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CORRECTIVE MEASURES STUDY REPORT ADDENDUM SOLID WASTE MANAGEMENT UNITS 21 AND 54 (SWMU 21 AND 54) ZONE E CNC CHARLESTON SC

10/1/2004

CH2M HILL

CORRECTIVE MEASURES STUDY REPORT ADDENDUM

SWMUs 21 and 54, Zone E

Charleston Naval Complex
North Charleston, South Carolina

SUBMITTED TO
U.S. Navy Southern Division
Naval Facilities Engineering Command

PREPARED BY
CH2M-Jones

October 2004

Revision 0
Contract N62467-99-C-0960
158814.ZE.EX.25

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Certification Page for Corrective Measures Study Report Addendum (Revision 0) — SWMUs 21 and 54, Zone E

I, Dean Williamson, certify that this report has been prepared under my direct supervision. The data and information are, to the best of my knowledge, accurate and correct, and the report has been prepared in accordance with current standards of practice for engineering.

South Carolina

P.E. No. 21428

Dean Williamson, P.E.

10/26/2009

Date

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A **Subsurface Soil Sampling and Analysis Plan**

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Acronyms and Abbreviations

BEQ	benzo(a)pyrene equivalent
CMS	corrective measures study
CNC	Charleston Naval Complex
COC	chemical of concern
COPC	chemical of potential concern
DAF	dilution attenuation factor
ft bls	feet below land surface
IM	interim measure
LUC	land use control
MCS	media cleanup standard
µg/kg	microgram per kilogram
mg/kg	milligram per kilogram
PAH	polycyclic aromatic hydrocarbon
RAO	remedial action objective
RFI	RCRA Facility Investigation
SCDHEC	South Carolina Department of Health and Environmental Control
SPLP	Synthetic Precipitation Leaching Procedure
SSL	soil screening level
SWMU	solid waste management unit

Section 1.0

1.0 Background

Solid Waste Management Units (SWMUs) 21 and 54 are located in the industrial area of Zone E of the Charleston Naval Complex (CNC) between Roe Avenue and the Cooper River. SWMU 21, the Old Paint Storage Area, consists of a 20-foot by 180-foot concrete pad constructed in 1942 for welding operations. Beginning in 1973, the slab was used for storage of containerized paint wastes from ship repair and overhaul operations. SWMU 54, the Former Abrasive Blasting Area, consists of the unpaved area around SWMU 21. The site was used for abrasive blasting of ship components and hull sections. Ship components, including anchor chains, were also painted in this area. SWMU 21 is located completely within the boundary of SWMU 54. These sites were combined into one investigation area due to their close proximity and their potential for similar chemicals of potential concern (COPCs).

Several interim measures (IMs) have been performed at SWMUs 21 and 54 to remove contaminated soil. The Navy implemented a major soil remediation IM in 1996. Over 1,400 tons of impacted soil and spent abrasive media were removed from the site; this IM was previously described in reports provided to the South Carolina Department of Health and Environmental Control (SCDHEC). An additional IM was performed by CH2M-Jones in 2003 to remove surface soil impacted with polycyclic aromatic hydrocarbons (PAHs) above the CNC sitewide reference concentration of 1,304 micrograms per kilogram (µg/kg) (expressed as benzo(a)pyrene equivalents [BEQs]).

A RCRA Facility Investigation (RFI) Report Addendum and Corrective Measures Study (CMS) Work Plan were prepared for SWMUs 21 and 54 (CH2M-Jones, 2003). The RFI Report Addendum and CMS Work Plan presented the remedial action objectives (RAOs) and media cleanup standards (MCSs) proposed for SWMUs 21 and 54. The RFI Report Addendum and CMS Work Plan report was approved by SCDHEC in July 2003.

No chemicals of concern (COCs) were identified for surface soil for the industrial land use scenario. Antimony and lead were identified as subsurface soil COCs due to several localized exceedances of the unpaved soil screening level (SSL). BEQs were identified as a subsurface soil COC due to several localized exceedances of the sitewide reference concentration for BEQs. Several metals (antimony, nickel and thallium) were identified as groundwater COCs.

