPMENT: HSA; CME-LAR
WATER LEVELS: **START:** 10/1/13 **LOGGER:** C. Kamali

DEPTH BELOW (Feet)	SAMPLE TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	GRAPHIC LOG	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Ground Surface	
0					Hand augered to 6' bgs to clear subsurface utilities	
5					Silt (ML) Grayish brown (10YR 5/2), moist, 95% fines, 5% fine sand lenses, tr. mica, low plasticity.	
10					Poorly Graded Sand (SP) olive Gray (5Y 4/2), wet, med. dense, 95% fine sand, 5% fines, tr. mica.	
15					Poorly Graded Sand (SP) Olive Gray (5Y 4/2), wet, dense, 70% fine sand, 30% med. sand, tr. coarse sand, tr. mica.	
20					Poorly Graded Sand (SP) olive Gray (5Y 4/2), wet, dense, 90% med. sand, 10% fine sand, tr. coarse sand, tr. mica.	
25						

CH2MHILL

PROJECT NUMBER: 460434·FI·01

BORING NUMBER: MW-29B

Sheet: 1 of 1

SOIL BORING LOG

PROJECT: Halaco Superfund Site
LOCATION: water treatment plant - SE
ELEVATION:
DRILLING CONTRACTOR: National EWP
DRILLING METHOD AND EQUIPMENT: HSA; CME-LAR
WATER LEVELS:
START: 10/1/13
LOGGER: C. Kamali

DEPTH BELOW (Feet)	SAMPLE TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	GRAPHIC LOG	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Ground Surface	
0					Hand augered to 6' bgs to clear subsurface utilities.	
5					Silt (ML) Brown (10YR 5/3), moist, 95% fines, 5% fine sand as thin lenses, tr. fine mica, low plasticity.	0.0 ppm
10		1	9, 10, 14		Poorly Graded Sand w/silt (SP-SM) olive Gray (5Y 4/2), wet, med. dense, 90% fine sand, 10% fines, tr. mica.	0.0 ppm
15		1.5			Poorly Graded Sand (SP) Olive Gray (5Y 4/2), wet, med. dense, 70% Med. sand, 30% fine sand, tr. mica flakes.	0.0 ppm
20		1.5			Poorly Graded sand (SP) olive Gray (5Y 4/2), wet, Med. dense, 70% med. sand, 30% Coarse sand, tr. mica	0.0 ppm
25					Same as above dense,	0.0 ppm
26		1.5				
27					TD = 27'	

reference template: Ch2m_GeotechBoring_KMEP

CH2MHILL

PROJECT NUMBER: 460434.FI.01 **BORING NUMBER:** MW-30C

Sheet: 1 of 3

SOIL BORING LOG

PROJECT: Halaco Superfund **LOCATION:** New 2ndy containerboard – SE

ELEVATION: **DRILLING CONTRACTOR:** National EWP

DRILLING METHOD AND EQUIPMENT: HSA; CME-95; 8" Augers

WATER LEVELS: **START:** 10/2/13 **LOGGER:** C. Kamali

DEPTH BELOW (Feet)	SAMPLE		STANDARD PENETRATION TEST RESULTS	GRAPHIC LOG	SOIL DESCRIPTION	COMMENTS
	TYPE	RECOVERY (FT)	6"-6"-6" (N)		SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Ground Surface	
0					Hand augered to 3' bgs to clear subsurface utilities	Difficult hand augering due to concrete fragments at 3' bgs
5	Grab	0.5			Fill very dark grayish brown (2.5Y 3/2) concrete fragments within silty sand matrix, moist, 70% silt-sand mixture, 30% concrete fragments.	0.0 ppm
10	SPT	1.5	4,7,7		silt w/ sand (ML) dark olive gray (5Y 3/2), moist, med dense 85% fines, 15% fine sand, more clayey at 10.5'–11.0'	0.0 ppm
15	SPT	1.5	13,15,18		Poorly Graded sand (SP) olive gray (5Y 4/2), wet, dense, 70% med. sand, 30% fine sand, tr. mica.	0.0 ppm
20		1.5	15,18,23		Poorly Graded Sand (SP) olive gray (5Y, 4/2), wet, dense 60% med. sand, 40% coarse sand, tr. seashells & fine gravel, tr. mica	0.0 ppm
25						

reference template: Ch2m_GeotechBoring_KMEP

CH2MHILL

PROJECT NUMBER:

BORING NUMBER: MW-30C

Sheet: ~~1~~ of ~~1~~ 2 of 3

SOIL BORING LOG

PROJECT:

LOCATION:

ELEVATION:

DRILLING CONTRACTOR:

DRILLING METHOD AND EQUIPMENT:

WATER LEVELS:

START:

LOGGER:

DEPTH BELOW (Feet)	SAMPLE TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	GRAPHIC LOG	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Ground Surface	
25 ~~0~~	SPT	1.5	10, 12, 14 26.2' 26.5'	SP / CH / SP	25-26.2' Poorly Graded Sand (SP) olive gray (5Y 4/2), wet, med. dense, 60% med. sand, 40% coarse sand, 26.2-26.5' Fat Clay (CH) dark gray (5Y 4/1), wet, 100% fines high plasticity.	0.0 ppm
30 ~~5~~	SPT	1.5'	14, 17, 21		Poorly Graded Sand (SP) Dark gray (5Y 4/1), wet, dense, 80% fine sand, 20% med. sand tr. mica flakes	0.0 ppm
35 ~~10~~	SPT	1.5'	13, 15, 18		Poorly Graded Sand (SP) Dark Gray (5Y 4/1), wet, dense, 95% fine sand, 5% fines, tr. fine mica	0.0 ppm
40 ~~15~~	SPT	1.5	12, 15, 15		Poorly Graded Sand (SP) Same as above, med. dense.	0.0 ppm
45 ~~20~~		1.5	13, 18, 22		Poorly Graded Sand w/ silt (SP-SM) Dark gray (5Y 4/1) wet, dense, 90% fine sand, 10% fines, tr. fine mica tr. fine gravel, subrounded.	0.0 ppm
50 ~~25~~						

reference template: Ch2m_GeotechBoring_KMEP

CH2MHILL

PROJECT NUMBER:

BORING NUMBER: MW-30C

Sheet: ~~1~~ of ~~1~~ 3 of 3

SOIL BORING LOG

PROJECT:

LOCATION:

ELEVATION:

DRILLING CONTRACTOR:

DRILLING METHOD AND EQUIPMENT:

WATER LEVELS:

START:

LOGGER:

DEPTH BELOW (Feet)	SAMPLE TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	GRAPHIC LOG	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Ground Surface	
50	SPT	1.5	20, 20, 20		Poorly Graded Sand (SP) Dark gray (5Y 4/1), wet, dense, 70% fine sand, 25% med. sand, 5% fines, tr. mica	0.0 ppm
55	SPT	1.5	15, 18, 20		Silty Sand (SM) Dark Gray (5Y 4/1), wet, dense, 80% fine sand, 20% nonplastic fines, tr. fine mica.	0.0 ppm
60 ~~10~~	SPT	1.5	13, 15, 17		Poorly Graded Sand w/ silt (SP-SM) Dark Gray (5Y 4/1), wet, dense, 90% fine sand, 10% nonplastic fines, tr. fine mica	0.0 ppm
65 ~~15~~	SPT	1.5	18, 23, 25		Poorly Graded Sand (SP) Dark Gray (5Y 4/1), wet, dense 85% fine sand, 10% med. sand, 5% nonplastic fines, tr. fine Mica	0.0 ppm
70 ~~20~~	SPT	1.5	14, 18, 22		Poorly Graded Sand w/ Silt (SP-SM) Dark Gray (5Y 4/1), wet, dense 90% fine sand, 10% nonplastic fines, tr. seashells. TD = 70'	0.0 ppm
75 ~~25~~						

reference template: Ch2m_GeotechBoring_KMEP

CH2MHILL

PROJECT NUMBER: 460434.FI.01

BORING NUMBER: MW-30B

Sheet: 1 of 1

SOIL BORING LOG

PROJECT: Halaco Superfund Site

LOCATION: New Indy Containerboard - SE

ELEVATION: TBD

DRILLING CONTRACTOR: National EWP

DRILLING METHOD AND EQUIPMENT: HSA; CME-95; 8" Augers

WATER LEVELS: TBD

START: 10/2/13

LOGGER: C. Kamali

DEPTH BELOW (Feet)	SAMPLE		STANDARD PENETRATION TEST RESULTS	GRAPHIC LOG	SOIL DESCRIPTION	COMMENTS
	TYPE	RECOVERY (FT)	6"-6"-6" (N)		SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Ground Surface	
0					Hand augered to 3' bgs to clear subsurface utilities	Difficult hand augering due to concrete fragments at 3' bgs
5					Fill Very dark grayish brown (2.5Y 3/2) Concrete fragments within silty sand matrix, moist, 70% silt sand mixture, 30% Concrete fragments.	0.0 ppm
10					Silt w/sand (ML) Dark olive gray (5Y 3/2), moist, med. dense 85% fines, 15% fine sand, clayey at 10.5-11.0'	0.0 ppm
15					Poorly Graded Sand (SP) Olive gray (5Y 4/2), wet, dense 70% med. sand, 30% fine sand, tr mica.	0.0 ppm
20					Poorly Graded Sand (SP) Olive gray (5Y 4/2), wet, dense, 60% med. sand, 40% coarse sand, tr. seashells & fine gravel, tr. mica	0.0 ppm
25						

reference template: Ch2m_GeotechBoring_KMEP

CH2MHILL

PROJECT NUMBER:

BORING NUMBER: MW-30B

Sheet: ~~1 of 1~~ 2 of 2

SOIL BORING LOG

PROJECT:
LOCATION:
ELEVATION:
DRILLING CONTRACTOR:
DRILLING METHOD AND EQUIPMENT:
WATER LEVELS:
START:
LOGGER:

DEPTH BELOW (Feet)	SAMPLE: TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	GRAPHIC LOG	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Ground Surface	
25 ~~0~~					25-26.2' Poorly Graded Sand (SP) olive gray (5Y 4/2), wet, med. dense 60% med. sand, 40% coarse sand, 26.2-26.5 Fat clay (CH) dark gray (5Y 4/1), wet, 100% fines high plasticity.	0.0 ppm
29						
30 ~~5~~					TD = 29'	
10						
15						
20						
25						

reference template: Ch2m_GeotechBoring_KMEP

CH2MHILL

PROJECT NUMBER: 460434.FI.01

BORING NUMBER: MW-31B

Sheet: 1 of ~~1~~ 2

SOIL BORING LOG

PROJECT: Halaco Superfund Site

LOCATION: New Indy Containerboard

ELEVATION: TBD

DRILLING CONTRACTOR: National EWP

DRILLING METHOD AND EQUIPMENT: HSA; CME-95; 8" Auger

WATER LEVELS: TBD

START: 10/3/13

LOGGER: C. Kamali

DEPTH BELOW (Feet)	SAMPLE TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	GRAPHIC LOG	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Ground Surface	
0					Hand augered to 3.5' bgs to clear subsurface utilities.	Difficult hand auguring due to concrete fragments at 3.5'.
5	SPT	1.5	15, 9, 6		Fill Silty sand (SM) brown (10YR 4/3), moist, med. dense 70% silt-sand mixture, 30% concrete and asphalt fragments, some glass fragments, locally iron oxide staining	0.0 ppm
10			5, 7, 9		@ 10.5' sandy silt (ML) olive gray (5Y 4/2), wet, stiff, 70% nonplastic fines, 30% fine sand, tr. fine mica.	0.0 ppm
15		0.8	5, 5, 5		Poorly Graded Sand (SP) Olive Gray (5Y 4/2), wet, loose, 60% med. sand, 40% fine sand, tr. mica.	0.0 ppm
20		1.5	10, 10, 12		Poorly Graded Sand (SP) same as above, medium dense	0.0 ppm
25						

reference template: Ch2m_GeotechBoring_KMEP

CH2MHILL

PROJECT NUMBER:

BORING NUMBER: MW-31B

Sheet: ~~1 of 1~~ 2 of 2

SOIL BORING LOG

PROJECT:

LOCATION:

ELEVATION:

DRILLING CONTRACTOR:

DRILLING METHOD AND EQUIPMENT:

WATER LEVELS:

START:

LOGGER:

DEPTH BELOW (Feet)	SAMPLE: TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	GRAPHIC LOG	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Ground Surface	
~~0~~ 25		1.5	9,12,17		Poorly Graded Sand (SP) olive gray (5Y 4/2), wet, med. dense 70% med. sand, 30% coarse sand, tr. fine gravel	0.0 ppm
~~5~~ 30					TD = 28'	
10						
15						
20						
25						

reference template: Ch2m_GeotechBoring_KMEP

CH2MHILL

PROJECT NUMBER: 460434.FI.01

BORING NUMBER: MW-32C

Sheet: 1 of 1

SOIL BORING LOG

PROJECT: Halaco Superfund Site **LOCATION:** NCL North

ELEVATION: TBD **DRILLING CONTRACTOR:** National EWP

DRILLING METHOD AND EQUIPMENT: HSA; CME-95

WATER LEVELS: TBD, ~4' bgs **START:** 10/3/13 **LOGGER:** C. Kamali

DEPTH BELOW (Feet)	SAMPLE TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	GRAPHIC LOG	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0					Ground Surface Hand augered to 4' bgs to clear subsurface utilities	
5	SPT	1.5	3,3,4		Silt (ML) Olive (5Y, 4/3), wet, med. stiff 100% fines, low plasticity.	0.0ppm
					some clay at 10-11.2'	0.0ppm
10	SPT	1.5	4,7,9		@11.2' Poorly Graded Sand (SP) olive gray (5Y 4/2), wet, med. dense, 60% fine sand, 40% med. sand, tr. fine mica	
15	SPT	1.5	10,12,15		Poorly Graded Sand (SP) olive (5Y 5/3), wet, med. dense, 75% med. sand, 25% fine sand	0.0 ppm
20	SPT	1.5	5,12,20		Poorly Graded Sand w/ Clay (SP-SC) olive (5Y 4/3), wet, dense, 90% fine sand, 10% fines as thin lenses at 20.6', tr. mica	0.0ppm
25						

reference template: Ch2m_GeotechBoring_KMEP

CH2MHILL

PROJECT NUMBER:

BORING NUMBER: MW-32C

Sheet: ~~1 of 1~~ 2 of 3

SOIL BORING LOG

PROJECT:

LOCATION:

ELEVATION:

DRILLING CONTRACTOR:

DRILLING METHOD AND EQUIPMENT:

WATER LEVELS:

START:

LOGGER:

DEPTH BELOW (Feet)	SAMPLE TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	GRAPHIC LOG	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Ground Surface	
25	SPT	1.5	9,14,16		Poorly Graded Sand (SP), olive (5Y 4/3), wet, med. dense, 80% fine sand, 20% med. sand, tr. fine mica.	0.0 ppm
30	SPT	1.5	7,9,11		Poorly Graded Sand w/ silt (SP-SM) olive (5Y 4/3), wet, med. dense, 70% med. sand, 20% fine sand, 10% silt as thin lenses at 31-31.5'	0.0 ppm
35	SPT	1.5	8,8,10		Silty sand (SM) olive (5Y 4/3), wet, med. dense, 60% fine sand, 40% nonplastic fines tr. fine mica	0.0 ppm
40	SPT	1.5	7,7,12		same as above	
45	SPT	1.5	10,12,14		Poorly Graded Sand (SP) olive (5Y 5/3), wet, med. dense, 70% med. sand, 30% fine sand, tr. seashells & gravel, up to 1" subrounded	
50						

reference template: Ch2m_GeotechBoring_KMEP

CH2MHILL

PROJECT NUMBER: **BORING NUMBER:** MW-32C
Sheet: 1 of 1 3 of 3

SOIL BORING LOG

PROJECT: **LOCATION:**
ELEVATION: **DRILLING CONTRACTOR:**
DRILLING METHOD AND EQUIPMENT:
WATER LEVELS: **START:** **LOGGER:**

DEPTH BELOW (Feet)	SAMPLE TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	GRAPHIC LOG	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Ground Surface	
50	SPT	1.5	10,14,17		Poorly Graded Sand (SP) olive (5Y 5/3) wet, dense, 70% med. sand, 30% fine sand, tr. seashells.	See photo
55	SPT	1.5	11,13,15		Poorly Graded Sand (SP) olive (5Y 4/3), wet, med. dense, 80% fine sand, 15% med. sand, 5% fines as lenses of clay at 56' and silt at 56-3'	0.0 ppm
60	SPT	1.5	10,15,15		Poorly Graded Sand (SP) olive (5Y 4/3), wet, med. dense, 60% med. sand, 40% fine sand, tr. seashells.	0.0 ppm
65	SPT	1.5	11,15,16		Poorly Graded Sand (SP) olive (5Y 4/3), wet, dense, 70% fine sand, 30% med. sand, tr. seashells, tr fine mica	0.0 ppm
					TD = 67'	
20						
25						

CH2MHILL

PROJECT NUMBER: 460434.FI.01

BORING NUMBER: MW-33C

Sheet: ~~1 of 1~~ 1 of 3

SOIL BORING LOG

PROJECT: Halaco Superfund Site
LOCATION: NCL, north side of fence by McWane Rd.
ELEVATION: TBD
DRILLING CONTRACTOR: National EWP
DRILLING METHOD AND EQUIPMENT: HSA; CME-95; 8" Auger
WATER LEVELS: TBD, ~ 4' bgs
START: 10/4/13
LOGGER: C. Kamali

DEPTH BELOW (Feet)	SAMPLE TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	GRAPHIC LOG	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0					Ground Surface Hand augered to 5' bgs to clear subsurface utilities.	
5	SPT	1.5	5,5,5		Silt w/sand (ML) Dark grayish brown (10YR 4/3) Moist, stiff, 85% fines, 15% fine sand, tr. fine mica	0.0 ppm
10	SPT	1.5	4,5,6 10' - 11.3	CH	10 - 11.3' Fat Clay (CH) olive (5Y 4/4), wet, stiff 100% fines, high plasticity	0.0 ppm
15	SPT	1.5	5,7,7		Poorly Graded Sand w/silt (SP-SM) olive gray (5Y 4/2), wet 70% fine sand, 10% med. sand, 10% nonplastic fines, tr. fine mica.	0.0 ppm
20	SPT	1.5	6,8,10		Poorly Graded Sand (SP) olive (5Y 4/3), wet, med. dense, 70% coarse sand, 30% med. sand	0.0 ppm
25						

CH2MHILL

PROJECT NUMBER: 460434.FI.01

BORING NUMBER: MW-33C

Sheet: ~~1 of 1~~ 2 of 3

SOIL BORING LOG

PROJECT:

LOCATION:

ELEVATION:

DRILLING CONTRACTOR:

DRILLING METHOD AND EQUIPMENT:

WATER LEVELS:

START:

LOGGER:

DEPTH BELOW (Feet)	SAMPLE TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	GRAPHIC LOG	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Ground Surface	
25.0 ~~0~~	SPT	1.5	10,12,14		Poorly Graded Sand (SP) Olive Gray (5Y 4/2), wet, med. dense, 60% med. sand, 40% fine sand	0.0 ppm See photo
30 ~~5~~	SPT	1.5	8,8,10		Poorly Graded sand (SP) Same as above, tr. seashells & fine gravel subrounded	0.0 ppm
35 ~~10~~	SPT	1.5	9,11,13		Poorly Graded Sand w/silt (SP-SM) Olive gray (5Y 4/2), wet, med. dense, 90% fine sand, 10% nonplastic fines, tr. mica.	0.0 ppm
40 ~~15~~	SPT	1.5	11,13,15		Silty Sand (SM) Olive Gray (5Y 4/2), wet, med. dense, 80% fine sand, 20% nonplastic fines, tr. fine mica	0.0 ppm
45 ~~20~~	SPT	1.5	8,14,16		Poorly Graded sand w/silt (SP-SM) Olive Gray (5Y 4/2), wet, med. dense 90% fine sand, 10% nonPlastic fines, tr. fine mica	0.0 ppm
50 ~~25~~						

CH2MHILL

PROJECT NUMBER:	BORING NUMBER: MW-33C
	Sheet: ~~1 of 1~~ 3 of 3

SOIL BORING LOG

PROJECT: LOCATION:
ELEVATION: DRILLING CONTRACTOR:
DRILLING METHOD AND EQUIPMENT:
WATER LEVELS: START: LOGGER:

DEPTH BELOW (Feet)	SAMPLE TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	GRAPHIC LOG	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Ground Surface	
50	SPT	1.5	14,17,21		Poorly Graded sand (SP-SM) olive Gray (5Y 4/2), wet, dense 90% fine sand, 10% fines, tr. seashells.	0.0 ppm
55	SPT	1.5	9,13,16		same as above, no seashells.	0.0 ppm
60 ~~10~~	SPT	1.5	15,20,20		Silty Sand (SM), olive (5Y 4/3), wet, dense, 70% fine sand, 30% fines, tr. fine mica.	0.0 ppm
65 ~~15~~					Same as above, trace seashells. TD = 65'	
70 ~~20~~						
25						

reference template: Ch2m_GeotechBoring_KMEP

CH2MHILL

PROJECT NUMBER: 460434·FI·01

WELL NUMBER: MW-28C

SHEET 1 OF 1

GROUNDWATER MONITORING WELL CONSTRUCTION DIAGRAM

PROJECT: 460434·FI·01

LOCATION: Water Treatment Plant (SE)

