



United States Air Force
15th Air Base Wing
Environmental Restoration Program

**ENGINEERING EVALUATION/COST ANALYSIS
(EE/CA) REPORT FOR SITE LF01**
Operable Unit 1,
Bellows Air Force Station, Oahu, Hawaii



Attachment D
Estimates of Samples that May Exceed TCLP
Criteria Based on the 20:1 Dilution Rule

Attachment D: Estimates of Samples that May Exceed TCLP Criteria Based on the 20:1 Dilution Rule

This attachment presents tables showing worst-case estimates of toxicity characteristic leaching procedure (TCLP) exceedances for surface soil and landfill materials. This analysis was conducted for two reasons: (1) to provide a basis for estimating the amount of material that may be identified as hazardous, as it pertains to Alternative 2 for Site LF01; and (2) to evaluate whether long-term monitoring (LTM) of groundwater is warranted under Alternative 3 for Site LF01, even though no further action for groundwater was identified based on the screening-level risk evaluation conducted for groundwater (as discussed in Section 2.4 in the main text of this EE/CA Report).

No actual TCLP data have been obtained for Site LF01; however, total analysis results may be conservatively screened against TCLP criteria using what is commonly referred to as the "20 to 1 Rule" (U.S. EPA, 1992). This rule simply states that if a total analyte concentration is less than 20 times the TCLP criterion, then the sample could not fail the TCLP criterion for the analyte because a 20:1 dilution factor is built into the TCLP test procedure. Conversely, if a total analyte concentration is greater than 20 times the TCLP criterion, then the sample theoretically could fail the TCLP criterion, but the outcome is uncertain because of the physical and chemical characteristics of the analyte and the matrix being sampled. Therefore, comparing total sample analyte concentrations to 20 times the TCLP criteria provides worst-case *estimates* of samples that could potentially fail the TCLP criteria.

As indicated in Table D-1 for surface soil, based on maximum detected concentrations, it is possible that if TCLP analyses were performed for cadmium, chromium, lead, and mercury, the results could potentially fail the criteria. As indicated in Table D-2 for landfill materials, based on maximum detected concentrations, it is possible that if TCLP analyses were performed for chromium and lead, the results could potentially fail the criteria.

Based on these findings, it is assumed that approximately 40 percent of the surface soil and landfill materials have the potential to fail the TCLP criteria. This assumption was used for cost estimating purposes in this EE/CA Report. In addition, long-term monitoring of groundwater (for up to 5 years) has been included with Alternative 3 for Site LF01 because the soil and waste would be left in place, and soil and landfill materials have the potential to fail the TCLP criteria.