A CMS was prepared for SWMUs 21 and 54 and submitted to SCDHEC. The proposed remedy for the site included long-term groundwater monitoring and land use controls (LUCs). SCDHEC provided comments on the CMS, including a suggestion that additional soil samples be collected in the vicinity of subsurface soil samples with elevated lead concentrations. CH2M-Jones provided a work plan to SCDHEC to collect these additional samples and implemented the field sampling work in August 2004. A copy of this work plan is provided in Appendix A. The analysis of the samples included total lead and Synthetic Precipitation Leaching Procedure (SPLP) to allow for evaluation of the overall leachability for lead. The results of this additional sampling and analysis are presented in this report.

Section 2.0

2.0 Sample Collection and Analysis and Discussion

Nine subsurface soil samples were collected as proposed in the sampling plan. Figure 2-1 shows the locations of the nine subsurface soil samples that were collected in August 2004. Sampling was targeted in the vicinity of previous borings E054SB035 and E054SB048, which had exhibited elevated lead. An additional sample was also collected at the location of these two elevated samples. Soil samples were collected from 3 to 5 feet below land surface (ft bls). Standard sample collection, shipping, and analytical procedures were followed. The analytical data summary is provided in Appendix B.

2.1 Total Lead Results

The results for total lead analysis for the nine samples are presented in Table 2-1. The results of the original results for samples collected at borings E054SB035 and E054SB048 are also presented adjacent to the samples collected nearest these previous samples for comparison.

It can been seen in Table 2-1 that lead concentrations in five of the nine subsurface soil samples are well below the Zone E subsurface soil reference concentration of 322 milligrams per kilogram (mg/kg). The mean concentration of lead in these samples is 659 mg/kg.

2.2 SPLP Results

SPLP analyses were performed on each of the nine samples collected. The SPLP results for each samples are presented in Table 2-2. To determine partitioning coefficients, leachate results from the four samples that had total lead concentrations above the Zone E subsurface soil reference concentration of 322 mg/kg were used, along with total lead results those samples.

Site-specific dilution and attenuation factors were then calculated for the unpaved and paved scenario (see Table 2-3). For these conditions, as well as for the generic dilution attenuation factor (DAF) = 10, the following site-specific SSL values were calculated for lead that would be protective of site groundwater from leaching.

DAF	SSL (lead, mg/kg)
5.4 (site-specific unpaved)	919
10	1698
56.5 (site specific paved)	9602

Comparison of the average lead concentration of the recently collected samples to these values indicates that the current lead concentrations are adequately low; therefore, leaching of lead to groundwater is not expected. The lack of elevated lead concentrations in groundwater samples collected downgradient of the elevated lead concentrations confirms that lead is not leaching to groundwater at unacceptable levels.

It should be noted that the two subsurface samples that had elevated lead concentrations that led to the request for this resampling were collected in 1995 prior to the implementation of several IMs at the site. These IMs included the excavation and removal of a significant amount of soil and residual abrasive blasting media from the site. Because highly elevated concentrations of lead were not found in the resampling effort, it appears that the IMs were successful in removing significant contamination from the site.

TABLE 2-1
Results of Total Lead Analysis for Samples Collected
CMS Report Addendum, SWMUs 21 and 54, Zone E, Charleston Naval Complex

	Total Lead, August 2004		Total Lead, November 1995	
Sample ID	**Result**	**Qualifier**	**Result**	**Qualifier**
054SB062	812	J		
054SB063	81.2	J	32,300	J
054SB064	2760	J		
054SB065	46.5	J		
054SB066	19.1	J		
054SB067	217	J		
054SB068	5.1	J		
054SB069	367	J		
054SB070	1620	J	12,100	=
Average	**659**			

Note: Results for samples dated November 1995 are from the Zone E RFI Report, Revision 0 for subsurface soil samples from borings E21SB035 and E21SB048.

TABLE 2-2
Total Lead, SPLP Results and SSL Calculation
CMS Report Addendum, SWMUs 21 and 54, Zone E, Charleston Naval Complex