DRILLING CONTRACTOR: National EWP

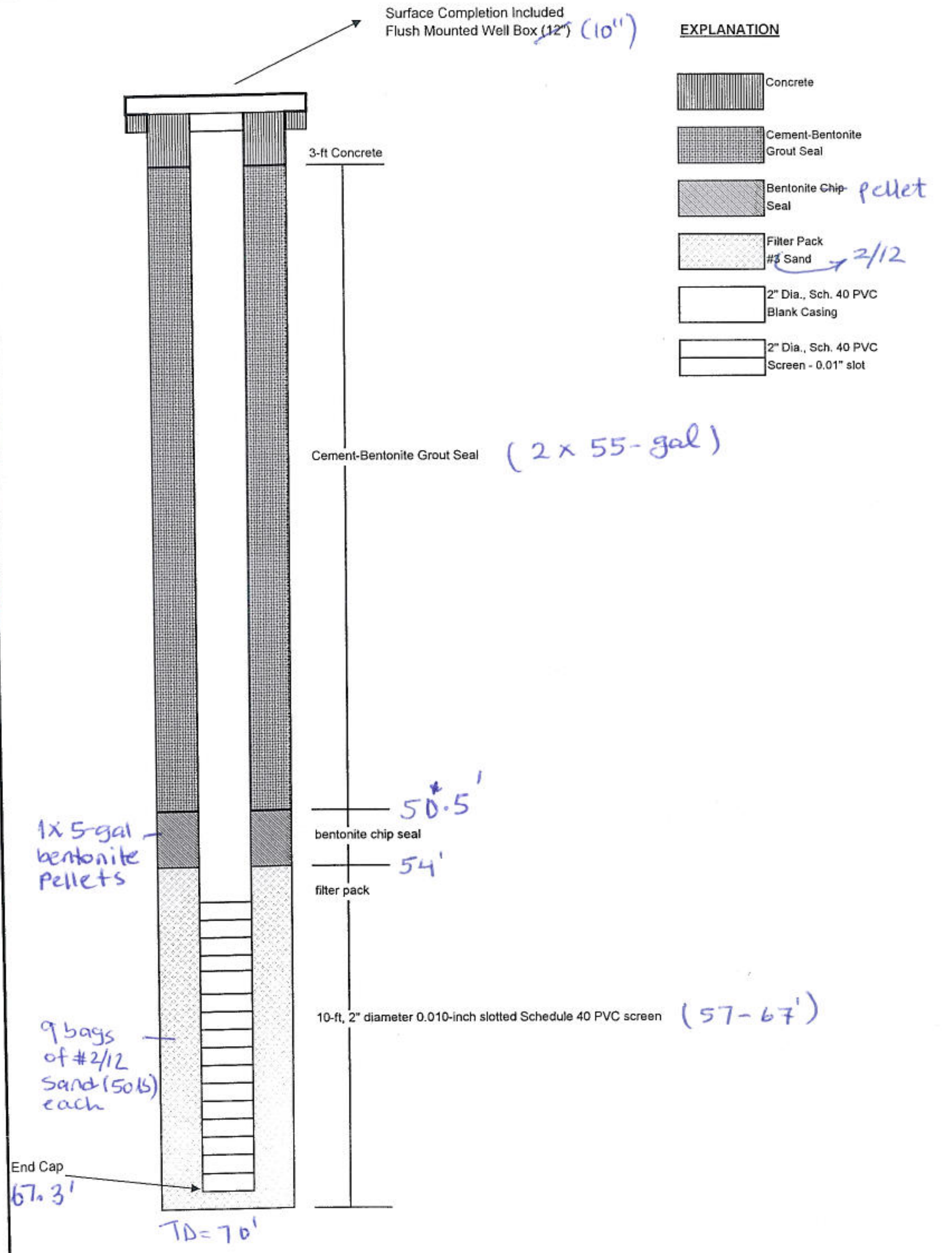
GROUND SURFACE ELEVATION:

DRILLING METHOD AND EQUIPMENT USED: HSA; CME-LAR

REFERENCE POINT ELEVATION:

BOREHOLE DIAMETER: 8"

START: 9/30/13 END: 9/30/13 LOGGER: C. Kamali

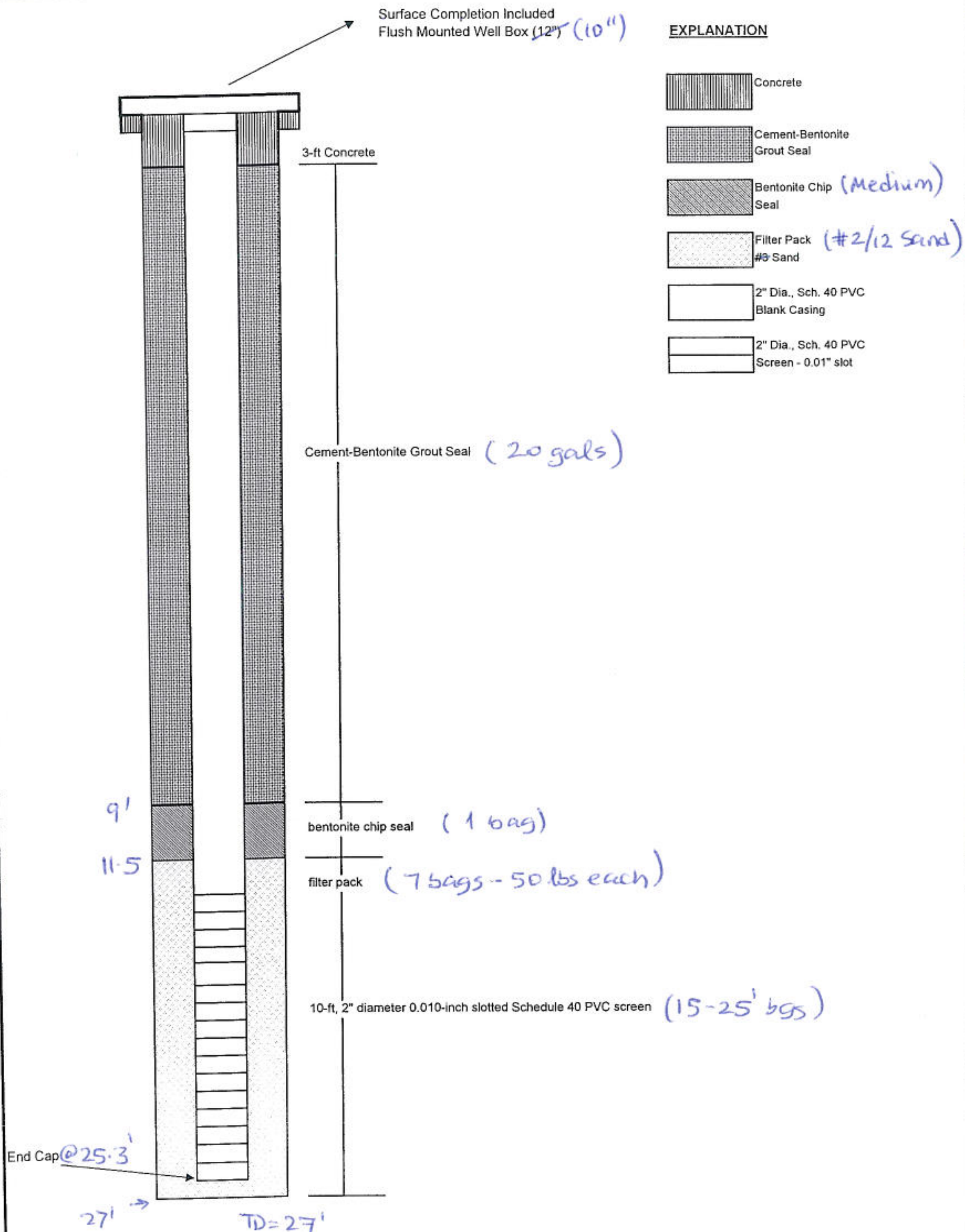


Not to Scale, depths approximate

CH2MHILL	PROJECT NUMBER 460434.FI.01	WELL NUMBER MW-28B SHEET 1 OF 1

GROUNDWATER MONITORING WELL CONSTRUCTION DIAGRAM

PROJECT : Halaco
LOCATION : Water treatment plant-SE
DRILLING CONTRACTOR : National EWP
GROUND SURFACE ELEVATION: TBD
DRILLING METHOD AND EQUIPMENT USED : HSA; CME-LAR
REFERENCE POINT ELEVATION: TBD
BOREHOLE DIAMETER : 8"
START : 10/1/13 END : 10/1/13 LOGGER: C. Kamali