TABLE D-1

Worst-Case Estimates of TCLP Exceedances for Surface Soil Samples

EE/CA for Site LF01, Bellows AFS

Chemical Group	Analyte	CAS	Units	Number of Detects	Number of Rejects	Number of Samples	Total Number of Samples	Frequency of Detection (a)	Minimum MDL	Maximum MDL	Minimum Detected Value	Maximum Detected Value	Regulatory Level (mg/L)	20 X Regulatory Level (mg/L)	Maximum Detected Value > 20 X Reg Level?
TPH	TPH-Diesel	TPH-DIESEL	mg/kg	33	1	38	39	87%	8.1	9.1	2.3	53			
SVOC	Bis(2-ethylhexyl)phthalate	117-81-7	mg/kg	6		53	53	11%	0.05	4	0.0425	6.97			
SVOC	Butyl benzylphthalate	85-68-7	mg/kg	1		39	39	3%	0.04	0.23	0.06	0.06			
SVOC	Diethyl phthalate	84-66-2	mg/kg	1		39	39	3%	0.06	0.24	0.14	0.14			
SVOC	Di-n-butylphthalate	84-74-2	mg/kg	3		53	53	6%	0.04	4	0.11	0.14			
SVOC	Di-n-octylphthalate	117-84-0	mg/kg	1		39	39	3%	0.04	0.06	0.04	0.04			
PEST	4,4'-DDD	72-54-8	mg/kg	18	20	33	53	55%	0.00089	0.037	0.00099	0.092			
PEST	4,4'-DDE	72-55-9	mg/kg	12	18	26	44	46%	0.0004	0.0038	0.0016	0.81			
PEST	4,4'-DDE/Dieldrin (b)	72-55-9/60-57-1	mg/kg	7	19	18	37	39%	0.00047	0.0006	0.0023	0.026			
PEST	Dieldrin	60-57-1	mg/kg	1		1	2	100%			0.0022	0.0022			
PEST	4,4'-DDT	50-29-3	mg/kg	22	26	27	53	81%	0.0011	0.0039	0.0014	0.45			
PEST	Aldrin	309-00-2	mg/kg	20	17	22	39	91%	0.0002	0.00021	0.00022	0.013			
PEST	alpha-BHC	319-84-6	mg/kg	14	17	22	39	64%	0.00026	0.00045	0.00042	0.0049			
PEST	beta-BHC	319-85-7	mg/kg	17	17	22	39	77%	0.00055	0.0006	0.00061	0.0245			
PEST	Chlordane (Alpha)	5103-71-9	mg/kg	8	22	17	39	47%	0.00056	0.00073	0.00098	0.012	0.03	0.6	NO
PEST	Chlordane (Gamma)	5103-74-2	mg/kg	10	19	20	39	50%	0.00032	0.00036	0.00042	0.00715	0.03	0.6	NO
PEST	delta-BHC	319-86-8	mg/kg	13	17	22	39	59%	0.00017	0.0002	0.00026	0.0087			
PEST	Endosulfan I	959-98-8	mg/kg	9	19	19	38	47%	0.00058	0.00065	0.00063	0.0059			
PEST	Endosulfan II	33213-65-9	mg/kg	6	21	32	53	19%	0.0011	0.0042	0.0019	0.01			
PEST	Endosulfan sulfate	1031-07-8	mg/kg	18	18	21	39	86%	0.0011	0.0012	0.0012	0.013			
PEST	Endrin	72-20-8	mg/kg	10	18	35	53	29%	0.0012	0.0042	0.0024	0.0091	0.02	0.4	NO
PEST	Endrin aldehyde	7421-93-4	mg/kg	5	18	35	53	14%	0.0021	0.0042	0.0049	0.0125			
PEST	gamma-BHC (Lindane)	58-89-9	mg/kg	13	17	22	39	59%	0.00033	0.00038	0.0004	0.0058			
PEST	Heptachlor	76-44-8	mg/kg	19	18	21	39	90%	0.0002	0.00022	0.00031	0.019	0.008	0.16	NO
PEST	Heptachlor epoxide	1024-57-3	mg/kg	12	17	36	53	33%	0.00024	0.0022	0.00033	0.015	0.008	0.16	NO
PEST	Methoxychlor	72-43-5	mg/kg	9	17	36	53	25%	0.0013	0.022	0.0017	0.024	10	200	NO
PEST	Toxaphene	8001-35-2	mg/kg	--	39	39	39	--	--	--	--	--	0.5	10	NO
PCB	Aroclor-1016	12674-11-2	mg/kg	2	1	41	42	5%	0.0077	0.08	0.05	0.071			
PCB	Aroclor-1242	53469-21-9	mg/kg	8	1	55	56	15%	0.0092	0.08	0.22	2.9			
PCB	Aroclor-1248	12672-29-6	mg/kg	3	1	41	42	7%	0.013	0.11	0.062	4			
PCB	Aroclor-1254	11097-69-1	mg/kg	4	1	55	56	7%	0.0022	0.042	0.06055	0.25			
PCB	Aroclor-1260	11096-82-5	mg/kg	3	1	55	56	5%	0.0031	0.042	0.082	0.16			
PAH	Acenaphthene	83-32-9	mg/kg	1		53	53	2%	0.02	4	0.086	0.086			
PAH	Acenaphthylene	208-96-8	mg/kg	1		39	39	3%	0.026	0.044	0.0315	0.0315			
PAH	Anthracene	120-12-7	mg/kg	8		39	39	21%	0.001	0.002	0.005	0.035			
PAH	Benzo(a)anthracene	56-55-3	mg/kg	26		53	53	49%	0.0013	4	0.0027	0.9			
PAH	Benzo(a)pyrene	50-32-8	mg/kg	27		53	53	51%	0.0016	4	0.0032	0.68			
PAH	Benzo(b)fluoranthene	205-99-2	mg/kg	23		53	53	43%	0.003	4	0.0064	1.1			
PAH	Benzo(g,h,i)perylene	191-24-2	mg/kg	28		53	53	53%	0.004	4	0.005	0.27			
PAH	Benzo(k)fluoranthene	207-08-9	mg/kg	25		53	53	47%	0.0015	4	0.0023	0.39			
PAH	Chrysene	218-01-9	mg/kg	29		53	53	55%	0.001	4	0.004	0.98			
PAH	Dibenzo(a,h)anthracene	53-70-3	mg/kg	5		39	39	13%	0.003	0.006	0.01025	0.111			
PAH	Fluoranthene	206-44-0	mg/kg	22		53	53	42%	0.002	4	0.006	1.8			
PAH	Fluorene	86-73-7	mg/kg	2		53	53	4%	0.003	4	0.014	0.13			