Lead	StationID		054SB062	54SB063	054SB064	054SB065	054SB066	054SB067	054SB068	054SB069	054SB07002
	SampleID		054SB06202	054SB06302	054SB06402	054SB06502	054SB06602	054SB06702	054SB06802	054SB06902	054SB07002
	DateCollected		08/18/04	08/18/04	08/18/04	08/18/04	08/18/04	08/18/04	08/18/04	08/18/04	08/18/04
Parameter	Units										
Initial Soil Concentration	mg/kg		812 J	81.2 J	2760 J	46.5 J	19.1 J	217 J	5.1 J	367 J	1620 J
SPLP Water Concentration	mg/L		0.0249 U	0.038 J	0.063 J	0.046 J	0.0249 U	0.048 J	0.0249 U	0.15 J	0.34 J
Soil mass	kg	0.1									
Water volume	L	2									
Total contaminant mass in soil	mg		81.2	8.12	276	4.65	1.91	21.7	0.51	36.7	162
Total contaminant mass in water	mg		0.0249	0.076	0.126	0.092	0.0249	0.096	0.0249	0.3	0.68
Adjusted soil concentration	mg/kg		811.8	80.4	2758.7	45.6	18.9	216.0	4.9	364.0	1613.2
Kd	L/kg		32600	2117	43790	991	757	4501	195	2427	4745
For DAF = 1, SSL = Kd x MCL											
DAF =	10		4,890.066	317.526	6,568.429	148.630	113.560	675.125	29.223	364.000	711.706
DAF =	5.4		2,646.876	171.869	3,555.333	80.450	61.467	365.429	15.818	197.024	385.229
DAF =	56.5		27,644.972	1,795.069	37,133.245	840.251	641.989	3,816.679	165.206	2,057.798	4,023.481

MCL, mg/L 0.015

Note: For SSL calculations, samples where lead was not detected in the leachate, or in soil samples where lead was detected within the range of background concentrations (surface soil, 400 mg/kg, subsurface soil, 322 mg/kg), were not used in the SSL (Kd) calculation for SWMU 5/18

SSL = Kd x MCL x DAF

geometric mean of Kd	11323
SSL, DAF=10	1698.4
SSL, DAF=5.4	919.3
SSL, DAF=56.5	9602
min/max soil concentration, mg/Kg	5.1 / 2760
min/max liquid concentration, mg/L	0.0249 / 0.34

TABLE 2-3
Dilution Attenuation Factor (DAF) Calculation
CMS Report Addendum, SWMUs 21 and 54, Zone E, Charleston Naval Complex

Site(s) 706	Hydraulic Conductivity K (m/yr)	Hydraulic Gradient I (m/m)	Aquifer Thickness da (m)	Source Length Sw (m)	Infiltration Rate i (m/yr)	Mixing Zone d (m)	DAF
Unpaved	445.0	0.010	7.32	10.0	0.14	1.4	5.4
Paved	445.0	0.010	7.32	10.0	0.0086	1.1	56.5

K the value for the hydraulic conductivity is based on CH2M-Jone's map of hydraulic conductivities (GIS, 4.0 ft/day).

I The hydraulic gradient is based on the estimated distance (370 ft) between 3- and 4-foot shallow groundwater contours from the GIS (CH2M-Jones, 5/14,2002).

Da The aquifer thickness is estimated based on an estimated shallow groundwater is contour (4 ft msl) – the estimated top of Ashley formation depth (-20 ft msl) from the GIS (CH2M-Jones, 2002)