Not to Scale, depths approximate

CH2MHILL

PROJECT NUMBER 460434.FI.01	WELL NUMBER MW-29B SHEET 1 OF 1

GROUNDWATER MONITORING WELL CONSTRUCTION DIAGRAM

PROJECT: Halaco

LOCATION: water treatment plant

DRILLING CONTRACTOR: National EWP

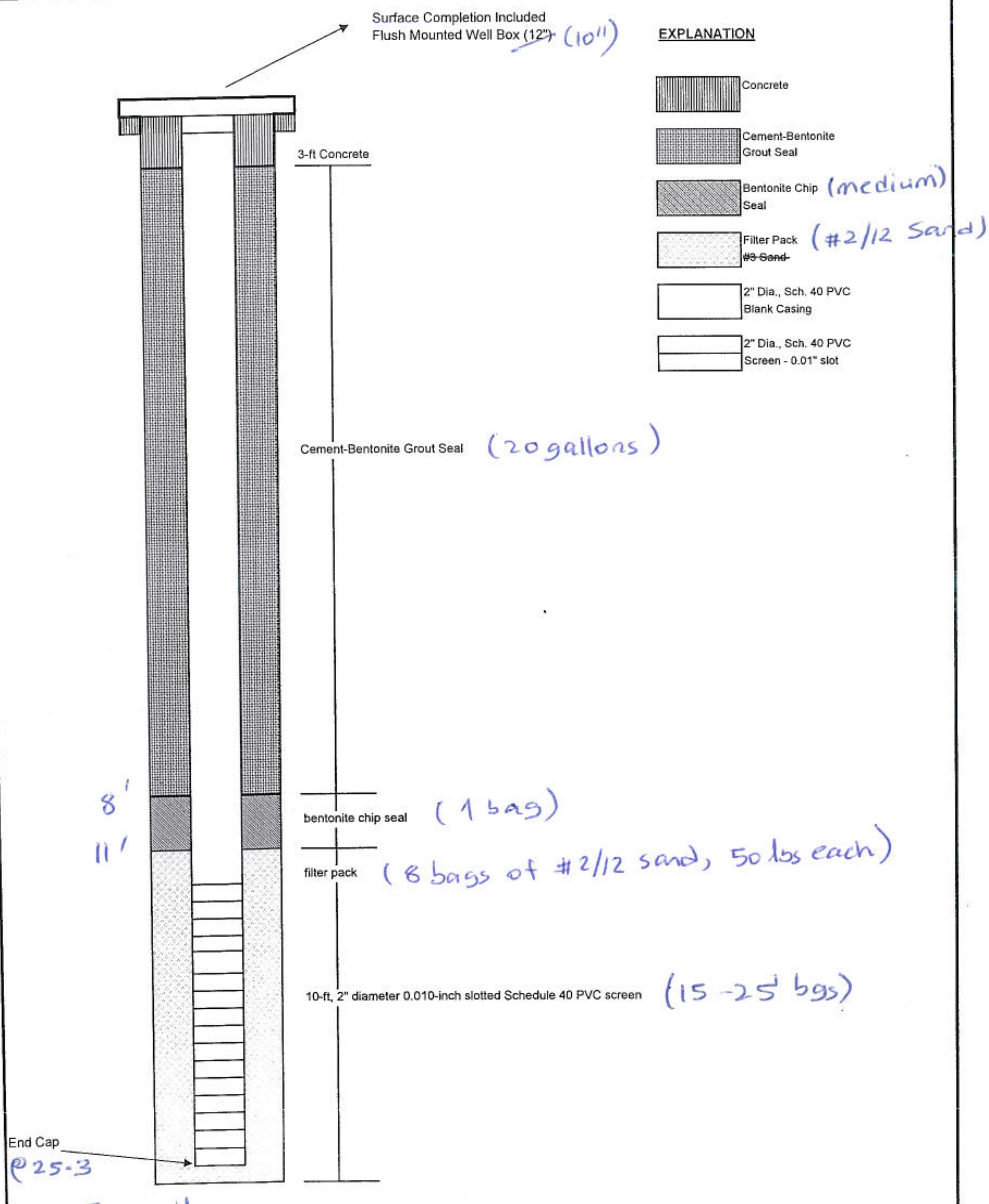
GROUND SURFACE ELEVATION: TBD

DRILLING METHOD AND EQUIPMENT USED: HSA; CME-LAR

REFERENCE POINT ELEVATION: TBD

BOREHOLE DIAMETER:

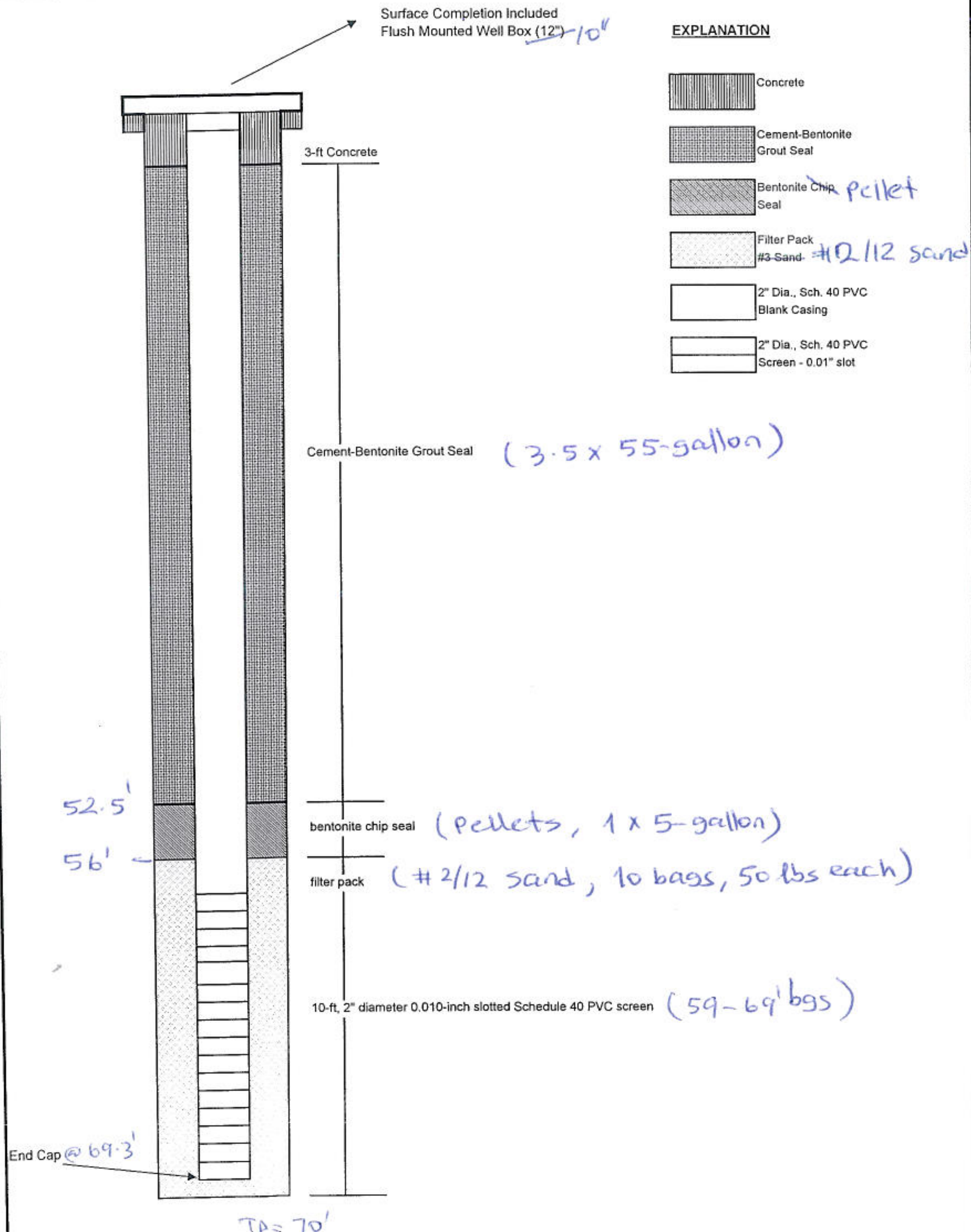
START: 10/1/13 END: 10/1/13 LOGGER: C. Kamali



Not to Scale, depths approximate

CH2MHILL	PROJECT NUMBER: 460434.FI.01	WELL NUMBER: MW-30C SHEET 1 OF 1
	GROUNDWATER MONITORING WELL CONSTRUCTION DIAGRAM	

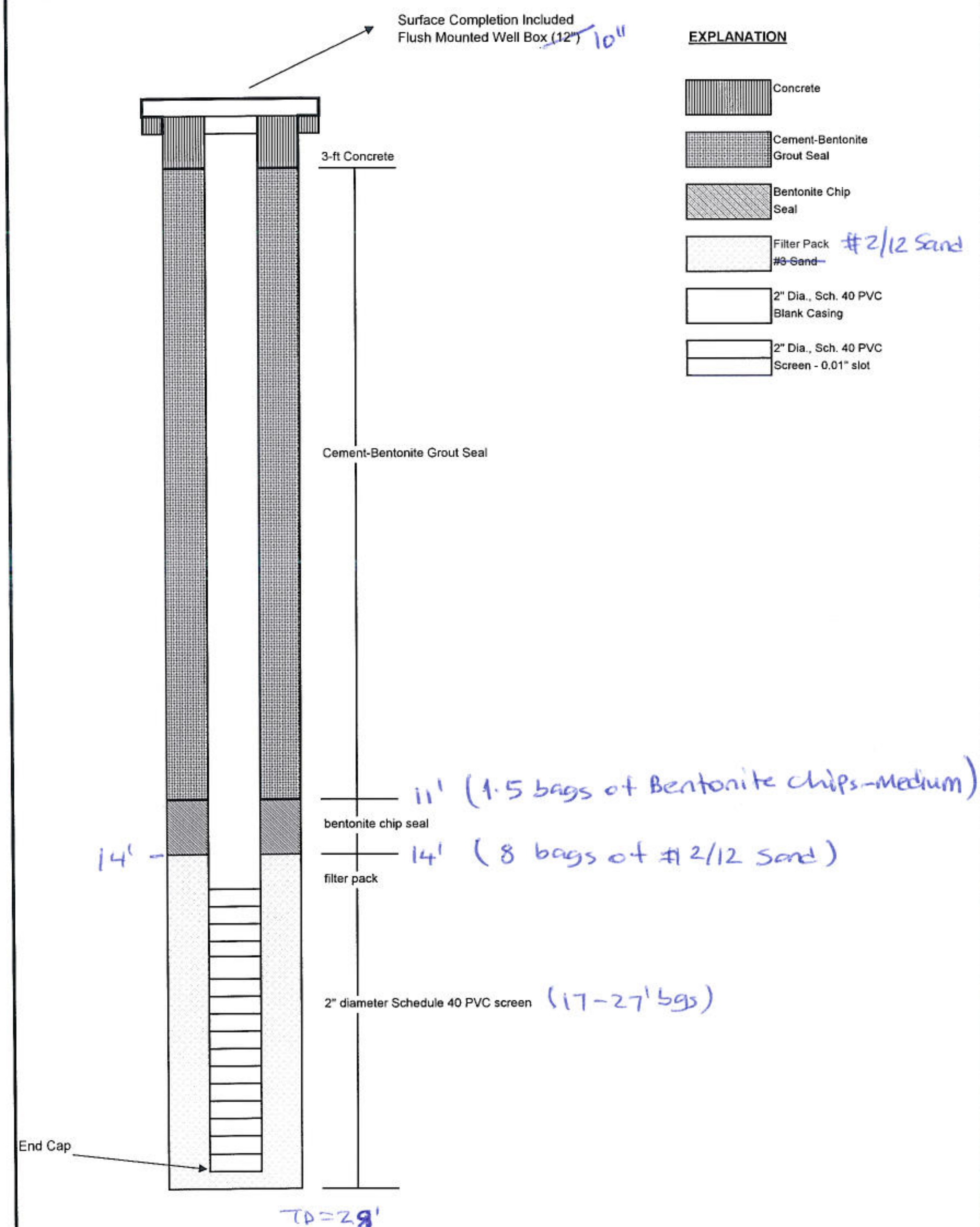
PROJECT: Halaco Superfund Site
LOCATION: New Indy Containerboard - SE
DRILLING CONTRACTOR: National EWP
GROUND SURFACE ELEVATION: TBD
DRILLING METHOD AND EQUIPMENT USED: HSA; CME-95; 8" Auger
REFERENCE POINT ELEVATION: TBD
BOREHOLE DIAMETER: 8"
START: 10/2/13 END: 10/2/13 LOGGER: C. Kamali