TABLE D-1

Worst-Case Estimates of TCLP Exceedances for Surface Soil Samples

EE/CA for Site LF01, Bellows AFS

Chemical Group	Analyte	CAS	Units	Number of Detects	Number of Rejects	Number of Samples	Total Number of Samples	Frequency of Detection (a)	Minimum MDL	Maximum MDL	Minimum Detected Value	Maximum Detected Value	Regulatory Level (mg/L)	20 X Regulatory Level (mg/L)	Maximum Detected Value > 20 X Reg Level?
PAH	Indeno(1,2,3-c,d)pyrene	193-39-5	mg/kg	28		53	53	53%	0.006	4	0.006	0.3905			
PAH	Phenanthrene	85-01-8	mg/kg	21		53	53	40%	0.001	4	0.002	1.6			
PAH	Pyrene	129-00-0	mg/kg	29		53	53	55%	0.001	4	0.002	1.5			
METALS	Aluminum	7429-90-5	mg/kg	39		39	39	100%			4140	34200			
METALS	Antimony	7440-36-0	mg/kg	34		53	53	64%	1.12	1.43	1.7	565			
METALS	Arsenic	7440-38-2	mg/kg	53		53	53	100%			2	78.7	5	100	NO
METALS	Barium	7440-39-3	mg/kg	39		39	39	100%			7.2	178	100	2000	NO
METALS	Beryllium	7440-41-7	mg/kg	45		53	53	85%	0.09	0.55	0.11	0.81			
METALS	Cadmium	7440-43-9	mg/kg	52		53	53	98%	0.114	0.114	0.14	42.1	1	20	YES
METALS	Calcium	7440-70-2	mg/kg	39		39	39	100%			101000	342000			
METALS	Chromium	7440-47-3	mg/kg	53		53	53	100%			22.7	170	5	100	YES
METALS	Cobalt	7440-48-4	mg/kg	39		39	39	100%			2.3	31.55			
METALS	Copper	7440-50-8	mg/kg	53		53	53	100%			6.2	5290			
METALS	Iron	7439-89-6	mg/kg	39		39	39	100%			5670	174500			
METALS	Lead	7439-92-1	mg/kg	53		53	53	100%			1.4	2910	5	100	YES
METALS	Magnesium	7439-95-4	mg/kg	39		39	39	100%			3520	12000			
METALS	Manganese	7439-96-5	mg/kg	39		39	39	100%			147	1285			
METALS	Mercury	7439-97-6	mg/kg	36		53	53	68%	0.05	0.07	0.0375	18.9	0.2	4	YES
METALS	Nickel	7440-02-0	mg/kg	53		53	53	100%			12.1	152			
METALS	Potassium	7440-09-7	mg/kg	39		39	39	100%			125	2210			
METALS	Selenium	7782-49-2	mg/kg	14		53	53	26%	0.86	1.5	0.93	4.1	1	20	NO
METALS	Silver	7440-22-4	mg/kg	29		53	53	55%	0.32	0.45	0.32	5.65	5	100	NO
METALS	Sodium	7440-23-5	mg/kg	39		39	39	100%			250	3320			
METALS	Thallium	7440-28-0	mg/kg	8		39	39	21%	0.74	1.28	0.97	1.5			
METALS	Vanadium	7440-62-2	mg/kg	39		39	39	100%			13.45	112			
METALS	Zinc	7440-66-6	mg/kg	53		53	53	100%			8.8	2950			
HERB	2,4-D	94-75-7	mg/kg	9	1	38	39	24%	0.02	0.034	0.022	0.067			
HERB	Dalapon	75-99-0	mg/kg	8		39	39	21%	0.022	1.4	0.94	3.1			
HERB	MCPA	94-74-6	mg/kg	13		39	39	33%	3.6	6.1	4.1	11			
HERB	MCPP	93-65-2	mg/kg	4	1	38	39	11%	1.9	3.2	2.3	12			