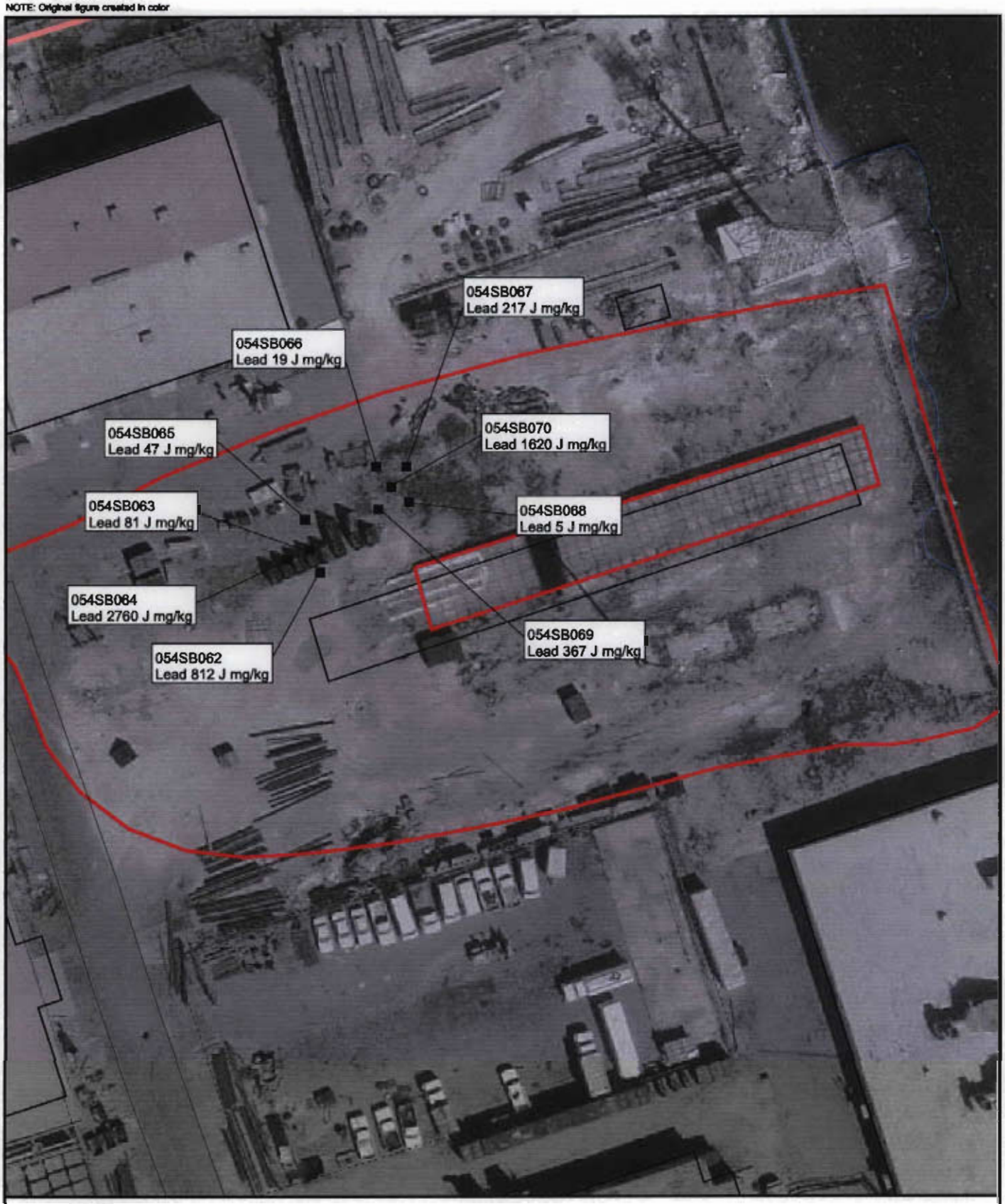
Sw The source length is the estimated lead source area (180ft ~ 54.9 m).

i Internal CH2M HILL Technical Memorandum, *Infiltration Variable Used in SSL Calculation*, 0.45 ft/yr for unpaved areas and 0.026 for paved areas, October 5, 2001.

d is the smaller of the aquifer thickness (da) or the result of the mixing zone equation:

$$d = (0.0112\ Sw^2)^{0.5} + da\{1 - \exp[(-Sw\ I')/(K\ I\ da)]\}$$

NOTE: Aerial Photo Date is 1997
NOTE: Original figure created in color



■ 2154lead.dbf

N

0 40 80 Feet

1 inch = 52.2581 feet

Figure 2-1
Lead Results for Subsurface Soil Samples; August 2004
SWMUs 21 54 CMS Addendum Report
Charleston Naval Complex

File Path: c:\18gis\cnc\cno-egis.apr, Date: 21 Oct 2004 16:58, User: DWILLIAM, EGIS: Charleston Naval Complex - Figure 2-1 Lead Results for Subsurface Soil Samples; August 2004

Section 3.0

3.0 Recommendations

Based on the results of this additional sampling and analysis, the Navy and CH2M-Jones recommend that the corrective measures recommended in the SWMUs 21 and 54 CMS Report (long-term monitoring and LUCs) (CH2M-Jones, 2003) be implemented since the resampling and analysis did not identify a significant source of lead in subsurface soil that poses a leaching concern. The recent soil sampling indicates that lead is not expected to cause a leaching concern to groundwater.