Not to Scale, depths approximate

CH2MHILL	PROJECT NUMBER 460434.FI.01	WELL NUMBER MW-30B SHEET 1 OF 1
	GROUNDWATER MONITORING WELL CONSTRUCTION DIAGRAM	

PROJECT: Halaco Superfund	LOCATION: New Indy Containerboard
DRILLING CONTRACTOR: National EWP	GROUND SURFACE ELEVATION: TBD
DRILLING METHOD AND EQUIPMENT USED: HSA; CME-95	REFERENCE POINT ELEVATION: TBD
BOREHOLE DIAMETER: 8"	
START: 10/2/13 END: 10/3/13	LOGGER: C. Kamali



Not to Scale, depths approximate

CH2MHILL

PROJECT NUMBER 460434·FI·01

WELL NUMBER MW-31B

SHEET 1 OF 1

GROUNDWATER MONITORING WELL CONSTRUCTION DIAGRAM

PROJECT : Halaco Superfund Site

LOCATION : New Indy Containerboard – SE

DRILLING CONTRACTOR : National EWP

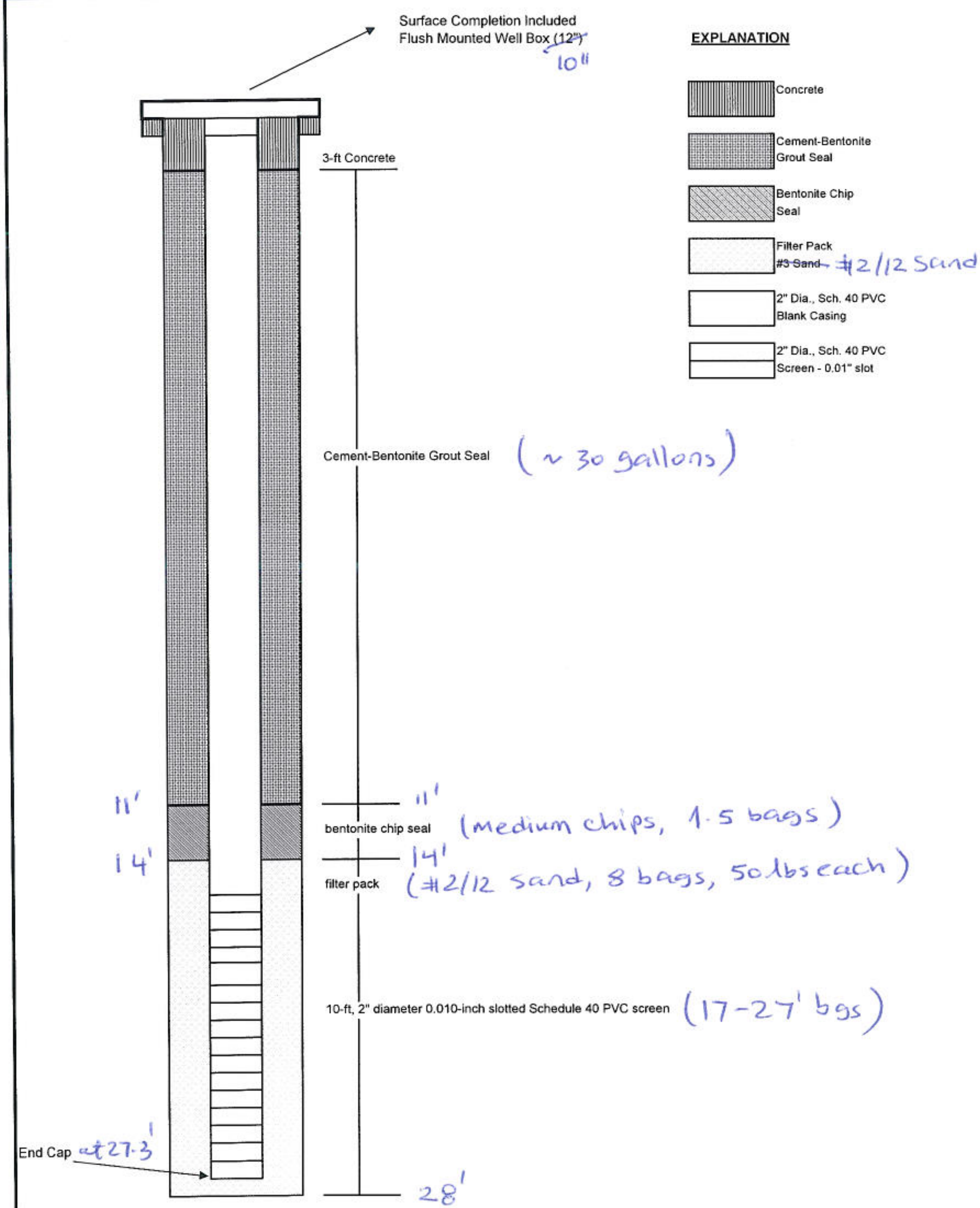
GROUND SURFACE ELEVATION: TBD

DRILLING METHOD AND EQUIPMENT USED : HSA; CME-95; 8" Auger

REFERENCE POINT ELEVATION: TBD

BOREHOLE DIAMETER : 8"

START : 10/3/13 END : 10/3/13 LOGGER: C. Kamali



Not to Scale, depths approximate

CH2MHILL	PROJECT NUMBER 460434.FI.01	WELL NUMBER MW-32C SHEET 1 OF 1
	GROUNDWATER MONITORING WELL CONSTRUCTION DIAGRAM	

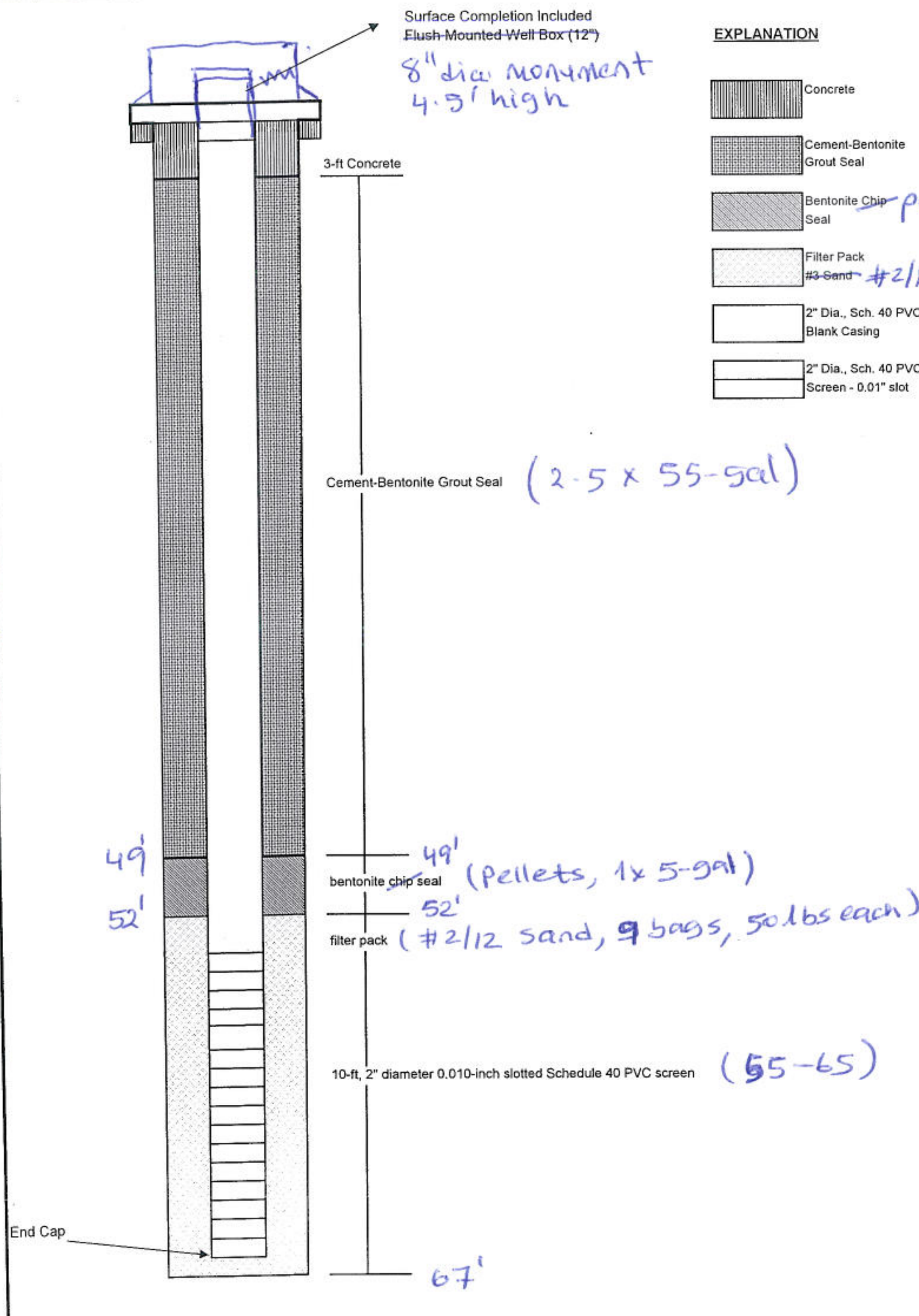
PROJECT: Halaco Superfund Site — LOCATION: NCL-North

DRILLING CONTRACTOR: National EWP — GROUND SURFACE ELEVATION: TBD

DRILLING METHOD AND EQUIPMENT USED: HSA; CME-95; 8" Auger — REFERENCE POINT ELEVATION: TBD

BOREHOLE DIAMETER: 8"

START: 10/3/13 — END: 10/4/13 — LOGGER: C. Kamali



EXPLANATION

- Concrete
- Cement-Bentonite Grout Seal
- Bentonite ~~Chip~~ pellets Seal
- Filter Pack ~~#3 Sand~~ #2/12 Sand
- 2" Dia., Sch. 40 PVC Blank Casing
- 2" Dia., Sch. 40 PVC Screen - 0.01" slot