Notes:

- (a) Frequency of detection is based on number of detections divided by [total number of samples minus number of rejections].
 (b) The laboratory could not distinguish between 4,4'-DDE and dieldrin; however, when resolvable, individual results for 4,4'-DDE and dieldrin were reported.

Chemical Groups

TPH = total petroleum hydrocarbons
 SVOC = semivolatile organic compounds
 PEST = pesticides
 PCB = polychlorinated biphenyls
 PAH = polynuclear aromatic hydrocarbons
 HERB = herbicides

Abbreviations

MDL = method detection limit
 mg/kg = milligrams per kilogram
 mg/L = milligrams per liter
 TCLP = toxicity characteristic leaching procedure

TABLE D-2

Worst-Case Estimates of TCLP Exceedances for Landfill Material Samples

EE/CA for Site LF01, Bellows AFS

Chemical Group	Analyte	CAS	Units	Number of Detects	Number of Rejects	Number of Samples	Total Number of Samples	Frequency of Detection (a)	Minimum MDL	Maximum MDL	Minimum Detected Value	Maximum Detected Value	Regulatory Level (mg/L)	20 X Regulatory Level (mg/L)	Maximum Detected Value > 20 X Reg Level?
VOC	1,2-DCB	95-50-1	mg/kg	2		7	7	29%	0.0001	0.0001	0.000175	0.0003			
VOC	1,4-DCB	106-46-7	mg/kg	1		7	7	14%	0.0003	0.0003	0.0004	0.0004			
VOC	Benzene	71-43-2	mg/kg	1		7	7	14%	0.0002	0.0003	0.0007	0.0007	0.5	10	NO
VOC	m, p-Xylene	108-38-3/1	mg/kg	1		7	7	14%	0.0003	0.0004	0.001	0.001			
VOC	TCE	79-01-6	mg/kg	1		7	7	14%	0.0003	0.0003	0.0012	0.0012	0.7	14	NO
VOC	Toluene	108-88-3	mg/kg			7	7	43%	0.0002	0.0002	0.0003	0.0009			
VOC	Trichlorofluoromethane	75-69-4	mg/kg	2		7	7	29%	0.0004	0.0004	0.0007	0.0021			
TPH	TPH-Diesel	TPH-DIESEL	mg/kg	6		7	7	86%	8.8	8.8	2.1	48			
TPH	TPH-Gasoline	TPH-GASOLINE	mg/kg	3		7	7	43%	0.004	0.005	0.01	0.02			
SVOC	3,3'-Dichlorobenzidine	91-94-1	mg/kg	--	7		7	--	--	--	--	--			
SVOC	4-Chloroaniline	106-47-8	mg/kg	--	7		7	--	--	--	--	--			
SVOC	Bis(2-ethylhexyl)phthalate	117-81-7	mg/kg	1		8	8	13%	0.05	0.8	0.28	0.28			
SVOC	Butyl benzylphthalate	85-68-7	mg/kg	1		7	7	14%	0.04	0.04	0.64	0.64			
PEST	4,4'-DDD	72-54-8	mg/kg	1	2	3	5	33%	0.00091	0.00096	0.061	0.061			