Appendix A

Proposed Subsurface Soil Sampling at SWMUs 21/54

TO: Darryl Gates/CH2M Jones

COPIES: Jerry Stamps/SCDHEC

FROM: Dean Williamson/CH2M Jones

DATE: July 19, 2004

Objective

This sampling plan presents a proposed subsurface soil sample locations to further evaluate the presence of lead in subsurface soil at two locations at SWMUs 21/54. The proposed investigation is consistent with recent conversations between the South Carolina Department of Health and Environmental Control (SCDHEC) and CH2M-Jones.

A CMS for SWMU 21/54 was submitted to SCDHEC in November 2003. Several interim measures were previously implemented at this site to remove residual sand blast media and impacted soil. Because the previous Interim Measures had removed most of the contaminated media contributing metals to groundwater, it is feasible that additional soil removal may not be needed in order to meet the target remedial objectives. The CMS addressed the presence of several metals remaining in groundwater and soil. The leading candidate alternatives evaluated were 1) implementation of a focused soil removal action followed by long term groundwater monitoring and 2) continued groundwater monitoring with removal of soil in the event that unacceptable groundwater impacts were observed.

Subsequent to submittal of the CMS Report, SCDHEC and CH2M-Jones have discussed the presence of lead in subsurface soil and have agreed to conduct additional subsurface soil sampling around soil borings E054SB035 and E054SB048, which have exhibited lead concentrations in excess of 10,000 mg/Kg. This SAP presents the proposed additional sampling to better assess lead concentrations in these areas.

Proposed Additional Investigation

The investigation will include the collection of subsurface soil samples for analysis of lead. In addition to lead, analysis for lead in Synthetic Precipitation Leaching Procedure (SPLP) extract from the samples is also proposed. The SPLP test will assist in determining the extent to which the lead in the soil is leachable, which is the key concern at the site. The lead in the soil at the site is believed to be present due to former sand blasting operations and is therefore likely in a paint-related form. In this form, the lead is expected to have limited leachability.

Subsurface soil samples from two locations (E054SB035 and E054SB048) were identified during the RFI to contain lead above 10,000 mg/Kg. In order to confirm that these locations do not represent a significantly sized source area, additional subsurface soil sampling is proposed near these locations.

Figure 1 presents results of lead analyses for several locations at SWMUs 21/54, including the two locations (E054SB035 and E054SB048) which exhibited lead concentrations above 10,000 mg/Kg. The proposed subsurface soil sample locations around soil borings E054SB035 and E054SB048 are also presented in this figure. In general, subsurface soil samples are proposed for collection at the original locations of borings E054SB035 and E054SB048 as well as at an approximately 10-foot radius from these soil borings. Four new samples are proposed near soil boring E054SB048. One subsurface soil sample, E054SB052, was previously collected approximately 12 feet to the east-northeast of soil boring E054SB035. Therefore, three subsurface soil samples are proposed for collection around this location.

A total of nine subsurface soil samples. Samples will be collected at 3 to 5 ft bls, to be consistent with previous sampling. The soil samples will be submitted for laboratory analysis for lead using U.S. Environmental Protection Agency (EPA) Method 6010. Additionally, each sample will be analyzed for SPLP lead.

The sample collection procedures will be performed in accordance with the standard procedures used the BCT, such as Environmental Services Division *Standard Operating Procedures and Quality Assurance Manual* (ESDSOPQAM), (EPA, 1996). The sample collection and analyses will also follow the procedures described in the approved Comprehensive Sampling and Analysis Plan (CSAP) portion of the *Final Comprehensive RFI Work Plan* (EnSafe/Allen & Hoshall, 1994). The CSAP outlines all monitoring procedures to be performed during the investigation to characterize the environmental setting, source, and releases of hazardous constituents. In addition, the CSAP includes the Quality Assurance Plan (QAP) and Data Management Plan (DMP) to verify that all information and data are valid and properly documented. Sample analysis will be performed in accordance with the guidance in EPA's *Test Methods for Evaluating Solid Waste, SW-846, Revision 4* (1996b), Office of Solid Waste and Emergency Response (OSWER) and in the EPA Environmental Services Division *Laboratory Operations and Quality Control Manual* (ESDLOQCM) (1997).

The analytical results of the proposed groundwater sampling will be presented in a CMS Addendum for SWMUs 21 and 54. The addendum will describe the sampling activities and results and provide recommendations for concluding the CMS activities.