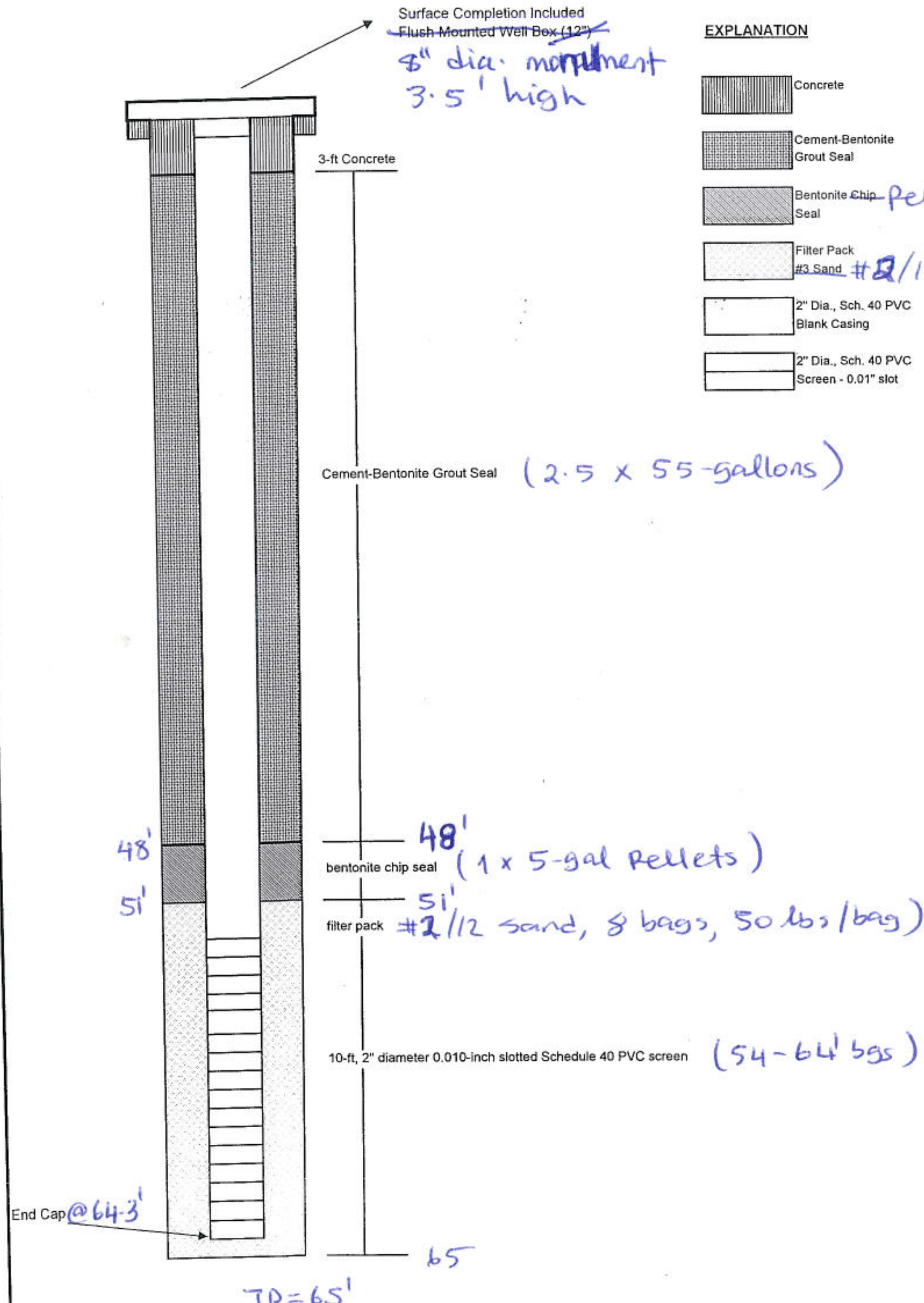
Not to Scale, depths approximate

CH2MHILL

PROJECT NUMBER	WELL NUMBER
460434.FI.01	MW-33C SHEET 1 OF 1

GROUNDWATER MONITORING WELL CONSTRUCTION DIAGRAM

PROJECT: Halaco Superfund Site
LOCATION: NCL, North of Fence dump Access Road
DRILLING CONTRACTOR: National EWP
GROUND SURFACE ELEVATION: TBD
DRILLING METHOD AND EQUIPMENT USED: HSA; CME-95; 8" Auger
REFERENCE POINT ELEVATION: TBD
BOREHOLE DIAMETER: 8"
START: 10/4/13 END: 10/4/13 LOGGER: C. Kamali



EXPLANATION

- Concrete
- Cement-Bentonite Grout Seal
- Bentonite ~~Chip~~ Pellets Seal
- Filter Pack #3 Sand #2/12
- 2" Dia., Sch. 40 PVC Blank Casing
- 2" Dia., Sch. 40 PVC Screen - 0.01" slot

Not to Scale, depths approximate

Attachment C
Monitoring Well Survey Report
(FJS Land Consulting)

Halaco Field Surveying and Control Summary
Oxnard, California
(Monitoring Well Survey April 9, 2014)

The purpose of this survey is to locate the horizontal and vertical location of the new monitoring wells: 28B, 28C, 29B, 30B, 30C, 31B, 32C, 33C, 23B, 25B.

Control for this project is based upon the California State Plane Coordinates System Zone Five and North American Vertical Datum of 1988. The specific control point used for this project were provided to subconsultant by the EPA in a spreadsheet format and specifically based upon the following three control point: MW-19C (500); MW-24C (501) and MW-23C (523). See coordinate print out "ADJUSTED-COORDINATE FILE.ASC".

Locations and elevations were determined with Leica (TCR 1205) Total Station by shooting distances and angles to monitoring wells. All monitoring well measurements were kept within 100' of primary control network. All measured elevations corrected for earth curvature and refraction. Differential leveling was not used to determine elevations.

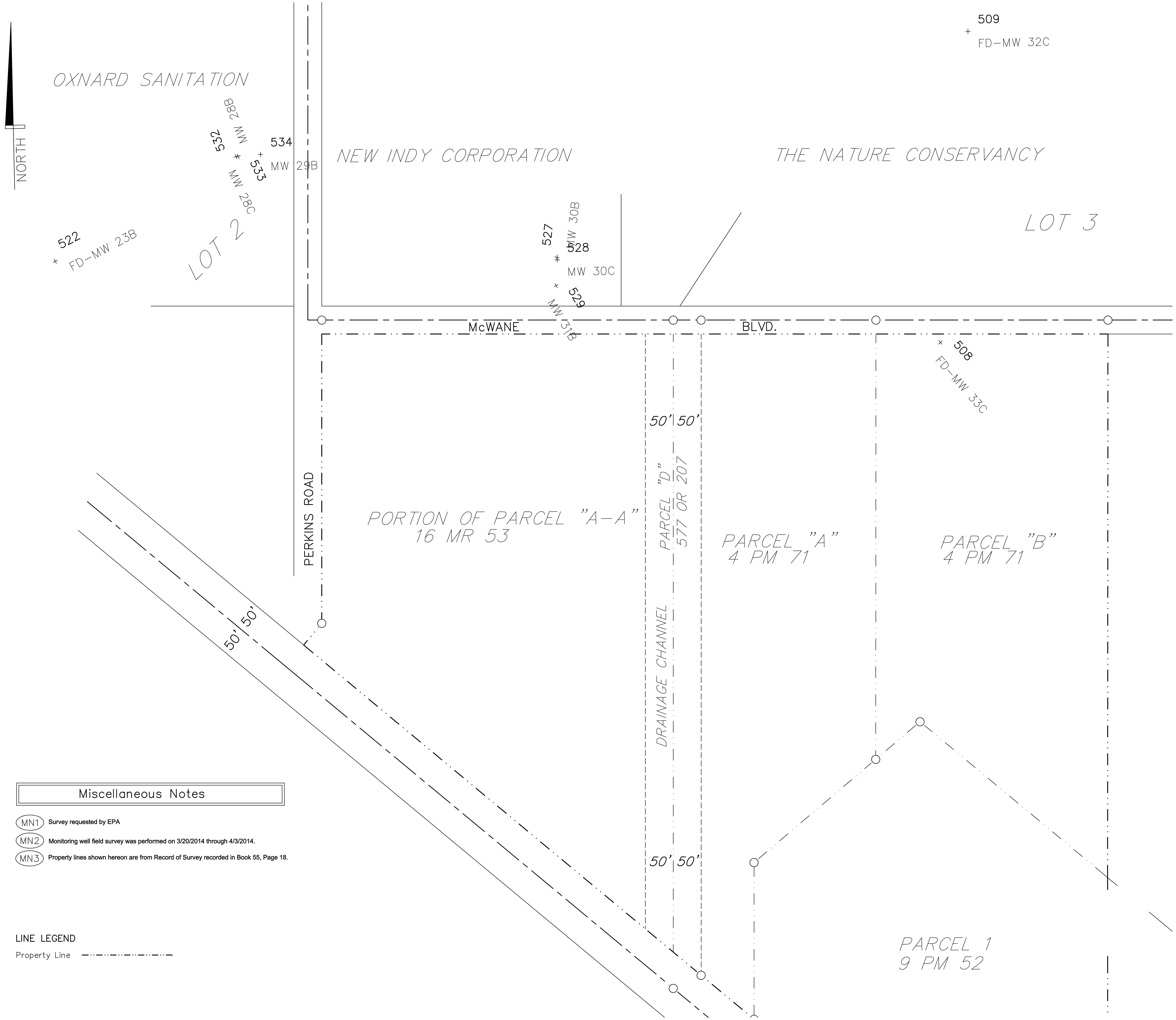
This survey meets all State of California, Federal and Local laws relative to the practice of land surveying. Additionally, this survey meets or exceeds the horizontal and vertical specifications contained in the scope of work for this project.

Attachments:
ADJUSTED-COORDINATE FILE.ASC
Halaco.pdf (plot)
MONITORING WELLS 4-5-2014.xlsx (spread sheet)
Raw field notes 3-2-2014 thru 4-3-2014.pdf
3-20-14R.asc (Raw data collector file)
4-3-14R.as (Raw data collector file)

Equipment used: Leica (TCR 1205)

Frank J Sobecki, PLS 5975
FJS Land Consulting
805-501-4075

LICENSED LAND SURVEYOR
FRANK J.
SOBECKI
5975
STATE OF CALIFORNIA



COORDINATE LIST

THE FOLLOWING NORTHING AND EASTING COORDINATES ARE BASED UPON CALIFORNIA STATE PLANE COORDINATE SYSTEM OF 1983, ZONE 5 (CCS83) AND TIE-ED TO RECORD OF SURVEY RECORDED IN BOOK 51, PAGES 93-96, CONTROL MONUMENT NUMBERS 1251 AND 1252 LISTED THEREIN.