PEST	4,4'-DDE	72-55-9	mg/kg	1	3	2	5	50%	0.00041	0.00041	0.17	0.17			
PEST	4,4'-DDT	50-29-3	mg/kg	4		5	5	80%	0.0011	0.0011	0.007275	0.22			
PEST	alpha-BHC	319-84-6	mg/kg	--	4		4	--	--	--	--	--			
PEST	beta-BHC	319-85-7	mg/kg	--	4		4	--	--	--	--	--			
PEST	Chlordane (Alpha)	5103-71-9	mg/kg	3		4	4	75%	0.0006	0.0006	0.0022	0.019	0.03	0.6	NO
PEST	Toxaphene	8001-35-2	mg/kg	--	4		4	--	--	--	--	--	0.5	10	NO
PCB	Aroclor-1016	12674-11-2	mg/kg	1		4	4	25%	0.0079	0.0083	0.007	0.007			
PCB	Aroclor-1242	53469-21-9	mg/kg	1		5	5	20%	0.0094	0.0099	0.61	0.61			
PCB	Aroclor-1260	11096-82-5	mg/kg	2		5	5	40%	0.0032	0.038	0.0143	0.1			
PAH	Anthracene	120-12-7	mg/kg	2		7	7	29%	0.001	0.01	0.007	0.06			
PAH	Benzo(a)anthracene	56-55-3	mg/kg	6		8	8	75%	0.0135	0.8	0.0026	0.0588			
PAH	Benzo(a)pyrene	50-32-8	mg/kg	6		8	8	75%	0.016	0.8	0.003025	0.123			
PAH	Benzo(b)fluoranthene	205-99-2	mg/kg	6		8	8	75%	0.03	0.8	0.006975	0.103			
PAH	Benzo(g,h,i) perylene	191-24-2	mg/kg	6		8	8	75%	0.04	0.8	0.0065	0.19			
PAH	Benzo(k)fluoranthene	207-08-9	mg/kg	7		8	8	88%	0.8	0.8	0.002425	0.045			
PAH	Chrysene	218-01-9	mg/kg	6		8	8	75%	0.01	0.8	0.00525	0.16			
PAH	Dibenzo(a,h)anthracene	53-70-3	mg/kg	1		7	7	14%	0.003	0.035	0.086	0.086			
PAH	Fluoranthene	206-44-0	mg/kg	5		8	8	63%	0.002	0.8	0.015	0.07			
PAH	Indeno(1,2,3-c,d)pyrene	193-39-5	mg/kg	4		8	8	50%	0.006	0.8	0.015	0.068			
PAH	Phenanthrene	85-01-8	mg/kg	6		8	8	75%	0.01	0.8	0.003	0.033			
PAH	Pyrene	129-00-0	mg/kg	6		8	8	75%	0.01	0.8	0.00225	0.049			
METALS	Aluminum	7429-90-5	mg/kg	7		7	7	100%			5330	15600			
METALS	Antimony	7440-36-0	mg/kg	7		8	8	88%	0.57	0.57	0.52	16.7			
METALS	Arsenic	7440-38-2	mg/kg	8		8	8	100%			9.6	54.9	5	100	NO
METALS	Barium	7440-39-3	mg/kg	7		7	7	100%			19	96	100	2000	NO
METALS	Beryllium	7440-41-7	mg/kg	8		8	8	100%			0.11	0.24			
METALS	Cadmium	7440-43-9	mg/kg	8		8	8	100%			0.51	18.7	1	20	NO
METALS	Calcium	7440-70-2	mg/kg	7		7	7	100%			177000	330000			
METALS	Chromium	7440-47-3	mg/kg	8		8	8	100%			26.2	147	5	100	YES
METALS	Cobalt	7440-48-4	mg/kg	7		7	7	100%			5.1	19.2			