Appendix B

Sample ID	Location ID	Northing	Easting	Elevation	Date Collected	EDD Name	Analyte	Result	Qualifier	Remarks	Sample Type	Parameter	Detection Limit	Reporting Limit	Fraction	Units
054CB07002	054SB070	377708.4426	2317590.88	7.0431	08/18/2004 11:15	119408	PB	400	J	FD	Lead	0.244	0.498	METAL	mg/kg
054CB07002	054SB070	377708.4426	2317590.88	7.0431	08/18/2004 11:15	119408-1	SPLPPB	0.092	J	FD	Lead, SPLP	0.0249	0.5	SPLPMET	mg/L
054SB06202	054SB062	377674.4024	2317562.909	7.7443	08/18/2004 14:20	119408	PB	812	J	N	Lead	0.243	0.488	METAL	mg/kg
054SB06202	054SB062	377674.4024	2317562.909	7.7443	08/18/2004 14:20	119408-1	SPLPPB	0.0249	U	N	Lead, SPLP	0.0249	0.5	SPLPMET	mg/L
054SB06302	054SB063	377683.2304	2317559.048	7.7975	08/18/2004 10:25	119408	PB	81.2	J	N	Lead	0.243	0.488	METAL	mg/kg
054SB06302	054SB063	377683.2304	2317559.048	7.7975	08/18/2004 10:25	119408-1	SPLPPB	0.038	J	N	Lead, SPLP	0.0249	0.5	SPLPMET	mg/L
054SB06402	054SB064	377679.0371	2317549.689	7.8441	08/18/2004 9:30	119408	PB	2760	J	N	Lead	0.246	0.516	METAL	mg/kg
054SB06402	054SB064	377679.0371	2317549.689	7.8441	08/18/2004 9:30	119408-1	SPLPPB	0.063	J	N	Lead, SPLP	0.0249	0.5	SPLPMET	mg/L
054SB06502	054SB065	377694.7442	2317556.882	8.0468	08/18/2004 10:15	119408	PB	46.5	J	N	Lead	0.244	0.528	METAL	mg/kg
054SB06502	054SB065	377694.7442	2317556.882	8.0468	08/18/2004 10:15	119408-1	SPLPPB	0.046	J	N	Lead, SPLP	0.0249	0.5	SPLPMET	mg/L
054SB06602	054SB066	377715.963	2317584.961	7.718	08/18/2004 10:45	119408	PB	19.1	J	N	Lead	0.245	0.498	METAL	mg/kg
054SB06602	054SB066	377715.963	2317584.961	7.718	08/18/2004 10:45	119408-1	SPLPPB	0.0249	U	N	Lead, SPLP	0.0249	0.5	SPLPMET	mg/L
054SB06702	054SB067	377716.3082	2317596.765	8.8651	08/18/2004 9:15	119408	PB	217	J	N	Lead	0.25	0.502	METAL	mg/kg
054SB06702	054SB067	377716.3082	2317596.765	8.8651	08/18/2004 9:15	119408-1	SPLPPB	0.048	J	N	Lead, SPLP	0.0249	0.5	SPLPMET	mg/L
054SB06802	054SB068	377702.2626	2317598.209	7.0995	08/18/2004 10:50	119408	PB	5.1	J	N	Lead	0.247	0.498	METAL	mg/kg
054SB06802	054SB068	377702.2626	2317598.209	7.0995	08/18/2004 10:50	119408-1	SPLPPB	0.0249	U	N	Lead, SPLP	0.0249	0.5	SPLPMET	mg/L
054SB06902	054SB069	377699.3034	2317586.295	7.3744	08/18/2004 11:00	119408	PB	367	J	N	Lead	0.247	0.498	METAL	mg/kg
054SB06902	054SB069	377699.3034	2317586.295	7.3744	08/18/2004 11:00	119408-1	SPLPPB	0.15	J	N	Lead, SPLP	0.0249	0.5	SPLPMET	mg/L
054SB07002	054SB070	377708.4426	2317590.88	7.0431	08/18/2004 11:15	119408	PB	1620	J	N	Lead	0.246	0.498	METAL	mg/kg
054SB07002	054SB070	377708.4426	2317590.88	7.0431	08/18/2004 11:15	119408-1	SPLPPB	0.34	J	N	Lead, SPLP	0.0249	0.5	SPLPMET	mg/L