THE FOLLOWING ELEVATIONS ARE BASED UPON NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88) AND TIE-ED TO RECORD OF SURVEY RECORDED IN BOOK 51, PAGES 93-96, CONTROL MONUMENT NUMBERS 1251 AND 1252 LISTED THEREIN.

(All values are in feet)

508	1875432.479	6204541.342	12.492	MW33C
509	1875988.598	6204603.384	12.066	MW32C
511	1875421.571	6205267.101	12.047	MW25B
522	1875614.457	6202958.496	11.898	MW23B
527	1875601.079	6203857.635	9.938	MW30B
528	1875596.177	6203858.113	9.944	MW30C
529	1875550.146	6203855.01	10.98	MW31B
532	1875794.695	6203286.755	9.555	MW28B
533	1875794.666	6203290.652	9.481	MW28C
534	1875797.408	6203330.654	9.271	MW29B

ALL MEASUREMENTS TAKEN ON THE NORTH SIDE AND TOP OF PVC PIPE.

Miscellaneous Notes

MN1 Survey requested by EPA

MN2 Monitoring well field survey was performed on 3/20/2014 through 4/3/2014.

MN3 Property lines shown hereon are from Record of Survey recorded in Book 55, Page 18.

LINE LEGEND

Property Line —··—··—··—

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HALACO MONITORING WELL SURVEY MAP	DRAWN BY: FJS
	CHECKED BY: FJS
	DATE: 4/5/2014
	SCALE: 1" = 80'
OXNARD, CA	SHT 1 OF 1

C:\FJS\PDATA\00-283\AUTOCAD\EXHIBITS\HALACO.DWG

HALACO SUPER FUND SITE - MONITORING WELL SURVEY
OXNARD, CA
5-Apr-14
ORDER No. EP-14-9-000020
REQUISITION No. PR-R9-14-00015

		Elevation (NAVD 88 ft)						CA STATE PLANE - NAD 83 ZONE V (ft)	
POINT #	WELL NUMBER	OUTER TOC ELEVATION	INNER TOC ELEVATION	GROUND ELEVATION	STICKUP ABOVE GROUND	Latitude (DMS)	Longitude (DMS)	Northing	Easting
508	MW33C	12.76	12.49	9.8	3.0	34.082405	-119.104886	1875432.479	6204541.342
509	MW32C	12.27	12.07	8.2	4.1	34.082956	-119.104820	1875988.598	6204603.384
511	MW25B	12.29	12.05	9.5	2.8	34.082403	-119.104022	1875421.571	6205267.101
522	MW23B	11.99	11.90	9.4	2.6	34.082567	-119.110771	1875614.457	6202958.496
527	MW30B	10.24	9.94	10.2	FLUSH	34.082564	-119.105702	1875601.079	6203857.635
528	MW30C	10.33	9.94	10.3	FLUSH	34.082559	-119.105701	1875596.177	6203858.113
529	MW31B	11.33	10.98	11.3	FLUSH	34.082513	-119.105704	1875550.146	6203855.01
532	MW28B	9.77	9.56	9.8	FLUSH	34.082749	-119.110383	1875794.695	6203286.755
533	MW28C	9.77	9.48	9.8	FLUSH	34.082749	-119.110379	1875794.666	6203290.652
534	MW29B	9.57	9.27	9.6	FLUSH	34.082752	-119.110331	1875797.408	6203330.654

SURVEYED BY: FJS LAND CONSULTING
LICENSED SURVEYOR: FRANK J SOBECKI, PLS 5975

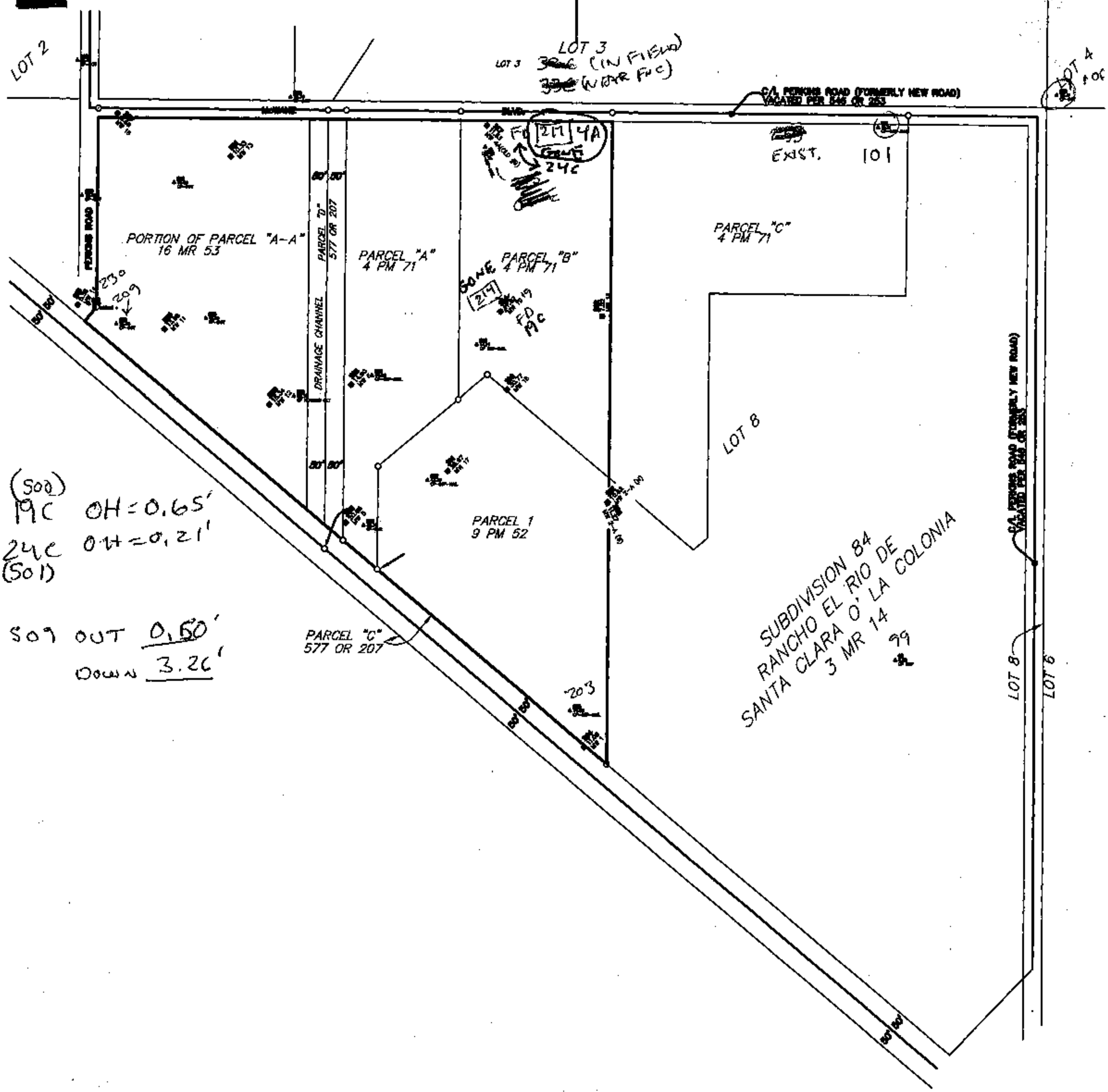
3-20-14

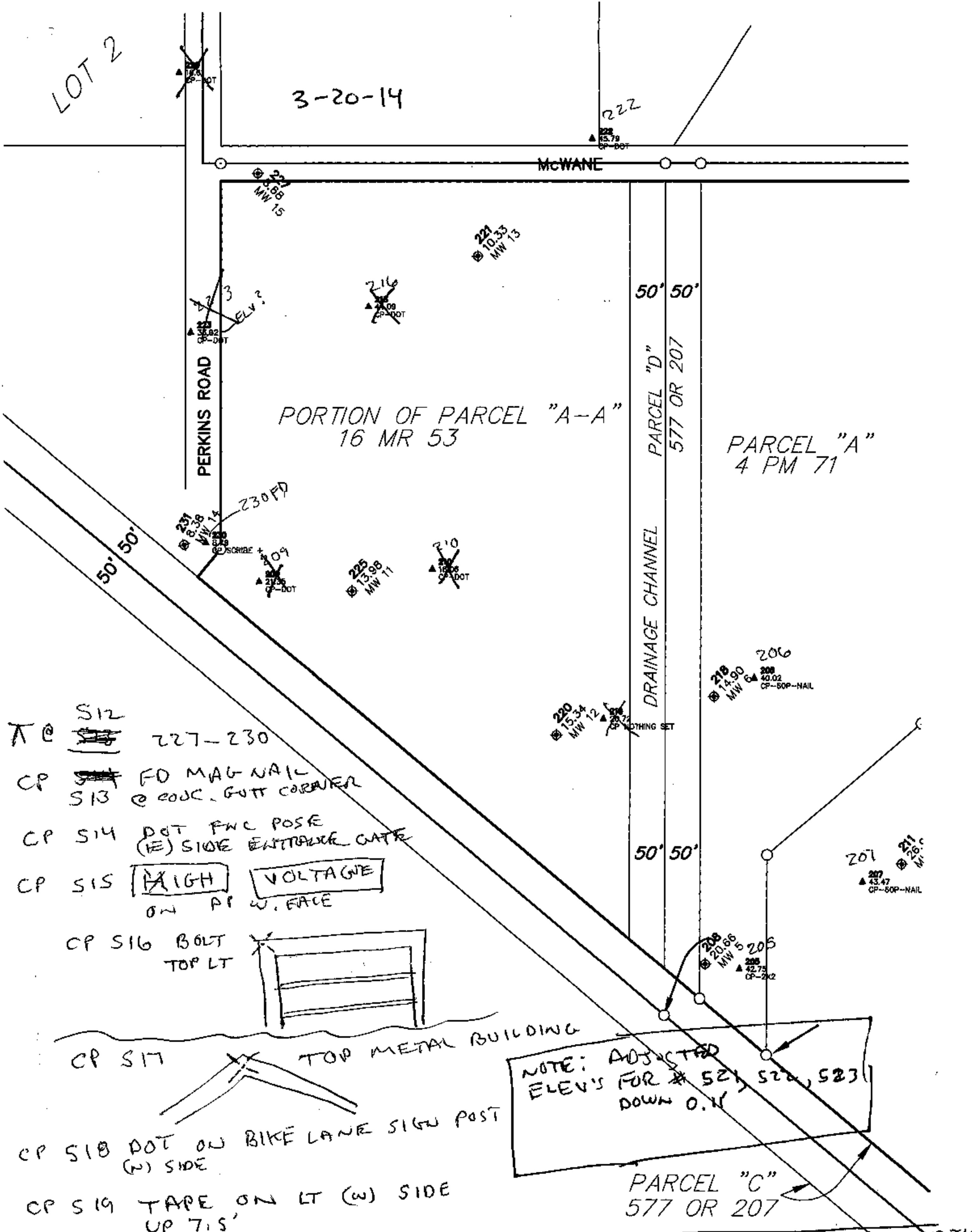
NEW 28B (532) 28C (533) 29B (534) 30B (527) 30C (528) 31B (529) 32C (509) 33C (508)