TABLE D-2

Worst-Case Estimates of TCLP Exceedances for Landfill Material Samples

EE/CA for Site LF01, Bellows AFS

Chemical Group	Analyte	CAS	Units	Number of Detects	Number of Rejects	Number of Samples	Total Number of Samples	Frequency of Detection (a)	Minimum MDL	Maximum MDL	Minimum Detected Value	Maximum Detected Value	Regulatory Level (mg/L)	20 X Regulatory Level (mg/L)	Maximum Detected Value > 20 X Reg Level?
METALS	Copper	7440-50-8	mg/kg	8		8	8	100%			23.8	1600			
METALS	Iron	7439-89-6	mg/kg	7		7	7	100%			11100	109000			
METALS	Lead	7439-92-1	mg/kg	8		8	8	100%			59.9	1670	5	100	YES
METALS	Magnesium	7439-95-4	mg/kg	7		7	7	100%			4300	10200			
METALS	Manganese	7439-96-5	mg/kg	7		7	7	100%			177	1180			
METALS	Mercury	7439-97-6	mg/kg	5		8	8	63%	0.05	0.06	0.07	0.33	0.2	4	NO
METALS	Nickel	7440-02-0	mg/kg	8		8	8	100%			20.8	177			
METALS	Potassium	7440-09-7	mg/kg	7		7	7	100%			326	782			
METALS	Selenium	7782-49-2	mg/kg	1		8	8	13%	0.44	0.88	2.1	2.1	1	20	NO
METALS	Silver	7440-22-4	mg/kg	5		8	8	63%	0.32	0.34	0.44	3.8	5	100	NO
METALS	Sodium	7440-23-5	mg/kg	7		7	7	100%			286.5	1380			
METALS	Thallium	7440-28-0	mg/kg	3		7	7	43%	0.08	0.39	0.08	0.62			
METALS	Vanadium	7440-62-2	mg/kg	7		7	7	100%			12.7	44.2			
METALS	Zinc	7440-66-6	mg/kg	8		8	8	100%			70	1400			
HERB	2,4,5-T	93-76-5	mg/kg	--	7		7	--	--	--	--	--			
HERB	2,4,5-TP (Silvex)	93-72-1	mg/kg	--	7		7	--	--	--	--	--	1	20	
HERB	2,4-D	94-75-7	mg/kg	--	7		7	--	--	--	--	--			
HERB	2,4-DB	94-82-6	mg/kg	--	7		7	--	--	--	--	--			
HERB	Dinoseb	88-85-7	mg/kg	--	7		7	--	--	--	--	--			
HERB	MCPA	94-74-6	mg/kg	1		6	7	17%	3.6	3.8	9.8	9.8			
HERB	MCPP	93-65-2	mg/kg	--	7		7	--	--	--	--	--			

Notes:

(a) Frequency of detection is based on number of detections divided by [total number of samples minus number of rejections].

Chemical Groups

VOC = volatile organic compounds
 TPH = total petroleum hydrocarbons
 SVOC = semivolatile organic compounds
 PEST = pesticides
 PCB = polychlorinated biphenyls
 PAH = polynuclear aromatic hydrocarbons
 HERB = herbicides

Abbreviations

TCLP = toxicity characteristic leaching procedure
 mg/L = milligrams per liter
 mg/kg = milligrams per kilogram
 MDL = method detection limit