EXIST. 23B (522) 25B (511)

π @ 502 501-500
CP 505 RED PIPE B.C. CENTER
CP 506 TEMP LATH
CP 507 POT FNC POST
FD MW 33C (3' TALL; UP 0.27')
GRD → RIM RIM

FD MW 32C (4.1' TALL; UP 0.20')
π @ 510 507-506
FD MW 25B (2.79 TALL; UP 0.24')





⊼ @ 512 227 – 230

CP FD MAG NAIL
513 @ CONC. GUTT CORNER

CP 514 DOT FNC POST
(E) SIDE ENTRANCE GATE

CP 515 HIGH VOLTAGE
ON PP W. FACE

CP 516 BOLT
TOP LT

CP 517 TOP METAL BUILDING

NOTE: ADJUSTED
ELEV'S FOR # 521, 522, 523
DOWN 0.11'

CP 518 DOT ON BIKE LANE SIGN POST
(N) SIDE

CP 519 TAPE ON LT (W) SIDE
UP 7.5'

⊼@520 230 – 513
CP 521 60P NAIL

⊼@ 521 IH= 5.40 BS 519 522-RS CP 524 CHECK VERTICAL
[redacted] MW 23B (2.6' TALL; UP 0.08') N25-34-56W ON CP 519 0.99' 0.22 DIFF.
[redacted] MW 23C (2.78 TALL, UP 0.30') 523 → REC N25-56-51W 0.98'

4-3-14

△ @ 525 515 – 514 – 526 CHECK 505 CTR RED PIPE
(CHECK TO 519 GOOD)

526 → 505 N 6-39-12 W 0.95'

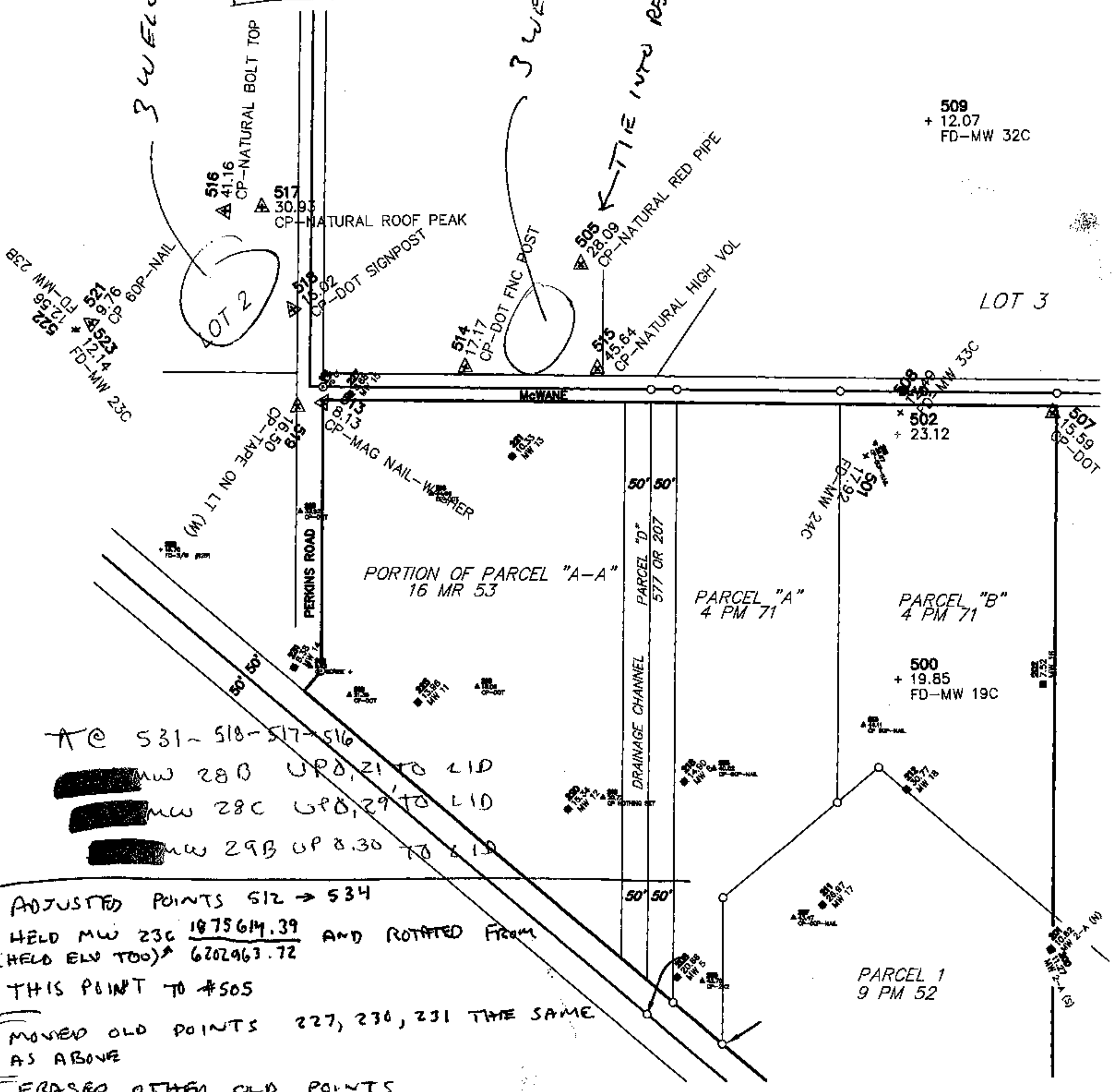
[redacted] MW 30B UP 0.30 TO F.S. (LID)
[redacted] MW 30C UP 0.39 " " "
[redacted] MW 31B UP 0.35 " " "
} FLUSH IN A/C PAVEMENT

CP 530 ↳ P.P. ~~HIGH~~ WEST FACE

3 WELLS

3 WELLS

TIE INTO RED PIPE



△ @ 531 – 518 – 517 – 516

[redacted] MW 28B UP 0.21 TO LID
[redacted] MW 28C UP 0.29 TO LID
[redacted] MW 29B UP 0.30 TO LID

ADJUSTED POINTS 512 → 534
HELD MW 23C 1875614.39 / 6202963.72 AND ROTATED FROM
(HELD ELV TOO)
THIS POINT TO #505

MOVED OLD POINTS 227, 230, 231 THE SAME AS ABOVE

ERASED OTHER OLD POINTS

Attachment D
Field Parameters Measured during Well Development and Sampling

TABLE D-1

Field Parameters for Piezometer and Monitoring Well Development

Halaco Superfund Site, Oxnard, California

Location	Well Name	Date	Time	Temperature (ºF)	pH	Conductivity (uS)	Turbidity (NTU)	Depth to Water (feet)	Volume Removed (gal)
Oxnard Wastewater Plant	MW-28B	10/3/13	14:11	67.7	7.3	14,440	55	6.86	53.0
	MW-28C	10/3/13	14:42	66.4	7.1	38,050	194	6.95	180.0
	MW-29B	10/3/13	15:28	68.6	7.3	13,350	38	6.72	42.0
New Indy Container Board Plant	MW-30B	10/4/13	11:30	66.4	7.4	9,784	30	9.54	49.0
	MW-30C	10/4/13	10:34	65.1	7.4	45,450	34	7.89	145.0
	MW-31B	10/4/13	12:55	67.1	7.1	10,950	32	12.01	45.0
The Nature Conservancy	MW-32C	10/7/13	10:22	61.5	7.5	9,612	12	7.17	100.0
	MW-33C	10/7/13	12:49	67.0	6.9	78,440	25	9.88	140.0

TABLE D-2

Field Parameters for Groundwater Sampling

Halaco Superfund Site, Oxnard, California

Location	Well Name	Date	Time	Temperature (ºC)	pH	Conductivity (uS)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Depth to Water (feet)	Volume Removed (mL)
Semiperched Aquifer Wells	MW-12	10/28/13	14:04	21.2	9.34	100.10	8.60	0.67	8.37	6,300
	MW-21	10/30/13	12:44	19.3	7.37	14.63	30.00	0.25	2.20	12,000
	MW-23C	10/28/13	13:37	18.3	7.27	22.62	8.20	1.21	6.91	7,500
	MW-25C	10/30/13	8:47	17.9	7.01	32.34	3.00	0.28	7.15	12,000
	MW-27C	10/28/13	12:36	19.0	7.25	3,990	24.40	0.99	5.28	9,000
Oxnard Wastewater Plant	MW-28B	10/28/13	11:00	20.2	7.25	13.66	165.00	0.48	7.00	9,000
	MW-28C	10/28/13	9:35	19.1	6.99	41.27	380.00	0.56	7.25	13,500
	MW-29B	10/28/13	12:19	20.7	7.01	12.59	83.50	0.99	6.87	16,500
New Indy Container Board Plant	MW-30B	10/29/13	9:21	18.0	7.17	10.55	48.00	1.18	9.21	18,000
	MW-30C	10/29/13	10:28	18.4	7.20	50.47	55.00	0.97	7.70	15,000
	MW-31B	10/29/13	11:35	18.7	7.13	11.95	8.00	1.11	11.47	9,000
The Nature Conservancy	MW-32C	10/29/13	13:11	16.8	7.26	10.13	34.00	1.14	5.97	9,000
	MW-33C	10/30/13	9:58	18.5	6.82	9,121	28.00	0.26	8.21	10,500
Oxnard Aquifer Wells	MW-2D	10/28/13	1:30	21.8	7.47	1,231	8.80	0.94	31.75	9,000
	MW-3D	10/28/13	10:08	18.9	7.54	1,287	5.88	1.04	29.41	9,000
	MW-6D	10/30/13	11:13	22.5	7.31	2.10	1.00	0.30	23.27	16,500
	MW-19D	10/28/13	8:50	20.8	7.25	1.58	40.70	1.11	21.58	12,000